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PhysTEC Grows
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Roger Falcone Chosen as Vice President of APS for 2016

By Emily Conover

APS members took to the polls in May and June to select new leadership, and the votes have been tallied. The majority of voters in the annual general election chose Roger Falcone to fill the office of vice president beginning January 1, 2016. Falcone, a professor of physics at the University of California, Berkeley, is the director of the Advanced Light Source, an x-ray synchrotron facility at Lawrence Berkeley National Laboratory.

Under the APS governance structure, the vice president joins the presidential line, eventually ascending to the presidency after one-year terms as vice president and then president-elect.

In January 2016, the current president, Samuel Aronson, will step down to become past president, and the current president-elect, Homer Neal, will assume the position of president. The current vice president, Laura Greene, will become president-elect, and Falcone will assume the vice presidency. Falcone will become president of the Society in 2018.

"I'm very pleased to be able to serve the Society and the physicists within APS," Falcone said. "I will be spending a lot of time listening, to understand the work of the APS more close-up, and also hearing from people who are members of the Society."

Falcone also cited the important role that physicists can play in influencing science policy in the nation. "APS can strengthen the collective impact of physicists, and improve the educational, industrial, private, and government institutions within which science is carried out," Falcone said in his candidate statement.


Roger Falcone
Vice President


James Hollenhorst
Treasurer


Deborah Jin
Chair-Elect
Nominating Committee


Johanna Stachel
International Councilor


Bonnie Fleming
General Councilor

The election is the first since the corporate reform that was instituted last year, which included amendments to the *APS Constitution & Bylaws* and *Articles of Incorporation.* Members voted to adopt the reform in November 2014.

As a result of the restructuring, this year's election marks the first time APS members have voted for a treasurer, a position on the APS Board of Directors. James Hollenhorst, senior director of technology for Agilent Technologies, will be the first elected treasurer of APS. Past president Malcolm Beasley is serving as interim treasurer.

"I look forward to making a contribution to the Society," Hollenhorst said. "It is a new role, and so what's done by the first person in that role will have an impact on what the definition of that role is going forward. So it's a responsibility, but also an opportunity to make the best of the new structure of the APS."

In his candidate statement, Hollenhorst cited sound financial management as a top priority. "Without it, none of the exciting goals of APS will survive the test of time."

One important challenge is the changing face of scientific publishing, Hollenhorst added. "Open access is the rallying cry from the government, the universities, and

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U.S. Physics Olympiad Team Returns With Gold and Silver

By David Voss

In a four-way tie for second place overall, the United States Physics Olympiad team won four gold medals and one silver medal at the International Physics Olympiad in Mumbai.

Three other countries — Russia, Taiwan, and South Korea — also won four gold and one silver medal, while China took home first place with five gold medals.

At the Olympiad, top high school physics students from around the world face a challenging battery of tests: a five-hour theory exam and a five-hour experimental exam. The theory questions ranged from the physics of neutrinos and photons emitted from the Sun, to the engineering design of a nuclear reactor. The experimental challenge involved measuring complex optical diffraction patterns and the diffraction of surface waves.

The U.S. team's performance is the best relative to other teams since 2009, said Paul Stanley of Beloit College in Wisconsin, academic director of the team. "[There were] some remarkably creative solutions by all of the U.S. Team, but unfortunately the scoring system did not award extra points for creativity!" Stanley wrote in an email.

The U.S. Physics Olympiad program was started by the American Association of Physics Teachers (AAPT) and is co-sponsored by a number of societies, including APS. "Everyone at AAPT is very proud of the second place position of the team and for each individual's medals and

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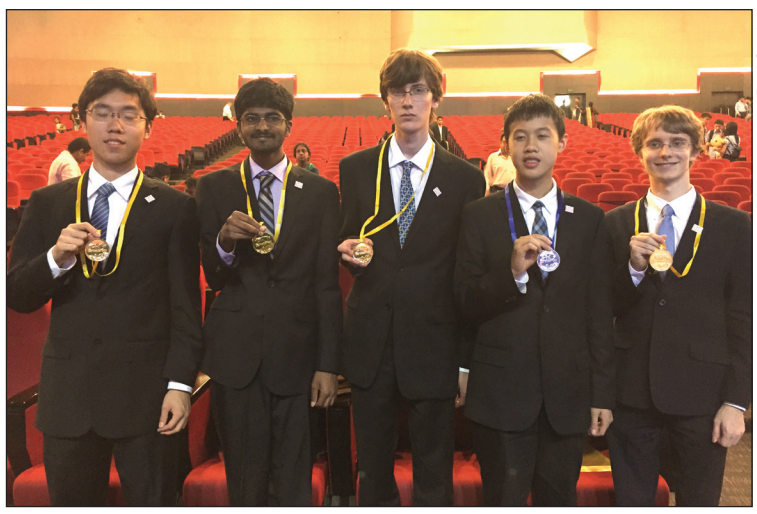
Paul Stanley

The 2015 U.S. Physics Olympiad traveling team brings home gold and silver medals: (l to r) Kevin Li, Saranesh Prembabu, Zachary Bogorad, Jason Lu, and Adam Busis.

JOURNAL PUBLISHING

Getting Up to Speed on FASTR Legislation

By Emily Conover

A bill that would mandate public access to federally funded research is now one step closer to becoming law. On July 29, the Senate Committee on Homeland Security and Government Affairs unanimously approved the Fair Access to Science and Technology Research (FASTR) Act. This bill would require that peer-reviewed scientific publications from federally funded research be made freely available to the public within a year of publication. The bill will next move to the full Senate for a vote. The bill has also been introduced in the House, but the committee responsible for the bill has yet to vote on it.

The bill is similar to a White House Office of Science and Technology Policy (OSTP) memo from February 2013; the memo requires agencies that fund more than $100 million worth of research to fashion plans to make peer-reviewed publications available to the public. Federal agencies and some publishers have since begun arrangements to release publications in accord with the OSTP mandate. (See page 4 for a related article.) The new legislation would codify public-access policies into law, making requirements less likely to shift with each administration.

Open-access proponents have come out in support of the legislation. "The passage of the bill would be a step forward," says Michael Eisen of the University of California, Berkeley, and a co-founder of the Public Library of Science (PLoS), a nonprofit open-access publisher. But, he says, "My hesitancy is that it doesn't go far enough." Eisen would rather see a bill requiring papers to be immediately available upon publication. The current legislation originally called for a 6-month time limit before publications must be made

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Inclusive Astronomy Conference Confronts Diversity Issues

By Emily Conover

Astrophysicist Jedidah Isler has not always felt welcomed by the scientific community. "Being part of a minority group can feel very daunting and very lonely," says Isler, an African-American woman and a postdoc at Vanderbilt University. And although scientific communities — physics and astronomy included — have paid great attention to the status of women in recent years, other underrepresented groups have remained in the shadows. Among those are scientists who are members of racial or ethnic minorities, who are lesbian/gay/bisexual/transsexual/intersex/queer or questioning (LGBTIQ), who are neuroatypical (e.g., have autism), and who belong to more than one underrepresented group — like African-American women such as Isler.

But change is on the horizon. Isler and others recently convened the inaugural Inclusive Astronomy conference, held June 17 - 19 at Vanderbilt University, to explore how to make astronomy accessible to all. Following two influential Women in Astronomy meetings in recent years, the group "felt that the field was really ready to think about … diversity and inclusion more broadly," says Keivan Stassun, a professor of physics and astronomy at Vanderbilt and the chair of the local organizing committee for the meeting.

The goal is not just diversity, but also an atmosphere where everyone is welcome. "It's not just having people at the table, it's making sure that they feel like they … are encouraged to be who they are," Isler says.

Making science more inclusive is crucial for its success, the meeting's participants say. "Talent is not restricted to one group, so when you limit yourself to one group, you're necessarily excluding a lot of talent, a lot of genius," says Jesse Shanahan, a graduate student at Wesleyan University. "A lot of people in science like to claim that this is a true meritocracy, and that's not true."

Organizers designed the conference not only to help attendees understand the issues, but also to give them tools and strategies to

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Members in the Media

"He would pull one rabbit out of the hat, and another, and then suddenly the rabbits would arrange themselves in a pattern and start dancing in a way you'd never seen before."

***Peter Freund**, University of Chicago, Illinois, after the death of Yoichiro Nambu, who studied broken symmetry,* The New York Times*, July 17, 2015.*

"It would be incredibly naive of me to think that there aren't people who rely on my blog for a bit of help."

***John Eric Goff**, Lynchburg College, Virginia, who has used physics to accurately predict the outcome of the Tour de France bicycle race,* The Washington Post*, July 25, 2015.*

"The scientist in me rebels against that. We should start with the technical facts of the agreement, and then proceed to a very complicated diplomatic and psychological judgment call of what the world looks like if Congress does vote this agreement down."

***Bill Foster**, Democratic congressman from Illinois, on partisanship surrounding the proposed U.S. nuclear agreement with Iran,* realclearpolitics.com*, July 27, 2015.*

"We really had the prejudice that pentaquarks were fakes and that nobody would believe it."

***Sheldon Stone**, Syracuse University, New York, collaborator on the recent discovery of two kinds of five-quark objects,* insidescience.org*, August 10, 2015.*

"[The program is] losing patience with those of us who want to understand the fundamentals."

***Robert Austin**, Princeton University, on the direction of a physical science oncology program of the U.S. National Cancer Institute (he was not funded),* Nature*, August 5, 2015.*

"He'll be able to speak, you just wouldn't be able to hear him, and if you could hear him you wouldn't be able to stop laughing."

***James Kakalios**, University of Minnesota, on what physics says about the changes to the main character in the movie "Ant-Man,"* fivethirtyeight.com*, July 17, 2015.*

"He knew I was a loudmouthed New Yorker. … He said, 'Here's your chance to get back to New York.' "

***Benjamin Bederson**, former editor in chief of the APS, on his commanding officer in the army telling him about the Manhattan Project,* The New York Times*, July 26, 2015.*

"Encouragement is always useful, but it's not necessarily the rate-limiting step."

***Mildred Dresselhaus**, Massachusetts Institute of Technology, on the fact that her thesis advisor didn't think that women should be in science,* arstechnica.com*, July 30, 2015.*

"You don't have to ask me. … You can ask any of the more than 30 scientific societies in the U.S. — the American Physical Society, the American Geophysical Union, the American Meteorological Society. I could go on and on."

***Michael Mann**, Pennsylvania State University, when asked whether global warming is settled science, "Real Time With Bill Maher" broadcast on HBO, August 7, 2015.*

"What we try to do is ... keep the administration's claims and the claims of others a little bit more honest."

***John Gibbons**, former head of the U.S. Office of Technology Assessment, who passed away on July 17, in a 1989 interview,* The Washington Post*, July 30, 2015.*

This Month in Physics History

August 1620: Kepler's Mother Imprisoned for Witchcraft

In 1615, Lutherus Einhorn, a local magistrate of Leonberg, Germany, launched a series of witch trials, part of a witch-hunting hysteria then sweeping across Europe that claimed the lives of thousands of suspected sorcerers. In all, 15 local women were accused of witchcraft on Einhorn's watch; eight were executed. Among those caught up in the hysteria was the mother of one history's greatest astronomers: Johannes Kepler.

Born Katharina Guldenmann in Stuttgart (part of the Duchy of Württemberg) in 1546, she was raised by an aunt who was later burned at the stake for witchcraft. She married Heinrich Kepler, the son of a prominent merchant who served as mayor of the town of Weil. They had four children, one of whom was Johannes. It was not a happy marriage: The family fortune was in decline, exacerbated by Heinrich's volatile temper and heavy drinking. Kepler described him as "a man vicious, inflexible … and doomed to a bad end." Katharina's temperament wasn't much better. One historical account describes her as an "evil-tempered virago," and Kepler wrote that she was "small, thin, swarthy, gossiping and quarrelsome, of a bad disposition."

konbini.com

Portrait of Katharina Guldenmann, mother of Johannes Kepler, by an unknown painter in the 17th century.

Heinrich bought a small tavern with what was left of his inherited wealth, and when that failed, he abandoned his family entirely, enlisting in the Austrian army for the war against the Turks. By then, Kepler had completed his studies at the University of Tübingen, settled in Linz, and gained the patronage of the Duke of Württemberg. He largely kept his distance from his difficult mother. Katharina supported herself in Leonberg as a local "wise woman," concocting herbal potions for common ailments, "augmented" by spells and charms. Combined with her bad temper and family history, it is small wonder that town gossips soon labeled her a suspected witch.

Some historians have speculated that Kepler may even have contributed to the rumors by virtue of an allegory he wrote called *Somnium* (*The Dream*), arguably the earliest work of science fiction, given its description of a trip to the moon and speculation on what astronomy would be like if practiced on another planet. The characters include a fictional wise woman named Fiolxhilde who sells magic charms and communes with a demon in the moon — a strong resemblance to Katharina. The book wasn't published officially until 1634, long after Katharina's trial, but a footnote Kepler added to the main text suggests a copy of the manuscript-in-progress found its way to Tübingen around 1611, and he believed it had fueled suspicions of sorcery. "You would think a spark had fallen on dry wood," he wrote. "My words had been taken up by dark minds which suspect everything else of being dark."

Regardless of whether Kepler was correct in this assessment, the rumors about his mother intensified. In 1615, a local woman named Ursula Reingold, who had also fallen out with Kepler's brother, Christoph, claimed that Katharina had poisoned her with a potion. After Einhorn — a cousin of Reingold's as well as magistrate — attempted to force a confession at sword point while drunk, the fiery Katharina countered by suing her accuser for slander.

This was a dangerous gambit. The witch-hunting hysteria was at its height in Europe during Kepler's day, so even a malicious rumor could put Katharina in potentially mortal peril. Standard court procedure for examining an accused witch usually involved severe torture to elicit a confession; all were presumed guilty until proven innocent, and those found guilty were summarily executed. Still a dutiful son, Kepler took the threat seriously enough to hire lawyers and take Katharina to Linz, commuting between the two cities. He set aside much of his scientific research for a time, although he still managed to complete his "harmonic theory," published in 1619 as *Harmonices Mundi*.

The suit dragged on for several years, and when a new, less sympathetic judge took on Katharina's case, Reingold took advantage of the switch to file a formal charge of witchcraft against her. By then Katharina had returned to Leonberg, determined to confront her accusers face to face. It proved a serious mistake. In August 1620, she was taken from her daughter's home by court order and found herself in prison, accused of 49 counts of practicing witchcraft. Along with hired lawyers, Kepler mounted a very effective defense, penning the bulk of the exhaustive 128-page statement demolishing the prosecution's arguments.

In the end, the judicial college at the University of Tübingen ruled that there was insufficient evidence on either side. Rather than order her subjected to torture to induce a confession, or release her outright, the college decided she should be shown the instruments of torture — hot irons, pincers, long needles, the rack, and a gallows used for drawing and quartering — with a graphic description of how each implement would be used. This was a practice known as *territio verbalis* meant to frighten the accused into a confession. But Katharina was made of sterner stuff. She stubbornly refused to confess, declaring, "Do with me what you want. Even if you were to pull one vein after another out of my body, I would have nothing to admit." Then she recited a *Pater Noster* on her knees in a savvy display of piety.

Ultimately, Kepler's defense was a success: Katharina was acquitted and released in October 1621 by order of the Duke of Württemberg, who ruled that her refusal to confess proved her innocence. An unre-

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Education News from APS

Top Physics Degree Producers Ranked

APS generates tables showcasing the top institutions (by number of physics degrees granted) in a variety of categories. These tables are freely available for your use. Access the tables here: aps.org/programs/education/statistics/topproducers.cfm

An APS website enables U.S. institutions to see how they compare nationally in terms of producing physics graduates and increasing the diversity of these graduates. Check it out here: aps.org/programs/education/statistics/compare.cfm

Save the Date for the 2016 PhysTEC Conference

The Physics Teacher Education Coalition (PhysTEC) Conference is the nation's largest meeting dedicated to physics teacher education. The 2016 PhysTEC Conference will be held March 11-13 at the Royal Sonesta Harbor Court, in Baltimore, MD, preceding the 2016 APS March Meeting. Faculty from minority-serving institutions are eligible to apply for travel grants.

Save the Date for Upcoming Faculty Workshops

Fall 2015 Physics and Astronomy New Faculty Workshop

The fall New Faculty Workshop will be held November 19-22 at the American Center for Physics in College Park, MD.

Fall 2015 Physics and Astronomy Experienced Faculty Workshop

The fall Experienced Faculty Workshop will be held October 9-11 at the American Center for Physics in College Park, MD.

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placement," said Beth Cunningham, executive officer of AAPT.

U.S. team members Zachary Bogorad (Solon High School, Ohio), Adam Busis (Montgomery Blair High School, Maryland), Saranesh Prembabu (Dougherty Valley High School, California), and Kevin Li (West Windsor-Plainsboro High School, New Jersey) won gold medals and Jason Lu (Adlai Stevenson High School, Illinois) returned with a silver medal. Stanley, and David Fallest of North Carolina State University, led the team.

Taehyoung Kim of South Korea had the top score in theory and was the overall individual winner of the Olympiad. Sol Kim of South Korea garnered the top experimental score, and gold medal winner Thao Thi Huong Dinh of Vietnam was recognized as the top female participant.

"This is an incredibly important opportunity for these students to get together and learn much more about physics than they can on their own, and to bring back excitement about engaging in physics to their friends and classmates," Cunningham said.

Editor's Note: *Team Director Paul Stanley is the author of this issue's Back Page (see page 8).*

International News

Working Together Towards a Future Circular Collider

By Frank Zimmermann

High energy physics has a century-long tradition of large international projects, providing collaboration models for numerous other fields of physics. The scale of its proposed next facility is likely to require an ever more global implementation, including international governance structures from the very outset. As scientists and policy makers alike seek ways to serve both national and international interests, I would like to inform APS members about the unfolding journey towards a future facility for particle physics.

In 2012 the Higgs boson was discovered by two experiments at CERN's Large Hadron Collider (LHC), straddling the Franco-Swiss border. This discovery concluded almost 80 years of theoretical and experimental efforts. All elements of the so-called "Standard Model" of particle physics are now experimentally validated. However, the Standard Model is not a complete theory, as it does not provide any answers to numerous fundamental questions, such as the composition of dark matter, the cause of the universe's accelerated expansion, the origin of the observed matter-antimatter asymmetry, the origin of neutrino masses, the reason for the existence of three families of quarks and leptons, the lightness of the Higgs boson, or the weakness of gravity. Operating at 7 and 8 TeV in 2010-12, the LHC has not yet uncovered any clear evidence for physics beyond the Standard Model. New information might come from proton-proton collisions at 13 and 14 TeV during the LHC Run-2 (2015-18), which has just begun, and from a future planned upgrade, the High Luminosity LHC (HL-LHC).

To go further we may need a new collider. Recognizing that circular proton-proton colliders are the only experimental tools available in the coming decades for exploring particle physics in the energy range of tens of TeV, the 2013 update of *The European Strategy for Particle Physics* requested CERN to "undertake design studies for accelerator projects in a global context with emphasis on proton-proton and electron-positron high-energy frontier machines … [which] should be coupled to a vigorous accelerator R&D programme, … in collaboration with national institutes, laboratories and universities worldwide" in order to be ready "… to propose an ambitious post-LHC accelerator project … by the time of the next Strategy update" (around 2019). In 2014 the International Committee for Future Accelerators stated that it "… supports studies of energy frontier circular colliders and encourages global coordination…", and the U.S. Particle Physics Project Prioritization Panel (P5) confirmed that "A very high energy proton-proton collider is the most powerful tool for direct discovery of new particles and interactions under any scenario of physics results that can be acquired in the P5 time window [10-20 years] …"

In response to the 2013 European strategy update, the international Future Circular Collider (FCC) study was launched in February 2014. The goal of this global study, hosted at CERN, is to deliver, by the time of the next update of *The European Strategy for Particle Physics*, a conceptual design, along with a preliminary cost estimate, of a future highest-energy circular collider complex. The focus of the FCC study is a 100 TeV proton-proton collider (FCC-hh) in a new tunnel of 80 to 100 km circumference (see figure on page 7), with a peak luminosity of 5-30 × 10^{34} cm^{-2} s^{-1}.

A key enabler of FCC-hh will be the availability of 16 T arc dipole magnets on an industrial scale. Over the last two decades Nb_3Sn high-field-magnet technology has made great strides forward, thanks to ITER conductor development, U.S. and European R&D activities for an LHC upgrade, and the U.S. high-field magnet core development program. The HL-LHC, which is expected to be completed by about 2025, includes a few tens of Nb_3Sn dipole and quadrupole magnets. The HL-LHC, thereby, prepares the technology base for the FCC-hh.

Since February 2014, a total of 58 institutes from 22 countries and four continents have joined the FCC collaboration, which also includes 8 U.S. universities. In parallel, a separate design effort hosted at IHEP Beijing aims at designing and constructing a similar, but domestic, Chinese collider with a smaller circumference of 50-70 km, called

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APS PUBLIC OUTREACH

Comic-Con Embraces Science Amid the Fantasy

By Emily Conover

A squadron of Stormtroopers marches past; Wolverine flexes his muscles and bares his claws; and an oversized Care Bear gives out free hugs. Such sights are all in a day's work for the APS Public Outreach team at Comic-Con International in San Diego, California, the annual convention that unites fans of comics, animation, science fiction, and related popular arts.

The convention, held this year from July 9 to 12, is wildly popular, with attendance topping 130,000 in recent years. But what is APS doing there? I tagged along with the APS Outreach team — on my first trip to Comic-Con — to find out.

APS has exhibited at Comic-Con for the past six years, to distribute and promote its line of physics comic books for middle school students. The APS flagship comic series is *Spectra: The Original Laser Superhero*, which now comprises seven issues. This year, for the first time, APS staff members participated in two panel discussions about educational comics at the convention.

Superhero Spectra is the alter ego of Lucinda Hene, a girl who discovers she has laser powers. She can cut metal, pass through glass, diffract — even play CDs! Spectra and her band of friends fight off bad guys such as the evil Miss Alignment, the authoritarian General Relativity, and the shy, elusive Quantum Mechanic (who can be in multiple places at one time), all while demonstrating the physics of optics, gravity, fluid mechanics, and more.

Each day of the event, we staffed the APS booth in the exhibit hall, handing out free physics comics to anyone who wanted them. This work was no picnic — I found myself working as fast as I could to keep throngs of kids, parents, and science lovers supplied with comics. According to Rebecca Thompson, head of APS Public Outreach and author of the *Spectra* comics, the crew gives out three comic books a minute on average. With so many people in attendance at the convention, fans pack the aisles of the exhibit hall — especially when Batman shows up and causes gridlock.

One might wonder whether superhero-worshippers are really the right crowd for physics outreach. But I was impressed with the conference-goers' enthusiasm for science. As we hawked our wares, calling out, "free science comics!" many eagerly replied, "I love science!" and grabbed copies from our hands. A few readers even came back the next day to tell us how much they enjoyed them. And many attendees remembered APS from past years, proclaiming that their kids loved *Spectra*.

Science-themed events and panels abound at Comic-Con. This year, two panels about NASA research drew a crowd that packed a large room in the convention center. During the NASA panel "Turning Science Fiction into Science Fact," there was thunderous applause from the audience as astrophysicist Amber Straughn of NASA's Goddard Space Flight Center discussed the Kepler Space Telescope and the discovery of over 1,000 confirmed exoplanets. "NASA's Kepler Telescope has completely revolutionized our understanding of planetary systems," she said, to cheers from the crowd.

While passing out our comics, we not only met physics fans, but also full-fledged physicists in various stages of their careers — undergrads studying for their degrees, graduate students, professors, and even a scientist sporting an APS baseball cap. And science-loving kids drifted over to our booth, impressed with the cover of *Spectra* Issue #7, with Miss Alignment's villainous face towering over Spectra and her crew.

The APS Comic Team in San Diego. (l-r) Stephen Skolnick, David Ellis, Becky Thompson, Brian Jacobson, Emily Conover, and James Roche.

I quickly became convinced that the Comic-Con crowd enthusiastically embraces science.

The *Spectra* comics, as part of APS's PhysicsQuest program, also come with a teachers' guide and a kit of science experiments that let kids help Spectra fight the scientific evil-doers. During the convention, many teachers stopped by the booth and asked how they could get materials for their classrooms. (The answer: Go to PhysicsCentral at physicscentral.com and sign up for PhysicsQuest!) Each year, APS sends PhysicsQuest kits, with accompanying comics, to 15,000 middle school classrooms throughout the country.

Spectra is not all that APS offers. We also distributed copies of a PhysicsQuest comic about Nikola Tesla, which recounts his infamous feud with Thomas Edison during the War of the Currents that pitted AC against DC in the 19th Century.

APS participated in two panels

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Letters

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

Guns on Campus

The right of individuals to carry guns onto the campuses of Texas colleges and universities is now the law of the land. By this one act, the government of Texas has guaranteed that the recruitment of first-rate faculty for its universities will be essentially impossible. No experienced qualified potential faculty prospect would consider any offer from any state higher education institution. Bright people do not put themselves at risk on purpose.

During my 36-year career as a university professor, if any student would have shown up carrying a gun into my classroom, I would have had him removed by campus security and permanently banned him from my class. If I were presently a faculty member of any Texas university I would now be looking for a job elsewhere. There are many much higher-paying jobs available for physicists outside of academia, and I would have no difficulty finding a job where guns are not allowed.

The stupidity of the politicians who have foisted upon us the law that allows people other than law enforcement personnel to carry guns onto the campus of any state university is beyond belief. The damage done is not repairable as long as we are ruled by stupidity instead of reason.

Tom Gray
Corpus Christi, Texas

Careers Report

Raising Student Awareness of Non-Academic Career Paths

By Crystal Bailey

Whether at the bachelor's, master's, or Ph.D. level, most physics graduates will find permanent careers in the private sector rather than in academia (Careers Report, *APS News*, June 2015).

To enable students to map out their future possible careers, a mentor can help educate them about the full range of career options available to them — and these efforts should begin years before students are nearing graduation. Even the most organized students need time for self-assessment, skill-building, and networking before they start focusing in earnest on the next steps of their careers.

Fortunately there are a number of ways that you as an academic mentor can do this, without adding much to your own or your students' workload. One is to utilize the *Physics InSight* slideshow, which you can display on screens in common areas around your department.

Physics InSight is a free, downloadable PowerPoint slideshow that features physicists in various degree paths working in diverse sectors. It also includes up-to-date information on physics employment and salary statistics, opportunities for students — and also cool, cutting edge physics topics! A new version of the slideshow goes up about twice per semester; it's a great diversion for students (majors and non-majors alike) who are waiting in hallways for their classes to begin. You can download the most recent edition at aps.org/careers/insight/.

Students also benefit greatly from one-on-one contact with physicists working outside of academia. Consider holding special seminars in which a non-academic speaker visits the department to talk

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PRIVATE SECTOR JOBS

Physicists Find Fulfillment Outside of Academia

By Emily Conover

Physics students who contemplate private sector jobs are often at a loss; their academia-immersed advisors may know little about the opportunities available outside of the ivory tower, and data on physicists in private sector careers has been sorely lacking. But a new report from the American Institute of Physics (AIP) provides good news — most private-sector Ph.D. physicists find their careers rewarding and intellectually stimulating.

"We were really pleased to find out that the vast majority of the Ph.D.s we could track down who were working in the private sector in the U.S. were really happy with their careers," says Roman Czujko, director emeritus of AIP's Statistical Research Center, and first author of the report.

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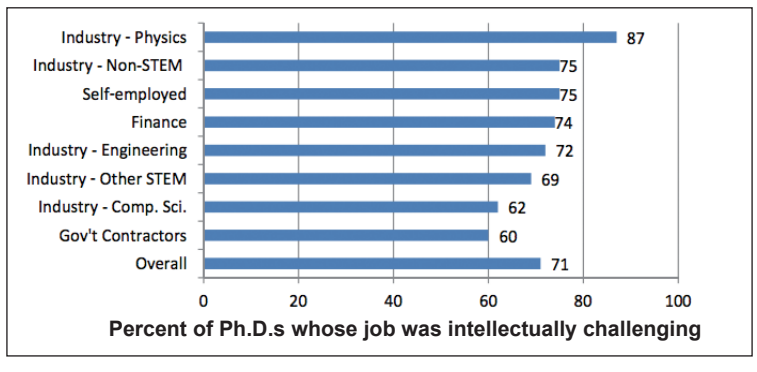


AIP Statistical Resource Center

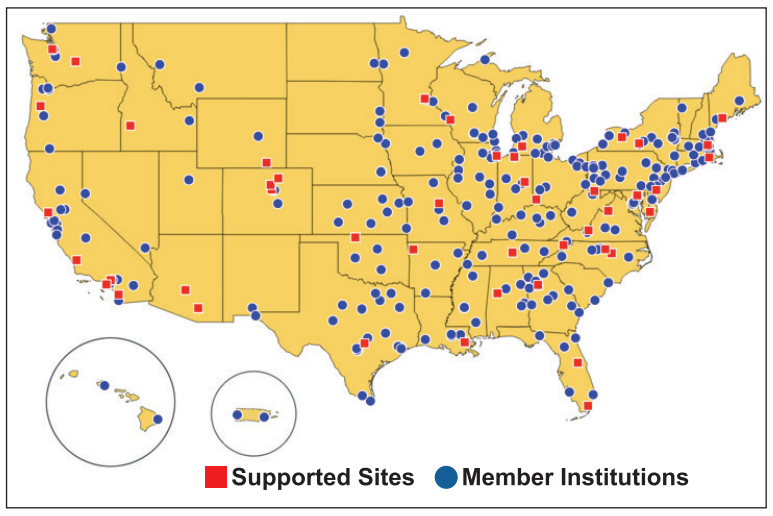
APS PROGRAMS

PhysTEC Coalition Grows to Over 300 Institutions

By Bushraa Khatib

According to APS program staff, the Physics Teacher Education Coalition (PhysTEC) now has grown to over 300 member institutions. The Coalition is part of the PhysTEC project, a partnership between the APS and the American Association of Physics Teachers (AAPT) that works with college and university physics departments to increase the number of well prepared high school physics teachers.

With support from the National Science Foundation, APS member donations, and partner society contributions, the PhysTEC project has grown dramatically since its inception in 2001. Coalition college and university members can apply to become a "supported site" with funding from PhysTEC in order to build and improve undergraduate programs for future high school physics teachers. The project now has funded 46 sites to develop and carry out multi-year programs to strengthen physics teacher education.



Source: PhysTEC project

The map shows U.S. member institutions, which are located in 49 states, the District of Columbia and Puerto Rico (and there are a few international members as well). The map was also featured in the 2014 NSF Budget Request to Congress, which highlighted only 13 NSF-funded programs.

PHYSTEC continued on page 6

JOURNAL PUBLISHING

APS Begins Release of Public Access CHORUS Papers

By Emily Conover

As the clamor for open access to scientific research has intensified in recent years, a group of scientific publishers — of which APS is a member — responded in 2013 by creating the Clearinghouse for the Open Research of the United States (CHORUS), which connects users with publicly accessible research on publishers' websites. Now, APS is releasing the first wave of articles, making papers funded by the U.S. Department of Energy (DOE) freely available through CHORUS effective August 1, several months ahead of the department's official October 1 start date.

In February 2013, the White House Office of Science and Technology Policy (OSTP) issued a memo requiring federal agencies that spend more than $100 million on R&D to fashion plans that would make published research freely available to the public within a one-year embargo period after publication. The memo also called for public-private partnerships between agencies and scientific journals, to avoid duplication of effort. CHORUS takes on that role.

"Publishers are providing a service across the community to help agencies and researchers meet the OSTP mandate, but at the same time are making these papers publicly accessible in the context of the peer-reviewed journals in which they were published," says APS Chief Information Officer Mark Doyle, co-chair of the technical working group for CHORUS.

One year ago, DOE unveiled its response to the OSTP memo, a website called the Public Access Gateway for Energy and Science (PAGES). PAGES is a searchable database that links to DOE-funded research available on publishers' websites, or if none is available, to a version in DOE's repository.

CHORUS provides a portal that allows users to search for federally

CHORUS continued on page 5

APS PROGRAMS

APS Liquid Helium Purchasing Program Progress

By Tawanda W. Johnson

Scientists at West Texas A&M University used to worry about gaining access to the liquid helium necessary to operate their nuclear magnetic resonance spectrometers.

"We were concerned because we are both a new customer and a small customer," recalled Catherine F. M. Clewett, assistant professor of physics at the university. "We had never ordered liquid helium and were finding it difficult to begin a relationship with the major helium companies."

Those concerns have abated, thanks to the Liquid Helium Purchasing Program developed by the APS Office of Public Affairs (OPA). Last year, after learning of academic users' concerns about liquid helium price fluctuations and reliability issues, the OPA partnered with the Defense Logistics Agency (DLA) to pilot-test a liquid helium "brokerage," enabling academic users to obtain helium in a timely manner and at a reasonable cost. Recognizing that the issues were not exclusive to physicists, the OPA also partnered with the American Chemical Society (ACS). Enrollees began ordering their liquid helium on June 1, 2015.

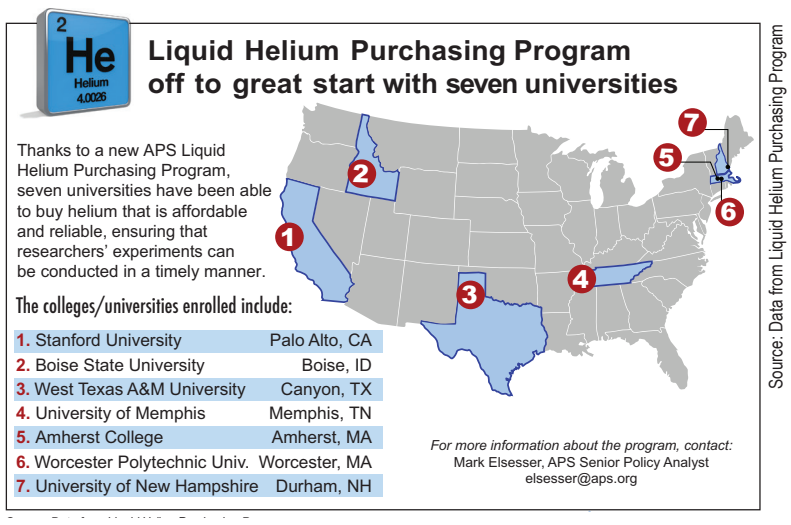
DLA contracts with vendors who purchase liquid helium from the Federal Helium Reserve in Amarillo, Texas. The agency secures the liquid helium via the federal in-kind program on behalf of any federal grantee. The agency currently purchases liquid helium and other chemicals for research groups at approximately 30 universities.

"The program has ensured that we can get the helium when we need it at a stable cost," added Clewett. "We also don't have to worry about being the last customer to have our order fulfilled when helium is in short supply."

The OPA and ACS pilot-tested the program with researchers at seven colleges and universities that had diverse liquid helium delivery and cost challenges: Stanford University, Boise State University, West Texas A&M University, University of Memphis, University of New Hampshire, Amherst College, and Worcester Polytechnic Institute. In general, academic researchers who are not participating in the program pay between $7 per liter and $30 per liter, depending on their location and usage. However, program enrollees are saving an average of 15 percent. One enrollee is saving as much as 27 percent.

The pilot program is slated for expansion in the fall, and new enrollees will be asked to commit to the program by December 2015. They would begin receiving their helium on June 1, 2016.

HELIUM continued on page 7



Source: Data from Liquid Helium Purchasing Program

Washington Dispatch

POLICY UPDATE

Appropriations Stall

The House has now passed all twelve appropriations bills (legislation that sets aside money for government agencies and programs) out of committee, and six have seen final floor action. The Senate has passed only nine out of committee, and none have seen floor action. In both chambers, few Democrats have supported them. And the president, asserting that the pending bills are all based on sequestration caps that he believes should be eliminated, has threatened to veto every one.

The defense appropriations bill is the only one that breaks the caps, using the Department of Defense's Overseas Contingency Operations fund as an off-budget vehicle to get around the legal restrictions. And it is the disparity between the Republican treatment of defense and non-defense spending that triggered a Democratic rebellion on the Senate floor. The FY16 defense bill easily cleared the appropriations committee on a 27-3 vote, but it failed to receive enough votes (50-45) to bring it to the floor for consideration.

Looking ahead to the culmination of the FY16 budget negotiations, it is appearing more and more likely that yet another Continuing Resolution is in the offing.

The American Research Investment Fund

As federal investment in fundamental science wanes, APS has been exploring other possible funding avenues for basic research ("Thinking Big and Outside the Box," *APS News*, July 2015). One possibility is the creation of the American Research Investment Fund (ARIF). In order to create ARIF, Congress would have to first pass comprehensive corporate tax reform that would encourage repatriation of money held overseas by large corporations. Currently money held overseas, largely by high-tech companies like Google and Microsoft, totals more than $2.1 trillion. If a deal is struck to repatriate the money at a relatively low tax rate, 5 percent to 15 percent for example, it would create a one-time net recovery of $100 billion to $300 billion for the federal government. Congress could then authorize the use of $100 billion to endow ARIF. ARIF would invest the money and use the interest to sustain itself and to fund research. ARIF would be a public-private partnership and would be able to nimbly fund scientific research in a number of ways, from encouraging Congress to boost science budgets by providing matching funds, to supporting midscale activities that currently fall through the federal budget cracks.

America COMPETES

The House version of the America COMPETES Act, which APS opposed, passed the House. There is no full COMPETES bill in the Senate; rather, there is a separate Energy title, and Senate Science Committee has put out a request for stakeholders to weigh in on the crafting the science portion of COMPETES. APS supports the Senate Energy title of COMPETES and has sent a letter urging lawmakers to use the Energy title as a blueprint for crafting the science portion of COMPETES.

The Elementary and Secondary Education Act

As this issue of *APS News* is being prepared, the Elementary and Secondary Education Act is being debated on the Senate floor, with a large number of amendments offered by both Republicans and Democrats. If the Senate bill passes, it will then be conferenced with the House bill, which passed the House the first week of July.

Of interest to physicists, a major difference between the two bills is that the House bill contains very little mention of science, technology, engineering, and mathematics education, whereas the Senate bill would maintain funding for the Math-Science Partnerships programs.

WASHINGTON OFFICE ACTIVITIES

Media Update

The Houston Chronicle published an op-ed on June 30 by Chris Jeffrey, a recent graduate of the University of North Texas. Jeffrey made the case for supporting the Energy Title of the America COMPETES Reauthorization Act of 2015 — legislation that would bolster energy research, reduce the nation's reliance on fossil fuels, and enable the development of energy-efficient technologies. Read the op-ed: bit.ly/1INAG3u.

U.S. Rep. Bill Foster (D-11th) opined about "maintaining America's global scientific leadership" in the May edition of *Capitol Hill Quarterly*, a newsletter produced by the APS Office of Public Affairs. Read the op-ed: aps.org/publications/capitolhillquarterly/201505/backpage.cfm.

Panel on Public Affairs

Panel on Public Affairs (POPA) members read through the overwhelmingly supportive comments of the APS membership on the proposed APS Statement on Earth's Changing Climate. POPA is now making minor edits in response to those comments and will present the final statement to the APS Council for a vote this fall. If approved, it would become an official statement of APS.

The POPA Physics & the Public Subcommittee will be working with the American Institute of Physics on a survey this summer focused on over-

DISPATCH continued on page 7

INCLUSIVE continued from page 1

improve the inclusiveness of their communities. It was also a chance to introduce people to one another, allowing attendees to meet and learn from people of different underrepresented groups and connect with astronomers like themselves.

One issue the conference participants tackled was how to promote access for underrepresented groups. "One of the most important and very concrete barriers that we talked about is the use of standardized tests — for example, the GRE — as part of admission to graduate programs," says Stassun. Research has shown that the GRE is a poor predictor of performance, Stassun says, and also that it is biased: "If you rank-order applicants to your program even just in part based on their GRE scores, you will systematically exclude women and minorities."

Participants also discussed the concept of intersectionality — the idea that people who fall under more than one underrepresented group can't be treated as if they fall solely under one group alone. "The lived experiences of people with intersectional identities don't fall along one particular facet, because they live all of them," says Isler. "It's unfair to ask me to identify either as a woman or a black person, when the fullness of my identity is seated in both." And while the percentage of female astronomers has grown over the years, female African-American astronomers are still few and far between.

Although scientific organizations like APS have paid significant attention to addressing the underrepresentation of racial and ethnic minorities, says APS Diversity Programs Administrator Arlene Modeste Knowles, "I think those efforts have still been limited in scope, and the commitment to racial and ethnic diversity in the scientific community does not seem to be as widely held as the commitment to women." Furthermore, she says, "Although APS has not focused on intersectional issues, I think this is an area of great opportunity for us."

In traditional academic spaces, Shanahan says, "When there is an issue, people don't feel like they can speak up." But the Inclusive Astronomy meeting was different. "The organizers worked incredibly hard to create a space where people would be respected, listened to, and a space that would accommodate as many people as possible," says Shanahan.

Shanahan participated in a panel on establishing inclusiveness in astronomy, in which she focused on disability issues. Shanahan, who is disabled and often walks with a cane or wears braces, says, "I feel like I'm excluded kind of on a daily basis because a lot of people don't think about including people with disabilities."

Transgender scientists as well still face many hurdles, says astronomer Jessica Mink of the Smithsonian Astrophysical Observatory, a transgender woman and one of the organizers of the meeting. "There's still a prejudice that people have that doesn't come to the surface very easily," she says. And there can be negative career repercussions for young scientists. "If you're early in your career you're dependent on what a lot of people think about you," which can make coming out as transgender a scary prospect.

The meeting had its snags. A banquet was held on the other side of campus, an unmanageable journey for some attendees with disabilities. And other types of exclusion cropped up along the way. Mink, who does not have a Ph.D., pointed out that much of the discussion centered on the academic pipeline. It is also important, Mink says, to appreciate the contributions of scientists who have not followed the traditional path.

Despite the hiccups, the meeting "was incredibly supportive," Shanahan says. "People were really willing to learn."

Talking about racism, sexism, ableism, and other exclusionary practices was a challenge, participants say. "One of the ground rules they put up was 'it's okay to be uncomfortable,'" says meeting attendee Meredith Rawls, a graduate student in astronomy at New Mexico State University. "As the conference went on, people would actually call each other out in a very friendly way," if they were excluding someone, Rawls says.

One aim of the Inclusive Astronomy meeting was to produce a concrete set of recommendations for improving diversity and inclusion in the field, following in the footsteps of previous Women in Astronomy meetings. Conference organizers are collecting and synthesizing feedback from the meeting's 160 attendees for a report that they will share with the community and the American Astronomical Society (AAS) leadership in 2016.

AAS President Meg Urry, who also attended the meeting, noted that the AAS leadership is looking forward to seeing the recommendations. "The AAS supported this meeting because we believe deeply in equity and inclusion, and in making sure that qualities that aren't relevant to the practice of astronomy not be used in determining one's suitability for it," Urry wrote in an email.

The meeting left a big impression on attendees in how they viewed diversity and inclusion. "The more you are aware of this stuff, you start seeing it everywhere," says Rawls. "When I first learned calculus it changed the whole way I saw the world," she says. "Learning about all this — how inclusivity is necessary to do good science … that realization was equally big in my mind."

Don Pickert, Vanderbilt University

Attendees at the first Inclusive Astronomy conference at Vanderbilt University in June 2015.

CHORUS continued from page 4

funded open-access research across the participating publishers and scientific societies, which include APS, the American Association for the Advancement of Science, AIP Publishing (the journal publishing arm of the American Institute of Physics), the American Astronomical Society, Elsevier, IOP Publishing (part of the Institute of Physics), and others. CHORUS also provides a set of tools that show publishers' progress in making research publicly accessible.

DOE will work with CHORUS to fulfill the OSTP mandate, according to an agreement made last spring. As part of CHORUS, publishers submit funding information and other metadata to CrossRef, a nonprofit that catalogs information about academic publications, provides Digital Object Identifier (DOI) registration, and allows reliable linking in citations across journals. PAGES can then use CrossRef to link to content on publishers' websites and access articles funded by DOE.

On August 1, APS began releasing DOE-funded papers that were published one year ago, and from now on about 150 to 200 articles will be released each month as their embargoes expire. This is around 10% of the average number of articles APS publishes monthly. In January 2016, APS-published articles funded by other federal agencies will begin to become available. However, the available version of the article may not be its "version of record," (the final version that will appear in the journal). Instead, the articles may be provided in the "accepted manuscript" state — before copyediting and formatting have taken place.

FULFILLMENT continued from page 4

AIP's Statistical Research Center surveyed more than 500 physicists who had completed their Ph.D.s 10 to 15 years earlier, and who had since entered the private sector. The study cataloged information about the physicists' salaries, job satisfaction, and the fields in which they were employed in 2011.

Most survey participants worked in science-technology-engineering-mathematics (STEM) fields, which tapped the scientific and technical knowledge they had gained through their physics training. And even for those who did not work in a STEM field, problem-solving and math skills were essential, the report indicates.

In written comments, physicists described the perks of their jobs, which included intellectually stimulating work, collaboration with smart colleagues, and being on the cutting edge of their fields. And 71 percent of physicists in all private sector jobs reported that their jobs were intellectually challenging, rising to 87 percent for those working directly in industrial physics (see graphic on page 4).

"The report clearly shows that physicists in the private sector enjoy diverse and stimulating careers," said APS Industrial Physics Fellow Steven Lambert. "I'd especially encourage students to read the comments from the respondents about their most rewarding experiences and job duties."

Unsurprisingly, those employed in physics-related industry jobs found their degrees most relevant, but physicists working in finance also felt their work was well suited to their level of education, due to the importance of mathematical modeling and development of algorithms in their field. In fact, many physicists working in finance noted that they regularly worked with other physicists.

Another private sector bonus? Better pay. Many of the surveyed physicists raked in higher earnings than those that went the academic route, and more than three-quarters pocketed six-figure salaries in 2011.

Nonacademic career data have been in short supply, as physicists who have left academia usually aren't included in physics career studies. Private-sector physicists also tend to be more difficult to track down than their academic peers.

The report bolsters the availability of data on alternative career paths, which should help graduate students and postdocs identify their best options. And those options look promising, Czujko says. "There's life after a Ph.D. outside of academe."

For more information, see aip.org/statistics

ELECTION continued from page 1

from the readers and authors of our journal articles; but someone has to pay for the added value that APS brings."

Voters elected Deborah Jin of the National Institute of Standards and Technology and the University of Colorado, Boulder to the position of chair-elect of the APS Nominating Committee. "It's an honor to be chosen. I'm excited to participate in this way in APS governance, to help out, and also just to learn more about what's going on at APS," Jin said.

The Nominating Committee prepares a roster of candidates for APS elections each year. Jin will serve for one year as chair-elect before becoming chair of the committee.

Two council positions were on the ballot in this year's election. The APS Council of Representatives comprises four general councilors, four international councilors, the presidential line, the treasurer, councilors representing APS committees, and councilors representing the divisions, forums, and sections. The Council's responsibilities include joint oversight of Society publications with the Board of Directors, approval of science policy statements, election of APS fellows, prizes and awards bestowed by APS, and final approval of amendments to the *Constitution & Bylaws*.

The position of international councilor will go to Johanna Stachel, a physicist at the University of Heidelberg. Stachel has previously served as president of the German Physical Society, and is currently serving as vice president.

Bonnie Fleming, a physicist at Yale University, was elected as general councilor. Fleming is the co-spokesperson of the MicroBooNE neutrino experiment, and has served on a number of APS committees, including the Division of Particles and Fields (DPF) Coordinating Panel for Advanced Detectors, and the APS DPF Nominating Committee.

FASTR continued from page 1

accessible, but this was amended to 12 months to more closely align with the OSTP policy and to respond to requests of academic publishers.

Publishers are concerned about the bill's potential impact on science and on their business model. If articles are freely available online, university libraries would be less likely to pay for access, the main funding source for scientific publishers, says Michael Lubell, director of the APS Office of Public Affairs (OPA), especially if the time limit for open-access publication shrinks in the future. "You can see where this is heading," Lubell says.

Journals will have to adapt in order to support their editorial operations in this new landscape. "The question is, 'At what point will we have to go to another kind of financial model for supporting the work that we do to maintain a high-quality peer-reviewed publication?'" says Kate Kirby, chief executive officer of APS.

The new model might be one in which the author pays, an approach that carries a price tag of a few thousand dollars per article. However, this cost, if borne by scientists' grants, would further squeeze tight research budgets, Kirby argues. The APS OPA is currently asking some members of the House to amend their bill to require a Government Accountability Office study on the impact of an author-pays model on science budgets and on research.

Still, Eisen contends that open-access scientific publishing can work. "The future could be one in which science publishing looks very similar to the one we have today, it's just paid for differently," he says.

But physicist Paul Ginsparg of Cornell University, creator of the preprint server arXiv.org, takes a different view. "Until you have a good financial model for open access it doesn't make sense to push it, burn bridges, and all the rest." And he draws a distinction between large, commercial publishers and small nonprofits. "This isn't the right way to address [open access], if it across-the-board impinges on the 'good guy' publishers." The twelve-month time limit, Ginsparg says, is probably a "good compromise."

CAREERS continued from page 4

about his or her work. An event like this not only provides students with information and insight about non-academic work, but also gives them an invaluable opportunity to network with potential employers.

Where colleges or universities are near industry, it is a common practice for companies to look to their local universities as a source of new talent. Your institution's alumni office can help identify good potential speakers — or you can use the APS Industrial Speaker's List, which is available at aps.org/careers/advisors/speakers.cfm (be sure to open "more options" and check "industrial careers" before you do the search).

You could also enlist the help of physicists who have won the APS Distinguished Lectureship on the Applications of Physics (DLAP). This award recognizes physicists in industrial or nonacademic careers for significant technical, industrial, or entrepreneurial contributions. The award is co-sponsored by the APS Forum on Industrial and Applied Physics and the Committee on Careers and Professional Development.

Each lectureship winner gives at least three talks at venues such as APS section meetings, annual meetings, and individual department colloquia during his or her term; all travel costs associated with talks are covered by APS. It's an easy way to get someone with a rich and interesting perspective on non-academic careers to visit your department. For more information please visit the DLAP homepage (aps.org/careers/lectureship/).

Another way you can bring students, faculty, and physicists in industry or national labs together is to start an APS Local Link in your area. APS Local Links are small, grassroots gatherings of local physicists in a concentrated geographic area (such as a city), who meet on a regular basis to network, build relationships, and discover new opportunities for employment and collaboration.

Local Links benefit employers and students as recruitment opportunities, and they also encourage new collaborations among national labs, industries, and academic research facilities. APS provides each Local Link with some administrative and logistical support, and helps boost the visibility of Local Links meetings by sending announcements about upcoming events to local membership. If you're interested in learning more about the APS Local Links program, please visit.aps.org/membership/locallinks/.

Building students' awareness of non-academic careers can seem daunting — but with a modest amount of energy you can build a solid program that will both benefit your students and help make your faculty colleagues aware of career paths and research opportunities outside of the academic sphere. Such efforts can improve students' confidence about — and preparedness for — their own future career prospects.

Crystal Bailey is APS Careers Program Manager.

PHYSTEC continued from page 4

The project has also increased its reach (see map). Coalition member institutions now include 40% of all physics departments in the U.S., and collectively educate over half of all new well-prepared U.S. physics teachers — defined as certified teachers who also have a degree in physics. To become a Coalition member institution, physics departments are asked to provide a letter of support from their chair and endorse the American Institute of Physics-Member Society Statement on the Education of Future Teachers. Membership benefits include reduced fees for conference attendance and eligibility for PhysTEC funding and awards. There is no charge for membership in the PhysTEC Coalition.

Each summer PhysTEC organizes the largest annual conference of physics educators in the country. There, participants share innovative ideas, learn from national leaders in the field, and promote awareness of the importance of improving physics and physical science teacher education. Next year's conference will be held March 11 - 13, 2016 in Baltimore, MD.

Nearly all Coalition member institutions have sent one or more people to the above-mentioned PhysTEC conference or to PhysTEC workshops, and over 180 have applied for funding to develop PhysTEC programs. Monica Plisch, PhysTEC Project Director at APS, said that these numbers speak to the fact that "We have members who are critically engaged in teacher education, and not members in name only."

Go to www.phystec.org for more information about the program and www.phystec.org/join to join the Coalition as a PhysTEC member institution.

The author is Outreach & Communications Specialist at the A.J. Drexel Autism Institute in Philadelphia. Until a few months ago, she was on the staff of the APS Department of Education and Diversity.

COMIC-CON continued from page 3

on science and comics at Comic-Con. Thompson spoke at a session on "Comics for Impact: STEM Education." The panel featured other prominent science comic book artists and writers, including Jorge Cham of *PhD Comics*, the popular web comic about grad student life.

Speaking to a room teeming with teachers of elementary, middle, high-school, and college students, Thompson discussed how the team designed Spectra to appeal to middle school-aged kids, and girls in particular. Thompson consulted with the staff of the website girl-wonder.org, which promotes positive representation of women in comics. Per their advice, Spectra is a multi-dimensional, believable middle school girl: She has a love interest; she has fights with her friends; and she's not perfect. "Girls know when they're being pandered to," Thompson said, "so we tried not to do that."

And the plot is the priority. Rather than awkwardly bombarding kids with science facts through the comic, "We really tried to make the story first and [then] make sure the physics was there," Thompson said. The focus on the story keeps kids reading, she said, and it means "you're going to learn without paying attention."

A second panel, "Teaching Comics," was part of the Comics Arts Conference, an academic conference that takes place during Comic-Con. This panel featured Thompson and David Ellis, illustrator for *Spectra* Issue #7. The pair discussed the teamwork necessary to communicate complex scientific principles through the medium of art and comics.

"We would try to sneak in ways to teach about the spectrum and optics visually instead of beating the kids over the head with a lot of word balloons," Ellis said. To achieve that, the pair worked together on a daily basis, panel by panel, to make the art and the science align. "It really has to be done in a way where the script and the art merge together without being physically incorrect," Thompson said.

Over four days, we distributed 7,000 comic books — more than two tons' worth. "The fact that we are in 7,000 people's hands now is really important," Thompson says. "Comic-Con is a good place for us to bring science and bring some real superhero physics to people that already like comic books."

ANNOUNCEMENTS

HELIUM continued from page 4

Mark Elsesser, APS senior policy analyst, who oversees the program, is elated about its success.

"I was apprehensive at the start because we were trying something different; but for all enrollees to see immediate savings and have reliable delivery is a huge win for the community," said Elsesser. "I'm excited to work with DLA on the program expansion this fall."

Added Laura Greene, a condensed matter physicist and vice president of APS: "It is remarkable what the OPA has done on behalf on the scientific community."

Notwithstanding the success of the program, the scientific community remains concerned about the future availability of liquid helium.

William Halperin, a low-temperature physicist at Northwestern University and chair-elect of the APS Division of Condensed Matter Physics, testified about those challenges during a Capitol Hill hearing on July 8, 2015, before the House Energy and Mineral Resources Subcommittee. "For some scientists, purchasing liquid helium has become an existential issue — as the price has gone up, they have been forced to choose between abandoning a research project or laying off employees and students," he said.

In addition to informing lawmakers about the purchasing program, Halperin told them APS is partnering with the ACS and the Materials Research Society to determine the best path for "transitioning as many academic researchers as possible to systems that recycle helium."

Although the Helium Stewardship Act of 2013 extends the lifetime of the Federal Helium Reserve to 2021, the long-term supply of liquid helium is still a concern. Therefore, Halperin added that another step should be taken: "This subcommittee should carefully consider possible legislative fixes to shutting down the reserve."

For more information about the OPA Liquid Helium Purchasing Program, contact Mark Elsesser at elsesser@aps.org.

The author is Press Secretary, APS Office of Public Affairs.

KEPLER'S MOTHER continued from page 2

pentant Katharina promptly filed another lawsuit insisting Reingold should cover the costs associated with her trial as recompense for making a false accusation. That suit never went to trial; Katharina died the following year.

Further Reading:

1. James A. Connor. *Kepler's Witch: An Astronomer's Discovery of Cosmic Order Amid Religious War*. San Francisco: Harper, 2004.

DISPATCH continued from page 5

coming the obstacles to recruiting teachers in the physical sciences. The project is being carried out in partnership with the American Chemical Society and the Computing Research Association.

A workshop intended to address the long-term challenges of helium supply and pricing will be held this fall. A study committee has been assembled and planning for the two-day meeting has begun. This project is being carried out in partnership with the American Chemical Society and the Materials Research Society (see the article in this issue on page 4).

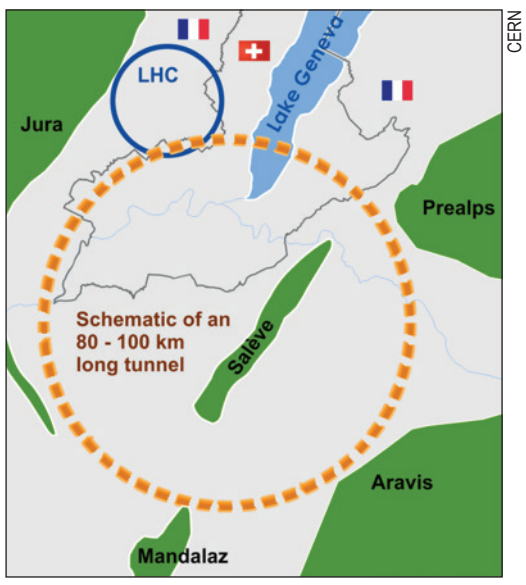
A template for study proposals can be found online, along with a suggestion box for future POPA studies: aps.org/policy/reports/popa-reports/suggestions/index.cfm.

COLLIDER continued from page 3

CEPC/SppC.

In early 2015 the FCC study was recognized by the European Commission through the funding of the FCC technical design study (EuroCirCol) via the program of HORIZON2020 (the largest European Union research and innovation funder). The nuclear study institute KEK in Japan and sixteen beneficiaries from the European Research Area committed to perform the core of the FCC-hh collider ring design and the 16 T magnet R&D. The four key themes addressed are the arc design, led by CEA Saclay (CEA is the French Atomic Energy Commission), the interaction-region design (John Adams Institute in the United Kingdom), the cryo-beam-vacuum system (CELLS consortium), and the high-field magnet design (CERN). Four major U.S. laboratories, Brookhaven National Laboratory (BNL), National High Magnetic Field Laboratory (NHMFL), Fermi National Accelerator Laboratory (FNAL), and Lawrence Berkeley National Laboratory (LBNL), are associated with the EuroCirCol high-field magnet design.

In March 2015, some 340 physicists, engineers, science managers, and journalists gathered in Washington, DC for the first annual meeting (FCC Week 2015) of the global FCC collaboration (*APS News*, May 2015). This meeting was jointly organized by CERN and DOE, sponsored by the IEEE, the European Community's Enhanced European Coordination for Accelerator Research & Development FP7 EuCARD2 project, and several superconductor manufacturers. It covered all aspects of the study, e.g., designs of 100 km hadron and lepton colliders, infrastructures, technology R&D, experiments, and physics.



Sketch of a future 80-100 km tunnel in the Lake Geneva basin, which would allow for an energy-frontier hadron collider and an e^+e^- Higgs factory.

The Washington meeting began with an exciting presentation by U.S. Congressman Bill Foster, who encouraged the high-energy physicists in the audience to "never be shy in standing up for the unique nature of their field and never be afraid of big numbers." A special session was devoted to FCC-related efforts in the U.S. Importantly, James Siegrist from the U.S. Department of Energy (DOE) pointed the way for aligning the high-field magnet R&D efforts at the four leading U.S. magnet laboratories (BNL, FNAL, LBNL, and the NHMFL at Florida State University) with the goals of the FCC study. An implementation plan for joint magnet R&D is being drawn up. First demonstrator magnets could be ready by 2017 or 2018, both in Europe and in the U.S.

The FCC Week 2015 also featured a plenary meeting of the FCC Gender Equality Working Group, where personal experiences of women physicists were reported from all around the world. At this meeting, Director of APS Education and Diversity Theodore Hodapp, representing both the APS committees on the status of women in physics and on minorities in physics, gave an intriguing presentation on how to support women physicists, which triggered lively discussions.

R&D progress will be reviewed at the next FCC Week, to be held in Rome from April 11 - 15, 2016. Further information about the global FCC study is available at cern.ch/fcc (general FCC), eurocircol.edu (EuroCirCol), and cern.ch/fccw2015 (FCC Week 2015).

Frank Zimmermann, a senior scientist at CERN and an APS fellow, is the FCC deputy study leader. He also serves as the editor of the APS journal Physical Review Special Topics - Accelerators and Beams. *Portions of this article previously appeared in* CERN Courier *(http://cerncourier.com/cws/article/cern/60865).*

The Back Page

A Passion for Problem Solving

By Paul Stanley

Imagine an international sport where eager high school students who share a passion for problem-solving compete with peers from around the world to demonstrate quick prowess and the ability to work independently to find solutions, and then gain recognition for their efforts; a program with provision for friendship and networking across national lines; a chance for students to do what they enjoy with others who are like-minded. That event is the International Physics Olympiad (IPhO), a competitive physics program first established among the former Soviet eastern block countries in 1967.

History of the Olympiads

The program was likely a response to the already successful International Math Olympiad that had begun eight years earlier, except that it would include both a theory-based examination and an experiment-based examination. The early physics Olympiads were relatively informal affairs that were organized by host nations somewhat hastily; now planning begins several years in advance.

"Imagine an international sport where eager high school students who share a passion for problem solving compete with peers from around the world..."

By the time of the third Olympiad in 1969, a set of statutes had been drafted, and in 1972 the first western country, France, participated. There were rough patches: Efforts to politicize various academic Olympiads in 1977 into socialist events resulted in several years without any physics Olympiads. True international participation began when the Federal Republic of Germany hosted the IPhO, and the program has been hosted by various nations around the world every year since 1981.

In 1984 a permanent leadership program was established, and the Polish physicist Waldemar Gorzkowski became the first president of the IPhO. With the support of active members of the international board, he solved the problems of hosting the IPhO. Gorzkowski served as president of the IPhO until he passed away during the 38th IPhO in Iran, doing what he enjoyed most: supporting a friendly competition amongst the world's best high school physics students.

The international competition

The current IPhO comprises two five-hour exams: a theory exam that accounts for 60% of the total score, and an experimental exam that accounts for the remaining 40%. The allowed topics are drawn from a syllabus that is similar to algebra-based AP Physics. The use of calculus to solve problems is permitted, but is expected to be minimal. Each nation is allowed to bring five high school competitors and two leaders; the leaders help moderate the exams.

There are three theoretical questions, but the level of difficulty of the exam has grown over the past four decades to the point that each question is usually composed of many parts. These questions are set by the host country, but then debated and approved by the international board, which is composed of two leaders from each of the represented countries. These board discussions take place after the opening ceremony and after the leaders are removed from contact with the competitors.

Host countries are expected to draw from the entire syllabus, and often select problems of relevance to the host nation. In Vietnam, a problem was devoted to the physics of a rice pounder; in Denmark, one was devoted to Greenland. Sometimes the problems are farfetched, such as the problem from Singapore: What would be seen by a pinhole camera observing an object that is moving at relativistic speeds?

Preparing the experimental portion of the IPhO is probably the most difficult, requiring some 400 pieces of reliable and accurate experimental apparatus. Moreover, unforeseen problems with room lighting, room temperature, or floor vibrations do sometimes arise.

Some exams have had some particularly interesting experiments. In Mexico competitors assembled an optics table using cabinetry parts in order to measure the wavelength of light with a millimeter scale, taking advantage of the fringes produced when circularly diffracted light interferes with light diffracted off of a single straightedge. Korea developed a mechanical spring system that was enclosed in a tube. Competitors determined the spring constants of the springs and the mass of the contained ball with a series of measurements made possible with a timer and an optical detector. In Iran the task was examining the band gap in ferrous oxide using a mechanical spectroscope.

Paul Stanley

2015 Physics Olympiad Participants

Participation of the United States

The United States began competing in 1986 and hosted the event in 1993. Since then, the U.S. has selected a Physics Team of 20 to 25 high school students that trains every year for a week to ten days at the University of Maryland, with additional training hosted by George Washington University during 2014. The American Association of Physics Teachers, the American Institute of Physics (AIP), and the AIP member societies (including APS) are the primary sponsors of the U.S. Team.

The U.S. Team selection process is managed through two exams: a 25-question multiple-choice exam that covers Newtonian mechanics is given to some 5,000 students. The top 400 or so are invited to sit a six-question long-answer exam that covers mechanics, thermodynamics, modern physics (including relativity), and electrodynamics. Exam questions are designed to test fundamental physics as well as problem-solving techniques, and often require the competitors to construct analytical, numerical, or graphical solutions. Ordinarily the top 20 eligible competitors are invited to the ten-day training camp.

"Exam questions are designed to test fundamental physics as well as problem-solving techniques...."

As with most nations, the U.S. Team struggles with successful recruitment of underrepresented groups. Several years ago the U.S. Physics Olympiad publicized the names of all the competitors (rather than just those selected for the team). This public recognition increased interest in the exam, but also resulted in the challenging of exam scores by the competitors, their teachers, and their parents.

The demographics are interesting. First-generation Asians have a strong presence in the U.S. Team, a pattern that goes back at least a dozen years; often more than half of the team is composed of such students. The racial diversity of those current and former U.S. Team members who were not first generation Asians is much closer to that of the U.S. population as a whole, but the presence of African-American or Hispanic students, while not zero, is lower than the corresponding percentages of the population.

Approximately 20% of the almost five thousand initial test-takers are women, as are 16% of those on the U.S. Team. Since 2003 seven women have represented the United States at the IPhO.

A decade ago many of the U.S. Team members came from private high schools or special science high schools. This has changed: Several public high schools throughout the nation have active preparation programs and now regularly send a student or two to the training camp.

The training program for the U.S. team involves lectures, experiments, exams, and problem-solving practice. Exam questions are kept secret, as good questions can take weeks to develop despite the fact that it sometimes takes the students only minutes to figure out a correct path to the solution. Recently a coach commented that the internal training program had reached such a level that we were scouring the graduate level texts of Jackson and Goldstein to find problems that were hard enough to challenge these high school students.

Olympiad outcomes and differences in preparation

A decade-long ranking of the top teams is independent of the choice of measure. China, Taiwan, and South Korea are ranked first through third. The U.S. is ranked fourth. Thailand and Russia are fifth and sixth. The most commonly used measure of national performance is the medal count: how many gold and silver medals each country wins. Less common is the aggregate point score of a team, and even less common is the aggregate ranking of the members of a team. Though the statutes of the IPhO are careful to point out that this is a competition among individuals, the team leaders, as well as the national organizations that back the training of the teams, do watch overall team performance and how it relates to other nations, in a friendly and supportive manner.

All five of the U.S. Team travelers have won medals every year since 1991. Though the U.S. Team has secured four golds and a silver on five different occasions, it has yet to acquire the coveted five-gold status, a privilege held only by China, Korea, Singapore, Taiwan, and Thailand. Still, U.S. Team travelers have won special recognition in top theory, top experiment, top overall, top female participant, and best solution.

One complaint about the program is that it does not train students to do real-world physics as a physicist would do it. This is true, but that is not the point of the program. Part of the training camp does develop problem-solving and laboratory skills outside the realm of the IPhO, but the focus is on competitive techniques. Even so, the playful conceptual problems that students enjoy are often similar to the problems posed by Newton, Einstein, or Feynman.

All members of the U.S. Team have fun doing physics: One of their favorite activities is competing against the coaches to solve "Fermi problems" — order-of-magnitude back-of-the-envelope physics calculations. It is, in fact, this playfulness that likely enables the U.S. Team to over-perform when compared to countries with considerably more extensive training programs.

The U.S. Team has 10 structured days of training followed by several weeks of independent study. The other top-performing nations have training programs that consist of a mix of supervised and independent work that takes place over the course of many months, and some for longer than a year.

The IPhO enables current high school students who love problem-solving to do just that: solve problems. The students relish rising to the challenge and engaging in intellectual competition, and the degree of difficulty of the problems has increased over the years to reflect that. Though the Olympiad is not a program for creating future Ph.D. physicists, U.S. Team members go on to careers in the STEM fields and also in economics. Former team members have become professors in a multitude of disciplines, Wall Street analysts, medical doctors, engineers in Silicon Valley, and yes, even physicists.

For more information, visit www.ipho.org and www.aapt.org/physicsteam/2015.

Paul Stanley is professor of physics at Beloit College and the holder of the Dobson Endowed Chair of Physics. He has also served as chair of the natural sciences since 2012. He has been involved with the U.S. Physics Team since 2003, and he has been academic director of the program since 2008.