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2016 APS MARCH MEETING

# Watch Out Baltimore, Here Come the Physicists

*By Emily Conover*

Baltimore will be teeming with physicists this spring. The largest yearly physics meeting in the U.S., the APS March Meeting, heads to Charm City from March 14 through 18. The meeting will feature more than 900 invited talks and over 9,200 papers presented. Organizers expect nearly 10,000 attendees.

The meeting includes presentations from the APS Divisions of Biological Physics; Chemical Physics; Polymer Physics; Laser Science; Atomic, Molecular and Optical Physics; Condensed Matter Physics; Fluid Dynamics; Materials Physics; Computational Physics; and other groups.

The Kavli Foundation Symposium on Wednesday will feature talks from Deborah Jin of JILA, a joint institute of the University of Colorado Boulder and the National Institute of Standards and Technology; Xiaowei Zhuang of Harvard University; David Weitz, also of Harvard University; Naomi Halas of Rice University; and John Grunsfeld, the associate administrator of NASA's Science Mission Directorate and former astronaut. From the Department of Energy, Secretary Ernest Moniz and the newly confirmed Office of Science Director Cherry Murray will give talks.

Pre-meeting events will begin March 11 and run through the start of the meeting. The 2016 Physics Teacher Education Coalition Conference will bring educators together for workshops and

BALTIMORE continued on page 7

# Report: Making the National Labs More Effective

*By Emily Conover*

The relationship between the Department of Energy (DOE) and its national labs is "broken," the co-chair of the Commission to Review the Effectiveness of the National Energy Laboratories, T.J. Glauthier, told members of Congress in two hearings this fall.

The Commission released a report in October, which emphasizes that the country's 17 national labs are an important and valuable asset. But, "The national lab system is not realizing its full potential," said Glauthier — an energy consultant who served as the deputy secretary of DOE during the Clinton administration — at a hearing of the Senate Appropriations Subcommittee on Energy and Water Development in October.

The report includes 36 recommendations to improve the effectiveness of the labs — from mending the DOE-laboratory relationship, to boosting technology transfer, to making it easier for laboratory researchers to attend conferences.

LLNL

The National Ignition Facility at Lawrence Livermore National Laboratory. DOE's national labs and its headquarters in Washington, DC need to improve their relationship, says commission report.

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# Top Ten Physics Newsmakers of 2015

*By Emily Conover*

We present our selection of the top ten physics stories that made it into newspapers and onto televisions in the U.S. and across the world in 2015. These may not be the most scientifically notable events, but they are the ones that captured the public imagination.

### Deflategate

The ideal gas law rarely makes headlines, but last January it was on the lips of journalists everywhere. After the New England Patriots football team was accused of intentionally deflating footballs in a playoff game — which they won, to go on to a Super Bowl victory — physicists weighed in. Could the temperature difference between the locker room and the outside air explain why the footballs tested at lower pressures than regulations required? And if a simple ideal-gas-law effect can't explain the amount of deflation (as many scientists argued), could the rainy weather have contributed by moistening the balls? The debate rages on — especially for Patriots fans.

Wikipedia

Findings from BICEP2 (right) turned to dust

### Foiled by Dust

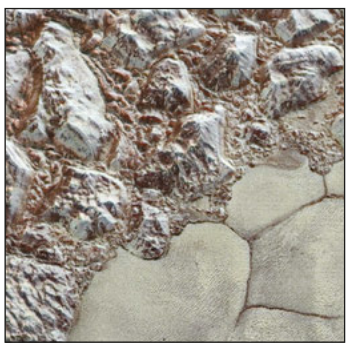
In a disappointing end to a story that enthralled the public when it first made headlines in 2014, BICEP2's claimed detection of primordial gravitational waves was definitively refuted in 2015. In January, a joint analysis from BICEP2 and the European Space Agency's Planck collaboration concluded that the observations of swirling patterns in the polarization of the Cosmic Microwave Background could be chalked up to dust in our galaxy, instead of inflation in the early universe. For now, the search continues.

### Prizewinning Particles

Neutrinos raked in the awards this past year. In October, the 2015 Nobel Prize in Physics went to the leaders of the Sudbury Neutrino Observatory and Super-Kamiokande experiments, for the discovery that neutrinos oscillate, and therefore have mass. And the Breakthrough Prize in Fundamental Physics — a glitzy, modernized version of the Nobel with larger monetary prizes but less prestige — went to a slew of neutrino oscillation experiments. Instead of honoring just a few winners, the Breakthrough Prize recognized the full collaborations — a total of more than 1,300 individual physicists.

### Pluto's Close-up

Perhaps the biggest science story of the year, NASA's New Horizons spacecraft sent breathtaking photos of Pluto back to Earth in July after its ten-year journey to the dwarf planet's distant neighborhood. Far



NASA/JHUAP/SwRI

Stunning views of Pluto

from being a boring, dead world, scientists found plenty of surprises: unblemished plains of nitrogen and methane ice, free from impact craters; towering mountains of water ice; and an extended, hazy atmosphere.

### A Special Year in Physics

2015 marked one hundred years since Einstein formulated his theory of general relativity, and humanity is still awed by his achievements. From *Science* to *Discover* magazine, publications celebrated the famous scientist's work, explaining the theory and its history — and the public ate it up. Last year was also the International Year of Light and Light-based Technologies, as designated by the United Nations. Special events organized across the globe celebrated optics, photonics, and light-related sciences.

### Iran Nuclear Deal

In 2015, world powers negotiated a nuclear deal with Iran to lift sanctions in exchange for restrictions aimed at preventing the country from acquiring nuclear weapons. U.S. Secretary of Energy

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APS GOVERNANCE

# New Organizational Structure in Place

*By Emily Conover*

It was anything but business as usual at the latest APS Council of Representatives meeting, held this past November in Chicago. Previous meetings lacked enthusiasm, says former APS President Michael Turner, but now, thanks to the APS governance reform that took place over the past year, the Council's purpose has been redefined, so that it "really gets at the issues of science and policy." As a result, "It was an entirely different meeting," with engaged, energized councilors, says Turner, who helped initiate the reform when he was APS president in 2013.

In November 2014, members voted in favor of governance reform, which restructured the APS senior management staff, adjusted and clarified the roles of the APS Board of Directors (previously called "the Executive Board") and Council of Representatives (previously called "the Council"), added a new elected position of treasurer to the Board, and amended and modernized the hundred-year-old *Articles of Incorporation* and *Constitution and Bylaws*, among other changes. Since then, the Society has been implementing these reforms.

One of the most prominent shifts was the redefinition of the responsibilities of the Board and the Council. In the new scheme, the Board of Directors focuses on financial and governance issues of the Society, and the Council of Representatives focuses on science, policy, and membership matters.

Previously, says APS Past President Sam Aronson, there was too much duplication in the duties of the Board and the Council, meaning that "[the Council] was to a large extent just rubber-stamping decisions made by the Executive Board." Now, with the Council freed from overseeing finances, its members can devote their time to issues of science.

"In the old structure, the responsibilities of the Council and the Board were pretty much tangled up together," says Nan Phinney, who is serving as the first Speaker of the Council — a new role added by governance reform. "I think the main difference with the new organization is the Council is much more engaged on some of the science issues of how to do things so that they serve the members best."

The Council has now begun addressing previously neglected issues. It has already improved communication with the units, Phinney says, by assigning a councilor to units that didn't have one, and by distributing information about Council meetings to unit leadership prior to the meetings.

The Council is also reviewing the honors program and the committees, says Phinney. "It's the start of a process, and there were a lot of things that hadn't had enough attention in a long time, and now that the Council has a little more energy there's time to work our way

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Revised 04/11/2016

# CIFS Briefs: Connecting Human Rights and Science for the Physics Community

The APS Committee on International Freedom of Scientists (CIFS) defends the rights of scientists around the globe. Here are some of some of the current issues CIFS is working on.

### Omid Kokabee

CIFS continues to monitor the situation of APS member and physics graduate student Omid Kokabee, who is serving a ten-year prison sentence in Tehran. In November, CIFS was notified by Kokabee's family that he had been hospitalized.

CIFS and APS leadership had been advocating for Kokabee to receive adequate medical care in light of his declining health. Kokabee has suffered from kidney, dental, stomach, and heart ailments since his imprisonment in 2011, but has only just recently been admitted to the hospital. Thus, while it is troubling to know that Kokabee's poor health requires his hospitalization, CIFS is pleased that he is now receiving medical attention.

Kokabee was a Ph.D. student at the University of Texas at Austin when he was arrested in 2011 in Tehran while trying to return to Austin after visiting family. Kokabee has said that Iranian authorities have repeatedly asked him to take part in classified military research, but he refused, resulting in his imprisonment.

### AAAS Science and Human Rights Coalition

APS members will be in attendance at the next meeting of the AAAS Science and Human Rights Coalition, which will be held January 25-26, 2016, at AAAS headquarters in Washington, D.C. The Coalition is a network of scientific associations and societies — like APS — that facilitates communication and cooperation on the topic of human rights within the scientific community, as well as between the human rights and scientific communities. Coalition members recognize that there is a connection between science and human rights and that scientists have an important role to play in the realization of human rights.

The Coalition meeting in January will focus on scientific approaches to human rights. The plenary session will address evidence-based approaches to human rights practice, examining ways that scientists' research informs this field. The meeting will also offer workshops, including one focused on developing strong communications plans for sharing human rights resources within scientific organizations. The Coalition's five working groups will also meet at this time, including the Working Group on the Welfare of Scientists, in which CIFS is active. This working group aims to expand the effectiveness of scientific associations in defending the human rights of scientists. It also seeks to assist associations to better respond to violations of the human rights of scientists.

APS members who will be in the D.C. area at that time are encouraged to attend. More information about the meeting, including registration, is available on the AAAS website at aaas.org/event/science-human-rights-coalition-meeting-scientific-approach-human-rights

### Human Rights Talks at the 2016 APS April Meeting

CIFS encourages APS members to attend a session (see below) at the 2016 APS April Meeting that will include talks by Zafra Lerman, the 2016 Andrei Sakharov Prize recipient, and Perry Link, the translator of the autobiography of astrophysicist and human rights advocate Fang Lizhi, who died in 2012. The session is being organized by the Forum on International Physics (FIP).

Lerman, who is president of the Malta Conferences Foundation, will give the Andrei Sakharov Prize lecture. The Andrei Sakharov Prize recognizes scientists who have demonstrated leadership in defending and supporting human rights. Lerman is being recognized for her "life-long devotion to the scientific freedom and human rights of scientists throughout the world and for compelling leadership in using science as a bridge to peace in the Middle East."

Link, professor emeritus of East Asian Studies at Princeton University, will discuss Fang Lizhi's human rights contributions in a talk titled "Why Science Implies Human Rights: the Thought of Fang Lizhi." Link recently translated Fang's memoir, "The Most Wanted Man in China," into English.

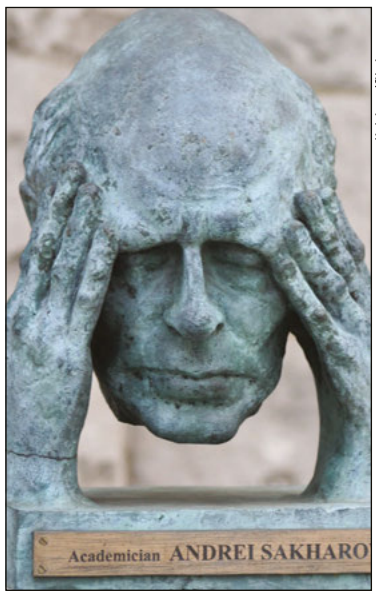
The FIP session is scheduled for Monday, April 18, at 3:30 p.m.

# This Month in Physics History

## January 22, 1980: Soviet Dissident Andrei Sakharov Arrested

Andrei Sakharov became famous as a young physicist for being the father of the Soviet hydrogen bomb — Russia's version of J. Robert Oppenheimer. But he eventually became a staunch advocate of nuclear test ban treaties, and a passionate crusader for human rights in the final days of the Soviet Union.

Born in Moscow to a physics teacher, the young Andrei was raised to love both literature and science — and music, since his father was a gifted pianist. Home-schooled for his early education, he began his physics studies at Moscow University in 1938, at a time when many of its best teachers had been purged for political reasons. Then the Germans invaded in 1941, and he found himself juggling his coursework with air raids. The students were forced to evacuate to Central Asia. Conditions were harsh. Sakharov recalled spotting a spice cake in the snow during that month-long journey; he was so hungry he devoured it.



dbking/flickr.com

**Sculpture of Andrei Sakharov by Peter Shapiro, outside the Russia House Restaurant & Lounge on Connecticut Ave in Washington, D.C.**

He was exempted from military service during World War II for medical reasons, only later appreciating his good fortune. He survived; many other young men did not. He worked at a munitions factory in Volga as an engineer instead, inventing a magnetic device to detect shrapnel in wounded horses, and managing to write a few scientific articles on theoretical physics. They weren't published, but it gave the young man confidence to pursue a Ph.D. at the Physical Institute of the USSR Academy of Sciences (FIAN) in Moscow. He completed his studies in 1945, just as the war was drawing to an end.

Sakharov recalled first hearing about nuclear fission from his father, but it didn't make a strong impression on him until news broke of the bombing of Hiroshima on August 6, 1945. "I was so stunned that my legs practically gave way," he wrote in his memoirs. "There could be no doubt that my fate and the fate of many others, perhaps of the entire world, had changed overnight."

His mentor, Igor Tamm, recruited him to work on the Soviet nuclear weapons program in 1948. Sakharov later said he felt he had no choice, but he threw himself into the research with gusto. He genuinely believed at the time that his work was vital to ensure a balance of power in the world. Ultimately he devised a novel design for a hydrogen bomb that he dubbed "layer cake" (*sloyka* in Russian), because it had alternating layers of fission and fusion fuel. At the same time, he and Tamm came up with an ingenious design for a thermonuclear fusion reactor, the tokamak; it remains a top candidate for fusion energy.

The Soviets detonated their first H-bomb in August 1953. This achievement made him a national hero, but witnessing the devastation launched him on the road to political activism as he began grappling with the moral implications of this work. "When you see the burned birds who are withering on the scorched steppe, when you see how the shock wave blows away buildings like houses of cards, when you feel the reek of splintered bricks, when you sense melted glass … all of this triggers an irrational yet very strong emotional impact," he later wrote.

Two years later, in an article about the biological risks of low-level radiation, he estimated that testing a one-megaton bomb could lead to 10,000 human casualties from cancer, and he called for a ban on further nuclear tests. A temporary ban was put in place, but Nikita Khrushchev lifted it in 1961 to test the so-called Tsar bomb (with a 50 megaton yield). The following year, Sakharov again failed to prevent a nuclear test — something he termed "the most terrible lesson of my life: you can't sit on two chairs." Disillusioned, he returned to academic research, where he worked on the problem of baryon asymmetry in the early universe, among other topics. But he became increasingly outspoken and politically active.

Matters came to a head in 1968, when Sakharov penned an essay critiquing the Soviet regime and calling for a "democratic, pluralistic society." He circulated the essay among friends and colleagues in the form of a typewritten pamphlet known as "samizdat." Eventually someone smuggled the text out of the country, and the *New York Times* published it in 1968.

Sakharov was fired from the weapons program and lost his privileged position at the top of the Soviet hierarchy. Yet he continued to fight for human rights. He was the target of multiple newspaper campaigns denouncing him, but his international stature grew. He won the 1975 Nobel Peace Prize for "his fearless personal commitment in upholding the fundamental principles for peace." Sakharov was not allowed to travel to Oslo to receive his prize, however; his wife, Yelena Bonner, accepted on his behalf.

The Soviet government decided it had had enough when Sakharov protested the military invasion of Afghanistan in 1979. He was arrested and exiled to Gorki in January 1980, and summarily stripped of his many honors. His wife joined him in exile four years later. Isolated from friends and family, and persecuted by the KGB, Sakharov went on

**SAKHAROV continued on page 4**

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# Education Update

### Submit an Abstract for the 2016 PhysTEC Conference

The 2016 Physics Teacher Education Coalition (PhysTEC) Conference, the nation's largest meeting dedicated to physics teacher education, will be held March 11-13 at the Royal Sonesta Harbor Court in Baltimore, Maryland, immediately preceding the 2016 APS March Meeting. Go to abstracts.aps.org to submit an abstract for the poster session now. For more information and to register, go to go.aps.org/1NAtJIh

### 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. Nominations for the award are being accepted until July 15, 2016. More information can be found at go.aps.org/14l8Qc2

### Free Graphs and Raw Data

APS generates statistical reports on issues in undergraduate physics. These reports are freely available for your use. You may use the graphs in reports and presentations or you may use the raw data to create new graphs and charts. Access the reports here: go.aps.org/22nvfFv

### Join the APS Topical Group on Physics Education Research (GPER)

In GPER, physics education researchers engage with working physicists to strengthen research on teaching and learning in physics departments and in the physics community. By joining GPER you will strengthen the APS commitment to physics education research (PER) as a research field within the physics community and physics departments; support dissemination of the results of PER to the broader physics community; and be informed of current PER events through newsletters and other communications.

### APS Speakers Lists Feature Physics Education Researchers

The APS Speakers Lists contain names and contact information for physicists who are willing to give talks on a variety of subjects, along with the titles of the talks they offer. Advanced searches enable search specifically for physics education researchers. Learn more at go.aps.org/1MtJblw

# Mass Media Fellowships Strengthen Both Science and Journalism

***Editor's Note**: APS participates in the AAAS Mass Media Fellows program, which places young scientists in media outlets such as radio, television, newspaper, and online publishing. The following two articles were written by recent APS-sponsored fellows about their experiences.*

### From Research to Journalism and Back

*By Andrew J. Berger*

When I learned of the AAAS Mass Media Fellowship, I viewed it as an opportunity to pay forward my love of science. And having just written a 300-plus page Ph.D. dissertation on some niche subspecialty, I wanted to stand back and reconsider the whole scientific endeavor and communicate its importance. After some frustration with research, I also wanted to test the waters of science communication. Was science journalism a better career path for me?

**Andrew Berger**

Much of the writing I did for *Discover* this past summer was for very short pieces — some of them only 150 words — which was very challenging. I would find so many interesting angles that I thought were worth telling. Nevertheless, I eventually came to embrace my task at *Discover*: identify *the* single take-away message and tell it in an accessible and captivating way.

Because it was so difficult, I learned a lot about distilling the essentials of a story and being ruthless with my edits. And I found that the editors at *Discover* were fantastic guides at helping me cut things down to a final take, which often took 7 or 8 or 12 iterations.

My physics pieces covered neutrino oscillations, ferromagnetism in copper, and stretchable conductors from carbon nanotubes. I found it tough to curb my own interest in the details of a study — especially during an interview with the scientist — for the sake of a stronger, easier-to-understand story. It was helpful to try to see things from the point of view of my readers. What can I assume they already know? What will they find interesting?

I also had to work on writing with a more relaxed and relatable tone, especially after spending the last seven years talking science with scientists. The *Discover* editors had a knack for this, and helped to gently nudge me in that direction.

I enjoyed the quick payoff of journalistic deadlines, since the pace of academic research can be painfully slow. For example, on my first day, I eagerly accepted a story that would post on the very next day. I had 24 hours to digest the study, prep for and conduct an interview,

**FELLOWSHIPS continued on page 7**

# Getting Amped for a Nikola Tesla Museum

*By Emily Conover*

An otherworldly light show blazed across the skies of Long Island, NY on several nights in July 1903, startling residents as far away as Connecticut with a display of massive electrical sparks emanating from a tower of wood and steel nearly 200 feet tall.

The people of Long Island had famed physicist and inventor Nikola Tesla to thank for the electrical theatrics. He had constructed this tower at his lab on a tract of land previously home to a potato farm, in what is now the modest town of Shoreham, NY. The tower's purported purpose: providing free, wireless electricity to the entire planet. But it was never finished, and Tesla tested his equipment only once before he lost funding. A bubbling undercurrent of rumors about the laboratory and its peculiar history has persisted in Shoreham ever since.

A community group has been working for decades to preserve the site, known as Wardenclyffe — named after the owner of the potato farm. With help from an internet crowdfunding campaign that raised over $1 million, the nonprofit Tesla Science Center at Wardenclyffe finally purchased the land in May 2013. The group plans to establish a science museum on the property, and perhaps solve some of the lingering mysteries about how the site was used, and how Tesla hoped to accomplish his improbable goal.

"[Tesla's] life story has a way of sparking your imagination," says Tesla Science Center President Jane Alcorn. "So he draws you in, but then, as you begin to work on something like this … you see what it can do for a community and a region." Alcorn, a dynamo of science education in Shoreham, has maintained an unwavering focus on the project over the past 20 years.

Although physicists are familiar with Tesla, or at the very least with the unit of magnetic field strength named after him, many members of the public have never heard of him. A prominent scientific figure in his day, he had largely faded out of view until a recent surge of interest propelled by internet science enthusiasts.

Tesla is known for his contributions to early electrical technology, particularly his development of an alternating current (AC) system and an AC induction motor. Entrepreneur George Westinghouse purchased Tesla's AC patents, and lit the 1893 World's Fair using the technology. During the infamous "War of the Currents," Tesla and Westinghouse faced off against Thomas Edison (who favored direct current). AC eventually emerged victorious, becoming the foundation for our current electric power system.

Tesla also worked on wireless communications, X-ray research, fluorescent lighting, and many other projects. A prolific inventor, he held hundreds of patents. Tesla even created a remote-controlled boat that awed the turn-of-the-century public. And artificial-lightning shows with his Tesla coils are a fixture at science museums.

wikipedia commons

**Image of Tesla's tower (now demolished) from 1904. Tesla aficionados want to turn the original lab building into a science museum.**

Despite his technical brilliance, Tesla was not a financial success. After he lost funding from his investor, J.P. Morgan, the Wardenclyffe project faltered, and Tesla fell into debt. Wardenclyffe is the only remaining Tesla laboratory; the tower, however, is long gone, demolished in 1917 and sold for scrap.

Now, only remnants of Tesla's audacious venture survive on the long-neglected site. On a bright autumn afternoon at Wardenclyffe, Christopher Wesselborg strides across the base of the former tower — an octagonal ring of cement and granite blocks, each sporting a thick metal stud that once connected to the tower. Wesselborg, vice president for technology for the Tesla Science Center and *Physical Review C* managing editor (based at the nearby APS Editorial Office in Ridge) describes the structure that once dominated the site: It was 187 feet tall, with a spiral staircase that plunged 120 feet into the earth and reportedly connected to a network of tunnels.

The center of the tower ring is now filled in with soft green grass — it seems a likely spot for a picnic. But until recently, says Wesselborg, "this was one of the dirtiest places on Long Island." The company that later occupied the site, Peerless Photo Products (later purchased by Agfa), disposed of chemicals on the land between 1939 and 1979, contaminating it with silver and cadmium. The property was designated a New York State Superfund site, and — after decades in limbo — Agfa completed the cleanup and put the property up for sale in 2012.

Tesla Science Center went to work trying to protect the site from developers looking to snatch it up. Attempts to get a benefactor to purchase the property fell flat, until the group harnessed the power of the Internet. The community group teamed up with the creator of the webcomic *The Oatmeal*, cartoonist Matthew Inman, an avid science fan who had created a comic lauding Tesla. Together they started a crowdfunding campaign on the website Indiegogo, which galvanized the public and raised $1.4 million — more than enough to purchase the property. "That it was so successful was simply beyond our dreams," Wesselborg says. "We were definitely looking for that somewhere, that light at the end of the tunnel."

Across from the tower base, Margaret Foster, a member of the Tesla Science Center's board of directors, surveys the facade of a squat red brick building with arched windows and a tall chimney; the building is still cheerful despite its disrepair. This was Tesla's laboratory, says Foster, an editor for *Physical Review A* and *Physical Review E*. Restoring the building, which was designed by the American architect Stanford White, is a major priority for the group.

The first step, removing asbestos, is already complete, says Foster, but much more remains to be done before it will be ready for the public. In 2014, the group received a one million donation from Elon Musk, CEO of electric car company Tesla Motors, for the purpose of restoring the building. Eventually, replicas of Tesla's equipment will show visitors what the lab was like in Tesla's day.

Other buildings on the site will be converted to offices, meeting rooms, and spaces for educational programs. If all goes well, the first building will be ready for the public by the summer of 2016. The group plans to create a "living museum" with classrooms, community programs, and a "maker lab," a place where people can come together to build, invent, and create. "Since Tesla was an inventor and his workshop was a place to do that kind of thing, it seems appropriate," says Alcorn.

The group continues to raise funds to aid the long, expensive process of creating the museum. A crowdfunding campaign currently offers donors the chance to inscribe a brick with text of their choice, to be used to pave the site. Although the full museum won't be ready anytime soon, the group is glad that, after two decades of trying, Tesla's legacy is finally secured.

"You just have to be patient for some things and they come about in their own time," says Alcorn. "This has so many people who believed in it. ... How could you back down?"

***Editor's Note:** The author grew up in the neighboring town of Wading River, New York, and has family members who have been involved in the effort.*

APS OFFICE OF INTERNATIONAL AFFAIRS

# A Historic Step Towards a Future African Light Source

*By Sekazi Mtingwa and Ernie Malamud*

At a conference and workshop held in November 2015 at the European Synchrotron Radiation Facility (ESRF), in Grenoble, France, the participants agreed that the construction of an African light source (AfLS) facility must begin somewhere in Africa in the near future.

The earliest call for an African governmental collaboration to construct a light source (LS) can be traced to the 2002 Strategy and Business Plan that defined the programs and goals of the African Laser Centre (ALC), which is a network of approximately thirty laser research and training laboratories throughout Africa. The organizers launched the ALC in 2003 as a nonprofit organization based in Pretoria, South Africa. From its genesis, the ALC has maintained an AfLS as one of its long-term goals.

In 2011, South Africa's Synchrotron Research Roadmap Implementation Committee and the South African Institute of Physics convened a workshop in Pretoria that produced a strategic plan for enhancing that country's synchrotron light source user community, which, numbering about forty, is by far the largest user community in Africa. One of the major recommendations was for South Africa to become a dues-paying member of the ESRF, which it did in May 2013.

More recently, a group of interested scientists, led by Simon Connell of the University of Johannesburg, called for nominations for an interim steering committee for the African Light Source (ISC-AfLS). They held elections and announced the results at an August 2014 Forum Day, which was part of the African School on Fundamental Physics and its Applications, hosted by the University of Cheikh Anta Diop in Dakar, Senegal.

It was a subgroup of the ISC-AfLS that organized the First African Light Source Conference and Workshop at the ESRF in November. They decided to convene the meeting there instead of at an African venue so that governmental officials not familiar with light sources could tour a world-leading facility. The first two days of the meeting consisted of invited talks by African users of light sources and by non-African users who study major challenges for Africa, such as malaria and HIV/AIDS. During the final three days, participants discussed policy and strategy, resulting in the following: a set of resolutions, dubbed the *Grenoble Resolutions*, that state the need for an AfLS; a roadmap consisting of short-, medium-, and long-term goals; and the election of a fully mandated steering committee to drive the roadmap forward, with Connell serving as the interim chair.

Advanced LSs are major transformative scientific instruments in a way similar to traditional lasers and computers. They embrace essentially all spectroscopy, scattering, and imaging techniques, utilizing radiation from the infrared, visible, ultraviolet, X-ray, and even the soft-gamma-ray portion of the electromagnetic spectrum. They are orders of magnitude brighter than traditional lasers, which for decades have transformed science and technology. Synchrotron light sources and free electron lasers address many challenging questions in life and condensed-matter sciences.

ESRF

**Organizers of the African Light Source Conference and Workshop, November 16-20, 2015, in Grenoble, France.**

LSs are not used solely by academic researchers, as an increasing number of industrial entities purchase beam time at many such facilities. The extremely high photon brightness and flux provided by LSs have allowed significant advances to be made in numerous applications for the benefit of society, including such biological and medical applications as drug development and better understanding of diseases, based upon the deciphering of protein, bacterial and viral structures.

Researchers work in close proximity, since as many as 50 or more beamlines at synchrotron facilities can operate simultaneously, with some beamlines supporting more than one experiment. Though costly, LSs have become clear leaders for research outputs, graduate student training, and drivers of technological innovation. Thus, they benefit nations far more than they cost.

There are many LS facilities in operation in the world. Africa is the only habitable continent without one. LS supporters argue that if African countries want to take control of their destinies, be competitive socially, politically, and economically, and become major players in the international scientific community in the years to come, access to a nearby light source will be an absolute necessity.

The AfLS is expected to contribute significantly to an African science renaissance, the return of the African science diaspora, the enhancement of university education, the training of a new generation of young researchers, the growth of competitive African industries, and the advancement of research that addresses issues, challenges and concerns relevant to Africa.

Once AfLS conference and workshop participants had agreed that construction of a light source must begin somewhere in Africa in the near future, they adopted a roadmap that describes concrete steps to realize that vision. In the short-term (up to three years), the main emphasis is on building awareness of the benefits of light-source-based research, especially among government officials; training new users, especially students; developing international collaborations; promoting access to current light sources; developing local infrastructure to support access to light sources; and launching the pre-conceptual design report for candidate sites. For the medium-term (up to five years), the steering committee will evolve into the AfLS task team that will produce the detailed governance model and business plan that includes costs for an AfLS. Finally, in the long-term (beyond five years), the task team will complete the technical design report for the selected site, and the construction of an African fourth generation light source with requisite infrastructure will commence.

Most light sources are single-country-owned; however, some are owned and operated by a consortium of countries, such as the ESRF, which is a collaboration of eighteen European governments, plus South Africa and Israel, and has been in operation since 1992. Another example of a light source collaboration is the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME), which is under construction in Allan, Jordan as a collaboration of nine Middle East governments that include Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestinian Authority, and Turkey. Scheduled to start research in 2016, SESAME is patterned closely after the model adopted by CERN, wherein UNESCO serves as the umbrella organization. We will see whether the AfLS collaboration will adopt a similar model. Stay tuned.

*Sekazi Mtingwa is Principal Partner, Triangle Science, Education & Economic Development, LLC. He is a founding board member of the African Laser Centre. Ernie Malamud is Scientist Emeritus, Fermi National Accelerator Laboratory, and Adjunct Professor of Physics, University of Nevada, Reno. Both are members of the steering committee for the African Light Source.*

**REFORM continued from page 1**

through the agenda."

There have also been major shifts in APS senior management, which was restructured in order to assign a single leader, the chief executive officer (CEO), to oversee all operations. Prior to the reforms, three top staff members — the executive officer, editor in chief, and treasurer/publisher — were on an equal footing.

Kate Kirby, who had been executive officer, was appointed CEO in February. In the lead-up to a full CEO search, a pre-search committee, chaired by Turner, recommended retaining Kirby, rather than doing a full search, and the Board agreed. "The transition has gone very smoothly because of [Kirby's] leadership," Turner says.

The new senior management structure serves to unite the Society, says Kirby. "Together with my Senior Management Team, I will be looking across the whole organization to identify challenges and to address priorities." Triumvirate structures, on the other hand, have a tendency to split an organization into individual "silos," Kirby says.

Additional changes in the senior management include appointing James Taylor as chief operating officer (in addition to his role as deputy executive officer), appointing Mark Doyle as chief information officer, and hiring a publisher, Matthew Salter. (See article on page 5.) Some positions on the senior management team are not yet filled: the editor in chief — a vacancy created last year when Gene Sprouse stepped down — and chief financial officer (CFO), a new role created in the restructuring.

The search for the editor in chief is in progress. A pre-search committee has already concluded its work, defining the job description and what qualities APS would like in a candidate. The search committee has been formed, and will be chaired by 2011 APS President Barry Barish. It will soon begin soliciting applications from suitable candidates in the community. The goal is to have someone in the position by the summer.

"We're going to be using our extensive networks within the Society, to reach out to all the members to solicit their recommendations for candidates," says Kirby. "I'm really confident we will find a great editor in chief, and that's critical to the future success of our journals." The CEO and the Board jointly appoint the editor in chief.

Thus far, says Aronson, "We've made a lot of progress in getting the right people with the right job descriptions in the right positions, and that's what the Society I think was looking for when we decided to take a look at our governance."

The makeup of the Board of Directors has changed as well. The CEO and the editor in chief are now nonvoting Board members, so that only elected directors have a vote, including the presidential line, nine councilors, and the treasurer.

2014 APS President Mac Beasley served as treasurer last year on an interim basis, and James Hollenhorst is now the first elected APS treasurer. The treasurer, says Kirby, "is really the eyes of the Board on the finances of the organization."

During his time as treasurer, Beasley began implementing a strategic budgeting process. Previously, budgeting looked one year ahead; now the process involves a three-year projection and stress tests. But APS needs a CFO in addition to a treasurer in order to have "somebody who thinks about these things every day with professional rigor," Beasley says.

The restructuring is important to surmounting the many challenges that all journal publishers currently face, Aronson says. For example, the open access publishing movement threatens the Society's revenue, most of which comes from journal subscription fees. This issue affects the whole Society, rather than falling solely under one of the three domains in the previous triumvirate structure, so having a single CEO allows a unified position, Beasley says.

The changes have also modernized the Society and made it more nimble, Beasley says. "Things move quickly these days and you have to stay with and try to stay ahead of [them] and we're in a much better position to do that now."

The new structure, Turner says, will make it easier for members to drive the organization. "I think there's going to be a quiet revolution where the members take more ownership, and I think it's going to benefit the organization, and it will just be a better force for physics. I think that's going to take a while, but I saw that at the Council."

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**SAKHAROV continued from page 2**

two hunger strikes on her behalf, so that she could travel to the U.S. for heart surgery. (She was granted permission in 1985.)

In 1986, Mikhail Gorbachev came to power, ushering in the era of *glasnost* and a series of reforms known as *Perestroika* (reconstruction). He invited Sakarahov to return home to Moscow, and the physicist was elected to the new parliament, co-leading the democratic opposition. He was also appointed to the commission charged with drafting a new Constitution.

On December 14, 1989, Sakharov went to take a nap in his study to prepare for a speech the next day in Congress. His wife found him dead in his study two hours later — he had suffered a fatal heart attack. Among the many remembrances in his honor is the APS Sakharov Prize, awarded every other year since 2006 "to recognize outstanding leadership and/or achievements of scientists in upholding human rights."

## Further Reading:

Gorelik, Gennady and Antonina W. Bouis. *The World of Andrei Sakharov: A Russian Physicist's Path to Freedom*. Oxford: Oxford University Press, 2005.

Sakharov, Andrei. *Progress, Coexistence, and Intellectual Freedom*. New York: Norton, 1968.

*Andrei Sakharov — Soviet Physics, Nuclear Weapons, and Human Rights*. Center for History of Physics, American Institute of Physics. www.aip.org/history/sakharov/

# Washington Dispatch

## POLICY UPDATE

### ISSUE: FEDERAL BUDGET

Once again, this session, Congress failed to meet its constitutional duty to pass the 12 appropriations bills needed to keep the government funded for an entire fiscal year. Instead, lawmakers put federal programs on autopilot with a short-term continuing resolution that kept agency doors open between the October 1, 2015 start of fiscal year 2016 and December 11, 2015. They had hoped the added time would allow them to resolve the fiscal and policy debates that held up the appropriations process. But the extra 10 weeks proved to be insufficient, and negotiators had to tack on another week. It turned out that was not enough, as well.

As this issue of *APS News* was going to press, negotiators were still haggling over "policy riders" on the $1.1 trillion omnibus spending bill. Although Democrats are in the minority in both the House and Senate, legislative aides said they would have to provide the majority of the votes if the bill is to pass. Armed with that knowledge, House minority leader Nancy Pelosi (D-Calif.) was driving a hard bargain to eliminate riders Democrats found particularly odious, among them restrictions on Planned Parenthood funding and Export-Import Bank reauthorization. In spite of the contentious policy issues, congressional leaders said they expect negotiations to wrap up before members of Congress leave town for the Christmas recess.

Although negotiators have been tight-lipped, insiders have indicated that science budgets would fare reasonably well, with NASA leading the way. Since the fiscal year 2016 spending plan is likely to provide the template for fiscal year 2017 — in accord with the two-year budget deal struck in October — scientists should scrutinize the final Omnibus numbers when they become available. The APS Washington Office will provide a complete budget analysis once final numbers are released.

## WASHINGTON OFFICE ACTIVITIES:

### MEDIA UPDATE

**Budget Deal Could Put Science Back on World Stage**

*The Hill*, one of three main Capitol Hill newspapers, published an op-ed on November 15 by APS Director of Public Affairs Michael S. Lubell titled "Budget deal could put science back on world stage." In the piece, Lubell points out that the agreement will boost both non-defense and defense spending by a total of $80 billion during the next two years. Read more at bit.ly/1M1bdVa

### APS PANEL ON PUBLIC AFFAIRS

The Council of Representatives at its November meeting voted to approve the APS Statement on Civic Engagement, the APS Statement on Earth's Changing Climate and the APS Statement on the Status of Women in Physics. Follow-on activities are being considered by the appropriate APS Panel on Public Affairs (POPA) subcommittees.

The Physics & the Public Subcommittee continues its work with the American Institute of Physics on a survey focused on overcoming the obstacles to recruiting teachers in the physical sciences. The American Chemical Society (ACS) and the Computing Research Association are collaborating in the effort. The subcommittee is also exploring a proposal in partnership with the Committee on the Status of Women in Physics and will present it to POPA in 2016.

A workshop addressing the long-term challenges of helium supply and pricing took place in November. The workshop study committee will present its findings to POPA in 2016. ACS and the Materials Research Society are collaborating in the effort. The Energy and Environment Subcommittee, under whose rubric the workshop took place, is also overseeing the expansion of two pilot programs initiated in 2015: The Liquid Helium Purchasing Program and a science policy internship centered on advancing APS policy goals derived from the 2011 *Energy Critical Elements* report.

A template for study proposals can be found online, along with a suggestion box for future POPA studies, at go.aps.org/1OIDBgR



# Matthew Salter Joins APS as New Publisher

*By Emily Conover*

On December 1, APS announced the appointment of Matthew Salter as its publisher, a new position created in the governance reform that began in 2014. Salter will come onboard in January 2016, and will be responsible for the business operations of APS journals.

The role of publisher, Salter says, is primarily to support the dissemination and publication of the peer-reviewed research reported in the journals. The job includes marketing and advertising the journals, ensuring that they are cost-efficient, developing new projects, and interfacing between the editorial arm of the Society and the rest of APS.

"I think APS has a wonderful position in terms of its authoritative voice in physics, not just in the United States but across the world," Salter says. "The publisher can be a big part of that — making sure that the journals are positioned in the market and against the competitors such that we really are able to go out there and continue getting the very top papers."

Because the position is new, "There's a lot of potential for developing that role," says Salter, "and that's going to be challenging and really exciting."

Salter earned his Ph.D. in organic chemistry from Imperial College London, and has held research positions there and at Tohoku University. He was a lecturer in chemistry at King's College London, and a group leader at the University of Tokyo. Salter then left academia for a position in chemical sales, before taking

**Matthew Salter**

on a series of publishing jobs based in Tokyo, first for Nature Publishing Group, and later for Institute of Physics (IOP) Publishing. He most recently served as associate director of journals for IOP Publishing in the Asia-Pacific Region.

Salter's interest in science communication is what drew him to the field of publishing, he says. "There's an important process that goes on between discovery in a laboratory or in an academic setting and communicating that research to other researchers and also to the public. I've always been interested in that process of how information is transmitted and disseminated."

In coming years, APS will face the challenges of a changing media environment, Salter says. "I think it's important that all publishers and certainly APS are sufficiently agile to be able to respond to things we can't see now." A decade ago, no one was talking about reading media on tablets, or the importance of social media, he points out. "APS has got to be in the forefront of making sure that we keep up with and anticipate any trends in dissemination of content."

Open access is another change looming on the horizon. How to offer and fund open access is a conundrum all publishers are currently facing, as is the handling of big data and making data available to the public, Salter says. And meanwhile, the journals will also face competition from other publishers, as all journals do.

But APS is well positioned to be successful, despite these obstacles, Salter says. "The challenge is to ... not rest on our laurels and really make good use of the very good position that the APS is in." And there are opportunities for APS as well: "We're in a great position to set the debate and set the direction of publishing in certain fields," Salter says.

Salter brings considerable experience with scientific publishing in the Asia-Pacific region, an area crucial for physics research:

**SALTER continued on page 6**

# Profiles in Versatility

## Sensing The Planet

*By Gabriel Popkin*

Earning a doctorate is usually cause for celebration. But when Sassan Saatchi graduated in 1988 from George Washington University with a Ph.D. in electrical engineering and math, he instead became "extremely depressed. … [my thesis] was a document full of equations," he says. "It hardly had any applications."

Saatchi found the solution to his quandary as a postdoc at NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, where he worked on a sensor to study Earth's soil moisture. The project had a clear purpose, Saatchi says, and more importantly, it opened the door to a career in remote sensing — using reflected electromagnetic radiation to gather information about faraway objects.

While at GSFC, Saatchi began traveling to nearby forests with researchers who were "ground-truthing" measurements taken from airplanes and satellites. Forest research and management had for decades relied on ground-based measurements, but these are labor-intensive and can only ever sample a tiny fraction of the world's approximately three trillion trees.

By contrast, remote sensors aboard airplanes and satellites can look down from above and take data over wide areas — potentially the planet's entire surface. To harness this potential, researchers have to carefully calibrate sensors and data-processing algorithms to measurements of actual trees, so they can accurately interpret their raw data. This is what Saatchi did on his field trips to local forests, and later to much more remote ones such as the tropical rainforests of Brazil's Amazon and the Congo in central Africa.

After his postdoc, Saatchi moved to NASA's Jet Propulsion Laboratory in Pasadena, California, where he has worked ever since. He has spent the last 25 years finding ways to gather more and better data on Earth's ecosystems. Saatchi specializes in radar and lidar systems—two different but related approaches that involve not just collecting reflected or emitted light, but actually shaping and delivering the pulses of incident light.

Radar is the more mature remote-sensing technology and relies on measuring microwaves sent down from a satellite or airplane and reflected back up by a surface. Its view is wide but relatively coarse, and it can penetrate clouds, which obscure around two-thirds of Earth's surface at any given time. By contrast lidar, which uses short pulses of light, can yield higher resolution, but the lasers involved are relatively expensive and fragile, and only recently have scientists developed techniques to deploy it efficiently over large areas.

Remote sensing's maturation comes at a critical time, Saatchi says, because scientists and policy makers are increasingly asking global-scale questions about forests, and specifically how much they can absorb carbon dioxide and limit global warming. For several decades scientists have approached this question in piecemeal fashion, but in 2011 Saatchi led a team that combined data from four different radar and lidar studies and published a global map of carbon stored in the world's tropical forests. Tight resources meant that Saatchi's team had to innovate — all the instruments were designed for other purposes in other projects.

Innovation is also key to bridging the gap between ecologists who can identify important research questions but often lack technical expertise, and engineers who need specifications for the remote sensing technology they're designing. The skill set needed is a perfect match for the rigorous training of a physicist, Saatchi says. "The earth system is as complex mathematically … as string theory. It's really tough to understand it and to quantify it."

### A science-policy two-step

Like Saatchi, Phil DeCola started his remote-sensing career in a physics lab. As a graduate student, DeCola came across a 1959 paper in *Reviews of Modern Physics* suggesting that his specialized research could have relevance far beyond condensed matter physics, for instance by helping astronomers interpret the light of distant stars and planets. The paper was inspiring, DeCola says, though he adds, "at the

**PLANET continued on page 6**

**LABS continued from page 1**

DOE owns the national laboratories, and nearly all are run by their own management teams; this government-owned, contractor-operated model applies to 16 of the 17 labs. (The lone exception is the National Energy Technology Laboratory, which is government operated.) The government sets program priorities, and the contractors must plan accordingly.

But, the report states, "The National Laboratories, for their part, do not fully trust DOE and therefore maintain secrecy about some of their actions. ... DOE, for its part, does not trust the laboratories to keep them fully informed about technical and financial progress or safety and security issues. As a result, DOE micromanages work at the laboratories with excessive milestones and budget limitations."

Instead, said Glauthier, "the labs should have more flexibility than they do now to implement [DOE's] programs without needing as many approvals from DOE along the way. In return, of course, the labs must operate with transparency and be fully accountable for their actions and results."

Senator Dianne Feinstein (D-CA), who originally pushed for the creation of the commission, expressed concerns about the commission's proposal to lengthen DOE's short leash, citing previous instances of ballooning project budgets and construction delays. "I think what's lacking is any kind of ongoing communication with us," Feinstein added, expressing interest in arranging regular meetings with laboratory directors.

Commission co-chair Jared Cohon, an engineer and president emeritus at Carnegie Mellon University, responded, "What we're reacting to is an overall tendency where the relationship between DOE and the labs becomes compliance focused." This leads to a box-checking mentality, Cohon said, rather than an environment where people think critically about what DOE and the labs are trying to accomplish. "When there are too many requirements," Glauthier added later in the hearing, "people get relaxed and they think, 'Well, if I met all those requirements it's all going to be okay.'"

The labs vary in their relationships with DOE — and those with the healthiest partnerships tend to fall under DOE's Office of Science, the commission says. Ten of the country's labs are Office of Science labs, three nuclear weapons labs are under the purview of the National Nuclear Security Administration (NNSA), and the rest fall under other DOE program offices.

"We're pretty well aligned and have a good relationship with the Office of Science, so I personally don't feel like there's a trust problem," Oak Ridge National Laboratory Director Thom Mason told *APS News*, noting that the situation is "probably more problematic within the NNSA." In general, Mason said that the recommendations were helpful. "Even though I wouldn't say we've got a fundamentally broken relationship, I think it is true that all of the labs could benefit from some thought about how we could be more cost-effective and efficient in what we're doing."

Mandated by the Appropriations Act of 2014, the commission, made up of nine commissioners, studied the labs over 18 months, visiting each laboratory and hearing testimony from 85 witnesses. Senator Feinstein initiated the effort, as the then-chair of the Energy and Water Development Subcommittee.

Such assessments of the national labs are by no means a new phenomenon. "Particularly in recent years, it's been kind of a cottage industry," said Mason. At least 50 reports have been written over the last four decades.

The commission reviewed the earlier recommendations, and found that the problems have been remarkably consistent over the years. To prevent their report from gathering dust, the commission recommends that a standing advisory body be created that would provide ongoing guidance for Congress, DOE, and the laboratories.

At a hearing of the House Science Committee's Subcommittee on Energy in November, Peter Littlewood, director of Argonne National Laboratory, endorsed the major recommendations of the report, and said that he has found other lab directors to be supportive as well. In particular, Littlewood highlighted the importance of acceptable risk-taking in producing successful, competitive research. "I'm concerned that we actually have too many programs which can neither succeed nor can they fail, and therefore they tend to stagnate," Littlewood said. "Sometimes, actually, we must risk success."

Representative Bill Foster (D-IL) agreed. Often, when something goes wrong, there's an overreaction, said Foster, a physicist who worked at Fermilab for 23 years before running for office. "And this gets amplified down the command chain at every step. ... As a result, by the time this gets down to the working level, sometimes these have morphed into really silly things." (Although Foster is not a member of the Energy Subcommittee, he asked to sit in because of his experience with the subject.)

The commission also recommends raising the cap on Laboratory Directed Research and Development (LDRD) funding, which supports discretionary research at the labs. The report suggests returning this cap to the level it was at before 2006 — six percent of the lab's budget. LDRD is particularly important for the NNSA labs, which use the money to recruit and train scientists, the commission says.

"Investment in LDRD has enabled virtually every major Argonne initiative," Littlewood said — from the Advanced Photon Source to supercomputing at the lab. "LDRD is peer reviewed and extraordinarily competitive."

The commission also calls for streamlining the process for laboratory employees traveling to scientific meetings. "At every laboratory, in our meetings with especially younger scientists, this issue came up, and came up as number one. It's a very serious constraint on their ability to be effective," Cohon said. "Being effective when you're involved in research means interacting with people who are at the frontiers of your area of science, and if you can't go to conferences ... you really are deprived." DOE is already implementing some changes to try to improve this situation, Glauthier added.

Senator Lamar Alexander (R-TN), chair of the Energy and Water Development Subcommittee, said he agrees with many of the recommendations of the report. "If we can ensure the labs are running as effectively as possible, then more money can be spent on research and development and the national labs can work more easily with private industries to support our 21st-century economy and create jobs." Alexander highlighted two additional recommendations of the report: using innovative financing approaches to fund projects, and enhancing technology transfer between the labs and industry.

The commission's recommendations, Glauthier said, are almost all within the power of DOE to implement without additional legislation from Congress. "A lot of it depends upon the culture between the department and the labs, and that culture change is not something that can be legislated or can be changed overnight, and it requires work on both sides."

The report is available at go.aps.org/doe-lab-report

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**SALTER continued from page 5**

In 2014 over 17 percent of APS published papers had corresponding authors hailing from that part of the globe. "The quality and quantity of research coming out of Asia has just been, certainly over the last ten years, just going up and up," Salter says. "So there are huge opportunities in Asia."

Salter hopes to continue strengthening the journals' strong reputations in Asia, and perhaps expanding to new projects there. "I think depending on how the feeling is within the Society and editorial, there are also opportunities of leveraging that brand of *Phys Rev* series to look at potential partnerships and starting new journal projects ... focusing on Asia."

The Asia-Pacific market, Salter says, continues to grow and change. Scientific research in Southeast Asia, China, and India is rapidly evolving, but the regions maintain one consistent thread: "Wherever you go that I've been in Asia … there is a huge respect for the APS journals. So I think our stock is very high," Salter says.

Salter is looking forward to working at APS: "Coming to work for the largest physical society in the world, with a hugely popular and high-quality and renowned set of journals, is a tremendous honor and a huge challenge," Salter says. "I will admit to being slightly nervous — it's a big job to take on."

**PLANET continued from page 5**

time I had no idea that remote sensing of the Earth and other planets could actually be a career."

DeCola started to see his way forward during a postdoc at GSFC in planetary science. His main research involved measuring Jupiter's atmosphere, but he also began hanging out in colleagues' labs and contributing to their Earth-focused remote-sensing projects. Despite his aptitude for science, DeCola soon felt himself drawn toward policy work, so he applied for a fellowship at the White House. NASA higher-ups heard about this and recruited him to NASA's D.C. headquarters instead.

At headquarters, DeCola helped develop a number of Earth science-focused remote sensing missions, including the Orbiting Carbon Observatory (OCO), a satellite designed to measure the concentration of carbon dioxide in Earth's atmosphere. Scientists had for decades measured carbon dioxide from the ground (the most famous site is on Mauna Loa in Hawaii), and such measurements continue to be critical for establishing an accurate benchmark. But localized measurements cannot tell policy makers and others hoping to actually reduce carbon dioxide emissions where on Earth carbon is actually being emitted and taken up.

To add this dynamic global view, OCO designers turned to spectroscopy, the topic of DeCola's Ph.D. thesis. Carbon dioxide absorbs a characteristic set of wavelengths of infrared light — this is what makes it a greenhouse gas — so NASA engineers, with DeCola's leadership, designed and built a sensor to measure how much of those wavelengths a column of atmospheric $CO_2$ removes from sunlight reflected from Earth's surface. Because $CO_2$ is so dilute in the atmosphere — only about 4 parts in 10,000 — deputy project scientist Annmarie Eldering has called the measurement "one of the most difficult observations to make from space."

DeCola finally made it to the White House in 2007 as an adviser in the Office of Science and Technology Policy. Soon thereafter, the rocket that should have carried OCO to space crashed into the ocean with the satellite attached, dealing a potentially devastating setback to NASA's carbon monitoring program. DeCola argued that the agency should rebuild the satellite because of its importance to the nation, and NASA's 2011 budget request included $170 million for OCO-2, essentially a copy of OCO. OCO-2 launched successfully in 2014 and has started delivering data that scientists hope will answer big open questions about the carbon cycle, including how and where does Earth's land surface take up roughly 2.5 billion tons of $CO_2$ annually?

Returning to his scientific roots, DeCola joined Sigma Space Corporation in 2010, where he helped design and test a new lidar system to quickly yet precisely measure forest carbon from airplanes. In November 2015 he flew to Europe for the UN climate talks to tell policy makers about the capabilities that scientists utilize to monitor whether countries' climate commitments are successful. "I'm doing both now — research and proof-of-concept of [remote sensing] capabilities, and … 'meta-level science', as I like to call it," he says. "Making sure that evidence-based information … is being used effectively to guide policy."

### A lofty career grounded in physics

Among a team of high fliers, GSFC's James "Bryan" Blair might be the highest-flying of all. He recently returned from two weeks flying at 65,000 feet over the Antarctic Peninsula with the Land Vegetation Ice Sensor (LVIS), an instrument designed to demonstrate the capabilities of lidar-based remote sensing.

LVIS sends out a precisely shaped pulse of laser light, and its sensor measures the pulse's return time and shape. This allows researchers to pinpoint surface elevation to 10-centimeter accuracy. Another innovation has enabled them to map huge areas, like a large section of the 522,000-square-kilometer peninsula, a capability that Blair says many in remote sensing previously considered out of reach for lidar.

Pushing the boundaries of precision mapping is nothing new for Blair. After studying math, physics, and computer science in college and graduate school, his first job was designing an altitude-measuring laser for the Mars Orbiter Laser Altimeter, launched in 1996. By 2001, the craft had produced a map of Mars that had better topographic precision than the best map of Earth's continents.

Blair went on to help design other remote-sensing instruments, including the laser on the Ice, Cloud, and land Elevation Satellite (ICESat). ICESat's primary purpose, as the name suggests, was to measure the elevation of ice sheets. On a plane flight to test the laser over Greenland, Blair left the device on over a forest in upstate New York. "All of a sudden we were getting all these signals that were stretched out and distorted and complicated," he recalls. The signals turned out to contain rich information about the forest's structure as well as its height. More than a decade later, forest measurements from ICESat played a key role in Saatchi's 2011 tropical carbon map.

Blair is now helping design the Global Ecosystem Dynamics Investigation (GEDI), which will put lidars inspired by those of ICESat and LVIS onto the International Space Station. GEDI will deliver "orders of magnitude" more forest height and structure data than ecologists have ever had access to, Blair says. Meanwhile, the scientists are already designing new lasers for future Earth and planetary science missions, some of which haven't even been conceived yet.

Like Saatchi and DeCola, Blair has built a career using light to observe Earth, and like his colleagues, he credits his physics and math background for being able to contribute in the way that he has. "If I didn't have a good grounding in physics and math," he says, "I wouldn't be able to do almost all of the stuff I'm doing now."

## ANNOUNCEMENTS





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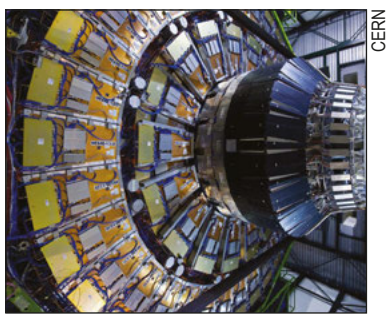
Ernest Moniz, a physicist, played a major role in the negotiations, and in championing the final agreement to skeptical politicians and the public. Other physicists used their expertise to weigh in on the science side of the deal. Many prominent physicists, including several Nobel laureates, signed a letter supporting the deal in August. The only physicist in Congress, Representative Bill Foster (D-IL), spent extra time scrutinizing the agreement, and eventually came out in support of it as well.

### Chinese-American Scientists Wrongfully Accused

A pair of high-profile cases of Chinese-American scientists accused of spying for China were resolved when government prosecutors dropped the charges without explanation. The latest case involved physicist Xiaoxing Xi, who made the front page of the *New York Times* when charges against him were dismissed in September. In March, the government dropped charges against Sherry Chen, a National Weather Service hydrologist. Members of Congress claimed the spate of cases indicates a pattern of racial profiling and called for an investigation by the Department of Justice.

### The Large Hadron Collider Strikes Back

The Large Hadron Collider (LHC) once again made headlines as it revved up to higher energy. In June, the LHC began slamming protons together at 13 TeV, stoking scientists' dreams of discovering evidence of supersymmetry, explaining dark matter, and better understanding the Higgs boson. The LHC also proved that it has more than just the Higgs up its sleeve, with the LHC collaboration's announcement of the discovery of pentaquarks, which are, as the name suggests, particles made up of five quarks. The discovery, which was somewhat esoteric for public audiences, begat headlines like "What the Heck is a Pentaquark?"



CERN

**Lowering of the final element of the Compact Muon Solenoid (CMS) detector into its underground experimental cavern**

### Superconducting Hydrogen Sulfide

Scientists announced in August that hydrogen sulfide is superconducting at a record-high temperature of 203 K — but only when subjected to crushing pressures of about 1.5 million atmospheres. This story received press coverage in part due to its connection to everyday life … and everyday smells. As a gas, hydrogen sulfide lends its odor to the stench of rotten eggs and flatulence.

### No More Quantum Loopholes

There is no getting around it — the quantum realm is undeniably strange. In particular, quantum entanglement is real, according to a new, more stringent experimental test, scientists announced in August. Such tests, named after theorist John Bell, measure the correlation between two entangled particles. The new Bell test eliminated loopholes found in previous tests, and showed that weird quantum behavior can't be explained by "hidden variables" that could make the quantum world more palatable to our macroscopic sensibilities.

For links to the stories mentioned above, visit the online version of *APS News*: aps.org/apsnews

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discussions, and the U.S.-Brazil Young Physicists Forum will provide opportunities for scientists to forge international connections. Social-media fiends can gather at the Official Tweetup on Sunday, aimed at attendees using Twitter during the meeting.

Physicists looking to deepen their knowledge in a particular field can partake in one of ten half-day tutorials, or a two-day course on polymer nanocomposites hosted by the Division of Polymer Physics, all preceding the full meeting.

Students will find a plethora of activities geared to their needs. The Future of Physics Days will cater to undergraduates, featuring research sessions, a grad school fair, and a workshop on professional skills for non-academic careers. Graduate students can attend the Lunch with the Experts for informal, in-depth discussion with scientists at the forefront of their fields, and the Careers in Physics workshop will cover all aspects of a job search, from networking to resumes. A job expo will give students the chance to speak with prospective employers. On Tuesday evening graduate and undergraduate students are invited to a student reception and award ceremony.

Special sessions and talks throughout the meeting will focus on industrial physics. The Meeting will host an Industry Day on Wednesday titled "From Nano to Meso." The session will examine techniques to model materials at the nanoscale and extrapolate to larger scales, which could allow industrial scientists to design materials with less experimentation. And a session on industrial careers is targeted at students.

The National Society of Black Physicists and the National Society of Hispanic Physicists will host a meetup, and the Committee on the Status of Women in Physics and the Committee on Minorities in Physics is sponsoring a Diversity Networking Reception. All interested parties are welcome to attend.

The Prizes and Awards Ceremony on Monday will honor physicists for their contributions to the field. A reception and coffee break with the APS editors will give members a chance to discuss the journals. Attendees can also peruse the Exhibit Hall, which will boast more than 100 exhibitors. And don't miss the Rock 'n' Roll Physics Sing-along, on Wednesday evening, where pop music gets nerdy with physics-themed lyrics.

For more information, go to aps.org/meetings/march

See you in Baltimore!

**FELLOWSHIPS continued from page 3**

and write the story, leaving time for back-and-forth edits. It was exciting to see the story make the home page at discovermagazine.com. I made sure to take a screenshot.

That story dealt with brain motion caused by an impact, like a football tackle. Readers later told me that they craved a final word on the subject of sports-related head injuries. But science works in baby steps. Rarely is there a single finding that writes the textbook on an entire subject. This taught me an important lesson about knowing one's audience, and the necessity of understanding the broader field into which a study fits.

As the summer passed, I found myself wanting to spend more time on each topic and also missing many aspects of the lab — building things with my hands, thinking about data, devising experiments. So for now, I'm headed back to research. But I know that the writing and editing skills I gained from the fellowship will prove themselves invaluable time and time again.

*Andrew Berger is currently a postdoctoral research fellow at NIST in Boulder, Colorado.*

### A Summer at *Scientific American*

*By Maria Temming*

As a physics and English double major, I am no stranger to the question, "What are you going to do with *that* degree?" Thanks to the AAAS Mass Media Fellows Program, I now have something I can point to and say, "*That* is what I want to do."

**Maria Temming**

Last summer, I worked at *Scientific American*, thanks to an APS sponsorship. I was a bit star-struck on my first day, when I found out that my immediate supervisors would be space physics editors Clara Moskowitz (whose voice was already familiar to me from *SciAm*'s 60-Second Science podcasts) and Lee Billings (whose book I'd been toting around in my backpack for the better part of spring semester). Under Clara and Lee's mentorship, I pitched, reported, and wrote stories on everything from high-energy astrophysics to 3D-printing. And, of course, I leapt at the chance to join in the media hullaballoo surrounding the New Horizons flyby in July.

Over the course of the summer, I worked on pieces for the print magazine, as well as news articles, blog posts, podcasts, and multimedia projects for the *SciAm* website. Writing for different media meant I could explore the variety of tools that journalists now use to get people excited about science.

The most surprising aspect of my fellowship experience was realizing that science journalism requires you to put yourself out there — not just in pitching stories and asking for advice from seasoned journalists, but also in talking to scientists. At the risk of perpetuating the physics student stereotype, I'll admit that I'm a total introvert. I went into this fellowship thinking (and hoping) that most of my "science writing" would happen while I was sitting alone at my desk, stitching together information from journal articles and correspondence with experts to create my story.

Instead, I found that the most important part of science journalism is interviewing the researchers I wrote about and other experts in the field. At first, the interview process intimidated me. Was I imposing on the researcher? When should I interrupt and request further explanation? How could I avoid making a fool of myself?

But I soon learned that even if an interview did not yield a single quotable line, simply hearing the excitement in someone's voice or seeing them brighten while they described their work was invaluable. These conversations helped bring my stories to life in a way that reading press releases or scientific papers could not. And they helped me realize that I should not feel so intimidated — I underestimated how excited scientists are to share their work. By the end of the summer, I had more Skype contacts with foreign physicists than with my own friends and family.

Interviews reminded me that science is a human endeavor with human characters, and that any new discovery or failed experiment produces real human emotion. Whether you're writing about something as tiny as a quark or as distant as a quasar, it's important not to underestimate the vital role human interaction plays in making a good story.

*Maria Temming is an undergraduate student at Elon University in the class of 2016. She plans to pursue a career in science journalism.*

# The Back Page

## Recruiting High School Physics Teachers

*By John Stewart, Gay Stewart, and Alma Robinson*

Of the 1400 new physics teachers hired each year in the United States, only 600 are highly qualified — i.e., they have a major or minor in either physics or physics education [1, 2]. Physics departments are uniquely responsible for this shortfall in that they are the only academic units that can produce highly qualified physics teachers. Also, physics departments disproportionally benefit from improved high school (HS) physics instruction through an increase in the number of majors and a general increase in the preparedness of the students in physics classes. Unfortunately, casting physics teacher preparation in the light of a public service responsibility places it amongst many other public service demands on departments, such as outreach and science advocacy, for which they receive little support and the immediate tangible benefits are small.

Yet for the last 15 years, the University of Arkansas (UA) physics department found that featuring HS teaching as one possible career path for its graduates produced dramatic, immediate benefits for relatively minor investments [3]. Sixteen percent of UA physics graduates chose to enter HS teaching, providing excellent outcomes for these students and significantly increasing the overall number of physics graduates. Discussions with these graduates find them nearly universally satisfied with their career choice.

A physics major's progression is a complicated personal journey where sometimes-naïve beliefs about the physics profession are replaced with tangible experience. At many institutions, professional internships in the form of mentored research experiences are available only to more senior students because of the prerequisite knowledge. After the experience, some students decide academic research and graduate school do not fit their personal goals. During this process a student is also maturing from an 18-year-old HS student to a more mature 22-year-old adult and has time to seriously consider both professional and personal goals such as quality of life, geographic flexibility to be near family and long-time friends, working environment, and the opportunity to directly impact people's lives.

HS physics teaching is a career path that has many attractive features for students who find their personal goals will not be well served by the 10 years of additional preparation (Ph.D. and postdocs) required to secure an academic position, and the dramatic personal pressures placed on individuals who pursue this path. HS teaching allows a student to directly apply skills learned in physics in a dynamic environment with rewarding personal interactions. With technology like robotics, cheap microcontrollers, and 3D printing, and pedagogical innovations, HS physics classrooms are exciting and creative work spaces for physics graduates. HS teachers are often more connected to physics than graduates pursuing industrial careers which use reasoning and lab skills but not physics content knowledge.

HS physics teachers can become central figures in many communities and impact a generation of students from their hometowns. HS teachers work hard, but enter their careers years earlier than students who pursue graduate training in physics, have significant flexibility in terms of where they work, the ability to leave and re-enter the workforce, and the possibility of sometimes leaving work at work.

Successfully preparing students to enter the HS classroom requires some effort by physics faculty, but effort commensurate with other nonacademic career paths such as medicine. To successfully allow students to enter teaching, a department must develop internal expertise in the paths to and requirements for licensure and train in-department advisers in them. At most institutions this information already exists on campus and can be obtained by working with the college of education.

**"... If one simply sends a student to the college of education, the likelihood of that student entering high school teaching is very small..."**

We need to stress that an understanding of the requirements must be contained in the physics department so that a physics adviser can immediately answer questions about the path to teaching. Education may be able to provide additional resources to allow a student to explore the option, but the conversation must start in physics. If one simply sends a student to the college of education, the likelihood of that student entering HS teaching is very small; by doing this, the physics department demonstrates a lack of respect for HS teaching by failing to understand the career.

Alma Robinson

Beyond the development of this basic career information, a physics department must present HS teaching as a respected possible career path in venues where career information is discussed: advising sessions, freshman seminar, and Society of Physics Students meetings. As with any prospective career for bachelor's students, the academic program must allow sufficient flexibility to incorporate the classes needed to prepare the students to enter it. If a department wishes to graduate pre-med students, the degree must allow space for pre-med requirements such as organic chemistry. If a physics department wishes to graduate HS teachers, its degree requirements must include space for classes relevant to teaching: electives that broaden the student's knowledge (e.g., cosmology instead of a second semester of electricity and magnetism). Broader licenses (most physics teachers also teach other subjects) may require additional science courses; these must fit within the elective structure of the degree requirements. Reformed introductory courses that offer good models for future teachers, and access to formal and informal teaching experiences are also important [4].

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*To illustrate the rich career trajectories available in education and to share advice on preparing future teachers, Alma Robinson, Physics Teacher Education Coalition (PhysTEC) Teacher in Residence (TIR) at Virginia Tech (VT), describes her experiences as a physics major who entered HS teaching:*

At some point during adolescence, my formal education, which once encouraged my curiosity and captured my imagination, had become dull and uninspiring. While I wasn't sure what my future entailed, I knew that I wanted a job where I'd feel both rewarded and challenged, and those goals felt unachievable within a school environment. But physics changed everything. Within the first few weeks of HS physics, I realized that my curiosity had found a place within the classroom walls. Physics wasn't about memorizing facts. When I asked a question, my physics teacher responded with, "Let's figure that out!" For the first time in a long time, school felt relevant; in fact, I can pinpoint the moment I knew I was hooked: During a grueling swim practice, my coach yelled at us, "Elbows up!" a reminder that we should use bent arms with a high elbow during the recovery phase of our stroke. I immediately thought, "Oh, of course! That reduces my arm's moment of inertia!" It was at that moment, surprised by my inner nerdiness, that I knew I should major in physics.

When I walked into my first physics course at VT, I fortuitously stumbled into a class taught by Dr. Dale Long, an award-winning teacher who taught his students to think about the concepts behind the equations. On one of my first visits during his office hours, he asked me about my long-term goals and I mentioned that I wanted to become a HS physics teacher. He smiled widely, regaled me with stories of his inspiring HS physics teacher, Alice Estes Martin, and encouraged me to work hard in hopes that I might also inspire young minds one day. I left his office feeling excited about my possible career, and a few years later, I received the Alice Estes Martin scholarship, an award created by Dr. Long to be given to a future HS physics teacher.

Only looking back do I fully appreciate how lucky I was to have such a positive conversation about physics teaching with my first physics professor. While I hear stories of professors discouraging their students from teaching, they ring hollow; my favorite professors seemed happy that I wanted to share my knowledge and enthusiasm for physics. The VT Physics department valued teaching and even encouraged us to visit schools to teach K-12 students physics concepts through the Physics Outreach program. That experience of helping students learn physics and become excited about science is what solidified my decision to become a physics teacher. Because the department supported me with scholarships during my undergraduate years and provided me with a physics graduate teaching assistantship (GTA) while I pursued my Masters of Arts in Education (MAEd), I was given validation that HS physics teaching is a worthwhile career.

Upon finishing my MAEd, I excitedly began my career in Arlington, VA, at Wakefield High School, a diverse school with students from over 80 countries and a variety of socioeconomic backgrounds. Although I chose teaching because I loved physics and sparking student interest in science, I was surprised to find that I fell in love with teaching because of the relationships that I built with these amazing kids. I learned that for many students the rapport that you build with them can make the difference in their academic success. If they feel respected and supported in your classroom, they work harder for you. But the students weren't the only ones who benefited from these relationships; few things are more fulfilling than making a difference in a student's life.

**"My favorite professors seemed happy that I wanted to share my knowledge and enthusiasm for physics..."**

Now, as the PhysTEC TIR at Virginia Tech, I have the opportunity to relay my personal story to our students. Through formal and informal interactions, I describe how rewarding teaching can be and encourage them to participate in our Learning Assistant program or one of our Outreach classes. Each semester students join these as a break from their core physics courses and are surprised by how much they enjoy teaching. After participating in these early teaching experiences, many consider physics teaching, but they, or their parents, have a slew of fears and questions. Luckily, I can assuage most concerns by laying out the facts: Historically, we have had a 100% job placement rate for physics teachers, and many start their teaching career with an annual salary over $50,000 (with the possibility of eventually earning a six-figure salary in some districts). Further, the physics department will provide them with GTA support while they earn their MAEd. Through these concerted efforts to offer more early teaching experiences and to affirm HS physics teaching as a worthwhile and valuable career, we have been able to increase the number of physics teacher graduates from our program. Physics teacher candidates are in your program: They just need the opportunity to discover how rewarding teaching can be.

*John Stewart and Gay Stewart are at West Virginia University, and Alma Robinson is at Virginia Tech.*


[1] S. White and C. L. Tesfaye, *Focus on Turnover among High School Physics Teachers* (AIP Statistical Research Center, College Park, MD, 2011).

[2] S. White and C. L. Tesfaye, *Focus on Who Teaches High School Physics* (AIP Statistical Research Center, College Park, MD, 2010).

[3] J. Stewart, W. Oliver III, & G. Stewart, Revitalizing an undergraduate physics program: A case study of the University of Arkansas. *American Journal of Physics*, 81(12), 943-950 (2013).

[4] C. Sandifer and E. Brewe, eds., *Recruiting and Educating Future Physics Teachers: Case Studies and Effective Practices* (APS, College Park, MD, 2015).