APSNEWS

A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY

WWW.APS.ORG/PUBLICATIONS/APSNEWS

January 2015 • Vol. 24, No. 1

APS physics

Physicist nominated to be Secretary of Defense

Page 3

APS April Meeting Heads to Charm City

This year's April Meeting will take place at the Hilton Baltimore Inner Harbor Hotel in Baltimore, Maryland, from April 11 through 14. The annual meeting is expected to attract about 1,300 attendees and will feature 72 invited sessions, more than 110 contributed sessions, three plenary sessions, poster sessions, and a public lecture. The recipients of APS prizes and awards will be honored at a special ceremonial session on Sunday evening.

The meeting will showcase the latest research from the APS Divisions of Particles and Fields, Astrophysics, Nuclear Physics, and Beam Physics, as well as the Topical Group in Gravitation. In addition, the Forums on Education, Graduate Student Affairs, History of Physics, International Physics, and Physics and Society will be participating, along with the Topical Groups on Energy Research and Applications, Few-Body Systems, Hadronic Physics, and Precision Measurements & Fundamental Constants.

The meeting will host several renowned plenary speakers weighing in on a variety of important physics topics. Monday's Kavli session will feature Nobel laureate John Mather commemorating the 50th anniversary of the discovery of the cosmic microwave background. Clifford Will from the University of Florida will highlight the precision tests that have confirmed general relativity. Stuart Shapiro of the University of Illinois at Urbana-Champaign will explore the origins and detection of gravitational waves.

Speakers from government agencies will open the meeting on Saturday and address the big scientific problems of the future. Secretary of Energy Ernest Moniz will lead off and John Grunsfeld, NASA's associ-

MEETING continued on page 4

Incoming 2015 APS President: Q & A with Samuel Aronson

Samuel H. Aronson, former director of Brookhaven National Laboratory and current director of its RIKEN BNL Research Center, will begin his term as President of APS on January 1, 2015. In an interview with APS News, *he discusses his goals for the coming year.*

What do you see as the most pressing issues facing the physics community right now?

There are a number of issues, one of which is federal research budgets. We're still in a chaotic and fractious government funding landscape, so that remains a big issue. Another is the transition to open access publishing, which affects the Society and other societies, and it will change the way which our members and physicists in general get access to scientific publications. That's something we have to focus on within the Society.

Other big issues are ones on which the Society has a public position that affects everybody, like climate change. I would mention education, starting with early STEM education and going all the way up to graduate level scientific training. Finally, the issue of maintaining and building the cohort of physicists pursuing their careers in this country. It will be a different mix than it has been in the past, due to our ability to retain people who come to this country for graduate level education in physics. More frequently than in the past, they return to pursue scientific careers at home. I think therefore, we need to access the American population in all of its diverse dimensions to find the best and brightest people to fill the pipeline domestically.

BNL

Samuel H. Aronson

What will be your main focus during your presidential year? What approach will you take towards achieving these goals?

There are a number of APS issues. The Society is going through a transition in the way it conducts its work on behalf of the members, and also perhaps in its response to externalities, such as open access publishing and open data. APS needs to rethink the way it finances its work on behalf of the members of the Society. There are issues internal to the Society that are going to take a lot of attention this year,

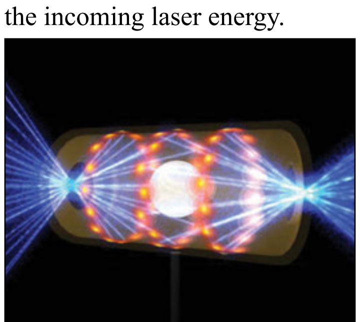
ARONSON continued on page 6

Top Ten Physics News Stories in 2014

Every year, *APS News* looks back to see which physics news stories grabbed the attention of the public. This list is not necessarily a compilation of the most important advances or discoveries of the year, but rather the ones that seemed to garner the most headlines and column-inches. In (roughly) chronological order, the top ten physics stories of 2014 were:

Fusion Milestone

Physicists at Lawrence Livermore National Laboratory announced in **February** that they reached an important milestone: At the National Ignition Facility, 192 simultaneous laser pulses blasted tiny hydrogen pellets, and the resulting fusion reactions emitted slightly more energy than was initially absorbed — a key first step in inertial confinement fusion. However, there is still a long way to go before the machine produces a net gain in energy, since the pellets absorbed only a small fraction of the incoming laser energy.

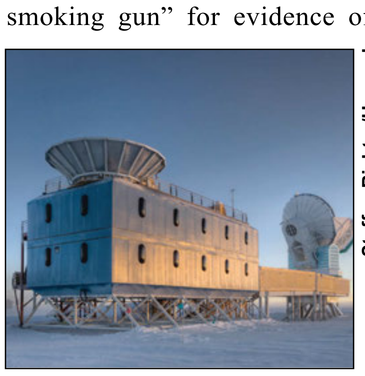


LLNL

Fusion first step

BICEP2

In **March** the scientific team behind the BICEP2 telescope at the South Pole made the sensational announcement that they had seen the first evidence of "B-mode" polarization in the cosmic microwave background (CMB) radiation. At the time it was held up as "the smoking gun" for evidence of gravitational waves left over from a period of rapid inflation in the early universe. However, soon after the announcement, doubts about the data started to emerge, and it was unclear if the team could definitively rule out the effect of cosmic dust. In the resulting scientific paper, published in **June**, the team acknowledged that dust may have affected the observations, but nevertheless they still felt the gravitational wave signal was real. In **September** a new report from the ESA's Planck satellite reinforced concerns about the initial results, but the two teams are continuing to work together to resolve the discrepancies. Also in **December**, independent of the BICEP2 research, Planck's team announced that they had finished processing the data from the satellite's four-year run and had created the most detailed map of the CMB.

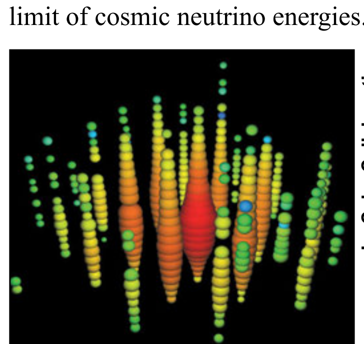


Steffen Richter/Harvard

BICEP2 searches for inflation.

Intergalactic Neutrinos

In 2013, the IceCube neutrino detector at the South Pole observed additional highly energetic neutrinos, which provided further evidence of neutrinos from outside our galaxy. A new event announced in **April**, dubbed "Big Bird," unseated the reigning champs "Bert" and "Ernie." At more than two petaelectronvolts, it's twice as energetic as the previous record-holders, but because it's not anything like an order of magnitude greater, investigators think that they might be close to seeing the upper limit of cosmic neutrino energies.



IceCube Collaboration

IceCube's big find

Physics in Movies

2014 was a blockbuster year for science on film and TV. Premiering in **March**, Neil deGrasse Tyson's highly anticipated follow-up to Carl Sagan's TV series *Cosmos* captivated audiences and took them on a journey into the universe. Also in

TOP TEN continued on page 6

Wanted: Input from Physicists on the Future of Computing

By Michael Lucibella

The National Research Council is developing a report for the National Science Foundation on advanced computing, and is looking for input from the physics community. The report, "Future Directions For NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020," will review what the NSF is doing to get scientists access to the advanced computing hardware and software they need, and what can be improved.

"This is an activity that the NSF conducts every five years or so," said Robert Harrison, co-chair of the committee putting the report together. "It assists them in creating a roadmap, a set of priorities for the next five years." He likened it to a smaller version of the surveys carried out every ten years by the astrophysics community to plan a decade's worth of scientific projects.

To help promote discussion in the scientific community, the committee released an interim version of its report this summer, which outlined the direction the full report will take. "It's really a list of questions on topics we're considering," Harrison said.

The NSF supports 16 sites across the country that let researchers use supercomputing hardware for computation-heavy research. The writers of the report are in part looking to see how beneficial

INPUT continued on page 6

LLNL

Future of supercomputing: Top computers are funded by the Department of Energy. Should NSF chase the bleeding edge?

Members in the Media

"It's an ordeal for anyone who's gone through it … . At the end of the day, I was exhausted. I got my first batch of candidates and I said, 'Wow, for this I paid $85?'"

***Neer Asherie**, Yeshiva University, on online dating,* The New York Times*, December 17, 2014.*

"Everybody including us would be shocked if we were actually to discover any significant differences. ... It would really revolutionize our thinking about how the universe behaves."

***Joel Fajans**, University of California at Berkeley, on whether antimatter would fall up or down.* PBS.org*, November 19, 2014.*

"I saw the title [and] I thought, 'Oh, I predicted those—I wonder how it turned out? ... I looked up their numbers and I said, 'Yeah, that looks a lot like what I predicted — great!"

***Randy Lewis**, York University, on predicting in 2009 the characteristics of two baryons discovered at CERN,* CBC News.ca*, November 19, 2014.*

"I think that entering the field of science is really almost the best career [women] can have. And what's the reason for it? There are two reasons. One, the work is very interesting and secondly, you're judged by what you do and not what you look like, and I think that is a very important thing for women in science. The sad thing is that so few women choose it because there aren't so many of us and they don't like to be outnumbered by the men."

***Mildred Dresselhaus**, MIT, after being named as a Medal of Freedom recipient,* NPR*, November 24, 2014.*

"I did beat Watson, but it was not televised. It was something IBM set up. It was an actual *Jeopardy!* match so it was very life-like, but it was a demonstration that IBM set up a couple of years ago."

***Rush Holt**, U.S. House of Representatives, on his trivia match with the IBM computer Watson,* USA Today*, November 25, 2014.*

"In the old days, all of the knowledge was in a cathedral. … Now it's here at CERN."

***Steve Goldfarb**, CERN,* The Wall Street Journal*, December 3, 2014.*

"This team has shown how to passively cool structures by simply radiating heat into the cold darkness of space."

***Burton Richter**, Stanford, on another team's research into materials to passively cool buildings,* CNN.com*, December 4, 2014.*

"Since the dawn of the 20th century, when scientists began exploring the inside of the atom, it has become increasingly clear that the brain is simply not designed to be comfortable with what goes on at that level."

***James Trefil**, George Mason University,* The Washington Post*, December 5, 2014.*

"Hopefully, the end will seem a lot less wacko when you read in my book the chapters 'Tesseract' and 'Messaging the Past,' and the technical notes on those chapters. The chapters 'Singularities' and 'Into Gargantua' may also be helpful."

***Kip Thorne**, Caltech, on the ending of his movie Interstellar,* NPR.org*, December 17, 2014.*

"You go into science because you want to make a discovery, you want to advance our understanding of the universe. … Not everyone gets to accomplish that. Stephen Hawking has."

***Neil deGrasse Tyson**, American Museum of Natural History,* Slate*, December 17, 2014.*

"It's extremely quiet out there… . The magnetic fields are constant, the flux of cosmic rays is constant."

***Donald Gurnett**, The University of Iowa, on the readings from the Voyager 1 spacecraft, indicating it's out of the solar system,* Time Magazine*, December 17, 2014.*

This Month in Physics History

January 1, 1925: Cecilia Payne-Gaposchkin and the Day the Universe Changed

By Richard Williams

Cecilia Payne made a long and lonely journey from her childhood in England to prominence in a scientific community that begrudged a place to women. She began her scientific career with a scholarship to Cambridge University, where she took the course in physics. After meeting Harlow Shapley from Harvard, she moved to Massachusetts and pursued a doctoral degree in astronomy. Her 1925 thesis, entitled *Stellar Atmospheres*, was famously described by astronomer Otto Struve as "the most brilliant PhD thesis ever written in astronomy." By calculating the abundance of chemical elements from stellar spectra, her work began a revolution in astrophysics.

Harlow Shapley liked to say that no one could earn a PhD unless he had suffered in the process. As she neared the end of her doctoral project on stellar spectra, Cecilia Payne wrote, "There followed months, almost a year as I remember, of utter bewilderment. Often I was in a state of exhaustion and despair, working all day and late into the night" [1]. The plight of suffering graduate students is perhaps best expressed by a line from poet Percy Bysshe Shelley, in 1819: "Like the poets, they learn through their suffering what they teach in their songs."


Smithsonian Institution

Cecilia Payne-Gaposchkin at Harvard

When Cecilia Payne began her study of stellar spectra, scientists believed that the relative abundance of elements in the atmospheres of the Sun and the stars was similar to that in Earth's crust. In 1889, geochemist Frank Wigglesworth Clarke's *The Relative Abundance of the Chemical Elements* was the result of his comprehensive sampling of minerals from many parts of Earth's crust. Many of the strong lines of the solar spectrum came from the elements most abundant on Earth. The pre-eminent American physicists at the time, Henry Norris Russell and Henry Rowland, believed that the elemental abundances on Earth and the Sun were substantially identical. Russell wrote [2] "The agreement of the solar and terrestrial lists is such as to confirm very strongly Rowland's opinion that, if the Earth's crust should be raised to the temperature of the Sun's atmosphere, it would give a very similar absorption spectrum." The spectra of the Sun and other stars were similar, so it appeared that the relative abundance of elements in the universe was like that in Earth's crust.

Payne had a better knowledge of atomic spectra than most astronomers at the time. She also knew the 1920 work of physicist Meghnad Saha on the thermal ionization of atoms. He showed how to use an equilibrium equation from physical chemistry to relate the ratio of excited states to ground states, and the fraction of ionized states to the temperature, electron concentration, ionization potential, and other properties of the stellar atmosphere. Payne met Saha when he visited Harvard, just as his work was becoming known to astronomers.

Payne's thesis [3], finished on January 1, 1925, confirmed the view of Russell and Rowland on the abundance of the heavier elements in stellar atmospheres. She then applied Saha's equations to the Balmer series absorption in hydrogen, which originates from atoms in the first excited state. She was the first to appreciate that, in the atmosphere of the Sun at 5700 K, only about one in 200 million of the hydrogen atoms is in this excited state, so that the total quantity of hydrogen is grossly underrepresented by the Balmer absorption. A similar argument holds for helium. She found similar results for other stars. Payne concluded that, unlike on Earth, hydrogen and helium are the dominant elements of the Sun and stars. Henry Norris Russell strongly opposed this conclusion and convinced her to omit it from her thesis. However, currently accepted values for the mass fraction of elements in the Milky Way Galaxy are: ~74% hydrogen, 24% helium; all the remaining elements, 2%, confirming Payne's result. Her discovery of the true cosmic abundance of the elements profoundly changed what we know about the universe. The giants — Copernicus, Newton, and Einstein — each in his turn, brought a new view of the universe. Payne's discovery of the cosmic abundance of the elements did no less.

In 1934 Payne visited the observatory in Leningrad, at a time of great Soviet-German tension, hard living conditions, and suspicion of foreigners. She continued on to visit Germany, where conditions were equally tense, and met a young Russian astronomer, Sergei Gaposchkin. Despite hardships and persecution in the Soviet Union because of his political views, he had achieved success as an astronomer. Now he faced persecution because he was Russian. He asked her to help him get to America. She was moved by his story, and, after returning home, she worked hard to get him a visa as a stateless person. He came and, later in 1934, they married and she became Cecilia Payne-Gaposchkin.

On completing her doctorate, after considering other opportunities, she decided to stay on at Harvard. At the time, advancement to professor was denied to women at Harvard, so she spent years in lesser, low-paid duties. She published several books, including *The Stars of High Luminosity*, 1930; *Variable Stars*, 1938; and *Variable Stars and Galactic Structure*, 1954.

PAYNE continued on page 4

APSNEWS

Series II, Vol. 24, No. 1
January 2015

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 Postage Paid at College Park, MD and at additional mailing offices.

For address changes, please send both the old and new addresses, and, if possible, include a mailing label from a recent issue. Changes can be emailed to membership@aps.org. **Postmaster:** Send address changes to APS News, Membership Department, American Physical Society, One Physics Ellipse, College Park, MD 20740-3844.

Coden: ANWSEN ISSN: 1058-8132

Physicist Nominated to Lead Pentagon

By Michael Lucibella

Physicist and former defense department official Ashton Carter is President Obama's pick to be the next secretary of defense, the White House announced in early December. If confirmed, Carter will succeed former Nebraska Senator Chuck Hagel as the head of the department.

Carter had been a long-time faculty member at Harvard University specializing in technology and security policy and previously served as the deputy secretary of defense from October 2011 through December 2013. He had recently started lecturing at Stanford in October of this year as a visiting scholar.

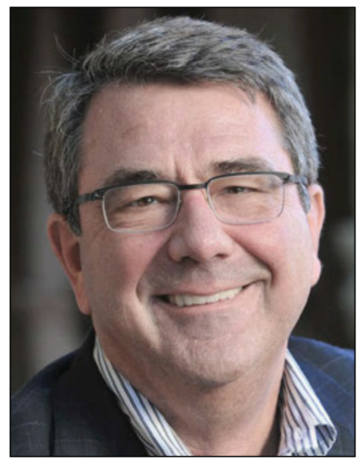
Prior to serving as deputy defense secretary he was the chief weapons buyer at the Pentagon and served as assistant secretary of defense for international security policy during Bill Clinton's first term. He's known for being a technocrat and has served on advisory panels and published numerous books and articles on the intersection of science, technology and defense.

"In one way or another, Ash has served under 11 Secretaries of Defense," President Obama said at the press conference announcing his nomination. "He's an innovator who helped create the program that has dismantled weapons of mass destruction around the world and reduced the threat of nuclear terrorism. He's a reformer who's never been afraid to cancel old or inefficient weapons programs. He knows the Department of Defense inside and out — all of which means that on day one, he's going to hit the ground running."

Carter first made his name in the early 1980s at the Kennedy School of Government at Harvard, assessing the technological feasibility of lasers and particle beams for President Reagan's proposed Strategic Defense Initiative missile shield. After the breakup of the Soviet Union, he helped draft the Nunn-Lugar amendment that provided U.S. funds to secure loose nuclear weapons.

While an undergraduate at Yale, Carter majored in both physics and medieval history and worked for a time at Fermilab in the search for the charm quark at the Tevatron. After graduating, he received a Rhodes scholarship to pursue a doctoral degree in theoretical physics at Oxford University.

After returning to the United States, he spent a year away from theoretical physics in 1979, when he worked with the Office of Technology Assessment on an assessment of the MX mobile missile project, including a proposal to mount ICBMs on blimps. After his work there, he refocused his career from theoretical physics towards public policy and international security.



Rod Searcy/Stanford University

Ashton Carter

"I accepted the President's offer to be nominated for Secretary of Defense because of my regard for his leadership," Carter said. "I accepted it because of the seriousness of the strategic challenges we face, but also the bright opportunities that exist for America if we can come together to grab hold of them."

Digital Archives Grow in Size and Usefulness

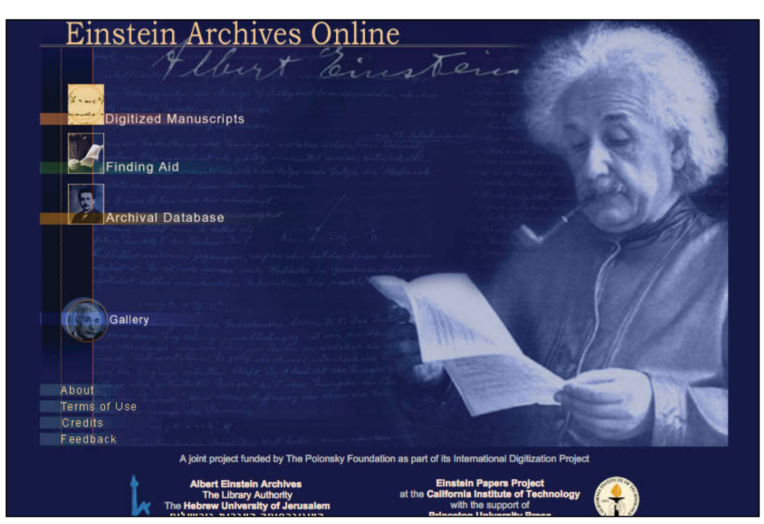
By Michael Lucibella

Historians, scientists, and the public now have more access to digitized raw materials than ever before. In the last few months, two large libraries of historical science documents were posted online, freely accessible to the public. Though online archives like these are becoming more common, the challenge of digitizing tens or hundreds of thousands of documents has kept the pace of uploads relatively slow.

In September, CERN began posting its massive photo archive (cds.cern.ch/collection/Photos) to the lab's online documents server. Already the group has posted nearly 40,000 of its more than 120,000 black and white photo negatives from the 1950s through the early 1980s.

Then in December, the Einstein Papers Project, located at Caltech, started publishing digitized versions of Albert Einstein's correspondence up through 1927. "What we put online are the existing scholarly annotated papers that have been collected," said Diana Kormos Buchwald, a Caltech historian and director of the Einstein Papers Project. "We are not just putting up copies or facsimiles of known documents written by Einstein."

The Einstein collection in particular required a lot of additional scholarship prior to its release, including transcription and translation of the original documents. "Throwing up scans or copies of manuscripts is not sufficient in this day and age. You want to explain when they were written, why they were written, and to whom they were written," Buchwald said. And there is so much scholarship and documentation surrounding the life of Albert Einstein that sifting through and picking the relevant documents to upload and providing context for each is a major undertaking.



Einstein Papers Project

Einstein Online: The Einstein Papers Project has posted scans, transcriptions, and translations of its collection.

In a way, CERN's photo archive poses the opposite challenge for the library team. Many of the photographs have little or no documentation, leaving the team in the dark about the events or the names of people and equipment depicted in many of their photos. "The old database that we have isn't as good as it could be," said Alex Brown, the assistant multimedia librarian at CERN who's helping digitize the photos.

To fill in some of the blank spots in the record, the team has been reaching out for help in identifying people and items in the photographs. Any member of the public or scientific community who recognizes someone or something in the photographs can post a comment to the document server.

The team wanted to concentrate on the older trove of black and white photos first because of concern for the longevity of both the negatives and the individuals who could help identify the people and items in them.

For historical researchers, these kinds of big online repositories have been a major boon. Digital tools like text search are letting researchers scan through collections of documents more efficiently than ever before, while the Internet brings the archives to people around the world.

"It allows me to do a lot of research that I otherwise wouldn't be doing because I don't have the time or the money," said Alex Wellerstein, a historian at the Stevens Institute of Technology. His own research is focused primarily on the history of American nuclear weapons and technology. He said also that traveling and staying in different cities to access physical archives is one of the biggest expenses in historical research.

Faster computers and ever-cheaper hard drive space have allowed more archives to put large portions of their collections online for public access. Archives have embraced these online repositories because it results in less wear and tear on the documents themselves as fewer people handle them. Their preservation was what in 2011

ARCHIVES continued on page 7

Directing Traffic

Michael Lucibella

Zahra Fakhraai of the University of Pennsylvania (far left) sorts March Meeting abstracts with Rob Riggleman, also from the University of Pennsylvania (far right) and Debra Audus of NIST, along with other volunteers.

INSIDE THE Beltway

Will Obama Opt for Triangulation?

by Michael S. Lubell, APS Director of Public Affairs

December was a particularly good month for Wall Street. And banking interests owe President Obama big time for his part in their largess.

What he did was clear. Why he did it remains a matter of speculation. But he might just be preparing to take a page from Bill Clinton's playbook and spend his next two years as "triangulator"-in-chief. Science, take note!

Here's what played out in the waning days of the 113th Congress: With just hours left on the budget clock, Capitol Hill was mired in another legislative morass of its own making. Having put the government on autopilot before the November election, lawmakers returned to a lame-duck session facing a December 11 midnight spending deadline. That's when the stopgap continuing resolution was scheduled to run out. And if they didn't take any action, the government would shut down.

House and Senate appropriators and their staff had spent much of the previous month hammering out budget compromises well into the wee hours. And their efforts paid off, generating more than 1,500 pages of directives in an omnibus bill that covered the fiscal year 2015 spending plans laid out by 11 of the 12 appropriations subcommittees. The 12th one, which would have funded the Department of Homeland Security (DHS), was put on a short-term continuing resolution as a concession to far-right Republicans who were seeking retribution for President Obama's executive action on immigration — which they assert is illegal and unconstitutional.

The bargain, a "Cromnibus" in Beltway-speak, received a reluctant blessing from congressional leaders of both parties, as well as the White House. In an unusual display of bipartisanship, lawmakers were on the verge of doing the unthinkable: taking sensible action that would keep Washington functioning.

Then, with few eyes focused on their machinations, Wall Street lobbyists, who had been thwarted repeatedly during the last few years, managed to insert language that would gut key provisions of the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act. The stealthy sentences would allow big banks to engage again in risky practices — trading credit default swaps, buying and selling opaque derivatives, and issuing collateralized debt obligations — all guaranteed by taxpayer money. If their bets come home, Wall Street firms could rake in hundreds of billions of dollars, and if they blow up completely, taxpayers once more would be on the hook for a trillion-dollar tab.

Led by Citibank and J.P. Morgan Chase — Chase's CEO, Jamie Diamond, reportedly made many of the calls to key legislators himself — Wall Street left its indelible imprint on the Cromnibus.

For Democrats, who had nearly gagged on the DHS deal, the Dodd-Frank gutting was too much to stomach. And as the House prepared to vote on the bill's rule — the first step in the chamber's legislative process — Democrats signaled they would not provide a single vote in favor. Under pressure from House Speaker, John Boehner (R-Ohio), some Tea Party Republicans agreed to support the bill's rule, but many said they would oppose its final passage. Unless Democrats broke ranks, the Cromnibus would die, and the government once again would face an imminent shutdown.

The rule passed, but only by the razor-thin margin of 214 to 212. The bill, itself, was facing certain defeat. So Speaker Boehner used the only tool he had immediately available. He declared a recess.

Enter Barack Obama. Bucking his own party, he lobbied House Democrats hard, arguing that pragmatism should be the new political maxim. In the end, he managed to cajole 57 of them into heeding his plea. And at the 11th hour the bill passed, 219 to 206, with 67 Republicans joining 139 Democrats in opposition and 162 of them sticking

TRIANGULATION continued on page 7

Letters

Members may submit letters to letters@aps.org. APS reserves the right to select letters and edit for length and clarity.

Use Judgment Instead of Impact Factors

The Back Page essay by Carlton Caves, "High-impact-factor syndrome," (*APS News*, November 2014) is a much-needed clarion call for more thoughtful evaluation of researchers and research institutions. The wisdom and truth of Caves' analysis should be self-evident, but is sadly and widely ignored. His proposed test of one's possible affliction with HIFS — asking if the same publication/citation record looks more impressive if the papers appeared in *Nature* and *Nature Physics* than if they appeared in PRL and PRA — is compelling and sobering. We would all be well advised to treat important decisions like hiring and promotion with laborious (but substantive) judgment rather than lazy (and near-empty) "objectivity."

William D. Phillips
Gaithersburg, Maryland

MEETING continued from page 1

ate administrator for science, will speak about the roles scientists can play in shaping the future.

Tuesday's plenary session will feature James Hartle of the University of California, Santa Barbara, speaking about quantum gravity and cosmology. Haiyan Gao of Duke will bring attendees up to date on the persistent mysteries of the proton.

Just before the April Meeting opens, APS will host a number of workshops. The Topical Group on Hadronic Physics is hosting its workshop on nuclear physics from April 8 to April 10. The Topical Group on Precision Measurements and Fundamental Constants in conjunction with the Group on Few-body Systems are putting together a one-day workshop on Friday on "Tests of fundamental symmetries" to bring participants up to date on efforts to search for time-reversal and parity violation. Also on Friday is a professional skills development workshop for women postdocs.

MIT physicist and science historian David Kaiser will deliver Saturday evening's public lecture. His historical investigations have focused on how physics research developed in the United States during the Cold War. His most recent book, *How the Hippies Saved Physics*, was named *Physics World's* 2012 Book of the Year. The Forum on Outreach and Engaging the Public is planning to host a special workshop on Saturday with the National Science Foundation to share ways to better communicate with the public. The plan for the half-day session is to mix both presentations and hands-on activities to better train scientists to share their science with the broader community.

The meeting will host a number of events aimed especially at students. As part of the "Future of Physics days" events, a panel of graduate students will answer undergraduates' questions about continuing their education. Undergraduate students will present their research at one of the undergraduate oral sessions or the afternoon's poster session, and there will be a special award brunch on Sunday for the top undergraduate presenters. Undergraduates are invited to apply for travel grants of up to $1000 to attend the meeting. The Forum on Graduate Student Affairs will sponsor a career session aimed at graduate students who are thinking about opportunities in physics, featuring experts from both the business world and academia with a particular focus on international opportunities. Speakers include Giorgio Paolucci, science director of the SESAME synchrotron in Jordan, entrepreneur Frank Levinson, and Megan Friend, an assistant professor in Japan.

Exhibitors, including publishers and other vendors, will have booths set up around the hotel to display their products.

Meeting attendees will be able to stop by the APS Contact Congress booth to send letters to their elected officials about the importance of continued Congressional support for scientific research.

PAYNE continued from page 2

Finally, in 1956, Payne-Gaposchkin achieved two Harvard firsts: she became the first female professor, and the first woman to become department chair.

Her obituary read, in part, "Cecilia Helena Payne-Gaposchkin, a pioneering astrophysicist and probably the most eminent woman astronomer of all time, died in Cambridge, Massachusetts, on December 7, 1979. In the 1920s she derived the cosmic abundance of the elements from stellar spectra and demonstrated for the first time the chemical homogeneity of the universe" [4].

1. C. Payne-Gaposchkin, *An Autobiography and Other Reflections*, Katherine Haramundanis, ed. (Cambridge University Press, 1996).
2. *Science* **39**, 791(1914).
3. C. H. Payne, *Stellar Atmospheres* (Harvard University Press, Cambridge, MA, 1925)
4. *Quarterly Journal of the Royal Astronomical Society*, 23, 450 (1982).

HIFS and Related Diseases

I enjoyed Carlton Caves' recent Back Page article on HIFS: high impact factor syndrome (*APS News*, November 2014). Having excellent scientists comment on issues like this can only improve our discipline.

Like many of my colleagues, I also find it annoying when someone talks of publication in high-impact journals as defining greatness. There are excellent papers published elsewhere as well.

Often some other proxy measures like bibliometrics are useful for objective reviewing. Yet I find in my reviewing duties two more factors relating to citations that are just as troublesome as HIFS.

The second issue is the CCS: citation club syndrome. This is the expanding average author number in every paper, driven by Thomson Reuters and Google crediting every author for their co-authors' work.

The third issue is the FJS: fake journal syndrome. This is the plethora of fake online journals, which only want to collect publication fees. They cite each other, so citation counting won't cure this.

Just how one should proceed with evaluations in science is not easy. Solving these other two problems might help to solve the HIFS problem, by making bibliometrics more reliable.

Peter D. Drummond
Hawthorn, Victoria, Australia

Voting is Fundamental

In *APS News* (November 2014) several distinguished physicists took exception to the new *Constitution & Bylaws* because they felt their voting rights would be denied. In response, 2014 APS President Beasley explained that the APS Council deliberated this issue but in the end chose the Council to approve amendments, partly because APS voting participation was low, 15 percent or less.

Beasley and the Council may be correct, but more importantly we need to rectify our abominable voting record. We cannot maintain a healthy APS if most of us shirk our voting responsibilities.

The world faces challenges, most of which will require skills and expertise found in APS. We can be of little service if our Society is in disarray because we refuse to participate in its proper functioning. Voting is crucial to our health, whether en masse like the recent *Constitution & Bylaws* vote or in APS units.

No excuse is valid. "I don't have time; I'm too busy with research and teaching; my vote won't matter anyway." I recently spent a half hour reviewing Forum on Education candidates. As a former teacher, I wanted to understand what challenges they face and how they respond. I voted and benefited from the experience.

We are an important microcosm of our country. To maintain our effectiveness, we must all participate. At its most elemental and unifying level, this means VOTE.

Michael Bozoian
Lynchburg, Virginia

Nature Publishing Group Starts "Free to Read" Link Sharing

By Tamela Maciel

Nature and 48 other academic journals in the Nature Publishing Group (NPG) have made all of their articles past and present "free to read" online, provided a subscriber or approved media outlet shares a link. But some open access advocates wish NPG had done more.

As of December 2014, anyone with a subscription to *Nature* or other NPG journals can, with the click of a button, send friends or colleagues an email with a link to the online article. Propriety software called ReadCube displays the article in a web browser for reading, but blocks saving or printing. NPG's publisher, Macmillan Science and Education, has a majority stake in ReadCube through its technology division, Digital Science.

"We know researchers are already sharing content, often in hidden corners of the Internet or using clumsy, time-consuming practices," said Timo Hannay, managing director of Digital Science, in a press release. "At Digital Science we have the technology to provide a convenient, legitimate alternative that encourages researchers to access the information they need and the wider, interested public access to scientific knowledge, from the definitive, original source."

Hannay is referring to the common practice among researchers of sharing their papers online, either by emailing PDFs ahead of publishing embargos or resorting to social media outlets like Twitter to crowdsource free copies. Since this "dark sharing," as NPG calls it, already occurs, their new read-only button is unlikely to change the amount of PDF sharing among scientists, according to a recent blog post by Michael Eisen, University of California, Berkeley biologist and open access proponent.

A larger effect might come from the 100 media outlets and blogs that can also provide "free to read" links. If the links prove popular, the public will have increased access to NPG research and, as Eisen pointed out, NPG will be able to track what is being shared and better quantify the impact on social networks.

This comes at a time when governments and funding agencies such as the National Institutes of Health and the Bill & Melinda Gates Foundation are calling for increased open access to research results. Many advocates want full open access — free access to research immediately upon publication — but faced with the need to cover publication costs, many publishers, including APS, implement a hybrid open access policy.

Some open access advocates are unconvinced that NPG's "free to read" initiative is the right move. "More access is always preferable to less access. But *Nature's* convoluted, read-only access is insufficient … because it adds arbitrary handicaps," said Stevan Harnad, a cognitive scientist at the University of Quebec at Montreal. Instead Harnad said the right step would be to drop the six-month embargo policy that NPG maintains before a paper can be shared online, as APS has already done.

Other publishers, including APS, allow authors to immediately self-archive their work. "The APS has long encouraged authors to share copies of the APS 'Version of Record' with colleagues, and APS allows authors to post copies of their articles on the author's website or the author's institution's website. This goes much further than what the NPG has now announced," said Gene Sprouse, the APS Editor in Chief.

But Sprouse also said that journal publishers must recover their costs, which include "hiring editors that manage the peer review process, building and maintaining the computer systems that preserve and serve the articles, as well as paying for copy editing and composing the articles." At the moment those costs are chiefly met through library subscriptions, sponsors, or optional publication fees, should the author wish to be published under full open access.

In response to open access demands, many institutions are currently paying for access in two ways: a publication fee to make outgoing research open access and a subscription fee for incoming articles that are not open access.

Many researchers, institutions, and publishers favor the fundamental principles of open access, but it is the details of how to transition to this access standard without crippling publishers or research institutions along the way that causes tension.

In the future, Harnad hopes to see more publishers adopt a stance similar to that of APS, so that research institutions become the main repositories for publicly accessible research. In this way, he thinks publishing fees can be scaled back to a fraction of what they currently are and institutions will be able to afford to pay publication costs from what they save in subscription fees.

Diversity Corner

Pre-Meeting Professional Skills Development Workshop for Women Physicists
APS, with support from the National Science Foundation, will host two Professional Skills Development Workshops in 2015 for female physicists just before the March and April meetings. Postdoctoral associates and early to mid-career faculty and scientists are invited to apply for the March 1 workshop, and postdoctoral associates are invited to apply for the April 10 workshop.

Applicants affiliated with a U.S. institution or facility are eligible for travel and lodging funding assistance. Those needing funding assistance are encouraged to apply early. The deadlines for the workshops and a link to the online application can be found here: www.aps.org/programs/women/workshops/skills/

Childcare Grants Available for APS March and April Meeting Attendees
Small grants of up to $400 are available to assist meeting attendees who are bringing small children or who incur extra expenses in leaving them at home (i.e., extra daycare or babysitting services). More information and the online application can be found here: www.aps.org/programs/women/workshops/childcare.cfm

APS Speakers Lists Feature Women and Minorities
Planning a colloquium series and want to include a female or minority speaker? The APS Women Speakers List and Minorities Speakers List contain names, contact information, and talk titles of physicists who are willing to give talks on a variety of subjects. The lists can be found here: www.aps.org/programs/women/speakers/ and www.aps.org/programs/minorities/speakers/

New Brookhaven Light Source Debuts in 2015

By Michael Lucibella

Brookhaven National Laboratory's new National Synchrotron Light Source-II (NSLS-II) is nearing completion, and the lab will put out a call for experiment proposals in October. The new, third-generation light source passed its accelerator readiness review on September 22, 2014 and is on schedule to start its first "early science" programs in winter.

The NSLS-II will succeed Brookhaven's current National Synchrotron Light Source, which has been operating since 1984. Once completed, the new facility will be the brightest x-ray light source in the world, ranking it as the nation's premier synchrotron user facility.

"I look forward to the exciting science and benefits that NSLS-II will deliver to the U.S. Department of Energy and the nation," Steve Dierker, Brookhaven's associate lab director for photon sciences, said in a statement.

The accelerator readiness review approved the synchrotron's request to start routine operations. It covers the lab's safety, environmental, management, documentation and personnel policies. The first tests to characterize the x-ray beams will start running this winter, while experiments selected from October's call will likely start in early 2015.

"Synchrotron light sources serve a very diverse user community —condensed matter physics, material science, chemistry, nanotechnology, structural biology," said Sam Aronson, the 2015 APS President and former director of Brookhaven Lab. "The new capabilities will provide access to experiments which are currently impractical or even impossible with current light sources."

Overall construction of the machine is about 98 percent completed. There are thirty initial beamlines in various stages of development that will come online between now and 2017. Ultimately the synchrotron will be home to more than 60 beamlines as more are designed and installed over the life of the facility. Construction began on the NSLS-II in 2009.

Brookhaven National Laboratory

NSLS-II will be a state-of-the-art, medium-energy (3-billion-electron-volt, or GeV) electron storage ring that produces x-rays up to 10,000 times brighter than the previous machine, NSLS.

Profiles In Versatility

Indiana Jones with a Physics Degree

By Alaina G. Levine

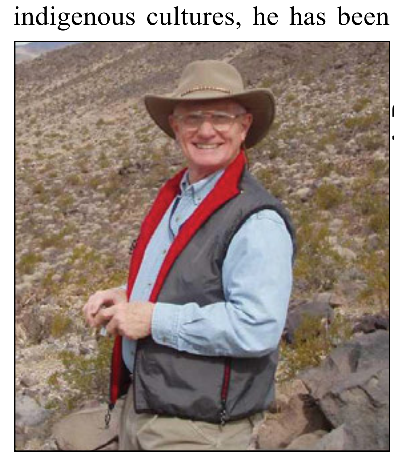
As an undergraduate, I pursued a double degree in mathematics and anthropology. Both subjects enthralled me — I loved the elegance and logic of math as well as the mystery and adventure of anthropology, especially archaeology. I saw links between the two seemingly disparate subjects, whereas my advisors and almost anyone else with whom I shared one or the other of my twin loves reacted much differently. Most raised an eyebrow, and I was met with puzzled faces. They grieved for my choice, and declared with sadness, "That's an interesting combination." But I wasn't deterred, and in fact I thrived while studying abroad in Cairo, as I pursued grant-funded research in Ancient Egyptian number theory, cryptography, and religion.

There are physicists who work on archaeological and other anthropological problems, physicists who have made career transitions into archaeology, and archaeologists who leverage their physics background to solve archaeological problems. Furthermore, some physicist/archaeologists conduct research in archeoastronomy and study how societies incorporate scientific knowledge into their culture.

Duane Hamacher is an example of the latter. An academic in the Nura Gili Indigenous Programs Unit of The University of New South Wales (UNSW) in Sydney, Australia, he has a bachelor's and a master's degree in astrophysics and a PhD in Indigenous Studies (with a focus on cultural astronomy) from Macquarie University in Sydney. "I moved to Australia to do astrophysics, but was pulled over to the dark side," he jokes. "I liked astronomy but also liked cultural studies. I wanted a job where I wouldn't have to be stuck coding all the time, where I could go out and explore." While completing his dissertation, Hamacher realized that he could carve his own niche combining astronomy and anthropology, which he envisioned would give him a competitive advantage in the academic job market.

His gamble paid off, in what is probably the most unusual example of networking and six degrees of separation I've come across. According to Hamacher, the head of the UNSW's Indigenous Studies program was riding a camel across the Gobi desert with the director of Microsoft Research. As they chatted, they discussed how the company was interested in enhancing its WorldWide Telescope project with indigenous aspects of astronomy. Did the professor know anyone with expertise in both astronomy and anthropology? Why yes, he did — a simple literature search turned up Hamacher, and soon the head of the program called him with a job offer.

Today, as an Australian Research Council Fellow, Hamacher studies the astronomical knowledge of Torres Strait Islanders, one of the indigenous peoples of Australasia, whose culture is largely based on their practical knowledge of the cosmos. "I am interested in scientific information encoded in oral traditions," he explains. "Indigenous knowledge has a scientific component developed by people who have used it for practical purposes for tens of thousands of years. It's structured knowledge about the natural world." Using ethnographic, historical, and archaeological methods to analyze indigenous cultures, he has been



A. Rogers

Sandy Rogers surveying in the Panamint Mountains of the Mojave Desert.

D. Hamacher

Astrophysicist-turned-anthropologist Duane Hamacher visiting Stonehenge

"blown away" by the Islanders, who, he says, "use astronomy for everything." They link the movement of the constellations to animal behavior. (For example, they know that when the big dipper touches the horizon at sunset, it is shark breeding season and time to stay out of the water.) They also use this knowledge to build timetables indicating when to hunt turtles and plant crops for food. He adds that the Islanders are also unique for using the scintillation of the stars to measure the degree of moisture in the atmosphere to predict weather.

Hamacher explains that although he doesn't conduct physics research, "My background is very useful. It provides a rigorous set of eyes for solving problems in a systematic fashion." Kate Craig, a UCLA doctoral student in history with an undergraduate degree in applied physics and history, agrees. She notes that for her work in investigating relics and their movement across societies, "Physics has given me the view from the mountain," and this 360 degree, holistic perspective has aided her in making her work "accessible and relevant to people in other fields."

Alexander "Sandy" Rogers has also found great value in studying physics as he transitioned into anthropology. He built a second career later in life after 40 years working as a physicist and an engineer at the Naval Air Weapons Station China Lake and The Johns Hopkins University Applied Physics Laboratory. He spent much of his time conducting experiments with infrared molecular spectroscopy, lasers and radar, but when he retired in 2002, he didn't spend his time playing golf. Instead he went back to school to investigate his other field of interest — archaeology.

Rogers immediately realized that his physics experience was a great asset in the field, especially as he began looking into obsidian hydration dating, an archaeological dating technique that was already in use but had not been analyzed in much detail. The method, which uses the water content in obsidian artifacts to identify how old they are, is extremely useful in determining the age of objects. It is cheaper and faster than carbon dating, he explains, and although it is less accurate, with obsidian dating, "You know you're dating the artifact [itself] and not … [its] material." Rogers has spent the last decade perfecting the technique, and says he "works on the math to compensate for changes in temperatures going back 12,000 years. … Most people who have worked on this method don't have a background in mathematics or chemistry. I am trying to give it solid footing in the community with scientific rigor." He has written numerous papers on obsidian dating and currently serves as an archaeological consultant and the archaeology curator for the Maturango Museum in Ridgecrest, CA, a resource for the cultural history of the Upper Mojave Desert.

Like Sandy Rogers, Michael "Bodhi" Rogers (unrelated) uses his physics expertise to solve archaeological problems. He started his career by pursuing a bachelor's degree in physics, but in graduate school did a double master's in physics and archaeology. His doctorate was in physics. Now he is in a unique position: He is an associate professor of physics and astronomy at Ithaca College, where he coordinates physics teacher education and conducts research related to improving physics education. But the majority of his time is spent as an archaeogeophysicist, and in that capacity he uses numerous techniques from physics research to aid archaeologists and other anthropologists in their projects. His toolbox includes above- and below-ground instrumentation, such as ground-penetrating radar, cesium magnetometry, fluxgate gradiometry, resistivity, conductivity, 3D laser scanning, and 3D printing. "I've worked at many

JONES continued on page 7

TOP TEN continued from page 1

March, the documentary *Particle Fever* was released across the country, offering an intimate look at the lives of CERN's researchers hunting for the Higgs Boson. The life of Stephen Hawking got the Hollywood treatment in the critically acclaimed film *The Theory of Everything*, as did mathematician Alan Turning in *The Imitation Game*. After years of development, the film *Interstellar* hit the big screen. Inspired by physicist Kip Thorne's theories of gravitation and relativity, it wowed audiences with its impressive visuals of black holes and time dilation.

Element 117

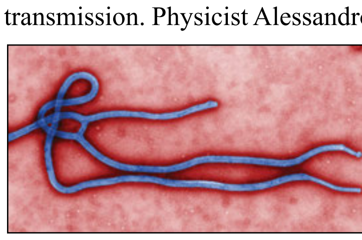
Ununseptium, the placeholder name for element 117, was spotted for an instant in Germany in **May**. At the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, scientists bombarded a berkelium target with accelerated calcium atoms to create the short-lived artificial element. This follows up on an experiment in Russia in 2010 that first created the element, confirming its existence and likely paving the way for its official inclusion on the periodic table of the elements. In addition, one of the isotopes of lawrencium discovered in the process had a half-life of nearly eleven hours, giving physicists hope that experiments might be bringing them close to the hypothesized shores of the "Island of Stability" for superheavy elements.

Galactic Black Hole

In 2012, astronomers discovered a mysterious massive object falling towards the giant black hole at the center of the Milky Way galaxy. They predicted that its observed elliptical orbit would bring it closest to the black hole around **mid-summer** and were primed to watch the predicted fireworks of the object being ripped apart. Instead, it was more of a fizzle. Originally thought to be a giant gas cloud, the object might actually harbor a large star in its center, which would have held the cloud together in the face of the enormous gravitational tidal forces. Based on its trajectory, there's a chance that in a few decades the hypothetical star will pass through the dust and gas surrounding the black hole, and maybe then scientists will witness the show they had hoped for.

Ebola's Potential Spread

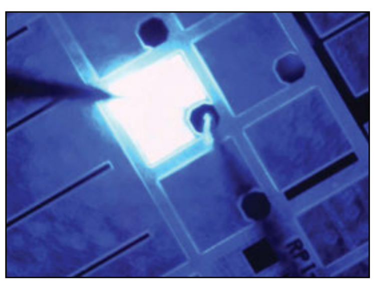
As the Ebola virus ravaged West Africa, researchers worried about its potential spread started mapping its transmission. Physicist Alessandro Vespignani of Northeastern University used computer models to simulate the movement of people throughout the world and the ways the disease might spread. His dire conclusion in **August** was that if nothing was done, tens of thousands of people could be infected within months. Fortunately, a lot is being done to combat the outbreak, which according to the Centers for Disease Control so far has resulted in just over 6000 deaths.


CDC

Ebola virus

Nobel Prizes

Without winning the Nobel prize in their own field, physicists did well in **October** anyway. The physics prize went to two engineers and a materials scientist, one from the United States and two from Japan, for their work developing the blue light emitting diode. After the quick invention of the red and green LED, an efficient blue device took nearly twenty years to produce. The following day, physicists from the United States and Germany won the chemistry prize for the development of super-resolved fluorescence microscopy, which pushed the limits of optical microscopy down to the nanoscale.


NSF

Nobel prizes for blue LEDs

Space Exploration

This fall, interplanetary exploration was a central focus of the world's space agencies. In **October**, India made headlines by successfully placing a small satellite into Martian orbit, only the fourth space agency to do so and more cheaply than any other Mars mission to date. On **November** 12, the European Space Agency's Rosetta space probe dropped the its tiny Philae lander onto the surface of the comet 67P/Churyumov-Gerasimenko, but its operational life was cut short after the lander bounced off its planned landing zone into a shady crater. Without functioning solar panels, the reserve battery discharged, but not before the lander carried out 80 to 90 percent of its scientific mission. This included a startling discovery announced in **December** that the isotopic content of the comet's water molecules didn't match that on Earth, rekindling questions about where our planet's water originated. Also in **December**, NASA successfully launched a prototype of Orion, its new spacecraft designed to take astronauts into Earth orbit and beyond.

Tabletop Accelerator

In **December**, scientists at Lawrence Berkeley National Lab announced a new world record for a compact particle accelerator. The team used a tabletop-sized laser-plasma accelerator to energize electrons up to 4.25 GeV. Though not nearly as powerful as the massive LHC, the tiny BELLA accelerator can do in about one meter what would take CERN 1,000 meters. Physicists hope that this emerging compact accelerator technology will pave the way to new generations of particle colliders.

ARONSON continued from page 1

in particular the implementation of the recently approved governance changes. Internal operations and relations between the membership of the Society and the leadership of the Society will be a big focus. Then there will be efforts to represent the Society's interests and concerns to the public, to the funding agencies, and to our international partners, so there will be a fair amount of outreach that will require attention.

How well do you think the Society is serving its members? Are there any areas where you think APS programs could be enhanced?

I think in general the Society is serving its members very well. The membership wants access to scientific publications in high quality journals, which the Society provides. Our journals are the benchmark journals of physics in the world. The membership wants to ensure that the Society continues to provide active and attention-worthy meetings and conferences, which we also do. Those I think are the main services that the membership expects. I have some concerns that as a Society our communications with our members, providing them with information more specific to the American Physical Society, could be improved and we're doing some work to look at whether that's so or not. That work will continue to improve our communications internally.

Something maybe not so visible to our members, but still important, is the strategic budgeting of the Society's operations.This ensures we're good stewards of the Society's assets and efficient providers of the services they expect with the funds available. The Society's staff and its governance bodies — the Board of Directors and the Council of Representatives — are responsible for the execution and the oversight of such functions. I think that's a little bit off the radar screen of the typical members in terms of the services that we provide.

What do you see as the Society's role in public policy?

I think we have an important voice in scientific matters and we need to continue to exercise it in our public statements and in our outreach efforts. Concerns and opportunities where this Society and the physics community can provide benefit to society overall comes in many forms; the research, education, and physics careers we advocate for or the impact of policies that we talk about in our public statements. There are a number of ways in which we can influence the public's opinion of the work of the physics community and its value to the larger society. I think those are the main things that we need to accomplish with our outreach.

What do you see as the Society's role on international issues?

Science is so international now that the Society has put effort into coordinating on some issues with other physics societies and scientific societies around the world. Many, probably the majority, of the scientific publications in our journals do not originate in the United States; they originate all around the world with big components in Europe and Asia. APS is in fact an international society and its publications are international physics publications. We have a role and responsibility on the international scene just in the course of doing our normal business. We serve a much bigger base than the American physics community.

In recent years, APS has been increasing its focus on education and outreach. What do you think of these efforts and how will you guide them?

I think they're very important for the reasons I mentioned earlier regarding the pipeline of physicists that is generated in this country and elsewhere, and that does the research in which the U.S. would like to maintain leadership. Education has two features. One is just raising the awareness and general literacy of the population at large on scientific matters. The other is helping to build the most robust and most diverse pipeline of people who want to work in STEM fields or fields where a physics degree turns out to be an important asset, and that can be in a very large variety of fields that are not scientific per se.

How will you guide APS through the current period of corporate reform transition?

We're well set up to implement the reforms that we've worked on over the past couple of years and which were supported by a very large majority of the voting members in the recent vote on the new *Constitution and Bylaws.* This will involve organizing the operations under a chief executive officer and giving new roles to the former Executive Board, now the Board of Directors and to the Council of Representatives. That work has already started. There is new leadership for the council and there are new meetings already going on to plan for more effective council meetings and more strategic board meetings. I'm very confident that with the work of the board and the council together with the CEO, we're heading in the right direction in implementing the changes we want to make. And I believe those are going to make us more into a modern and nimble society in terms of carrying out our work.

How did you become interested in physics?

That goes back to high school I guess. I was raised and in high school during the Sputnik era. I felt the tug of that kind of work as a result of being exposed to the advances in space science and finding that I had a facility for math and for physics starting in high school and certainly in college. I just never considered doing anything else other than physics as far back as I was making decisions or even having thoughts on those subjects.

Why did you choose to run for the APS presidential line?

I had been an APS member since I was in graduate school and felt that it was the right thing to do; to pay back in a way or give something back to the Society for its support over the years. I think the only thing I actually did as a member of the Society other than attend meetings was to review papers for *Physical Review*, and I felt there was more I should and could do more at this stage in my career.

Any other thoughts?

One thing I think I didn't touch on but maybe should have emphasized more is the importance of diversity in the physics community. I think we are missing the benefits of the participation of a lot of smart people, just because physics as a field is still not as diverse as it should be. In other words, it doesn't draw from the maximum pool of potential physicists. I'm very supportive of, and interested in, the Society continuing to develop a more diverse membership and programs aimed at attracting a more diverse future physics community.

INPUT continued from page 1

these centers are, and what can be improved with the resources available. "We look at the frontier of computing and the science that can be done on the biggest computers.

"Unfortunately the NSF is a long way from this frontier right now," Harrison said, adding that other agencies like the Department of Energy have the top-of-the-line computers. "Does it make sense for the NSF to chase the bleeding edge of supercomputing, or does it make more sense to partner with other federal agencies?"

The final report with concrete recommendations will be submitted to the NSF sometime in July 2015, and the committee putting it together hopes to hear from researchers by the end of January.

"What we would really value from *APS News* readers is that sense of what are the big science opportunities … that need advanced cyber infrastructure in any form," Harrison said. He added that it wasn't just hardware requirements they were looking for input on, but also software and access needs.

More broadly, the committee is looking for a picture of what scientists can do with more access to supercomputing centers over the next few years. Harrison said he hoped to be able to draw on white papers and other comments submitted through the website. "What are the big science drivers, what are the scientific frontiers in order for the NSF to maintain itself at those frontiers of science?" Harrison said. "What really needs this stuff and what happens if the NSF doesn't do something?"

Scientists can read the full interim report and submit comments nas.edu/sciencecomputing

JONES continued from page 5

sites and time periods, including the Revolutionary War era sites of Old Fort Johnson and Fort Klock in New York, Contact-period Native American sites in New York, an 8th-to-12th-century Irish monastic site, the Klondike Gold Rush city of Dyea, as well as several sites to locate unmarked burials," he says, just to name a few. He has also conducted archaeological excavations.

For a project in Cyprus, Bodhi Rogers and his team surveyed a 25-acre area dating to the late Bronze Age (approximately 3,000 years old). He explains, "The goal was to map the remaining city walls to understand the layout of the city and see how people express power through urban design. ... We still have to excavate, because archaeo-geophysics doesn't tell us how old things are or what the function of the buildings was." But his efforts "make the archaeological excavation much more efficient and focused, since we already know where to dig and what questions to ask." Using ground-penetrating radar and magnetometry, he was able to reveal the pattern of the city. Ever the physicist, Bodhi has also examined how to improve ground-penetrating radar, especially under wet conditions, and has published studies on this topic.

The appeal of a dual career that unites these fields is clear. For Bodhi Rogers, the range and abundance of intellectual challenges never ceases, especially since, given his knowledge, he can easily navigate a diversity of archaeological sites and time periods. "I get to travel the world and visit cultures most people don't get to experience," adds Hamacher. "It's a phenomenal job that is incredibly interdisciplinary and extremely rewarding." It's amazing what can happen when one explores an "interesting combination" of subjects."

Alaina G. Levine is a science writer and President of Quantum Success Solutions, a science career and professional development consulting enterprise. Her new book, Networking for Nerds*, on networking strategies for scientists and engineers, will be published by Wiley in 2015. She can be contacted through her website or via twitter @AlainaGLevine.*

ARCHIVES continued from page 3

prompted the archivists at the Niels Bohr Library & Archives at the American Institute of Physics to digitize its most popular collection, the Samuel A. Goudsmit Papers.

"One of the interesting things is that archives have moved very quickly in a very short period of time towards online archives and digitization," said Joe Anderson, director of the Bohr Library.

However, the process of scanning potentially millions of pages of documents is time-consuming and labor intensive. In 2012, comedian Seth McFarlane made a donation that enabled the Library of Congress to acquire the collected papers of Carl Sagan. The library posted on its website about 110 selected items from the more than 1,700 document boxes, but has no plan to digitize the whole collection.

"It's basically an online exhibit that was created to commemorate the acquisition of the papers," said Trevor Owens, a digital archivist at the Library of Congress. "The idea of that project is to situate Carl Sagan's papers within the broader collection of the L.O.C."

The library is home to enormous troves of books and documents extending over hundreds of years, and the archivists have to conserve their digitization resources. Other collections like presidential or congressional records take precedence, largely because a collection like Sagan's poses more challenges than older ones.

"The biggest challenge in doing modern collections like the Sagan papers … [is that] there's a lot of rights issues to consider," Owens said. He added that this becomes especially difficult as the collections grow in size.

However, one problem researchers have run into is that online archives are not inherently permanent fixtures. In late 2013, two big online archives maintained by the Department of Energy (DOE) went dark. A collection of documents and photographs about the agency's Hanford Site was turned off around November, as was its Marshall Island document collection. The Hanford archive was likely taken down because of the outdated infrastructure it used. A number of the photographs once available through the site have migrated onto the DOE's Flickr account.

The Marshall Island archives hosted about 14,000 individual documents, largely related to nuclear testing in the Pacific and the health effects on the Marshall Islanders. When Wellerstein inquired about the status of the archive, the department informed him that it would be a temporary outage, but more than a year later the archive still has not returned

"The problem with the government hosting these archives … [is] the government may have a million reasons to take them down. There's no mandate for keeping them online," Wellerstein said. "The real scary thing about digital is that [while] it's easy to put things out there, it's really easy to turn it off again."

However, disappearing archives are the exception rather than the rule, and interest from the public has helped encourage these kinds of projects. The CERN photo project was made possible by a fund personally authorized by the lab's director general. "We were really impressed by the interest it generated," said Jens Vigen, the head librarian at CERN. "Across European media, it has been all over the place."

Part of the reason for the archive's popularity is that the public has not only been encouraged to help identify the photos, but also to use them as well. CERN allows anyone to reuse their photos as long as they credit the lab.

Brown said also that the artistic quality of a lot of the photographs caught the public's eye. "You had to make sure you were going to get a good shot and that you were taking pictures that were going to be enduring. The artistic value of some of these pictures is quite high," Brown said. "This kind of old-school cool is a bit of a trend at the moment."

TRIANGULATION continued from page 3

with the GOP leadership.

During a press briefing afterward, the president openly acknowledged that he was staking out new strategic ground in advance of the 114th Congress, which Republicans will fully control.

Obama's actions, which split the Democrats, galled many of them, including the party's House Leader, Nancy Pelosi (D-Calif.). His approach was all too reminiscent of Bill Clinton's rapid pivot to the center following the 1994 midterm election that gave Republicans control of the House for the first time in 40 years.

During Clinton's final six years in office, Washington came to recognize there were three separate power centers to be conjured with: congressional Republicans, congressional Democrats and the White House. Dick Morris, a political consultant, who has been famous for working both sides of the aisle and had advised Clinton to adopt the new third-way strategy, called it "triangulation." And the name stuck. So did the presidential strategy, which many political analysts credit for the success and public popularity Clinton enjoyed until he left office in 2001.

It is possible President Obama had other motivations when he threw some of his party's leaders under the Cromnibus, but I doubt it. Legacy has to be on his mind, and the legend of Bill Clinton might be shaping up as his guide star. If Obama adopts a triangulation posture, the science community, which has long emphasized the need for support across party lines on Capitol Hill, will have to acknowledge the importance of the White House as a separate actor in the final years of POTUS 44.

ANNOUNCEMENTS

The Back Page

Starting Up But Staying Put

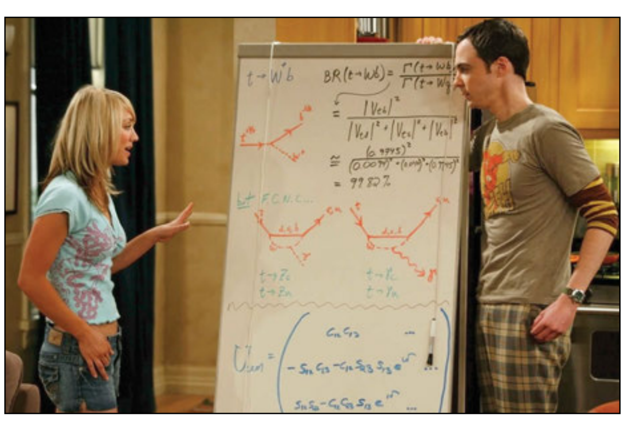
By Robert Brown

Starting a business occupies your mind 24/7, but a faculty position is very much a full-time job, too. Nonetheless, there is a path to getting the satisfaction of doing both. It requires a team effort but maintains individual pride. As a Case Western Reserve University professor spearheading both an entrepreneurial master's program and an applied physics PhD program, I have mentored four-dozen master's, doctoral, and postdoctoral students in industrial work, been closely involved with a number of successful start-up manufacturing companies, and spent three decades collaborating with industry. Based on this experience, I believe faculty can have viable entrepreneurial careers without leaving the university and without an initial invention. The path is facilitated by our teaching, and the two most important words are "former students."

The entrepreneurship pathway follows a tenure track. The professor begins her career in some specialty — it doesn't matter which — and establishes credentials. She builds a network of former students, particularly in the business world, enhanced by media. This network offers opportunities pertaining to underserved markets, innovations, and companies' outsourcing needs. Importantly, business partners are identified. Today's university, increasingly encouraging entrepreneurship, is a source of advice for business and technology, as well as programs to teach creativity and, what is often distinguished from it, innovation.

Whatever Your Background

We tell students they can have successful careers — if they follow their passion and work hard. This advice can help us to be entrepreneurs, and not only in science, technology, engineering, or mathematics (STEM) but in art, too. (Full STEAM ahead!) Author Malcolm Gladwell says that mastery of a skill requires 10,000 hours of practice. We can put that time into disciplines that include social sciences and humanities. My background began with a "big bang," where a particle physics PhD enabled me to understand Sheldon's whiteboard formulas and build computational muscles. A network of students and collaborators included researchers at Fermilab and CERN carrying out experiments connected to our work. Such basic research seemed impractical, but ended up connecting well with industry.



CBS/Warner Bros. Entertainment Inc.

Particle physics à la "The Big Bang Theory"

An early connection came from former students employed in industry who recruited me for product modeling. New students were trained as the modeling opportunities grew, and we created an imaging course and an industrial PhD track. With a healthy thirty-year run serving engineering and science departments as well as industry, two-dozen industrial physics PhD's have graduated, many with entrepreneurial bents. Together with burgeoning business collaborations, groundwork was laid for our start-ups.

In support of collaborations, we pioneered an award-winning professional master's Science and Technology Entrepreneurship Program (STEP) serving physics, mathematics, biology, and chemistry departments, and now in its fifteenth year with dozens of alumni. (Think of an MBA on high-tech steroids.) Program students have capstones involving a start-up company or an internship in industry.

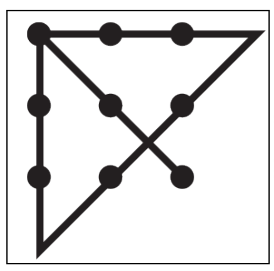
How We Define Stay-Put Entrepreneurship

While dictionary definitions refer to starting a business at some risk, a Harvard quotation [1] called "the best answer ever," says "Entrepreneurship is the pursuit of opportunity beyond resources controlled." Frankly, you can finance yourself and remain entrepreneurial, but outside help is usually needed. Tethered to the university, our partnered definition requires the small but critical change: *A full-time-faculty entrepreneur is one who collaboratively pursues opportunity beyond the resources controlled.* We need a full-time business partner.

ESTEAM: Creativity and Innovation

Are entrepreneurs made, not born? In the proposal [2] that incorporates entrepreneurship in an "ESTEAM" K-16 education (or K-18 with a STEP step), we suggest including professors as students. As noted, universities comprise mentors, advisors, partners, funding sources, and accounting help; programs like STEP study the "valley of death" (running out of money between incubation and commercialization), valuation (product/service pricing), marketing, salesmanship, and the creativity behind the inventions.

Creativity has been defined as "inside the box" in an approach [3] called "Systematic Inventive Thinking" (SIT). Consider system components, like in a computer. To improve it, the SIT rule is to avoid considering any outside, unconnected components; it is not creative to go "outside the box," which is to combine unrelated systems.



wikimedia commons

Thinking outside the box?

Consider a square of nine dots and the familiar puzzle of connecting all dots with only four straight lines along one path. Needing external intersections is usually regarded as a metaphor for thinking outside the box. Yet when students are told to consider outside intersections, most still fail to solve it. SIT suggests it is not thinking outside the box but rather the original straight-line components applied in a novel way. The famous outside-the-box example is actually an inside job.

To use SIT, make a list of the system parts and perform one or more of the following operations: SUBTRACT one of the parts, REARRANGE them, COPY one but with a new role for it, make a NEW TASK for one, and/or find NEW RELATIONSHIPS among them. Afterwards, assess the benefits of the new system, and ask, "Is it possible?" Many examples of all five techniques can be found. Although we have not been conscious of SIT, we can find connections to our work, and, besides, "staying inside the box" resonates as a metaphor for an entrepreneur staying at the university.

STEP focuses on "innovation," which includes inventiveness *and* commercialization. It emphasizes combining the acronym [4] NABC — the Needs (the problems), Approach (to show feasibility), Benefits per costs, Competition — with the "Champion," an outsider who benefits from or rhapsodizes over your endeavor. As satisfied customers, OEMs (Original Equipment Manufacturers) have been champions for us. With this background, we turn next to the results.

The Rest of the Story: Six Key Points

1. Ideas for business? Many ideas come from a collaboration on a new product or a problem with a present product. Industry's need to out-source work provides opportunities for start-ups.

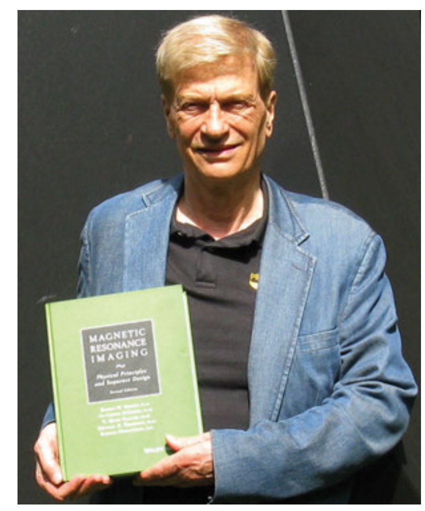
2. Multiple start-ups. A former student came back to co-start an award-winning radiofrequency-coil manufacturing business nine years ago, growing it to 120 employees. Another mentee was likewise the brains and brawn behind a company to make the whole MRI system, now with over 100 employees and \$100M in investment; a different former student was the key technologist in a new image-guided radiotherapy company. We have formed a partnership with one more new company making high-temperature superconducting MRI systems. My roles have been co-founder, recruiter, the aforementioned "Champion" in attracting investors, grant writer, and doing the myriad tasks sprinkled all over this essay. Dozens of former students are employees of these start-ups.

3. Patenting, Publishing, and Proposals. Start-ups need intellectual property (IP) to protect products and buttress their valuation. Co-sharing IP depends on whose facilities and funding have been utilized, but schools are looking at this touchy issue more broadly now, recognizing the value in nurturing businesses. Interestingly, patenting may be delayed to avoid divulging trade secret details. (However, U.S. patent offices are now looking for more general "blue-sky" submissions.) To deal with patent infringement, an entrepreneur may undergo a legal deposition (i.e., merciless grilling by aggressive lawyers). It is really painful, but if you prepare for it like a final exam you can win that battle.

Publications are good for business. For example, radiologists influence their hospitals' purchasing; they read clinical studies in journals highlighting new hardware. Publications are also critical for successful grant writing and funding proposals. Funding agencies with a forest of acronyms (SBIR/STTR/NIH/NSF/DOE etc.) nowadays support new business ventures. In this regard, publication of a 900-page textbook has had significant impact on reputation-building among investors and grant submissions. (My co-authors? Who else but former students!)

4. What about the Administration? A conflict-of-interest management plan is needed to declare any outside compensation, for recusal from university connections to your company, to acknowledge personal stakes in publications pertaining to its products, and so forth. Even if a professor forsakes salary, any ownership has to be declared as a conflict of interest.

The frequent faculty complaint of inadequate help in writing grants, let alone starting a company, is well-known. Universities are increasing efforts to address these systemic issues.



Claire Bonnett/John Wiley & Sons, Inc.

Publications have impact on investors.

5. Tenure Tracks. Will faculty entrepreneurs get tenure? Entrepreneurship can wait until tenure is earned, as I chose to do. But assistant professors can and do have business ideas and take on the juggling act. Someday, entrepreneurship may be a standard tenure track.

6. Risks versus Benefits. Entrepreneurship may force a career change, leaving faculty reluctant to try it. Much history beyond mine has shown, however, that the partnered faculty entrepreneur can successfully combine the new and old careers.

The Stay-Home Message

In summary, the following steps, I believe, can be taken to manage the risk for the partnered faculty entrepreneur:

- Obtain a tenure-track position in traditional STEAM disciplines.
- Master a discipline anywhere in STEAM, training students as you go.
- Grow a network of former students, colleagues, and collaborators in scholarship/research.
- Learn from ESTEAM mechanisms: internships, business schools, master's programs, etc.
- Create a commercialization venture from connections with industry, networks, SIT, etc.
- Choose a business partner from your network (or have them choose you) who can lead.
- Get help inside or outside the university to write business plans, determine shares, manage IP, get financing, and … learn how to charge for your product/service.
- Establish a conflict of interest management plan with the university.
- Contribute as an interim president, recruiter, researcher, grant writer, advisory board member, and so forth.
- Spend time consistent with the university's policy of allowing other outside activities such as consulting or book writing.

And you can gain the pride of ownership, of creating new jobs — and of maintaining the rewarding closeness of your former students.

ACKNOWLEDGMENT: Adapted from a keynote speech, Third Lubar-CEAS Joint Workshop on Entrepreneurship & Technology Management, University of Wisconsin-Milwaukee, 2014.

Robert W. Brown is Institute Professor and Distinguished University Professor in the physics department of Case Western Reserve University. He partners with a dozen manufacturing companies in a long career of industrial design, applied research, and entrepreneurial physics education.

REFERENCES

1. E. Schurenberg, "What's an Entrepreneur? The Best Answer Ever," www.inc.com/eric-schurenberg/the-best-definition-of-entepreneurship.html
2. S. Nambisan, "Make Entrepreneurship Part of Education," www.jsonline.com/news/opinion/make-entrepreneurship-a-part-of-education-b99214666z1-247680431.html
3. D. Boyd and J. Goldenberg, *Inside the Box: A Proven System of Creativity for Breakthrough Results* (Simon and Schuster, 2013).
4. C. Carlson and W. Wilmot, *Innovation: The Five Disciplines for Creating What Customers Want,* NSF Workshop: The Scientific Basis of Individual and Team Innovation and Discovery, August, 2006