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APS NEWS

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HONORS

2020 APS Medal for Exceptional Achievement in Research Awarded to Myriam P. Sarachik

BY DAVID VOSS

Physicist Myriam P. Sarachik has been selected to receive the 2020 APS Medal for Exceptional Achievement in Research for her "fundamental contributions to the physics of electronic transport in solids and molecular magnetism."

An APS Fellow, Sarachik is Distinguished Professor of Physics at City College of New York. She was President of APS in 2003 and received the APS Oliver E. Buckley Condensed Matter Physics Prize in 2005.

"Myriam Sarachik has been one of the world's leading experimental condensed matter physicists for over a half-century," said APS President-Elect Philip Bucksbaum, chair of the selection committee. "Her outstanding contributions helped to shape our modern view of many collective effects in solids, including the Kondo effect, heavy fermion physics, disordered 2-D systems, and strongly-correlated electron systems. I am very pleased that she will receive the APS Medal for Exceptional Achievement in Research. I'm especially pleased that this honor goes to someone who has also been so active in promoting the core values of APS. Not only is Myriam a past President of the Society; she is also well-known for her efforts to defend human rights and the principles of diversity and inclusion in physics."

The Medal for Exceptional Achievement in Research is the largest APS prize to recognize researchers from all fields of physics and is funded by a donation from entrepreneur Jay Jones. Previous recipients were Edward Witten (2016), Daniel Kleppner (2017), Eugene Parker (2018), and Bertrand Halperin (2019).

"I'm so pleased that Myriam has been selected for the APS Medal, which is our highest honor," said Kate Kirby, APS CEO. "Her research has been at the frontiers of con-

Myriam P. Sarachik

densed matter physics and her life of service to the physics community is an example for physicists everywhere."

Sarachik earned her B.A. degree (cum laude) from Barnard College in 1954, and her M.S. and Ph.D.

APS MEDAL CONTINUED ON PAGE 6

JOURNALS

Physical Review Research Publishes its First Papers

To launch its inaugural issue, *Physical Review Research* has published its first content less than two months since opening for submissions in June.

Demonstrating the journal's broad, multidisciplinary scope covering all of physics and related fields of interest to the physics community, the first release of peer-reviewed research articles includes advances in the areas of materials science, quantum information, soft matter, plasma science, optics, and condensed matter physics. Other papers accepted into the first issue of the journal were authored by researchers working in chemical physics, topological physics, complex systems, astrophysics, particles and fields, atomic and molecular physics, and other subject areas.

"When you submit a manuscript to *Physical Review Research* it is handled by a collaborative effort across the entire APS editorial team of Ph.D. scientists and professional support staff who manage the peer review for all of the *Physical Review* journals," notes Juan-José Liétor-Santos, Managing Editor. "This ensures submissions from all subject areas receive the editorial expertise necessary to provide authors with an efficient and effective peer review experience."

In addition to peer-reviewed research content, the first issue also contains two opening editorials. In the first, APS Editor

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MEMBERSHIP UNIT PROFILE

APS Membership Unit Profile: The Division of Soft Matter

BY ABIGAIL DOVE

The APS Division of Soft Matter (DSOFT) is concerned with dense, many-body systems in which quantum effects do not play a primary role. This encompasses a staggering variety of materials from the everyday to the exotic, including polymers such as plastics, rubbers, textiles, and biological materials like nucleic acids and proteins; colloids, a suspension of solid particles such as fogs, smokes, foams, gels, and emulsions; liquid crystals like those found in electronic displays; surfactant systems, which involve networks of amphiphilic particles with distinct hydrophobic and hydrophilic domains; and granular materials.

Perhaps counterintuitively, many forms of soft matter like window glass and "oobleck" (a non-Newtonian fluid like water and cornstarch) can be surprisingly hard. What makes soft materials "soft" is their ultra-responsiveness to external fields and therefore high susceptibility to deformation and falling out of equilibrium. These materials tend to be disordered at the molecular scale and homogeneous at the macroscopic scale, whereas the mesoscopic scale shows unexpected order and dynamics. It is the physics of these systems that occupies the minds of the approximately two thousand researchers in DSOFT.

Doug Durian

According to DSOFT chair Doug Durian (University of Pennsylvania), the field of soft matter is an ecosystem where each researcher establishes their own unique niche of research problems—in contrast to some

DSOFT CONTINUED ON PAGE 6

STRATEGIC PLAN

APS Innovation Fund: Inaugural Winners Selected

BY DAVID VOSS

The APS Innovation Fund (IF) was launched in early 2019 to encourage APS members to develop fresh approaches to serving the physics community (*APS News*, March 2019) in line with the Society's new Strategic Plan. Applicants were encouraged to think big, from advancing global engagement to fostering equity and inclusion in physics.

More than a hundred pre-proposals were received by mid-March, of which 10 full proposals were considered by the selection committee. Four of these were ultimately selected for funding at levels between $50,000 and $100,000 per year for two years, with a fifth proposal still under consideration.

"It was surprising that we received over a hundred proposals in a six-week time period," said APS President David Gross, co-chair of the selection committee. "I take that as an indication of the enthusiasm of APS members and staff for this initiative. I'm also very pleased that APS has been able to respond and launch the project so quickly."

Funded projects need to align with the APS Strategic Plan that was rolled out earlier this year and funds will not be used to support existing projects. "The Innovation Fund is a new initiative," explains APS Director of Project Development Theodore Hodapp, co-chair of the selection committee. "It is inspired by the APS Strategic Plan and will capture thoughtful and forward-looking

FUND CONTINUED ON PAGE 7

Rev. 09/06/2019

EDUCATION AND DIVERSITY NEWS

The STEP UP Movement is Changing the Face of Physics

BY ANNELISE ROTI ROTI

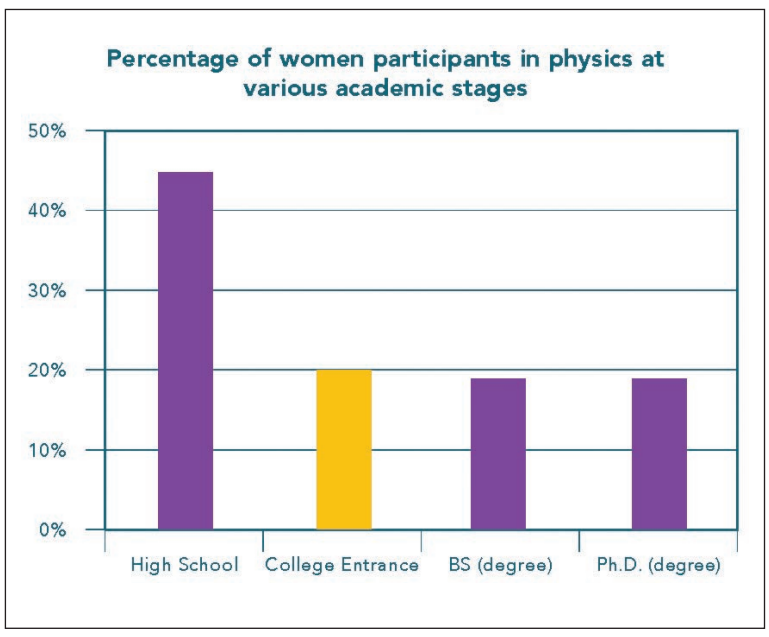
Physics is missing out. *Women are still a minority* of our undergraduates, graduate students, and professionals. And yet, I'm sure you know a young woman who would be a great physicist. What barriers might she face on her journey? What would it take to keep her on that path? We believe the STEP UP project, a recent effort by APS and its partners, can ensure the success of many women in physics, and our initial results agree. "I used to abhor physics, but then I saw how physics was so great and so amazing and it completely changed my mind," said Laura, a young woman from a Miami area school who experienced the STEP UP curriculum. This is why the STEP UP movement needs your help to get a specially designed physics curriculum into the hands of thousands of high school teachers. If you know a high school teacher, talk with them. Ask them to join our movement by registering for STEP UP and encourage them to use the lessons in their classrooms.

In 2017, the National Science Foundation recognized the innovative nature of this project and granted $3 million to APS and its partners Florida International University (FIU), Texas A&M University-Commerce (TAMUC), and the American Association of Physics Teachers (AAPT). The project's leaders then spent two years developing and testing research-based classroom strategies and demonstrated that our materials can impact the lives of thousands of women. High school classrooms are vital: although young women make up half of high school physics students, *only 20%* of those who enter college intending to major in physics are women, and only 20% of those who ultimately graduate with an undergraduate or graduate physics degree are women. Clearly the place and time to act is in high school (see chart). High school teachers are critically important in inspiring young women to pursue physics careers, so the project also made sure that teachers were part of every step of the curriculum development process.

The piloting and experimental phase of our classroom strategies and lesson plans was critical to creating the robust intervention we have now. Researchers and teachers worked together to draft, pilot, and revise the STEP UP materials: 2 lesson plans, a guide to 'everyday actions' that teachers can take to shift classroom culture, and suggested guidelines for classroom discussions. These were intentionally designed to help teachers motivate students to continue their studies in physics and illustrate the power of a physics degree. A series of in-person development meetings and pilot testing in classrooms from 2017-2018 led to these initial conclusions:

- STEP UP's lessons inspire, on average, 2.2 young women per classroom to shift their interest towards pursuing undergraduate physics.
- The lessons enable young women to see themselves as physicists.
- After participating in this intervention, students in the class are positively influenced

STEP UP CONTINUED ON PAGE 4



THIS MONTH IN

Physics History

September 15, 1910: Theodor Wulf Publishes First Evidence of Cosmic Radiation

The official discovery of cosmic rays is attributed to Austrian physicist Victor Hess, who won the 1936 Nobel Prize in Physics for his work. But as is often the case in science, Hess had plenty of contemporaries who made significant contributions to the discovery, including a German Jesuit priest and physicist named Theodor Wulf.

Born in July 1868, Wulf was ordained as a Jesuit priest by the age of 20 and then began studying physics at the University of Göttingen. He taught the subject at a Jesuit university for several years in addition to his experimental work. He soon became intrigued by the ongoing scientific debate about the origin of ionizing radiation measured in Earth's atmosphere, specifically over whether it was terrestrial in origin, or came from space.

Many scientists had been using gold leaf electrometers to measure radiation intensity in a variety of experiments. But the instruments, no matter how well insulated, invariably lost charge because of the constant bombardment of external radiation. Wulf thought the existing devices simply weren't accurate enough to measure radiation intensity outside the lab given how easy it was to damage the gold leaves simply by moving the device. So he designed his own electrometer, which used a pair of conducting quartz threads coated with platinum in place of the gold leaves. Wulf also housed the wires within a vertical cylinder to rule out charge losses due to, say, ionized gas around the instrument.

One way to determine whether the radioactivity was coming from Earth would be to measure whether it decreased with height. So Wulf used his improved electrometer to make measurements of radioactivity in several locations—at the foot of the Matterhorn, for instance, as well as in chalk mines near Valkenburg and inside Belgian caves. There was a fair amount of variability in those measurements, but the radioactivity did seem to be terrestrial in origin. Still, one of Wulf's experiments, involving an electrometer submerged in water, showed a slight decrease in ionization. From this, Wulf suspected that some kind of radiation from above must also be contributing.

Further evidence was provided by two independent measurements made at high altitudes from a hot air balloon in 1909. One might expect a decrease in radiation intensity at such heights if it was truly only terrestrial in origin. But Albert Gockel observed a smaller decrease than expected, and like Wulf, saw this as a clue that space-sourced radiation might be involved. However, another scientist, Karl Bergwitz, measured the expected large decrease. To resolve the issue, Wulf decided to take his electrometer to the Eiffel Tower and make measurements from there. This would remove the confounding effects of the balloon's motion on the radiation measurements.

Theodor Wulf

Wulf obtained permission to conduct radiation measurements from the Eiffel Tower and spent four days over Easter weekend in 1910 doing so. He compared those results against radiation measurements at the foot of the tower and at his home in Valkenburg. He published his findings on September 15, 1910, in the journal *Physikalische Zeitschrift*. While the radiation intensity was slightly lower at the top of the Eiffel Tower, this could be attributed to the fact that the intensity had been shown to drop by 50 percent traveling through 80 meters of air. The Eiffel Tower is 200 meters, so if the radiation were terrestrial in origin, the intensity should have been much lower at the top. As Wulf himself concluded, "the attempts made so far therefore require either excluding the earth's crust, another source of gamma rays in the higher layers of air, or a much weaker absorption in the air than [was] previously thought."

We now recognize this as the first concrete evidence for the existence of cosmic rays. But at the time, Wulf's scientific colleagues largely dismissed his efforts. In fairness, there were some issues with Wulf's choice of the Eiffel Tower for his experiments. He himself acknowledged that the metallic structure could actually be attracting radioactive particles, which might be an additional source of radiation, confounding his results. Nor could he entirely rule out unknown phenomena resulting in ground radiation not being absorbed by air quite as much as prior experiments with radium had indicated.

Shortly after Wulf published his findings, Victor Hess made a series of high-altitude radiation measurements from a hot air balloon during both day and night, over the course of three years. Other scientists mounted their instruments on balloons to record ionization at higher levels, but their results were inconclusive due to instrumentation defects. Hess designed improved instruments that could withstand the temperature and pressure changes at higher altitudes. He determined that the intensity

WULF CONTINUED ON PAGE 3

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CAREERS

New Approaches to Physics Education Flow from PIPELINE

BY LEAH POFFENBERGER

Three years ago, seven educational institutions embarked on a project to create new approaches to teaching physics to instill practical skills in undergraduate physics students. This project, known as the PIPELINE Network, is now bearing fruit with a published curriculum, the launch of a webinar, and a kickoff workshop in Provo, Utah on July 21.

The PIPELINE Network was assembled to address a need to improve student preparedness for careers in industry. A joint task force between APS and the American Association of Physics Teachers (AAPT) highlighted this deficit in undergraduate physics education in their 2016 report *Phys 21: Preparing Students for 21st-Century Careers*. The *Phys 21* report identified four major areas where students could benefit from additional training: connecting fundamental physics to real world applications; developing technological skills; improving communication; and acquiring workplace skills such as project management. These areas have since been used as a guide for the PIPELINE Network's development of new educational approaches for students entering the modern workforce.

"The workshop, publishing curriculum and launching webinars is a culmination of efforts at seven universities to give students skills for the workforce and help them develop entrepreneurial mindsets," says Crystal Bailey, Head of Careers Programs at APS.

Different methods of improving physics innovation and entrepreneurship (PIE) education were investigated at the seven institutions in the network: University of Colorado Denver, George Washington University, Loyola University of Maryland, Rochester Institute of Technology, College of William and Mary, Wright State University, and Worcester Polytechnic Institute. Representatives from three other institutions with strong PIE education programs—Carthage College, Case Western Reserve University, and Kettering University—served as advisors for the Network.

"I've learned from years of working with students that there's a barrier to the idea of connecting

PIPELINE CONTINUED ON PAGE 7

Participants in the PIPELINE workshop at the AAPT meeting in Provo, Utah, learned new ways to connect physics teaching with innovation and entrepreneurship.

Correction—Owing to an editorial error, an incorrect caption was included with the figure accompanying the article "Sorting out the Neutron Lifetime" (*APS News*, July 2019). The caption should read "NIST proton trap for measuring neutron lifetime. A free neutron entering the trap as part of a beam will decay into a proton, an electron, and an anti-neutrino. The number of protons detected can be used to calculate the neutron lifetime." The online and downloadable PDF versions have been corrected. We apologize for the error.

WULF CONTINUED FROM PAGE 2

increased significantly with height, and his radiation measurements during a solar eclipse effectively ruled out the sun as the source of these cosmic rays. Hess shared the 1936 physics Nobel Prize with Carl Anderson for the latter's discovery of the positron. Wulf was shut out of the honor entirely.

But at least he's not alone in losing out on a Nobel for cosmic rays. Another scientist, Domenico Pacini, made a similar discovery right around the same time as Hess. Pacini didn't use a balloon to measure changing radiation levels in the atmosphere. Instead, he went underwater, placing his instrument in a copper box and sinking it in the Bay of Livorno. He found that the radiation was significantly less intense at the bottom of the bay than at the surface, so the Earth's crust could not be the source of cosmic rays. Unfortunately, Pacini died in 1934, and the Nobel Prize cannot be awarded posthumously.

Further Reading:

de Angelis, A. (2010) "Domenico Pacini, uncredited pioneer of the discovery of cosmic rays," *Rivista del Nuovo Cimento* 33: 713-756.

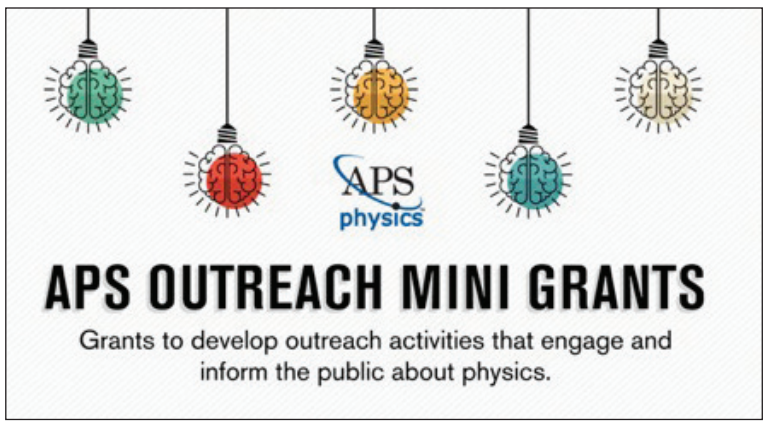
Gbur, Greg. "Paris: City of Lights and Cosmic Rays," Skulls in the Stars, October 9, 2014.

Wulf, Theodor. (1910) "Observations of the radiation of high-penetration capacity on the Eiffel Tower," *Physikalische Zeitschrift* 11: 811-813.

OUTREACH AND PUBLIC ENGAGEMENT

APS Awards Seven Outreach Mini Grants

BY LISSIE CONNORS



This past April, seven institutions were awarded APS Outreach Mini Grants of up to $10,000, which will fund public outreach programs in communities around the world. This year's awardees come from institutions large and small and include collaborations both domestic and international.

Many physics outreach programs focus on public lectures and demos, but applicants for the APS Outreach Mini Grants are encouraged to think outside the box and try something new. While traditional programs are funded through the Mini Grants, creative or experimental ideas are especially encouraged. For those looking to design new outreach activities, these awards can provide vital start-up funding to create long-term, sustainable programs. When selecting awardees, APS looks for projects that make physics accessible to historically underrepresented groups. Projects funded this year will include programs for students from kindergarten to high school, indigenous communities, and incarcerated populations.

The Cameroon Physical Society and Cameroon Academy of Sciences will be working together to create an informational campaign showing the impact of physics in Cameroonian society. They will design free booklets that showcase the history of physics, its importance in modern technologies, and how it relates to other fields of science. This will supplement a lecture tour, taking Cameroonian physicists to high schools across the country, with talks aimed at students, journalists, and the broader public. They will also share their lectures on radio programs and social media.

At the Texas Southmost College, faculty members will be building a science-based outreach network called "Fostering the Ultimate Science-based Integrated Outreach Network" (FUSION), which will help train college students with project-based courses in both physics and teacher education. Students will also be working to expand physics literacy in southern Texas by organizing community STEM events and social media campaigns.

In the neighborhood around Lane College in Jackson, Tennessee, faculty and students will be expanding an existing outreach program to include lessons on astronomy and optics. Elementary school students in the area will learn how light interacts with matter and have the chance to see how lenses, microscopes, cameras, lasers, and telescopes work; ultimately they will learn how these technologies help us look at the stars. At the end of the program, the students and their parents will gather for a springtime astronomy night, just in time to see Mars, Saturn, and Jupiter together in the night sky.

The University of Michigan is launching "Physics and Astronomy for Community Engagement" (PACE), a multi-phase outreach program to reach residents of Flint, Michigan. They plan to work with high school students on lab activities covering topics from renewable energy to radio astronomy. The students will then have a chance to put these lessons into practice at a physics competition. Lastly, the program will conclude with a community-wide event to discuss popular physics topics with the people of Flint.

In Colorado, the University of Denver will be visiting native communities across the Denver metropolitan area to lead "Indigilogix Pods"—physics labs integrated with indigenous culture. Indigenous science education research indicates that, "everyday community practices and their connections with Native ways of knowing must be the foundation of a community-based science curriculum." With that in mind, these outreach programs are designed to provide native communities in the Denver area with an enriching opportunity to learn science outside of a traditional classroom setting while celebrating their history.

Physicists at Caltech will also be working to reach indigenous communities in Montana and California, building on an already established outreach program to bring the excitement of science to small, rural communities. The project also involves working with language specialists to translate LIGO's gravitational wave discoveries into Navajo to celebrate indigenous language and culture.

Lastly, faculty and students at the University of Illinois Urbana-Champaign received a mini-grant to expand an outreach program called Opening the Cosmos to a Closed World, where they will lead astronomy workshops at a local correctional facility. Educational programs in prisons have been found to benefit the quality of life, build valuable skills that increase employment prospects, and reduce the chances of recidivism. Participants in the program will study the principles behind astronomical phenomena, interpret real astronomy datasets, and build their own code in Python.

To see how these projects progress, attend the 2020 APS March Meeting in Denver, where awardees will be speaking about their outreach activities in a special session. APS has awarded grants for outreach programs since 2005, and this year marks the ninth year of the APS Mini Grant program. The next application cycle opens in October. To learn more, please visit aps.org/programs/outreach/grants/.

The author is the Science Communications Intern at APS.

LETTERS

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

Sexual Harassment in Physics

I was very impressed by your decision to publish the April 2019 Back Page feature on harassment and troubling encounters at a DNP meeting as well as the May 2019 article *"Yes, Sexual Harassment Still Drives Women out of Physics."* This is an important issue that I am glad to see APS is willing to draw attention to and encourage discussion about.

I was less impressed, however, by the responses to these articles published in the "Letters to the Editor" section of the June 2019 issue. Most troubling to me is that, although these articles speak largely to the experience of women in physics, the three letters that were published on the topic were all written by men. The deep-seated, sexist notion that men's opinions are worth more than women's is one of the biases that feeds the very issues *APS News* was trying to draw attention to with these recent articles. To see this troubling idea reinforced a mere month after these eye-opening articles, by the same news outlet that published them, is depressing to say the least.

If you have received feedback from women about your recent articles on harassment, please consider publishing them. And if you haven't received such feedback, please consider soliciting it.

Emma Oxford
Pittsburgh, Pennsylvania

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The June issue of *APS News* featured three letters discussing previous issues' treatment of sexual harassment in physics. I was disappointed to see that all three letters were from men, two of them making all-too-common remarks to the effect of "well how do we know that sexual harassment is a real issue in physics?" The clear and persistent gender gap in our field should make it obvious that there are barriers to women's success in physics, and we should trust our female colleagues when they tell us what those barriers are. It worries me that *APS News* would choose to publish three letters from men, and no letters from women commenting on this issue.

Adam Iaizzi
Taipei, Taiwan

Editor's note: I sincerely thank the authors of these letters for the feedback. As the June 2019 issue of APS News *went to press, we had received exactly three letters about the articles cited and these are the letters that were published. We encourage readers to send letters about any matters related to articles in* APS News *to letters@aps.org.*

STEP UP CONTINUED FROM PAGE 2

to pursue physics careers ("Examining physics identity development through two high school interventions," Cheng et.al, 2018 PERC Proceedings, doi: 10.1119/perc.2018.pr.Cheng).

This also led to polished content that was ready for a quasi-experimental study, which was conducted in the 2018–2019 academic year. Detailed results are forthcoming and will be made available on the STEP UP website, but initial results are in alignment with previous findings. As the STEP UP program continues to be introduced to more classrooms, we will be watching for an increase in women entering college with a declared physics major, with critical time points of fall 2019 and fall 2020. A nationwide increase in the number of women pursuing physics is expected based on our positive research results; however, this is highly dependent on the curriculum being broadly implemented by teachers.

Over the last two years, the project has grown from a plan to a nationwide movement. What started as a group of about 10 researchers and around 20 teachers is now a network of more than 1,000 community members. STEP UP representatives have given talks at meetings, conferences and workshops attracting 450 teachers, as well as faculty, students, and other supporters who are all ready to spread the word about STEP UP. We also kicked off the STEP UP Ambassador program, with 48 teachers chosen to represent the project, through an in-person summit in Provo, UT in July 2019. Each ambassador will be recruiting and supporting 25–35 new teachers through workshops in their local area. A map of the Ambassadors' locations is available on our website (STEPUPphysics.org). In addition to the summit this summer, we presented at the AAPT Conference and the Physics Education Research Conference (PERC). We continued to spread the word by reaching out to supporters, partner organizations, and engaging on social media. These efforts are all aimed to put STEP UP materials in the hands of as many of the 26,000 U.S. physics teachers as possible.

This push will help to change the face of physics, but we can use your support. *Please talk with a high school physics teacher and ask them to join our movement.* APS has the materials to support your outreach—please visit STEPUPphysics.org to find talking points, promotional materials, and email templates to use in recruiting teachers. Let's give more young women the chance to see the power of physics. Ultimately, we will all reap the rewards of a physics community that is more diverse and striving towards its full potential.

The author was Project Development Intern for STEP UP and is now PhysTEC Program Coordinator. This article was co-written by Anne Kornahrens (STEP UP Project Manager, kornahrens@aps.org) and Raina Khatri (FIU Project Manager).

GOVERNMENT AFFAIRS

APS Advocacy Helps House Pass "Combating Sexual Harassment in Science Act"

BY TAWANDA W. JOHNSON

The majority of legislation introduced into Congress never reaches a committee hearing. But that wasn't the case with H.R. 36—the Combating Sexual Harassment in Science Act of 2019. Within seven months, the bill went from being introduced in the House to passing the full chamber in July. The APS Forum on Graduate Student Affairs (FGSA) and staff in the APS Office of Government Affairs (OGA) contributed to that terrific outcome by partnering with APS members across the country to contact congressional representatives about the legislation.

"The passage of the House bill is a success on a path that requires continued attention and measures to reach a level of zero percent of individuals being harassed. By creating a working group within the National Science Foundation to collect the data and develop a mechanism for combating sexual harassment, the bill will provide foundational work that is needed to achieve the zero-percent harassment goal," said FGSA Chair Tiffany Nichols (Harvard University).

She added, "The bill also creates a similar mechanism in the National Science and Technology Council that will focus on governmental science agencies. I believe all this is a step in a positive direction toward creating safe, diverse, and equitable environments where everyone can thrive and not have to worry about sexual harassment in the workplace."

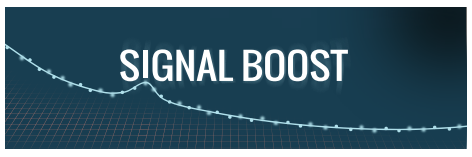
Callie Pruett, APS Grassroots Advocacy Associate, said she, too, was thrilled about the bill's success in the House.

"APS OGA is proud of this success, and it was wonderful working with FGSA on our first sustained grassroots advocacy campaign," she added. "It went on for 12 weeks, and it gave us time to target our message. It will serve as a model for future campaigns."

Key highlights of the campaign include the following:

- APS members wrote more than 550 letters in support of the Combating Sexual Harassment Act of 2019.
- The letters were sent to 111 House offices and 70 Senate offices.
- Nearly 40% of the House cosponsors who joined the bill after the campaign began had been contacted by APS members.
- APS members held in-state meetings with staffers representing House members and senators in multiple states. For example, in Tennessee, two physics professors from the University of Tennessee at Knoxville, along with a graduate student from the school, led the effort during meetings with staffers from the offices of U.S. Senators Lamar Alexander and Marsha Blackburn. Alexander is chair of the Senate Health, Education, Labor & Pensions Committee, which now has jurisdiction over the bill, and Blackburn is a supporter of anti-sexual harassment issues.
- APS members supported the bill through its hearing in

ADVOCACY CONTINUED ON PAGE 6



Signal Boost is a monthly email video newsletter alerting APS members to policy issues and identifying opportunities to get involved. Past issues are available at go.aps.org/2nr298D. **Join Our Mailing List: visit the sign-up page at go.aps.org/2nqGtJP.**

FYI: SCIENCE POLICY NEWS FROM AIP

Budget Deal Paves Way for Science Spending Boosts

BY MITCH AMBROSE

President Trump signed legislation on August 2 that suspends the federal debt ceiling and raises caps on discretionary spending for the next two fiscal years. Called the Bipartisan Budget Act of 2019, the law will enable Congress to continue its recent run of funding increases for science agencies. In setting spending levels for the final two years covered by the Budget Control Act of 2011, the law also marks a conclusion to the use of statutory spending caps and automatic budget sequestration as tools for reining in spending.

Most of the increase provided by the agreement will come in fiscal year 2020, with the cap on non-defense spending rising 4% to $622 billion and the cap on defense spending rising 3% to $667 billion. For the following fiscal year, the cap for each category will increase about 1%. Most science agencies are funded out of the non-defense portion of the budget.

These increases are not as large as those provided through the last budget agreement, reached in 2017, which raised the cap on non-defense spending by 12% for fiscal year 2018 and 3% the following year. Whereas that agreement resulted in a windfall for several science agencies, the new one enables Congress to sustain the current funding levels with room for some additional increases.

However, Congress and the president still must agree on how to apportion the budget among the 12 annual appropriations bills that fund the federal government.

The House approved most of its bills this summer, employing the assumption that non-defense spending would increase 6%. Meanwhile, the Senate opted to wait until a budget agreement was reached before advancing its own proposals, which it is now plans to release soon after Congress returns from recess in September.

Although House appropriators will likely have to rein in at least some of their proposed spending increases for science programs, their finished bills represent a starting point for negotiations with the Senate, conveying their prioritization of areas such as climate change research.

Given that the start of fiscal year 2020 on October 1 is fast approaching, Congress may well use one or more stopgap funding measures to buy time for crafting final spending legislation. However, the budget agreement decreases the possibility of another government shutdown.

In a set of principles released upon announcing the budget deal, congressional leaders and the Trump administration conveyed a desire for a smooth appropriations process, committing to "minimize procedural delays" and refrain from adding controversial policy demands to their spending bills.

The author is Acting Director of FYI.

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HONORS

Seven Apker Award Finalists Show Off their Research Skills

BY LEAH POFFENBERGER

On August 9, APS hosted seven of the nation's brightest young physicists for the annual Leroy Apker Award Selection Meeting. All of the Apker Award applicants boast an impressive resume of physics research at an undergraduate level, which they presented to a committee of distinguished physicists.

Previous Apker Selection Meetings have featured six finalists, three from PhD granting institutions and three from non-PhD granting institutions, but this year the committee made room for a seventh finalist—a testament to the talent of this year's field. Research topics ranged from the physics of the cosmos to the behavior of nanostructures.

The 2019 Apker Award finalists are: Tali Khain (University of Michigan), Dolev Bluvstein (University of California, Santa Barbara), Wenzer Qin (Johns Hopkins University), Lauren Zundel (University of New Mexico), Emily Churchman (Texas Lutheran College), Katelyn Cook (Houghton College), and Kai-Isaak Ellers (Amherst College).

The finalists each received a $2000 honorarium, a $1,000 award for their undergraduate physics institutions to support future undergraduate research, travel reimbursement, and a certificate. The two winners, selected by the committee, will receive an additional $5,000 award and $5,000 for their undergraduate physics departments. The winners will also receive funds to travel to an APS meeting to give their own invited talks.

"Each of the finalists is already a winner," Laura Greene (National High Magnetic Field Laboratory and Florida State University), chair of the selection committee, emphasizes. "They've all done incredible work and should be proud to reach this stage."

Leroy Apker Award finalists (front row): Tali Khain, Wenzer Qin, Dolev Bluvstein, Emily Churchman, Katelyn Cook, Kai-Isaak Ellers, Lauren Zundel; and selection committee (back row, L-R): Roger Falcone, Geoffrey Lovelace, Eun-Ah Kim, Sujit Datta, Laura Greene, Nima Arkani-Hamed, Talat Rahman, James Eckert, Shelly Lesher, Paul Miller.

The finalists each had thirty minutes to present their undergraduate research, display their expertise in the field, and clarify their direct contributions to the research. The selection committee then had fifteen minutes to question the presenters.

Bluvstein kicked off the selection meeting with a showcase of his work on quantum coherence in solid-state spin systems for applications in quantum sensing. Khain then discussed her contributions to plotting the orbit of objects within the Kuiper belt at the edge of the solar system and her investigations of evidence for a ninth planet.

Continuing in astrophysics, Qin presented a new formalism for characterizing gravitational waves using pulsar timing arrays and astrometry, allowing the measurement of properties beyond the capabilities of interferometers like LIGO. Zundel rounded out the finalists from PhD granting institutions with a presentation on her research of periodic arrays of nanostructures that has many practical applications, such as ultrasensitive biosensing.

After a break for lunch, Churchman was first up to share her journey in nuclear physics as part of the National Science Foundation Research Experiences for Undergraduates program. She also discussed her contributions to physics at her home institution which include building a muon detector for the physics department and participating in outreach activities. Cook, who also does nuclear physics research, came next to present her experimental work aimed at measuring low energy nuclear cross sections using internal confinement fusion, which involved building her own target chamber for testing the behavior of gas.

Ellers wrapped up the presentations with his work on enhancing coherence times in a molecular nanomagnet, Cr_7Mn. His experiments point to the potential use of molecular nanomagnets as qubits for quantum computing.

The two winners, which were selected by a ten-member committee of physicists from a variety of fields, will be announced in September.

For more on the APS LeRoy Apker Award, which is made possible through an endowment donated by Jean Dickey Apker, visit aps.org/programs/honors/prizes/apker.cfm.

APS PROGRAMS

Matthew Blackman Named 2019 PhysTEC Teacher of the Year

BY LEAH POFFENBERGER

The Physics Teacher Education Coalition (PhysTEC) addresses a shortage of qualified physics teachers in the United States. Each year, the coalition selects a graduate from a physics teacher preparedness program as Teacher of the Year to recognize outstanding physics educators. This year's recipient of the national PhysTEC Teacher of the Year Award is Matthew Blackman, a physics and robotics teacher at Ridge High School in New Jersey.

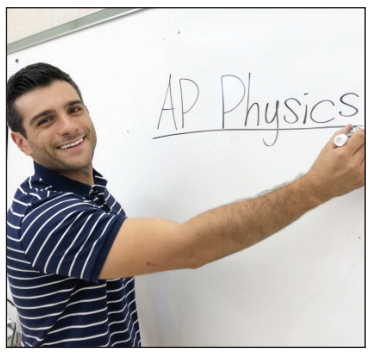
PhysTEC is a joint project of APS and the American Association of Physics Teachers that aims to transform physics departments and support successful models for physics teacher education programs. The Teacher of the Year award, which has one national winner and several local winners, is open to alumni from the 330 PhysTEC institutions to highlight the impact and value of physics teacher preparation programs.

Blackman completed the Five-Year Physics Education Program at Rutgers, a PhysTEC institution, in 2009, earning a joint master's in education and a teaching certification. Since then, Blackman has inspired both high school physics students and other teachers through innovative educational ideas.

At Ridge High School, Blackman has been instrumental in a dramatic increase in Advanced Placement (AP) Physics enrollment and improved AP test scores. Much of the increase in student enrollment came from Blackman's efforts to improve participation among female students. Since he began teaching, female student enrollment is now over 50%—up from just 20%.

Blackman has also been working to inspire interest in physics outside of his own classroom: He taught himself to code and has designed five free-to-play educational physics games. Teachers in classrooms across the country and around the world—in nearly 60 countries—have used Blackman's games to help students explore physics concepts like kinematics, waves, and electrostatics.

At Rutgers, Blackman teaches courses in the graduate education program and also runs a summer workshop for physics teachers, bringing in 20 teachers per year to learn new ways to interest students in physics.



Matthew Blackman

As PhysTEC Teacher of the Year, Blackman will receive a certificate of recognition, funding to attend two professional physics conferences focused on education and teacher preparedness, and a grant for classroom materials of $1,000.

The local PhysTEC Teachers of the Year will receive a certificate of recognition as well as an official acknowledgment to their school administrators and local press. These winners are:

- Aaron Curry, Dr. Henry A. Wise, Jr. High School, Salisbury University
- David Doty, Cattaraugus-Little Valley High School, Buffalo State College
- Julia Grimes, Westlake High School, Brigham Young University
- Chad Hobby, Timber Creek High School, University of Central Florida
- Kristin Kellar, Talkington School for Young Women Leaders, Abilene Christian University
- Donald Soper, David H. Hickman High School, University of Missouri-Columbia
- Heather Stirewalt, Whittier High School, California State University at Long Beach
- Jamie Vargas, Edison High School, California State University, Fresno

To learn more about PhysTEC and its member institutions, visit phystec.org.

John Robert Schrieffer 1931-2019

BY DANIEL GARISTO

John Robert "Bob" Schrieffer, the condensed matter theorist who explained the quantum rationale underpinning superconductivity, died July 27 at the age of 88.

Schrieffer was responsible for a critical component of the theory: defining the BCS wavefunction. For his work, Schrieffer—the "S" in BCS theory—shared the 1972 Nobel Prize in Physics with John Bardeen and Leon Cooper, and was later awarded the National Medal of Science. Schrieffer was a fellow of the APS and its president in 1996.

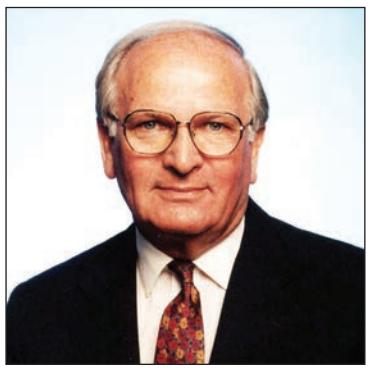
"He was the real discoverer of BCS," said fellow Nobel laureate Philip Anderson (Princeton University). "He took Cooper's pairs and made a real theory out of it."

For decades after superconductivity was discovered by Heike Kamerlingh Onnes in 1911, a mechanism remained elusive. Felix Bloch proposed an explanation, but after his first theorem failed, he proposed his now-famous second theorem: "every theory of superconductivity can be disproved." Schrieffer's work on BCS theory not only solved this supposedly intractable problem in condensed matter physics, but opened the way to a host of applications in other areas of physics.

"The BCS theory of superconductivity may well be the most important piece of theoretical condensed matter physics ever," said Steven Kivelson, a condensed matter theorist at Stanford University, and formerly one of Schrieffer's postdocs.

John Robert Schrieffer was born in Oak Park, Illinois to Louise (Anderson) and John Henry Schrieffer. As a teenager, Schrieffer built radio transmitters and read about physics to supplement a subpar high school curriculum.

He began attending MIT in the fall of 1949 and spent two years studying electrical engineering before switching to physics. Schrieffer graduated and went to the University of Illinois, Urbana-



John Robert Schrieffer

Champaign where he studied under John Bardeen. He was only a third year graduate student when he completed his Nobel-winning work.

According to legend, he was inspired while taking the subway to a conference in New York City. In Schrieffer's understated own telling, the crucial discovery was less momentous.

"So I guess it was on the subway, I scribbled down the wave function

SCHRIEFFER CONTINUED ON PAGE 6

DSOFT CONTINUED FROM PAGE 1

other branches of physics where only a few outstanding questions dominate the discourse. This breadth is a compelling aspect of the soft matter community but also makes it more challenging for researchers to pose the right questions. The result is a unique and "unusually close" interplay between theory and experiment in soft matter physics, in Durian's words. "As an experimentalist I have the opportunity to do theory, and I have theorist friends who have started labs. This is the sign of a vibrant young field."

As a sign of growth, what started as a Topical Group (GSOFT) is now a Division. This comes only five years after the group's original establishment in 2014—an unprecedented pace for achieving Division status. According to APS conventions, a Topical Group is eligible to become a Division once its membership exceeds 3% of total APS membership for two consecutive years. GSOFT petitioned for Division status as soon as its numbers reached this threshold (approximately 1,600); advancing to division status has been the goal since the group's inception.

With Division status, DSOFT is now entitled to a dedicated Division Councilor to represent the unit's views at APS council meetings. Nominations for the position are currently being solicited ahead of elections in the fall. The GSOFT to DSOFT transition will also usher in leadership posts for two graduate student representatives. Daria Atkinson (University of Massachusetts) has already been appointed to fill the first position.

On a symbolic level, DSOFT's new status comes as an important recognition of soft matter as a bona fide subfield of physics. This is long-awaited for the soft matter community, which has historically been decentralized due to the youth of the field and the breadth of its interests.

Notably, soft matter coalesced into a unified discipline only in the 1990s. The term "soft matter" was first popularized by Pierre Gilles de Gennes as the title of his 1991 Nobel acceptance speech. Now considered the father of the field, de Gennes revealed that the methods for studying ordering in simple systems can also be applied to more complex ones like liquid crystals and polymers. His work inspired physicists to apply the tools of statistical mechanics and thermodynamics to less conventional materials at the interface of physics, chemistry, and biology.

Less than three decades later, according to DSOFT chair-elect Zvonimir Dogic (UC Santa Barbara), almost every university has at least one soft matter expert in physics and in engineering. However, despite this impressive explosion in breadth and impact, soft matter researchers have been dispersed throughout other APS units centered on the related areas of biological physics (DBIO), polymer physics (DPOLY), fluid dynamics (DFD), and statistical and non-linear physics (GSNP), leaving less visibility for soft matter as a whole. The hope is that DSOFT will be an umbrella organization for soft matter researchers in all their diversity, while still maintaining synergy with other APS divisions.

Notable avenues of research in soft matter include everything from the so-called "extreme mechanics" of very slender objects, to the use of machine learning to study disordered, far-from-equilibrium systems, to the liquid crystal properties of biological materials. Particular excitement surrounds the topic of active matter, complex particulate systems in which the constituent parts have their own source of energy (such as a flock of birds, a swarm of bacteria, or self-assembling biopolymers). Soft matter encompasses even the physics of knitting—a fascinating example of emergent properties given that a one-dimensional strand of yarn can give rise to an extremely intricate, three-dimensional object, and that combinations of just two simple knit stitches can produce fabrics with vastly different elastic properties.

As these topics suggest, DSOFT is a natural home for interdisciplinary scientists. In fact, Durian underscored that DSOFT intentionally calls itself the Division of Soft Matter (as opposed to "Soft Matter Physics") to signal inclusivity to researchers from physics-adjacent specialties such as engineering, chemistry, geoscience, and biology. Accordingly, approximately one-third of DSOFT's members have an academic home outside of physics. Noted Durian, "of all disciplines within physics, soft matter connects to the most departments across a research university."

DSOFT boasts a diverse membership to complement its diverse subject matter. Vice chair Karen Daniels (North Carolina State University) explained that DSOFT's operating procedures emphasize inclusivity in division leadership, working group sessions, and APS sessions to allow a voice for researchers from underrepresented minorities, smaller institutions, and abroad. As for gender equality, DSOFT ranks among the top APS units in terms of female membership (greater than 20%).

Empowering graduate students and early-career researchers is also a top priority for DSOFT. Dogic explained that with DSOFT's new Division status the organization hopes to dedicate more resources to career development for young scientists—from grants that support conference travel to mentorship to hosting workshops on the various career paths in soft matter physics. In terms of exposing undergraduates to the science of soft matter, Durian noted that many liberal arts colleges are hiring soft matter experimentalists because the field enables cutting-edge research using relatively inexpensive table-top apparatus. Added Daniels, "young people are the ones who will be doing soft matter research for the longest in the future; they're our best investment."

Overall, DSOFT stands out as a long-awaited home for physicists studying the mysteries of the everyday. "The beauty of this field lies in its ability to reinvigorate the intrinsic curiosity about the world known to every child," remarked DSOFT member-at-large Elisabetta Matsumoto (Georgia Institute of Technology). "To the soft matter physicist a mystery lies hidden in every coffee stain, uncombed head of hair, and wrinkled shirt."

More information on this unit can be found here: aps.org/units/gsoft

The author is a freelance writer in Helsinki, Finland.

ADVOCACY CONTINUED FROM PAGE 4

the House, helping it to pass unanimously in the House Committee on Science, Space and Technology

During the House Science Committee hearing, U.S. Rep. Eddie Bernice Johnson (TX-30th), committee chair, touted the bill's importance.

"This is a moral issue—one that demands action to ensure women have equal access to their career of choice. It is also an issue of our economic and national security. The public investment in research needs to draw on all of our nation's talent to return the best possible science for the benefit of society. To reach this goal, we must do more to ensure that all researchers have access to a safe work environment. It does no good to invest in programs to encourage more young girls to pursue STEM studies if they end up in a research environment that drives them away," she said.

Nichols said FGSA members enjoyed their experience working with OGA on the campaign.

"OGA has extensive experience in influencing national policy that physics, and more generally, STEM fields can benefit from. Additionally, OGA is attentive to the pulse of its constituents—APS members, the physics community, and the larger STEM field, so it is in a position to organize effective grassroots campaigns that yield positive results," she said.

Nichols added, "FGSA looks forward to working with OGA on future campaigns when they fall within the purview of enhancing the experience of graduate students in physics and related fields."

The successful partnership between FGSA and OGA serves as an excellent example of how OGA strives to ensure that APS members have their voices heard in science policy arena.

"We understand that the best campaigns involve our helping APS members make contact with their congressional members, so they can influence policy decisions that are important to advancing not only physics but the entire scientific enterprise," said Francis Slakey, APS Chief Government Affairs Officer.

The work toward getting H.R. 36 enacted into law is unfinished, and APS OGA will continue to aim for the goal.

The author is APS Senior Press Secretary.

APS MEDAL CONTINUED FROM PAGE 1

degrees in 1957 and 1960 from Columbia University. Following research associate positions at IBM Watson Laboratories at Columbia University (1961-1962) and at Bell Laboratories (1962-1964), she joined the faculty of City College of the City University of New York as an Assistant Professor of Physics, and was promoted through the ranks to Distinguished Professor in 1995.

In addition to her research, Sarachik has served as a member (and chair) of the Solid State Sciences Committee of the National Research Council, the Human Rights Committee of the New York Academy of Sciences, and the Board of the Committee of Concerned Scientists.

An experimentalist in low-temperature research, Sarachik has investigated superconductors, disordered metallic alloys, metal-insulator transitions in doped semiconductors, hopping transport in solids, strongly interacting electrons in two dimensions, and spin tunneling in nanomagnets.

She received the 1995 New York City Mayor's Award for Excellence in Science and Technology and a 2004 Sloan Public Service Award from the Fund for the City of New York. She is a member of the National Academy of Sciences, and a fellow of the American Academy of Arts and Sciences, the New York Academy of Sciences, and the American Association for the Advancement of Science. She was awarded an honorary Doctor of Science degree by Amherst College in 2006.

"I am absolutely elated to receive this award from APS," said Sarachik. "As one of the very few women physicists when I was young, I fought hard to enter and to stay in the field. Little did I dream that I would become President of the APS (in 2003) leading and shaping policy for the society and traveling throughout the world to represent American physics, or that I would win this incredibly prestigious prize now. The message to my young colleagues is that, with strong commitment and hard work, they too can exceed their own expectations."

The formal award will be made at a ceremony in Washington, DC, on January 30, 2020. In addition, Sarachik is invited to give a presentation on her work at the 2020 APS March Meeting in Denver (March 2-6). The Medal is accompanied by a prize of $50,000.

For more on the award visit the APS Medal page. For more about Myriam Sarachik's life and work, see "Pushing Boundaries: My Personal and Scientific Journey," Annual Reviews of Condensed Matter Physics, vol. 9, p. 1 (March 2018), doi: 10.1146/annurev-conmatphys-033117-054029.

SCHRIEFFER CONTINUED FROM PAGE 5

and calculated the beginning of that expectation value, and I realized that the algebra was very simple," he said in a 1974 oral history.

BCS theory proposed that at sufficiently low temperatures, electrons would pair up with one another, behaving not like fermionic matter, but like bosons. The energy required to break the pairing being greater than the thermal energy, electrical resistance was predicted to disappear—a key feature of superconductivity.

For the first few years, many other theoretical physicists doubted this solution. But by 1961, when Bascom Deaver and William Fairbanks discovered that a superconductor quantized the magnetic field—a prediction of BCS—there was no doubt as to the validity of the theory.

Although Schrieffer's seminal work was done at a young age, he continued to make important contributions to physics. Notably, Schrieffer also worked on solitons in materials like plastic polymers.

"This was the beginning of two important prongs in condensed matter physics that we've seen blossom into major fields," said Kivelson. Schrieffer's work on solitons was among the first efforts to investigate fractionalized charge and how topology affects electronic properties in matter.

In the early 1990s, Schrieffer became interested in high-temperature superconductivity, and moved to Florida to head the National High Magnetic Field Laboratory. According to friends and colleagues, Schrieffer, who was bipolar, began to behave manically around this time. He refused to take medication for his condition and acted erratically at conferences.

Schrieffer's health continued to worsen. In 2004, he fell asleep while driving and crashed, killing one and injuring seven others. He spent two years in prison and never returned to physics.

Students and colleagues, though, remembered him fondly. In leadership roles, notably as director of the then-Institute for Theoretical Physics in Santa Barbara, he became well-known as a mentor.

"Bob was the best mentor you could possibly imagine. Kind, supportive, encouraging, and critical when necessary," said Kivelson.

Many physicists also admired Schrieffer's approach to physics—a visual, concrete way of understanding that didn't skimp on mathematical formalism.

"He explained complicated ideas in a very lucid and transparent fashion full of physical intuitions," said Wu-Pei Su, a physicist now at the University of Houston and former student of Schrieffer.

Sometimes, he taught through experience. The night before Doug Scalapino's first speech at a conference, Schrieffer coaxed him to say just a few words into the microphone. Scalapino, then Schrieffer's graduate student, reluctantly assented to the strange request. As soon as he spoke, a deafening echo came back due to the auditorium's bad acoustics. The next day, Scalapino was prepared. Schrieffer didn't need to say a thing.

"He was a remarkable man," said Scalapino. "He certainly knew what he had done and what he could do. Perhaps, for those reasons, he was very careful with how he interacted with people, and was just a marvelous human being."

The author is a science writer based in Bellport, New York.

PRR CONTINUED FROM PAGE 1

in Chief Michael Thoennessen describes the rationale behind the structure of the editorial leadership for the new journal.

"To effectively cover the topical breadth and geographic range of this multidisciplinary, international peer-reviewed journal, we have committed to appointing a diverse and global team of esteemed active researchers to serve as Lead Editors and Editorial Board members," explains Thoennessen. "I am extremely pleased to announce that Professors Raissa D'Souza, Jian-Wei Pan, and Nicola Spaldin have agreed to serve as the founding co-Lead Editors of *Physical Review Research* and represent the journal within their respective regions and research communities."

The second editorial is co-authored by D'Souza, Pan, Spaldin, and Liétor-Santos, and lays out the editors' shared vision for *Physical Review Research*. "In addition to maximizing reach and readership through open access, by covering the full scope of activities in physics and associated disciplines, we will provide an integrated and cohesive view of the forefront of modern physics for our readers and create an outlet for research that addresses the interdisciplinary challenges that we face in modern society."

The editors also define the relationship between the new journal and the other titles in the *Physical Review* family, noting that the editorial standards and acceptance criteria of *Physical Review Research* are similar to those of *Physical Review A-E*, *Physical Review Applied*, *Physical Review Fluids*, and *Physical Review Materials*. "Our goal is to establish a publication that offers the same experience and quality that we value and trust, while increasing authors' choice within the *Physical Review* portfolio," note D'Souza, Pan, Spaldin, and Liétor-Santos in their editorial. "As such, we welcome authors of quality manuscripts not accepted by *Physical Review X* or *Physical Review Letters* to seamlessly transfer their work to be considered for publication in *Physical Review Research*."

As the fourth fully open access, online-only journal published by APS, all *Physical Review Research* content is immediately free to read upon publication and allows reuse by readers world-wide under a CC-BY 4.0 International license. To allow all authors an opportunity to experience this exciting new offering, APS is waiving article publication charges (APCs) for all manuscripts submitted in 2019 and subsequently published in *Physical Review Research*.

"All of us at APS who are involved with the *Physical Review* journals care deeply about their ongoing significance to science, are excited about this new endeavor, and are dedicated to delivering the excellence our communities expect from us via this new member of the journal family," states Thoennessen in the closing lines of his editorial. "We hope that *Physical Review Research* will initiate conversations across traditional boundaries, reveal new opportunities for collaboration, and facilitate future discoveries, and thus directly support the aim of the APS to advance scientific discovery and research dissemination."

PIPELINE CONTINUED FROM PAGE 3

physics with innovation, which is [a lack of] knowledge and confidence that physics students have when turning physics into something practical," says Randy Tagg, Principle Investigator (PI) for the University of Colorado Denver's PIPELINE projects. "As part of the PIPELINE grant I've been trying to figure out a way to actually incorporate practical knowledge into regular physics curriculum."

As part of the PIPELINE Network, Tagg has implemented a two-semester sequence at the University of Colorado to give students a chance to learn practical skills like building circuits and assembling optics. The curriculum for these courses will be available through the PIPELINE Network, along with resources produced through the other institutions.

Throughout the three years of work on the PIPELINE Network, contributors at each university kept in contact, sharing notes and experiences through regular check ins, monthly video conferences, and one-on-one visits to collaborating institutions.

Tagg was a contributor to the Utah workshop, which took place at AAPT's 2019 Summer Meeting. Like the larger efforts of the PIPELINE Network, the workshop focused on how to help students learn the four skill sets outlined by the *Phys 21* report.

Bahram Roughani and Randall Jones, co-PIs for PIPELINE at Loyola University gave the first session at the workshop, focusing on a framework they've developed to incorporate real world physics applications into a regular introductory physics class. Tagg, assisted by University of Colorado lab managers Devin Pace and Kristopher Bunker, brought the apparatus they designed to teach students technical competencies and discussed the challenges with helping students grasp this knowledge.

Wouter Deconick from the College of William and Mary gave a shortened version of his three-week workshop on techniques for project management. His course will be available as a webinar through the PIPELINE network. Doug Arion, the PIPELINE advisor from Carthage College, finished out the workshop with a section on how to teach students oral and written communication skills.

Now that the PIPELINE's original three-year mission is up, the goal now is to disseminate what the Network has learned and created to other physics institutions.

"My aspiration is that we see a widening impact, with many more institutions thinking about how to build a curriculum that gives students learning opportunities, both formal and informal, around physics education," says Tagg. "I hope that we'll eventually develop a community of people who are really seeing this bear fruit."

For more on the PIPELINE project visit aps.org/programs/education/innovation/pipeline/. Additional APS Careers in Physics information is available at aps.org/careers/.

FUND CONTINUED FROM PAGE 1

ideas from our members. Our intent is to promote innovative ideas that engage the community and improve the discipline."

The four funded proposals are:

More Humane APS Meetings through Machine Learning: With multiple tracks and thousands of talks, the large annual APS meetings can be overwhelming. This project would test whether machine learning and natural language processing could help improve the member experience at APS gatherings. The goal would be to accurately identify talks on similar subjects and help attendees plan their schedules more effectively. Meeting organizers could also use these algorithms to better sort abstracts to reduce overlap and streamline the conference experience. Project Lead: Tim Atherton (Tufts University).

APS Inclusion, Diversity, and Equity Alliance (APS-IDEA): Physicists have been increasingly concerned with matters of equity, diversity, and inclusion within the field. This project will bring together representatives from about 30 physics departments to form a national leadership network to exchange ideas, explore effective practices, and develop strategic plans. By leveraging existing initiatives of APS and other organizations, the goal is to transform the culture of physics to advance equity, promote diversity, and establish an inclusive profession. Project Leads: Edmund Bertschinger (MIT), Geoff Potvin (Florida International University), and Monica Plisch (APS Programs Director).

Informing and Activating the U.S. Physics Community in Nuclear Threat Reduction: Today, the global threat from nuclear weapons remains grave and is worsening. In addition to concerns about existing nuclear arsenals, international tensions continue to rise over the threat of nuclear weapons proliferation. This project will educate and reengage the powerful voice of the physics community and the APS membership on this pressing and globally important issue. A team of experts will visit physics institutions, present overviews, conduct discussions, and build a coalition of volunteers to advocate for nuclear threat reduction measures. Project Leads: Stewart Prager, Alex Glaser, Zia Mian, and Frank von Hippel (Princeton University); Steve Fetter (University of Maryland).

U.S.–Africa Initiative in Electronic Structure: Strengthening relationships throughout the international physics community is a core part of the APS mission. This project will create a platform for collaborations between African and U.S. physicists in the form of workshops for participants to meet and identify common interests in the field of electronic structure calculations. The first workshop will take place in Africa, followed by a second workshop in the U.S., after which African researchers will visit a U.S.-based research group to give seminars and collaborate on a research project. Project Leads: Omololu Akin-Ojo (East African Institute for Fundamental Research, Rwanda), Richard Martin (University of Illinois), and Renata Wentzcovitch (Columbia University).

APS expects to put out a call for another round of IF proposals next year. "It was a selective process and a lot of work, but I look at this kind of activity as an experiment," said Gross. "I think it's really important for APS to do what scientists do all the time: experiment and see what happens. I have a lot of respect for physicists and, when given resources, they are very imaginative."

The Innovation Fund Committee: David Gross (co-chair, APS President), Ted Hodapp (co-chair, APS Director of Project Development), Andrea Liu (APS Council Speaker-Elect), John Rumble (APS Speaker of the Council), Francis Slakey (APS Chief Government Affairs Officer).

For more details on the Innovation Fund, visit aps.org/programs/innovation/fund/

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Conclusion

In its briefing to us, the FBI compared the danger posed by Chinese scientists working in U.S. research groups to cancer, which remains invisible only to manifest itself many years after the initial DNA damage occurs. We note that an overactive immune response to cancer leads to autoimmune disease, which is potentially even more deadly. An over-reaction to security risks can endanger U.S. physics, which relies upon international participation in research. Every country must evaluate the policies necessary for being internationally collaborative and globally competitive. For its part, APS will continue to engage vigorously in discussion with policymakers to help ensure a healthy balance between security concerns, openness, and the essential contribution international scientists make to the U.S. research enterprise.

David Gross is Chancellor's Chair Professor of Theoretical Physics and former Director of the Kavli Institute for Theoretical Physics at UCSB. Roger Falcone is Professor of Physics at the University of California, Berkeley. Philip H. Bucksbaum holds the Marguerite Blake Wilbur Chair in Natural Science at Stanford University, with appointments in Physics, Applied Physics, and in Photon Science at SLAC. S. James Gates, Jr. is Ford Foundation Physics Professor and Affiliate Mathematics Professor at Brown University.

THE BACK PAGE

Openness, Security, and APS Activities to Help Maintain the Balance

BY THE APS PRESIDENTIAL LINE: DAVID GROSS (PRESIDENT), ROGER FALCONE (PAST-PRESIDENT), PHILIP H. BUCKSBAUM (PRESIDENT-ELECT), S. JAMES GATES JR. (VICE PRESIDENT)

The success of the scientific enterprise of any nation requires maintaining a balance between being openly collaborative and securely competitive. Recently, in the United States, the current balance has been questioned by policymakers and by law enforcement and intelligence officials who are concerned about espionage and intellectual property loss impacting universities, companies, and government agencies. Many APS members, particularly those on visas studying or working in the United States, are likely concerned about various actions of US government agencies that can affect the openness of the scientific enterprise.

APS stands for the principle that the scientific enterprise thrives when openness and the free flow of long-term research results are the norm. Of course, we understand that in some areas of research it is essential to have appropriate controls in place. Many APS members are employed by national labs that work on highly sensitive issues that require the utmost attention to security and necessitate a classified environment. Other APS members work in industries or academic settings where they must be protective of intellectual property (IP). The urgent question we face is whether the actions taken or being proposed by the U.S. Government are an appropriate response to risks or are instead tilting away from a healthy balance.

We outline below our vigorous efforts to maintain the appropriate balance and support our members.

Clarifying the Problem

In February, the APS Presidential line, working with the APS Office of Government Affairs (OGA) and the APS Physics Policy Committee, received unclassified briefings from the Federal Bureau of Investigation and the Office of the Director of National Intelligence.

In addition, we have met with relevant leadership at the U.S. State Department, the Commerce Department, the Department of Defense, the White House National Security Council, and the Office of Science and Technology Policy. We have also discussed the issue and potential responses with science agencies including the National Science Foundation and Department of Energy.

What did we learn?

While we have not been presented with any hard data regarding the breadth or impact of possible espionage, in our view the discussions offered compelling anecdotal evidence of cases that have impacted industry, classified research, and applied research. The U.S. Federal Bureau of Investigation (FBI) has documented some of the cases in a publicly accessible document titled "China: The Risk to Academia" (go.aps.org/30gFCyL).

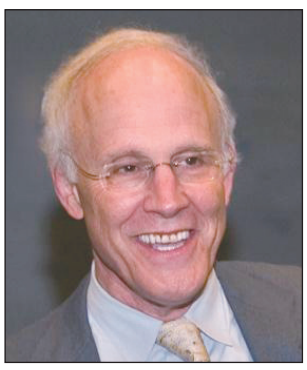
However, that FBI document does not provide cases of threats relating to unclassified basic research in academia. Further, the "annual cost to the U.S. economy" it identifies as "$225 - $600 Billion" turns out to be primarily based on a generic GDP multiplier that would apply to *any country* at *any time*—it has no specific bearing on current circumstances with China or academia, as the title of the document unfortunately suggests.

The Response of Federal Science Agencies

Independent reviews of the risks by the U.S. science agencies, including the National Institutes of Health, the National Institute of Standards and Technology, and the National Science Foundation, have uncovered issues that need to be addressed. These include intentional non-disclosure by principal investigators of financial ties, theft of experimental designs, unauthorized distribution of papers that have been provided for peer review, and establishment of "shadow labs" without full declaration by the researchers to their host institution. These cases have been primarily associated with China, suggesting a deliberate focus by—or on—China.

The NSF has not yet imposed new or revised external policies. Instead, their first step is to ask all principal investigators for more detailed information to uncover any conflicts of interest. The next step the agency is taking is to contract with an independent group of security experts (the JASONs) to assess the risks of espionage and IP theft and the benefits of international collaboration. That information will help inform any future policy change.

For its part, the U.S. Department of Energy (DOE) has identified seven "activities of concern" including: theft of proprietary or patented information, unauthorized access to export-controlled technology, misuse of lab resources for foreign projects, unauthorized transfer of information outside the US, misuse of information technology, failure to uphold host responsibilities, and recruitment activities.



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DOE's response thus far has focused on responding to recruitment activities. The agency has issued a new policy that employees of the national labs cannot participate in a foreign "talent program" (go.aps.org/2ZdMefP). This policy, as described by the Undersecretary for Science Paul Dabbar, "...has nothing to do with ethnicity or passport; it's simply that you can't work for our country and another country at the same time, no matter who you are."

In addition to that policy, the DOE is developing a "risk matrix"—emerging technologies vs. countries of concern—with policy responses to follow. The emerging technologies include: AI, battery chemistry, biotechnology, quantum information science, accelerator science, and high performance computing. The countries of concern include: China, Russia, North Korea, and Iran.

DOE has stated that any policy changes will be initiated at the national labs. Only after evaluation, and consultation with universities, would the agency apply those policies to grantees in academia.

The APS Response: Espionage

We will continue to have meetings with government officials to discuss any proposed policy responses and we'll continue to make the case that security concerns must be balanced against the value of keeping the scientific enterprise open and collaborative. In addition, we and APS OGA, and the APS Office of International Affairs, have also been carrying out numerous additional activities in response to the concerns about espionage and IP theft:

NAS Roundtable

It is essential for the Administration and the science agencies to develop informed policies, using adequate data that appropriately characterize the threat, identify the benefits of any response, and assess the impact of any response to a potential threat. To that end, last November, we began meeting with leadership of the National Academy of Sciences (NAS) to establish a roundtable of experts to assess risks, identify benefits, and examine potential policy responses.

SASTA

APS contributed to the work of congressional staff on the House Science Committee to develop the bipartisan Securing American Science and Technology Act of 2019 (go.aps.org/31Mn9dx). It establishes an interagency working group to coordinate activities to protect federally funded research and development from foreign interference such as espionage while "accounting for the importance of the open exchange of ideas and international talent required for scientific progress and American leadership in science and technology." It also formally authorizes the establishment of the aforementioned NAS Roundtable. In late June, SASTA was included as an amendment in the House version of the fiscal year 2020 National Defense Authorization Act.

Engagement with Chinese physicists

As a means to maintain and advance a common understanding of the balance between collaboration and security, we believe it is valuable for the U. S. physics community to sustain a dialogue with physicists in China. And so, we are exploring ways to convene a representative body of our respective leadership and members to engage in conversation.

The APS Response: Scientific Mobility

Amid the discussion of espionage and IP theft and the policy responses directed at China, we have grown increasingly concerned about the declining number of applications from international students to U.S. Ph.D. programs. A 2018 APS survey of 49 of the largest physics Ph.D. programs at U.S. institutions revealed an average decline of nearly 12 percent in international applications between 2017 and 2018 (see *APS News* story at go.aps.org/2OCNXGU). The concerns of espionage, and the current atmosphere around discussions of immigration, may only exacerbate that decline.

A top priority for APS is ensuring that the U.S. research enterprise remains world leading. One measure of that is ensuring that domestic students pursue careers in physics—and APS has established education programs to directly address that challenge. In addition, we also want to be sure that U.S. universities continue to attract the best students in the world, regardless of their country of origin. So, to track and respond to the decline in applications, APS has responded in several ways:

Senate Legislation

To help counter the decline in international applications to U.S. Ph.D. programs, APS has advocated for policies that allow international students to remain in the United States after graduation, and build a STEM career that contributes to the U.S. science enterprise. To advance that policy in Congress, APS worked with its members in target states and enabled in-state meetings for APS members and congressional staff. That effort led directly to the introduction of legislation that would enact the policy, the "Keep STEM Talent Act" (go.aps.org/31GjQVk).

House Resolution

It became clear in our conversations with staff in the Administration and numerous congressional offices, that there was a lack of awareness of the role that international scientists play in the U.S. scientific enterprise. With concerns over espionage and IP theft, some staff simply thought that banning foreign students from entering the U.S. could "solve the problem." To counter that misperception in a format that government staff are familiar with, APS is working with congressional staff to develop a Congressional Resolution that clarifies and quantifies the essential contribution of international students and scientists.

Survey of International Students

To explore additional ways to resolve and address the decline in applications, APS deployed a second survey (go.aps.org/2z9F164). Circulated to members of the APS Forum on Graduate Affairs (FGSA), the survey asks students about their experiences with U.S. visa and immigration processes.This is the first time a wide-spread, systematic approach has been taken to understand visa issues encountered by physics students who wish to study in the US.

Monitoring of Travel Visas

APS will continue to provide visa application guidance and information through its Office of International Affairs - Visa webpage (go.aps.org/2z9GysA), to enable scientists to engage in international meetings and collaborations. Here, visitors can learn about the visa application process, estimate wait times for visa interviews and processing, and find out how to report delays. Likewise, meeting organizers can learn how to register international meetings with the U.S. Department of State, along with the crucial information to provide to international meeting attendees.

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