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Going on Sabbatical? - Consider Industry
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Inside APS

Matthew Salter, Publisher

In this series of articles, *APS News* sits down with APS employees to learn about their jobs, their goals, and the things that make them tick. This month we chat with Matthew Salter. He discusses his role as APS publisher and future goals for the journals and their development. The interview has been edited for length.

Matthew Salter

This is the first time that APS has had a professional publisher. What are your duties in this role?

The role is really quite wide-ranging, and I actually have various responsibilities that might not be immediately obvious. A major responsibility is to ensure the financial health and sustainability of the APS journals, and so I manage the team that looks after our subscribers. I also oversee the journal marketing for APS to make sure we are correctly presented to the community.

Are there multiple publishers under APS, or are you the main "go-to" publisher?

APS is slightly unusual in having only one publisher for the whole portfolio, but my role is at

SALTER continued on page 6

Bringing Home the Gold From Zürich

By Rachel Gaal

In a weeklong competition in Switzerland and Liechtenstein, the traveling U.S. physics team placed high in the rankings of the 47th International Physics Olympiad, earning two gold and three silver medals. China, Taiwan, and Korea each had five golds; Russia, four; India and Japan, three each. Vietnam, Thailand, Singapore, Romania, and the U.S. each earned two golds. The U.S. tied for 7th place overall in the medal counts. (The cumulative scores ranked teams and individuals by medals, including honorable mentions.)

During the international competition, students are given both experimental and theoretical challenges. Hosted at the University of Zürich, the location offered inspiration to the five young U.S. physicists — in 1905, Albert Einstein was awarded his Ph.D. from Zürich.

The 2016 U.S. Physics Olympiad team and their medals. (L-R) Vincent Liu (silver), Jimmy Qin (silver), Tabijith Krishnan (gold), Srijon Mukherjee (silver), and Jason Lu (gold).

"The three theory questions were on mechanics, nonlinear circuits, and subatomic particle detection," wrote Paul Stanley of Beloit College, the U.S. team's academic

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APS' Spectra Inspires Teaching STEM with Comics

By Rachel Gaal

"Did you say science comics?"

A tiny Spider-Man swivels around, grabbing a stack of *Spectra: The Original Laser Superhero* comics from my hand. The free comics, published by APS, are snatched from the Physics Central booth faster than the public outreach team can hand them out.

A crowd starts gathering next to the little superhero, watching in awe as my coworker James Roche explains the magic behind the glowing LED pins that are grabbed off the table.

"Does anyone know what LED stands for?" James asked. "It stands for light emitting diode, where the diode means that current can flow in only one direction in the circuit — like a one-way street!"

Tiny Spider-Man, once enamored of my stack of comic books, is now closely investigating his mini-LED pin, impatiently explaining how it works to his sister, dressed as Princess Elsa from Disney's blockbuster film *Frozen*. I smile at them, handing over an icy-blue LED pin to match Elsa's gown. "It's real science in comic books!" I exclaim. "You both can read about her battles against the Terminal Twins in *Spectra's Current Crisis* that will be out really soon!"

They thank me and head for the nearby DC Comics booth, where I spot a goliath on stilts dressed as an 'autobot' from the movie *Transformers*. I grab my camera and snap a quick picture, working my way through the maze of attendees of Comic-Con International. More than 150,000 people attended this year, dressed to impress and embodying their favorite pop-culture characters for the weekend in San Diego, California.

STEM panel at Comic Con: (L-R) Tracy Edmonds (Moderator), Jen Aparhamian, Paige Braddock, Mairghread Scott, Betsy Gomez, Becky Thompson, Jim McClain

Slowly finding my footing, I take off walking toward the San Diego Public Library, where a panel discussion is taking place — Teaching STEM with Comics. After maneuvering through a gridlock of fans taking pictures of Conan O'Brian, I find my way into the 9th floor of the public library, where I eagerly sit down in the front row.

Amongst the other panelists sitting in the front of the room, Becky Thompson, the author of the *Spectra* comics, is prepping for her talk. As the head of APS Public Outreach, she is always eager to tell the triumphs of Spectra in the battles against her enemies, such as evil Miss Alignment and the dictatorial General Relativity, all while revealing the basic concepts of physics disciplines — such as magnetism, optics, and particle physics.

The crowd hushes as the moderator, Tracy Edmonds, approaches the podium. Giving a warm welcome, Edmonds prompts the panelists, who look keen to introduce themselves. Everyone on the panel is involved in educational comics for various science, technology, engineering, and mathematics (STEM) disciplines, and they had created numerous other characters beyond Spectra. The *Solution Squad* caught my eye — a comic book geared toward math concepts. A frog (which is actually a toad) waved at me from the cover of

SPECTRA continued on page 6

2016 APS General Election Results

By Rachel Gaal

With the polls closed and the results tallied, the 2016 APS general election winners will begin their terms on January 1, 2017. David Gross of the University of California, Santa Barbara (UCSB) has been elected the new APS Vice President; three other winners will fill the roles of Chair-Elect of the Nominating Committee, International Councilor, and General Councilor.

David Gross

David Meyerhofer

Marta Losada

Andrea Liu

Gross has been an APS member for over 50 years. A central figure in particle physics and string theory, he shared the 2004 Nobel Prize in Physics for the discovery of asymptotic freedom, which led to the formulation of quantum chromodynamics, the quantum field theory of the strong nuclear force. Previously the director of the UCSB Kavli Institute for Theoretical Physics, he now serves as the UCSB Chancellor's Chair Professor of Theoretical physics. "I am honored, flattered, and delighted to take on the position as Vice President," Gross commented.

The new Chair-Elect of the nominating committee is David Meyerhofer of Los Alamos National Laboratory (LANL). Currently the Chair of the APS Division of Plasma Physics, Meyerhofer is actively involved in high energy density and plasma physics, serving as the Physics Division Leader of the LANL Experimental Physical Sciences (ADEPS). Before taking his role at LANL, he spent 28 years at the University of Rochester as Professor of Physics and Mechanical Engineering; there he held a variety of management positions at the university's Laboratory for Laser Energetics.

Marta Losada of Universidad Antonio Nariño (UAN), Colombia, was chosen as International Councilor. The president of UAN since 2010, Losada is actively involved in higher education, having served as Commissioner of the CONACES Engineering, Architecture, Mathematics and Physical Sciences section of the Colombian Ministry of Education and Research Policy from 2006 to 2009. Her work in high energy physics took Losada to CERN as a postdoctoral fellow from 1997 to 1999, and she chaired the organizing committee for the CERN — Latin-America School of High Energy Physics in Columbia in 2009 and 2014.

ELECTION continued on page 3

Members in the Media

"The bad news is [the measurements] don't show anything … . The good news is that [they] did a really good job of not showing anything."

***Matt Strassler**, Rutgers University, on the 750 GeV bump seen at the LHC, now eliminated after more analysis,* livescience.com*, August 11, 2016.*

"It is a maxim in physics that most revolutionary observations are unlikely to survive further scrutiny. If this weren't the case, then revolutionary developments would be so common that they would no longer be revolutionary."

***Lawrence Krauss**, Arizona State University, on the 750 GeV bump,* sciam.com*, August 10, 2016.*

"On Tuesdays, Thursdays and Saturdays, I believe in it," he said. "On other days, I think it could be anything."

***Michael Peskin**, Stanford University, referring to the Standard Model of physics,* livescience.com*, August 11, 2016.*

"At the highest point is where you feel pushed into the seat the least and there's the highest potential to kind of fly out of your seat."

***Holger Meyer**, Witchita State University, interviewed after the death of a rider at a waterslide,* kwch.com*, August 10, 2016.*

"Swimming fast would be easy if it weren't for one thing — the water. A lot of the swimmer's energy goes into the kinetic energy of the water — what a waste!"

***Louis Bloomfield**, University of Virginia, on the summer Olympics,* washingtonpost.com*, August 5, 2016.*

"I'm hoping this movie finds those girls and sends them to me at MIT."

***Lindley Winslow**, Massachusetts Institute of Technology. Her comments refer to young women who see the remake of the movie Ghostbusters, which has an all-female cast,* Boston Globe*, July 27, 2016.*

"I probably have a reputation that it's difficult to work in my lab … [but] I'm able to work on that one important project all day every day."

***Jeff Steinhauer**, Technion Institute, on working alone and being the sole author on papers,* Nature*, August 15, 2016.*

"It's always heartening to see other disciplines belatedly joining the late 20th century … . And it's refreshing to see more experimentation in this space."

arXiv.org founder ***Paul Ginsparg**, Cornell University, on a new preprint server for chemistry,* Science*, August 11, 2016.*

"It's energy. It's not carried by particles; it's not carried by matter. We would like to know why there is the amount of it that there is. And that's been measured. The surprising thing is that there isn't an enormously bigger amount of energy. That's really what's surprising."

***Lisa Randall**, Harvard University, on dark energ,* cosmosmagazine.com*, August 15, 2016.*

This Month in Physics History

August 1827: Robert Brown and Molecular Motion in a Pollen-filled Puddle

Among Albert Einstein's seminal publications in his "miracle year" (*annus mirabilis*) of 1905 was a paper on the motion of small particles suspended in a stationary liquid. That work was rooted in the observations of a 19th century Scottish botanist named Robert Brown.

Brown was born in the coastal town of Montrose, north of Dundee, Scotland in 1773. The family moved to Edinburgh in 1790. Brown initially intended to study medicine at the University of Edinburgh, but soon fell in love with botany. He ventured into the Scottish Highlands, collecting plants and recording their descriptions in minute detail, and he discovered a new species of grass, *Alopecurus alpinus*.

His studies were interrupted by his military service, and he found himself stationed in Ireland as surgeon's mate — a position that left him with plenty of time to pursue his botanical interests.

Robert Brown

By the end of the century, Brown was well established as an amateur among the Irish community of botanists, even though he never completed a formal degree. But he had little hope of earning a living as a botanist, until he was selected to be the naturalist for a scientific expedition to explore "New Holland" — the continent we now know as Australia. His instructions were to collect as many plant, insect, and bird specimens as possible.

He set sail from London aboard the *Investigator* in July 1801 and stopped at the Cape of Good Hope several months later. Brown would later recall his two weeks there as "some of the pleasantest botanizing" he'd ever experienced. By December he had arrived in Western Australia, and he spent the next three and half years collecting 3400 specimens, some 2000 of them previously unknown species. Much of this collection was lost en route back to England, but there were still ample specimens for Brown to catalogue when he returned home in 1805.

This effectively launched his illustrious career in botany, although he was just as interested in studying the physiology of plants as collecting and classifying them. That is how he became fascinated with the pollen particles from the plant species *Clarkia pulchella* floating in water under his microscope — an instrument that was still a bit of a scientific novelty. Within those grains of pollen, he noticed even smaller particles jiggling in seemingly random motions, as if they were alive.

Brown was far from the first to report such motion in small particles. Around 60 BC, the Roman poet Lucretius noted the jiggling of dust particles suspended in air (which he claimed was proof of the existence of tiny indivisible air particles), but what he saw was more likely due to convection and turbulence. Nobody commented significantly on the phenomenon again until 1785, when Jan Ingenhousz discussed the strange motion of coal dust particles on the surface of alcohol.

Brown decided to repeat the experiment with many other kinds of plants, as well as powdered pit coal, glass, metals, and dust. He saw the same kind of jittery behavior, and concluded that the motion did not occur because the pollen particles were alive, since it also occurred in his dust samples. As he wrote at the time: "These motions were such as to satisfy me … that they arose neither from currents in the fluid, nor from its gradual evaporation, but belonged to the particle itself" [1].

Today scientists understand the underlying mechanics of Brownian motion and appreciate its importance as a means of indirectly confirming the existence of atoms and molecules, and demonstrating how they move. But Brown died in 1858 without providing any kind of theory to explain what he had observed. That task fell to Einstein nearly 50 years later.

Einstein reasoned that if tiny but visible particles were suspended in a liquid, the atoms or molecules in that liquid would bombard the suspended particles and cause them to move randomly. He explained this motion in much greater detail in a 1908 paper. He showed that the mean square distance the particle travels is a linear function of time, with the rate depending on the temperature, the drag coefficient, and Boltzmann's constant.

With accurate maps of a suspended particle's successive displacements versus time, this prediction could be tested experimentally. A French physicist named Jean Baptiste Perrin did the experiments, and he concluded that his results "cannot leave any doubt of the rigorous exactitude of the formula proposed by Einstein."

In 1991, a short comment in the *Bulletin of the American Physical Society* by D.H. Deutsch raised the question of whether the microscopes of Brown's era had sufficient magnification to enable him to observe what he'd claimed [2]. A British microscopist named Brian J. Ford leapt to Brown's defense, arguing that it was clear from Brown's own writings that the botanist was studying particles in a closed environment, and that he understood how turbulence and convection might influence his observations [3]. Ford also memorably recreated Brown's original demonstration and videotaped it. Most scientists now accept that Brown's original observations of pollen grains were indeed the result of Brownian motion.

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The Future of Liquid Helium Purchasing

By Rachel Gaal

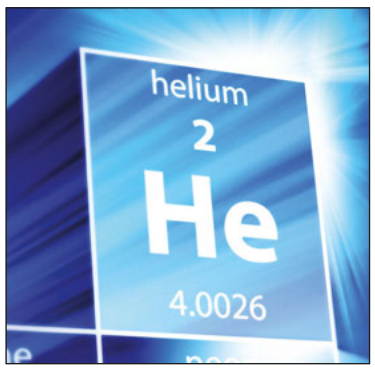
After a successful test-run ending in late May 2016, the Liquid Helium Purchasing Program is now in full swing, syncing reliable deliveries and discounted liquid helium to an expanded network of academic users within the United States. The program is a partnership of APS, the American Chemical Society (ACS), and the U.S. Defense Logistics Agency (DLA).

"It started as a pilot program with 7 institutions," recalled Mark Elsesser, the APS senior policy analyst who oversees the purchase program. "Now we are into the second iteration of the program with 12 universities — for us it's been a great success, and members are now enrolled for two years, receiving helium from the DLA through May 31, 2018."

The partnership is built upon short-term concerns: The increasing cost of helium and erratic delivery schedules have placed burdens on physicists and other researchers at their home institutions. Acting as a brokerage, the partnership allows the DLA to negotiate liquid helium contract terms on behalf of academic researchers — saving the program's enrollees an average of 15 percent.

Elsesser emphasizes that the problem of liquid helium supply is far from resolved. "Long term, there are still issues — as helium prices go up, [principal investigators] are spending more and more of their grants on helium, and this is unsustainable," he says.

To tackle this looming concern, the APS Office of Public Affairs (OPA) approached ACS and the Materials Research Society (MRS) to investigate what it would take to transition users into using less helium, by means of recycling and reuse.



Recently, a new helium deposit was discovered in the Tanzanian Rift Valley, a find that some argue solves the helium shortage. As much as 10 percent of a sizable 54 billion cubic feet gas source is helium. Geologists from Oxford and Durham universities are working to pinpoint the estimated areas where the trapped helium in the valley's rocks could be exploited in shallower gas fields, marked by frequent seismic activities.

"The recent discovery [of a new deposit] in Tanzania doesn't change the fact that helium is an irreplaceable, nonrenewable resource," mentions Elsesser. "That's why this issue of helium recycling and reuse is so important. My hope is that we can transition more of our users to systems with recycling capabilities, so their future helium purchases will be smaller and more inexpensive."

APS OPA, together with ACS and MRS, plans on releasing a science policy report within the next few months, detailing the long-term effort to move users toward systems that have the capability to recycle and re-liquefy helium being used in experiments.

The program's success in attracting buyers has led other liquid helium vendors to reduce their prices even further to bring back previous customers. While this means potential rivalries in store for the purchase program, the end result will be more liquid helium alternatives for researchers in academic institutions in future years.

Related Information

The APS-ACS-DLA Liquid Helium Purchasing Program — go.aps.org/2bS351n

APS Office of Public Affairs — aps.org/policy/reports/

Helium in Tanzania — go.aps.org/2bS3FfA

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

Since its creation in 1980, the APS Committee on International Freedom of Scientists (CIFS) has advocated for and defended the rights of scientists around the globe.

Omid Kokabee

In April, APS member and physics graduate student Omid Kokabee was diagnosed with kidney cancer after years of being denied medical treatment while serving a prison term in Iran. Kokabee subsequently had surgery to remove his right kidney. In May, he was granted a medical furlough on bail to recover. It is unclear if or when he may be forced to return to prison.

In light of Kokabee's serious health problems and the fact that he had been granted this temporary furlough, APS President Homer Neal wrote to the Ayatollah Ali Khamenei in June to request that Kokabee be released from prison permanently. As President Neal wrote, "We believe that his permanent release from prison is the only guarantee of his recovery."

Kokabee is serving a ten-year prison sentence in Evin prison. He was arrested in 2011 in Tehran while trying to return to the University of Texas at Austin, where he was a graduate student. Prior to his imprisonment, Kokabee had been asked by Iranian authorities to take part in classified military research. He repeatedly refused to do so, and consequently the Iranian government imprisoned him.

Imad al-Barghouthi

CIFS is concerned about the detention in Israel of Palestinian astrophysicist Imad al-Barghouthi, a professor at Al-Quds University in Jerusalem, who was arrested at a West Bank security checkpoint in April. The charges against him were not clear, and on May 29, Barghouthi was ordered released. Although the charges were insufficient to continue his detention, it was extended nonetheless after the military asserted that he poses a significant security threat.

Given these circumstances, CIFS wrote to Israeli Prime Minister Benjamin Netanyahu to ask that all charges and evidence against Barghouthi be made public, and that he be released immediately should the evidence be insufficient to continue his detention.

Masaud Mirza Jahromi

In March, CIFS expressed concern to the Ministry of Justice and Islamic Affairs in Bahrain about the impending deportation of Masaud Mirza Jahromi. Jahromi was the Chair of the Computer Science Department at Ahlia University in Manama, Bahrain. In 2011, he was charged with participating in political rallies, and he was subsequently convicted and imprisoned. In 2016, his citizenship was revoked and he was threatened with deportation. Unfortunately, despite protests from the scientific community, Jahromi was deported; he is currently in exile in Lebanon.

AAAS Science and Human Rights Coalition

In July, APS participated in the semiannual meeting of the American Association for the Advancement of Science (AAAS) Science and Human Rights Coalition, held at AAAS headquarters in Washington, D.C. The theme of the meeting was Climate Change and Human Rights. The meeting highlighted ways in which scientific research has contributed to human-rights-based policies for climate change prevention and mitigation.

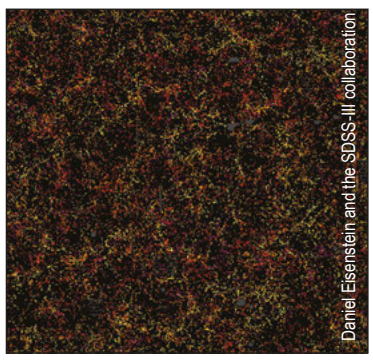
The Coalition is a network of scientific associations and societies, including APS, that facilitates communication and cooperation on the topic of human rights within the scientific community, as well as between the human rights and scientific communities. Coalition members recognize that there is a connection between science and human rights and that scientists have an important role to play in the realization of human rights.

Research News: Editors' Choice

A Monthly Recap of Papers Selected by the Physics Editors

Big Data for Astronomers

After a decade's work, researchers with the Sloan Digital Sky Survey have released the most comprehensive galaxy map to date, containing 1.2 million galaxies in a volume of 650 billion cubic light years. The map has allowed the group to make the most precise calculation of the effect of dark energy on the expansion of the universe. Even though about 70% of all of the energy in the observable universe is believed to be dark

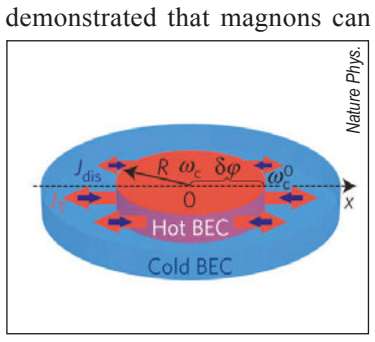


Mapping dark energy

energy, little is known about it. The latest measurements were made as part of the Baryon Oscillation Spectroscopic Survey (BOSS) and the results are contained in a group of papers posted to arXiv.org. BOSS looks for oscillations in the distribution of visible matter that were frozen into place following the big bang. This information can be used to determine the expansion rate of the universe, which allows researchers to understand the balance between dark energy accelerating the expansion and matter gravitationally slowing it. The hope now is that a detailed comparison of the BOSS results with precision maps of the cosmic microwave background (e.g., from the Planck mission) will drive improvements in the standard cosmological model of the universe.

A Room-Temperature Supercurrent

Researchers found that a supercurrent can flow at room temperature in a Bose-Einstein condensate of quasiparticles called magnons. Supercurrents are known to occur in superconductors (in the form of resistance-free charge currents) and superfluids (which support viscosity-free particle currents). Both of these systems are Bose-Einstein condensates (BECs) that can be described by a single wave function. But since heat destroys a BEC, such supercurrents have only been observed at cryogenic temperatures. As described in *Nature Physics*, the new experiments of Bozhko *et al*. indicate a room-temperature supercurrent of magnons flowing in a ferrimagnetic film. The result builds on previous work by some of the same authors, which demonstrated that magnons can form a BEC at room temperature. In the new study, the researchers used a laser to create a temperature gradient that drives a magnon current in the ferrimagnetic film hosting the magnon BEC. According to the authors, the resulting magnon density, which they measured with light-scattering experiments, can only be explained by the presence of a supercurrent. If further experiments confirm the dissipationless nature of these currents, the scheme could lead to low-power-consumption logic and memory magnonic devices.



Magnons on the move

Visualizing a Heartbeat

Researchers have engineered a new kind of artificial tissue in which cells' electrical activity can be stimulated and visualized with light. To achieve such a feat, McNamara *et al*. incorporated four additional gene sequences into human embryonic kidney cells. Two produced ordinary ion channels; the other two produced blue-light-activated ion channels (i.e., light-sensitive switches) and a protein that fluoresces with an intensity that depends on the voltage across the membrane in which it is embedded. Light activation of electrically excitable cells has been shown before, but the team has now included a convenient readout mechanism (the fluorescent protein). By means of patterning methods they can shape the cell cultures into "tissue circuits." They grew rings of cells a

RESEARCH continued on page 5

ELECTION continued from page 1

Andrea Liu of the University of Pennsylvania was elected the new General Councilor. As a condensed matter theorist, Liu conducts research in several areas, focusing on the role of physics in other scientific disciplines, such as physical chemistry, chemical engineering, and materials science. Named the Hepburn Professor of Physics at the University of Pennsylvania in 2004, Liu is known for her work in soft matter. She has led the development of the theory of jamming, through which a wide variety of disordered materials can exhibit the properties of solids.

BROWN continued from page 2

Further Reading:

1. Brown, Robert. "A brief account of microscopical observations on the particles contained in the pollen of plants and the general existence of active molecules in organic and inorganic bodies." *Edinburgh New Philosophical Journal* (1828): 358–371.
2. Deutsch, D.H. "Did Robert Brown Observe Brownian Motion: Probably Not." *Bulletin of the American Physical Society* 36 (1991): 1374.
3. Ford, Brian J. "Confirming Robert Brown's Observations of Brownian Movement," *Proceedings of the Royal Microscopical Society* 31 (1996): 316–321.

Letters

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

Don't Forget the Giants of Physics

The June 2016 issue of *APS News* gives a good description of the remarkable achievements of many of the physicists involved in obtaining a concordance of experiment with theory for the neutrino problem. However, a mention of Pauli, who first conjectured their existence, and of Fermi, who first offered a theory giving a fit to existing experimental results, would have been in order. It is true that these giants of physics go back a bit, but so do many others, and we are not averse to citing their names in connection with important discoveries in our field. Finally, Queen's is a university and has been so for many years (not that there is anything wrong with colleges).

Jacques Destry
Kingston, Ontario, Canada

Encouraging Public Engagement

Thank you for the well written and thoughtful piece by Spencer Weart on the politicization of science in matters of nuclear energy and global warming (*APS News*, June 2016).

My less scientific friends are often surprised that I can not only vigorously support nuclear energy but also see it as an essential tool in the fight against the existential threat posed by anthropogenic global warming. It is in my view a sad commentary on the triumph of ignorance over reason that pronuke environmentalists have so little pull in the political sphere, but the answer cannot be that we retreat into our ivory towers.

I do not see, however, how we as scientists can make the leap to matters of policy without it impacting our credibility, both within the scientific community and in the eyes of the public as well. Any number of extremely brilliant scientists over the years have been naïve on this point. We need more scientists to bring their training and knowledge to the public and to speak out and even advocate, but at a certain point you have to choose. Take a big and bold enough step into politics and you cannot, anymore, keep the other foot grounded in the world of pure science.

To encourage scientists to speak out, therefore, it seems to me that we in the community need to give more respect to those who make that choice – the political path – than we currently do. I have heard far more than enough of my colleagues' complaints about the state of political affairs. We sit back and kibitz as if politicians inhabited an intellectual sphere far below ours.

Appearances to the contrary, by and large that is quite simply not true, and until we give advocacy and the public life the respect it deserves, we cannot expect respect in turn.

Peter Todd Williams
San Carlos, CA

The Tide Goes In, the Tide Goes Out

In 2011, a prominent television personality on a national network proclaimed, "Tide goes in, tide goes out. You can't explain that"[1]. He repeated the statement more than once, and to my knowledge never retracted it. In 2012, NSF reported that 26 percent of 2200 people questioned responded that the sun goes around the earth, not the earth around the sun [2]. The general public's ignorance of science and scientific concepts is indeed abysmal.

In a Back Page article (*APS News*, July 2016), Joel Primack urges scientists and scientific societies to engage our knowledge and efforts to address the situation. I have no quarrel with that. He argues that our efforts will "help the public make better decisions about science and technology." Perhaps. But it is not the public that is making poor decisions.

In essence, this is the model of decision-making in a democracy: we, the people, make decisions. We elect representatives to determine ways to implement these decisions. The better informed we are, the better our decisions, and therefore those of our representatives. But that model no longer applies. Our representatives, in large part are selected by and are beholden to those that fund their campaigns, not to the rest of us.

I believe that, as scientists, and citizens, we must direct our efforts both at educating the public about the science we know and love, and also at exposing the realities of the political processes that no longer represent us. Given a choice, creating equitable political processes, I suggest, is far more important — and urgent — than educating the public about science. And indeed a democratic political process is a prerequisite without which advances in public knowledge will have little impact.

Eustace Mendis
Toronto, Ontario, Canada

[1] go.aps.org/2bS3BMW
[2] go.aps.org/2bS3Rf3

Katharine Blodgett Gebbie (1932-2016)

By Rachel Gaal

Katharine Blodgett Gebbie passed away on Wednesday, August 17th, at the age of 84. For over 20 years, she directed the National Institute of Standards and Technology's (NIST) Physical Laboratory (PL) and its successor, the Physical Measurement Laboratory (PML). From 1997 to 2012, her laboratory earned four Nobel Prizes in physics — an extraordinary accomplishment over the span of just 15 years.

"The wall of her office was filled with the posters that recognized the awards her people had received, and she gloried in their accomplishments," William Phillips, a fellow of NIST's Joint Quantum Institute, wrote in an email. "Each of those Nobel Laureates credited Katharine with building the institutional environment in which the work of their groups could flourish."

Known for her exceptional kindness and wisdom, Gebbie's colleagues renamed NIST's precision measurement laboratory in Boulder, Colorado, in her honor. "This renaming is our small way of saying thank you … for all [Katharine] has done for this organization over such a long period of time," said NIST Director Willie E. May in a tribute article covering the event in 2015.

An astrophysicist by training, Gebbie received her B.A. in Physics from Bryn Mawr College, subsequently earning a B.S. in Astronomy and Ph.D. in physics from University College London.

She initially joined NIST in 1968 as a physicist in the Quantum Physics Division (QPD) of JILA, a cooperative enterprise between NIST and the University of Colorado Boulder. Much of her research focused on the physics of

Katharine Blodgett Gebbie

planetary and stellar atmospheres. Moving up the ranks, she worked alongside NIST Director Ernest Ambler as a program analyst, and was the first person from the JILA lab to work in the National Measurements Laboratory in 1983. She was then appointed chief of the QPD at JILA in 1985, also becoming

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Careers Report

Industry Sabbaticals for Physics Faculty

By Crystal Bailey, APS Careers Program Manager

In June 2015, the APS Committee on Careers and Professional Development (CCPD) emailed a survey to industry-affiliated APS members in order to assess interest in hosting physics faculty on sabbatical at their companies. The response was positive, with over 50% of the 159 respondents stating that having an academic researcher as a visiting colleague would be beneficial.

According to survey respondents, the top benefits of visiting academic researchers include their fresh perspective on solving problems, their deep subject matter expertise — and their potential role as a conduit for fresh talent (in the form of their graduating students). Other benefits mentioned include joint publications, longer-term collaborations, and more industrially focused teaching/mentoring after the faculty member returns to his or her home institution. "[Industry sabbaticals] would allow us to import skills into our company that we don't already have. It can be difficult to find such a person to hire on a permanent basis," said one respondent. "Someone who would work on a research topic related to, but different from, our current research would significantly broaden our understanding of the underlying physics," said another.

Survey respondents also suggested several benefits for academics and their institutions. In addition to working on new and exciting projects, participants would also gain insight into the decision-making processes behind the development of new technology — for example, how to translate research into a marketable product, or how to assess whether research is a good return on investment. This insight could lead to a better non-academic career mentorship, which would certainly be a valuable outcome for academics and industrial physicists alike, given that the majority of physics graduates at all degree paths will find employment in the private sector. Furthermore, a robust research relationship between a local company and university could foster increased publications, increased opportunities for collaborative scientific research, as well as more internships and job opportunities for students.

Yet respondents also pointed out challenges to hosting academic researchers in companies. It usually takes at least one or two months for visiting faculty to gain enough background information about the project and company to make new and useful contributions, so short-term appointments (e.g., over a summer) were ranked less desirable compared to semester or nine-month appointments. Several respondents also mentioned the issue of intellectual property ownership — which often depends on what percentage of the researcher's salary is being covered by the company during the sabbatical — as a potential sticking point. Careful collaboration between a company and a university's intellectual property office is important to ensure that both parties receive satisfactory arrangements.

Given the potential benefit of industry sabbaticals both to companies and to academic researchers, APS would like to help facilitate connections between these groups. Faculty who are interested in the possibility of taking an industry sabbatical during the Fall 2017 – Spring 2018 academic year should contact Crystal Bailey (bailey@aps.org) by October 31, 2016. Correspondence should include at minimum an NSF-appropriate biographical sketch; additional information, such as salary requirements and expected period of sabbatical, would also be useful. APS will share this information with the companies that indicated interest in hosting faculty researchers, and these companies will then follow up directly with the faculty members who responded. Through this process, APS hopes to foster more collaboration between academia and industry, and help its members reap the full benefits from these relationships.

Related Information

Tools for Career Advisors (on the APS Careers in Physics website): aps.org/careers/advisors/

APS Professional Guidebook (for students): aps.org/careers/guidance/development/

Physics InSight (free physics careers slideshow): aps.org/careers/insight/

IMPact: Industry Mentoring for Physicists: impact.aps.org

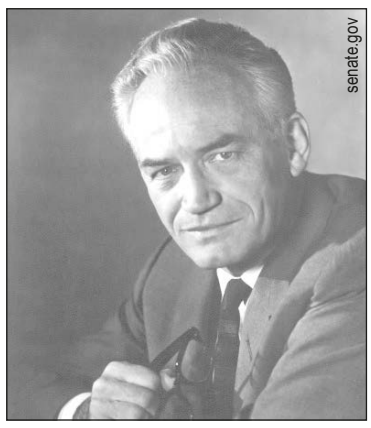
Correction: In the Back Page article "How Can Physicists Help the Public Make Better Decisions about Science and Technology" by Joel Primack (*APS News*, July 2016) the president of the National Academy of Sciences mentioned in the book *Merchants of Doubt* should have been identified as Frederick Seitz, not Detlev Bronk. The online version of this article has been updated with this correction.

On the Road to Research: Goldwater Scholarship and Excellence in Education

By Rachel Gaal

With a reputation for fostering research potential, the Barry Goldwater Scholarship and Excellence in Education Program provides funding for undergraduate students whose "lifelong dream" is working as a researcher in the natural sciences, mathematics, and engineering. Established in honor of Senator Barry Goldwater in 1986, the congressional program is highly competitive. Considered one of the premier U.S. undergraduate scholarships, the merit-based awards are offered only to students who are nominated by their current home institution. This year's awards recognized 54 scholars majoring in physics and astronomy plus related disciplines including engineering physics, geophysics, and biophysics, along with 43 honorable mentions.

From over 1,100 applications received each year, around 250 students are chosen based on academic achievement and demonstrated research ability. While research experience is not a requirement of the scholarship, the ability to pursue and excel in research shines through in many successful nominees. "The past president conducted a survey in 2014 of all Goldwater scholar recipients from 2008," explains John Mateja, recently appointed Goldwater president, and the third to hold the position in the foundation's 30-year history. "From those that responded, about 50% of students had gone on to get Ph.D.'s in their field, and another 20% were working toward [that goal]. Upwards of 72% reported they were actively involved in research, so that's a lot of positive feedback."



Senator Barry Goldwater (1909-1998)

Students are eligible to apply after either their sophomore or junior years. The scholarship provides up to $7,500 for each remaining undergraduate year, so the total award can be as large as $15,000.

"We've been funding about 300 students each year, and we have about 2,000 schools that have campus representatives for our scholar-

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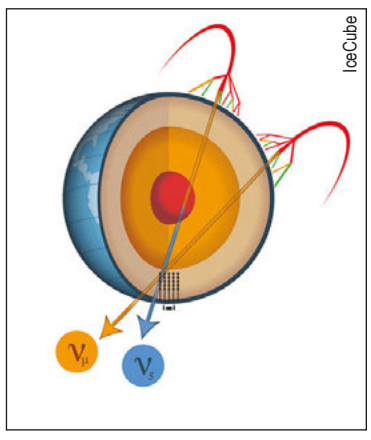
RESEARCH continued from page 3

few millimeters in diameter that could support circulating waves of electrical excitation. The coordination of this excitation is reminiscent of rhythmic activity in cardiac tissue. The researchers, who report their findings in *Physical Review X*, say that these tissues could be used to understand real cardiac cells, especially when exhibiting behavior such as arrhythmias. (For more, see the *Physics* Focus article "Biological Cells Form Electric Circuits".)

IceCube Searches for Sterile Neutrinos

A search for sterile neutrinos with IceCube — the world's largest neutrino detector — has found no evidence for the hypothetical particles, significantly narrowing the range of masses that a new kind of neutrino could possibly have. Following hints seen in some experiments, sterile neutrinos were proposed to interact with matter only through gravity, and researchers have sought such particles for decades. Some of these searches attempted to find evidence of sterile neutrinos from the oscillation of the known neutrinos. Normally, an oscillation caused by sterile neutrinos should be small. But if it occurs as the neutrinos pass through dense matter, it may be greatly enhanced by a so-called matter-induced resonance effect, creating a sizable disappearance of the muon neutrinos at certain energies. As reported in *Physical Review Letters*, IceCube looked for this disappearance for neutrinos and antineutrinos with energies between 320 GeV and 20 TeV, a range in which the resonance effect had never been explored. However, no such disappearance was observed. Other experiments may soon more completely rule out the possibility of sterile neutrinos or might close in on a crucial discovery. (For more, see the Viewpoint "Hunting the Sterile Neutrino" by David Schmitz.)



No hypothetical neutrinos

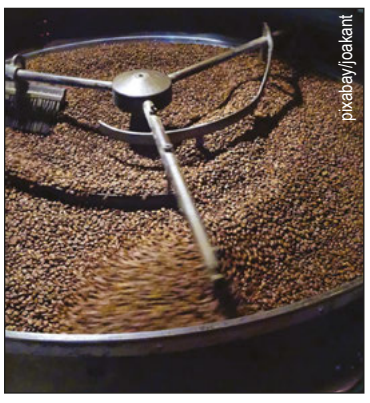
Those Eyes, Those Cephalopod Eyes

A pair of researchers has proposed a way that cephalopods—octopi, squids, and cuttlefish—can have color vision while technically being color blind. Organisms like humans see color because of multiple types of visual photoreceptors that produce different neural signals depending on wavelength. But marine animals like the cuttlefish have only one type of photoreceptor, yet they change their coloration to communicate with others of their species. In the *Proceedings of the National Academy of Sciences*, Stubbs and Stubbs suggest that cephalopods employ chromatic aberration and an off-axis pupil structure to achieve color sensing, although they are color blind in terms of photoreceptors. Chromatic aberration in a lens occurs when different wavelengths of light have different focal lengths. Considered a nuisance in telescopes, it could, however, confer color vision on cephalopods if varying the distance between lens and retina enabled the animal to acquire images in different colors. To test the idea, the researchers created a numerical model of such a visual system and found the results agree well with existing visual and physiological data on marine animals. They conclude by suggesting that other species with limited photoreceptor variety, such as spiders and some marine mammals, may have the same ability to overcome apparent color blindness.

Color vision in cuttlefish

How to Roast Coffee by Ear

Coffee geeks rejoice: Thanks to physics, an innovation in roasting may be just around the corner. Mechanical engineer Preston Wilson analyzed the sounds from roasting coffee to learn whether they could control an automatic roaster. Experienced roasters tweak a coffee's flavor by listening for the "first crack," a small popcorn-like explosion caused by steam escaping from the hot beans. Cutting off the heat soon after gives a light roast with high acidity, while waiting longer lets the sugars caramelize and (slightly) reduces the caffeine content. Eventually a "second crack" like a distant firecracker comes from the breakdown of cellulose in the beans and the release of oils, signaling a darker roast. To find out if these sounds were different enough, Wilson recorded a performance by an espresso blend in a home-roaster, capturing 62 first-crack events and 241 second-crack events. As he reports in the Journal of the Acoustical Society of America, first crack is louder (by 15%) and occurs at a lower frequency (factor of 19) and rate (factor of 5) than second crack, suggesting a robo-roaster could differentiate the two.



Beany noises

Inside the Beltway

Why Politicians Shun Science on the Campaign Trail

by Michael S. Lubell, APS Director of Public Affairs

Don't hold your breath waiting for Donald Trump or Hillary Clinton to bring up science on the stump. If either of them does, as Hillary did in her convention speech, watch out for the smackdown. I'll get to that event in a moment, but first let me make my case.

About 1 in 20 members of Congress has no college degree. And 9 out of 10 have little if any background in science. No one running for elective office wants to appear ignorant on an issue, and not speaking about science is the safest path politically.

Avoiding science also costs candidates few votes. Members of the public may be enamored of scientists, whom they regard as extremely trustworthy and not in the least self-serving, according to recent polling. But their esteem for the profession does not translate into voting decisions based on science issues. Even among physicists, a candidate's position on science plays no role in the voting booth.

Recognizing the disconnect between science and electoral outcomes, most campaigns at the congressional level devote scant resources to developing science and technology positions or targeting scientists as potential voters. Given the central role science and technology policy plays in the White House — from defense and energy to health and the environment — you might think that the presidential campaigns would be different. But, with rare exceptions, you'd be wrong.

Consider Barack Obama: He is without a doubt the biggest science booster to occupy the Oval Office in modern times. Two years ago, in an NPR interview, John Holdren, the director of the White House Office of Science and Technology Policy and assistant to the president on science and technology, said of Obama, "First of all, he is a science geek. He is the only president ever to have held a science fair, and he has held four of them [as of December 2014]."

Yet even Obama made few references to science when he campaigned for president in 2008 and 2012. There were instances when he spoke about the importance of science for economic growth and the importance of STEM education for the future workforce, but they were not part of his standard stump speech. During the Democratic primary campaign leading up to the 2008 election, Hillary Clinton made similar references, but again they were not integral parts of her stump fare.

As for the Republican candidates, they used to be strong promoters of science, dating to Dwight Eisenhower in the 1950s, but they have also been loath to feature the issue in their public campaigning for the same reasons. Neither John McCain in 2008 nor Mitt Romney in 2012 had much to say about it as they campaigned across the country.

You have to go back to the 1960s to find a time when science and technology took center stage. That was the era of the "space race" and the Apollo moon program, and almost every politician, beginning with President Kennedy, recognized that exploration and discovery were winners on the campaign circuit. Barry Goldwater, the 1964 Republican presidential nominee, is best known for his aggressive defense posture and iconoclastic — for that time — adherence to conservative political principles. But he too promoted the benefits of science. Today, the Barry M. Goldwater Scholarship, established by Congress in 1986 in his honor, is one of the most prestigious undergraduate awards given in science, mathematics, and engineering.

The 1960s were an anomaly. The public was engaged and, to a person, enthralled by space exploration. Sending humans to the moon was a proposition that every politician could explain and receive plaudits for supporting it.

But in the last decade, the only science issues that get the political and public juices flowing are climate change, evolution, and stem cell research. Unlike the Apollo program, they do not find universal acceptance among office-seekers or voters.

Which brings me back to Hillary Clinton's acceptance speech at the Democratic Convention the evening of July 28. Sandwiched between her rhetoric on tax policy and immigration policy, she interjected these words: "I believe in science." She paused, giggled and after the thunderous applause subsided, she continued, "I believe climate change is real and that we can save our planet while creating millions of good-paying, clean-energy jobs."

It didn't take long for a smackdown to materialize. Conservative syndicated columnist Ann Coulter was first out of the chute with her tweet: "I believe in science ... . Dem code for we're shutting down coal mines, steel plants and any other remaining manufacturing."

Within hours, Trump retweeted Coulter's barb. Not a surprise, since he had made his views on climate change well known months before, when he told a Hilton Head, S.C. rally in December, "Obama's talking about all of this with the global warming and … a lot of it's a hoax. It's a hoax. I mean, it's a moneymaking industry, OK? It's a hoax, a lot of it."

Clinton succeeded in firing up the crowd, but in so doing she created the opportunity for climate change deniers to denigrate science in general.

So here's the conundrum: If candidates don't connect science to a hot policy issue, they run the risk of boring their audience to death. And if they do make the connec-

POLITICIANS continued on page 6

SALTER continued from page 1

a higher level where I direct and manage all publishing aspects of the publications. I work closely with APS Editor in Chief Pierre Meystre, who oversees all the content in the journals. Ours is a key relationship, and I couldn't be happier to have him on board!

Because you are focused on attracting papers, do you get to choose the content of what APS publishes?

No, the publisher does not decide which papers should be published. Actually, I'm not a physicist, so even if I could I feel I wouldn't be the best fit to make those decisions.

What's your background?

I'm a chemist by training; I got my Ph.D. in organic chemistry at Imperial College London. Of course I've been interested in physics, and I considered it in university, but I've been seduced by chemical structures since an early age.

How did you find yourself in scholarly publishing?

After obtaining my Ph.D., I carried out postdoctoral research at Tohoku University in Sendai, Japan, and Imperial College before becoming a lecturer in chemistry at King's College London. The department was closed in 2005, and I returned to Japan as a group leader at the University of Tokyo, and then I moved into a commercial role as a chemical sales director based in Oxford. However, I have always been interested in science writing and communication, so when I was offered a position with a new unit of Nature Publishing Group based in Tokyo, it was a natural fit. I've been involved with *Nature* for a number of years, and also a stint with IOP Publishing in similar directorial roles.

What brought you to work at APS?

I was approached to take the position whilst working for IOP Publishing, starting at APS this past February. Because of its position as one of the largest physical societies in the world and itsoutstanding portfolio of journals, the nature of the role was too good to miss as a career challenge. I never thought I would have this wonderful opportunity to work and live in the U.S.

Are you involved with other parts of APS?

I serve as the APS representative on the CHORUS Board of Directors (Clearinghouse for the Open Research of the U.S.), which is basically an organization that aims to sustainably deliver public access to published articles. I am also on the board of STM, an association for academic and professional publishers, and partake in other lobbying and industry groups such as the Open Access Scholarly Publishers Association (OASPA).

Considering your experience in Japan, are you fluent in Japanese?

Well, there's always room for improvement, but I am very comfortable in Japan. I speak Japanese at home all the time, as my wife is Japanese. One of the great things about studying languages is there is always something more to learn so it keeps you humble! I also speak Mandarin to a reasonable standard.

What are the best parts of the U.S. you've seen so far?

I've been to New York City a couple of times and I [was] wowed by the Flatiron and the Empire State Building. It's an absolutely amazing place. I've seen more of the U.S. in the last six months than I could've imagined. I also had great sushi in Salt Lake City, which was a wonderful surprise; I've also seen the Ford River Rouge Plant in Detroit.

What do you do outside of work?

I'm married with two kids, so I don't have much time for hobbies. I actually would love to get back into karate — I got up to purple belt in Shorinryu karate when I was in Japan, but that style isn't widely taught in the US, so I'm afraid I'll have to start that up again from scratch in a different style. My wife's father was a karate master and both my sons do it as well. Most people begin learning when they are kids, but I started at the ripe old age of 45. It's never too late.

Around the office, you're well-known for your Twitter activity … care to explain?

I've actually got two Twitter accounts, wait no… I think I have three — one of them is purely for pictures. They are all personal accounts so don't reflect the APS official position on anything! I tweet about a wide range of things, mainly politics and publishing. I'm always on Twitter during the long bus commute to work. Maybe I tweet a bit too much, but I think I'm getting better at it.

I'm looking at your Twitter bio (biography), and it says you are an "award-winning pancake chef." Do you like to cook, too?

I've won the "Best Pancakes Made in Our House" award five years running—my kids always nominate me.

POLITICIANS continued from page 5

tion, as Clinton did, they run the risk of making science a wedge issue rather than a unifying theme.

The long-term remedy requires more scientists to run for elective office, make science a priority issue in the voting booth, and take the time to engage the public on the benefits of science. Of course that's easier said than done.

GOLD continued from page 1

director, in an email. "The uniqueness of the mechanics question was that it was a dialogue between two students about if it was possible to distinguish earth gravity from a space station's artificial gravity. The nonlinear circuit was based on the thyristor, and was possibly the hardest 'easy' question on the exam. The particle physics question was clearly in homage to CERN."

Added Stanley, "The two experimental questions dealt with a four-point resistance measurement of thin films and bifurcation behavior of [vibrationally] excited poppy seeds. As the poppy seed problem, with spontaneous seed sorting at some excitation ranges, produced unexpected results for most students, it might have been the most entertaining and counterintuitive experiment in years."

Taking home medals for the U.S. were Abijith Krishnan (gold, 16th place); Jason Lu (gold, tied for 17th); Srijon Mukherjee (silver, 50th place); Jimmy Qin (silver, tied for 53rd place); and Vincent Liu (silver, tied for 75th place).

While the exams ramped up their adrenalin levels, the 400 competitors were immersed in a great cultural and professional excursion, connecting with students representing 87 countries. The Department of Physics at the University of Zürich, the Office of Education of Liechtenstein, and the Associations of Swiss Scientific Olympiads recruited hundreds of volunteers to help organize an array of activities and facility tours to spark interest in the budding physicists.

"The midterm party was a highlight for all," wrote Stanley. "After the exams, [we were] called to attention by a trio of alpine horns … . We could play the alpine horn ([with a] prize to whoever could hold the note the longest) … . We could milk cows (fake cows, but realistic milking seats), toss chickens with slingshots (a fake chicken, but evidently a real sport, where you catch it in a frying pan), hammer nails (2 hits was record to sink it), shoot arrows, and cut logs with a two-person-long saw."

The U.S. team is organized and trained by the American Association of Physics Teachers, with sponsorship from a number of entities, including APS and the American Institute of Physics.

Related information

The final results are posted on the official IPhO website: go.aps.org/2biTCDW

The official IPhO 2016 Theory and Experimental Exams with translations: go.aps.org/2aWk9q7

More about the U.S. team: go.aps.org/29snYz6

SPECTRA continued from page 1

Stinky Cecil, which teaches readers about biology and ecosystems (including the difference between frogs and toads). Other panelists speak of their work with science fiction writing and science textbooks.

The overarching theme — educational comics — made me wonder how APS and Physics Central ended up here in the first place. Prior to my trip, I didn't know about Comic-Con, let alone expect that comics could go beyond fantasy and into non-fiction. But I learned our outreach team had its first booth back in 2010, aligned with the 50th anniversary of the first working laser. *Spectra* came alive to celebrate this special event, helping inspire the next generation of physicists in the classroom.

I'd already heard the gist of Thompson's talk many times, as Becky helped me refine my pitch about Spectra for our booth. But at Comic-Con, I had an "aha" moment when I heard her take on the impacts of *Spectra* in the classroom:

"When I talk about physics, people's eyes often glaze over … which unfortunately is a normal response. I knew [that] to grab children's attention, APS needed to do something different. That's why APS decided to use the comic book format — because storytelling keeps students turning the page and learning … also because there's plenty of physics that is better conveyed visually."

Thompson continues, "What got us the support of the APS membership was giving [them] *Spectra*, free of charge, and encouraging them to bring it home to their kids as comics. We found that when it was their own families enjoying the science, none of the data was as persuasive as the president of APS having their grandchild explain the history of the laser with the help from *Spectra*."

Jim McClain, the creator of *Solution Squad* and a middle school math teacher, leaned forward into his microphone to add to Becky's remarks. "When it came time to direct my students, I wanted to make sure they had comics in the classroom too," he explained.

He says that his comic has a cast of teenage heroes, each with a different math-based superpower: "One of my characters — Absolutia — her symbol is the absolute value sign. When she raises or lowers her hands, it represents when we have positive and negative numbers. The further you get away from zero, no matter if it's 'up' or 'down', that's the concept of absolute value. If you understand how she works, you understand how absolute value works — and I see my kids lifting and lowering their hands during class … that's when you know it's working."

The slide shifts to the cartoon toad named Cecil. Paige Braddock, who is the creative director of *Stinky Cecil*, notes her experience with her biology-based educational comics. "The kids always identify with the characters in comic books. It personalizes what you're trying to convey and engraves those concepts much deeper into their curriculum."

"That emotional connection to the story, the characters, will always carry your teaching," comments Mairghread Scott. She's a science-fiction writer and script coordinator for the comic series *Transformers Prime*.

"I think science gets linked to the idea of 'exceptionalism,'" Scott continues. "Kids think of science as a couple of genius people that have one brilliant moment, but real science is a progressive format. Kids can find science intimidating, but in educational comics, we have a lot of characters that access the scientific method. Kids can finally break down the idea that even though science is 'really special,' it doesn't require magic powers to understand."

At this point, it became clear that teachers in a variety of STEM fields were seeing impressive results with the use of educational comics. Betsy Gomez, an editor and content developer of school textbooks, practically jumped toward her microphone, eager to express her thoughts.

"Textbooks are very limited in their ability to engage with their readers," she said. "Comics can be used to add narrative and help students understand the story, reinforcing the concepts and engaging them in a more personal way."

The panel closed with numerous comments from educators, teachers, and parents, all requesting materials for their children and students. I sat quietly, wondering if there would be more panelists like these next year, waiting to tell their success stories with science comic books. For now, *Spectra: The Original Laser Superhero* is the only superhero that battles physics crime. I wonder who else could show up to save the day?

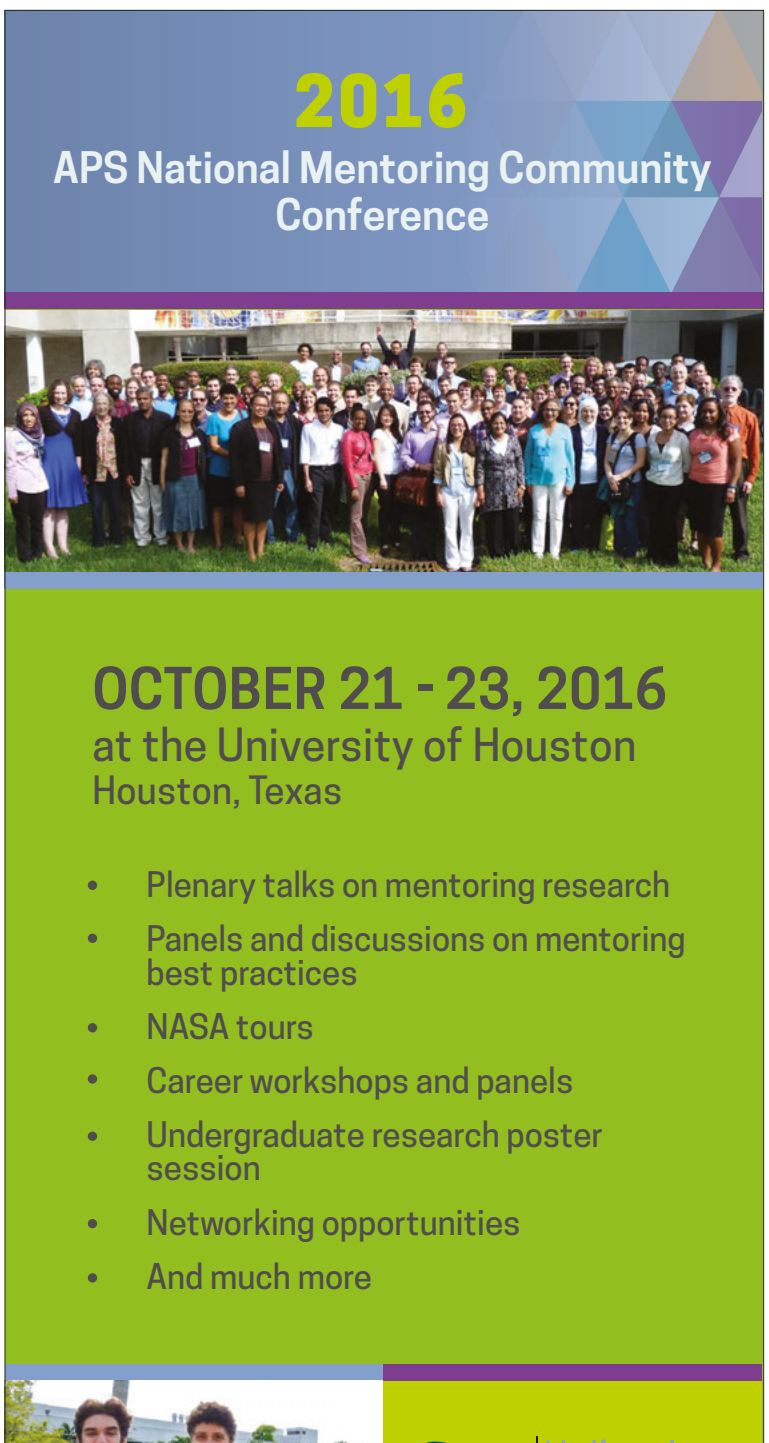
GOLDWATER continued from page 5

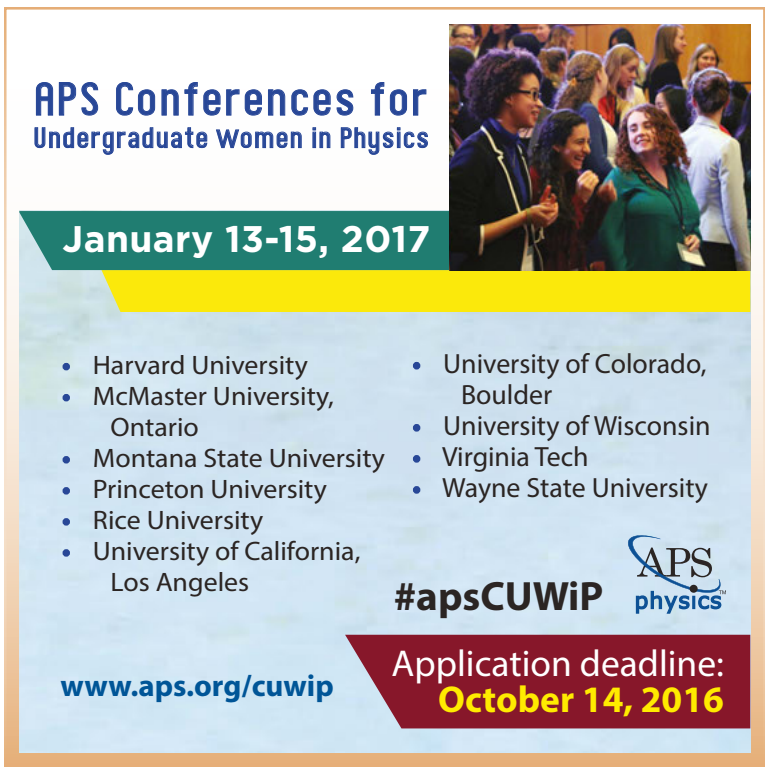
ship," says Mateja. "While many campuses are active in nominating students, I hope that we can [further] promote our scholarship — there are a lot of deserving students out there that should be nominated [for this award], celebrating students and their faculty members for their hard work."

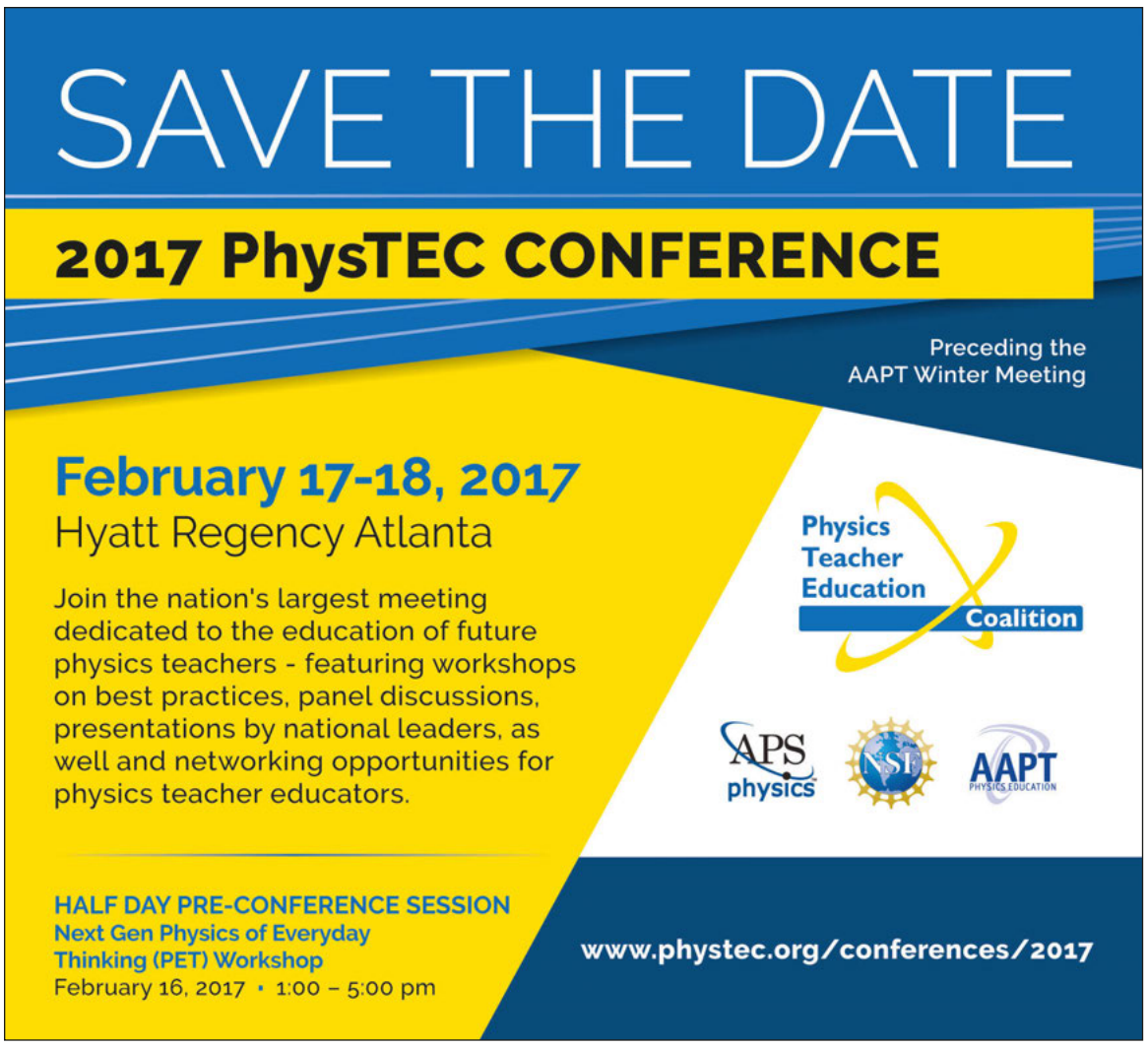
The 2016 Goldwater Scholars and Honorable Mentions also receive a free one-year APS membership for their exceptional achievements. Ted Hodapp, APS director of project development and senior advisor to APS education and diversity programs, expresses his excitement for this special offer to scholars. "We would like for [the scholars] to know about options in the professional life after their studies … what better way to do that [than] with access to APS membership, free of cost."

For more about the scholarship visit goldwater.scholarsapply.org

ANNOUNCEMENTS







GEBBIE continued from page 4

acting Director of the new Center for Atomic, Molecular, and Optical Physics in Gaithersburg, MD, in 1989. She eventually accepted the director position at NIST PL in 1990; in 2011 when PML was founded, she took on the role of director of the laboratory's research.

Reporting to six different NIST directors during her 45 years there, Gebbie pioneered the expansion and success of her laboratories, devoting her career to the advancement of her colleagues, researchers, and support staff.

This leadership earned her numerous awards. She received the highest honor of the United States Department of Commerce (DoC), earning the DoC Gold Medal for her leadership and professional excellence at NIST. She also received additional awards, including the Service to America Career Achievement Award, and Women in Science and Engineering Lifetime Achievement Award.

Gebbie also played a crucial role in the creation of undergraduate opportunities, such as NIST's Summer Undergraduate Research Fellowship (SURF) program and was an advocate for women and minorities in science.

"The creative environment and spirit of discovery that she nurtured continues to enrich us today," wrote Phillips. "Her passing has left me, and many more, heartbroken and unable to imagine NIST and our own lives without her."

A detailed profile of Katharine Blodgett Gebbie can be found on NIST's PML page: go.aps.org/2bS2GMD

The Back Page

Conveying gravity: Communicating the Discovery of Gravitational Waves

By Joey Shapiro Key, Martin Hendry, Daniel Holz

On February 11, 2016 the LIGO Scientific Collaboration and Virgo Collaboration announced the first direct detection of gravitational waves and the first observation of a binary black hole merger [1]. The physics community has been working toward these discoveries for a century; Einstein's theory of general relativity predicted gravitational waves and black holes in 1916 [2, 3]. Science is an inherently careful and skeptical pursuit and the discovery of gravitational waves is an especially salient example of work that takes dedication and patience by generations of scientists. The Education and Public Outreach Working Group of the LIGO Scientific Collaboration and the Virgo Collaboration (LVC) helped to inform the world about our scientific breakthrough, attempting to convey the basic science of what has been accomplished, and why it is exciting and important. As a group of professional scientists as well as educators, outreach professionals, and students, we assembled resources designed for different levels and for a variety of goals.

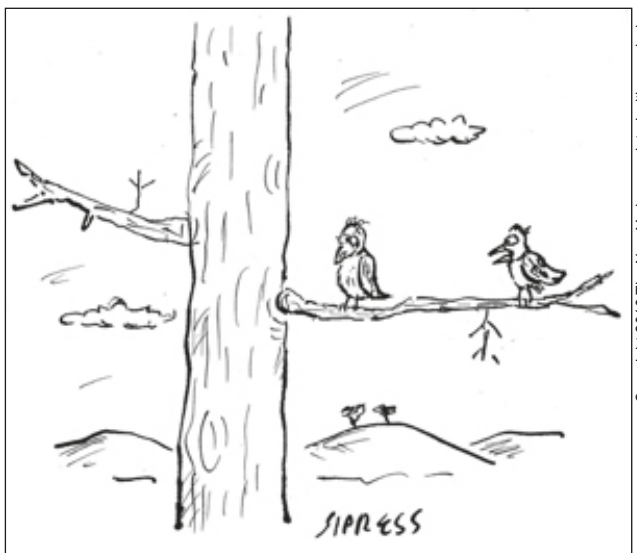
Physicists themselves were confused about the nature of gravitational waves for 40 years, and took an additional 60 years to build an experiment capable of detecting them. Given this, how do we efficiently and effectively convey the basics to a general audience with little or no mathematics? To do so we adopted a multi-level approach. We developed accessible resources using commonplace (if imperfect) analogies such as "waves on a stretched rubber sheet" and simplified schematics like our interferometer animations [4]. These were designed to give even the casual viewer some clear insight into what gravitational waves are and how we detected them.

In parallel, we prepared in-depth material designed to address more detailed questions about the science and technology behind gravitational wave detection, and made this material available principally via our website [5]. A key example here was our science summaries [6]: in-depth articles written without technical language but conveying the essential scientific arguments and conclusions presented in our detection papers.

We also sought to promote our outreach efforts vigorously using social media, formulating a comprehensive plan that would direct followers to the very latest news, provide clear pathways to more in-depth resources, and offer opportunities to engage directly with us as LVC researchers. These included, for example, a question@ligo.org address that since February continues to attract hundreds of inquiries from across the globe, posing to the collaboration some highly challenging and perceptive questions.

Finally, our strategy highlighted the importance of not just our scientific breakthroughs themselves, but also the scientific methodology that underpinned them. We emphasized three key messages:

1. Detecting gravitational waves was incredibly difficult and a quest that many had thought impossible (in the words of LIGO Executive Director Dave Reitze, the equivalent of the Apollo "Moonshot"). Thus our success was a triumph for the long-term vision and investment of NSF and other national funding agencies;
2. Our discovery relied on the teamwork and cooperation of many hundreds of scientists and engineers from dozens of countries across the globe — mirroring the modus operandi of many contemporary "big science" projects;
3. To quote Carl Sagan, "extraordinary claims require extraordinary evidence," so the five-month delay between our detection and its announcement involved a huge amount of meticulous analysis, leaving no stone unturned in the quest to convince ourselves that we detected a real signal.



Was that you I heard just now, or was it two black holes colliding?

Figure 1

***New Yorker* cartoon from Friday February 12, by David Sipress.**

Our announcement of the detection of gravitational waves became a worldwide sensation (see Box 1). For a brief moment the physics of black holes outshone all other news, generating a wave of positive coverage exciting the public consciousness.

The authors are writing on behalf of the Education and Public Outreach group of the Ligo Scientific Collaboration and the Virgo Collaboration. Joey Shapiro Key is an Assistant Professor of physics at the University of Washington Bothell and the Chair of the LIGO Scientific Collaboration (LSC) Education and Public Outreach Committee. Martin Hendry is professor of gravitational astrophysics and cosmology at the University of Glasgow. Daniel Holz is an Associate Professor in the Department of Physics, the Department of Astronomy and Astrophysics, the Enrico Fermi Institute, and the Kavli Institute for Cosmological Physics, at the University of Chicago. This article is adapted from a Commentary in Nature Physics *(Key & Hendry, June 2, 2016) with permission of the authors.*

References

[1] Observation of Gravitational Waves from a Binary Black Hole Merger, *Physics Review Letters* 116, 061102 (2016)

[2] A. Einstein, Sitzungsber. K. Preuss. *Akad. Wiss*. 1, 688 (1916)

[3] A. Einstein, Sitzungsber. K. Preuss. *Akad. Wiss*. 1, 154 (1918)

[4] LIGO interferometer animation (https://www.ligo.caltech.edu/video/ligo20160211v6)

[5] LIGO Scientific Collaboration (www.ligo.org)

[6] LVC Science Summaries (http://www.ligo.org/science/outreach.php)

[7] Newseum "Discovery of gravitational waves" (go.aps.org/2bS559O)

[8] PhD Comics on gravitational waves (youtube.com/watch?v=4GbWfNHtHRg)

[9] Brian Greene on The Late Show with Stephen Colbert (youtube.com/watch?v=ajZojAwfEbs)

[10] YouGov survey in the UK (go.aps.org/2bS571q)

[11] LVC Reddit on February 12, 2016 (go.aps.org/1ob8k0D)

[12] Astronomy Picture of the Day, February 11, 2016 (apod.nasa.gov/apod/ap160211.html)

[13] Missy Assink (about.me/missyassink)

[14] Spoken Word Paris (go.aps.org/2bS42qu)

[15] Saturday Night Live Weekend Update with Von Miller (go.aps.org/2bS4oxl)

Making waves about gravitational waves

The worldwide response to the announcement that gravitational waves had been discovered wasn't restricted to the mainstream media. The sheer breadth and depth of interest it generated was a testimony to the importance of the result:

- Newspaper and television news coverage of the gravitational wave detection included front-page articles in the *New York Times*, and coverage on CNN and the BBC. According to the Newseum, a total of 961 newspaper front pages from February 12 featured the discovery, which included the "Discovery of Gravitational Waves" on their list of dates in 2016 deemed to be of historical significance [7].
- Caltech media reported 70 million aggregate impressions on all tweets using the #gravitationalwaves, #LIGO, and #EinsteinWasRight hashtags.
- The LIGO Scientific Collaboration Facebook page top post reached 665K people, with 15K likes and 2.8K shares. From February 8 to March 8, the page reached 1.5M people, 7.3K shares, 42.4K reactions, and gained 8.7K new followers.
- The top tweet of the LIGO collaboration had 639K impressions, 4116 retweets, and 2996 likes. From February 8 to March 8, the account had 4.7M impressions and gained 19.2K new followers. The top LIGO mention was from President Obama tweeting as @POTUS: "Einstein was right! Congrats to @NSF and @LIGO on detecting gravitational waves — a huge breakthrough in how we understand the universe," with 80K engaged, 9.5K retweets, and 21K likes.
- The *PhD Comics* on gravitational waves has over 1.5 million views [8].
- Brian Greene appeared on The Late Show with Stephen Colbert to discuss the discovery of gravitational waves and a binary black hole, generating 2.2 million views on YouTube [9].
- In the YouGov survey in the UK, a third of people polled thought that the discovery mattered a "fair amount" or "a great deal" [10].
- Our Reddit Ask Us Anything (AMA) session on February 12 provided 923 comments, with LVC scientists answering more than 90% of the questions asked, and sparking a separate thread discussing the LVC AMA on reddit.com/r/bestof [11].
- The NASA Astronomy Picture of the Day (APOD) with the gravitational wave discovery had over one million views February 11 - 16, plus translation into over 20 languages on external mirror sites [12].
- Poet and non-scientist Missy Assink read her original poem 'GW150914 or a love story between two black holes' at Spoken Word Paris in March 2016 [13, 14].
- In popular culture there were tweeting birds in a *New Yorker* cartoon (see Figure 1), a mention in "News from Lake Wobegon" on *A Prairie Home Companion*, and a *Saturday Night Live* sketch with the Super Bowl MVP Von Miller comparing himself and Cam Newton to colliding black holes [15].