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APS NEWS

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HONORS

2020 LeRoy Apker Award Winners Reflect on Undergrad Research and Pandemic Presentations

BY LEAH POFFENBERGER

In an effort to provide encouragement to young physicists with potential for future discoveries in physics, each year APS presents the LeRoy Apker Award to two recipients for outstanding undergraduate research. In a typical year, eight finalists are invited to Washington, DC, to present their research to a panel of judges, but the 2020 selection meeting in August saw finalists making their case over Zoom.

Despite the curveball of having to go fully online during a pandemic, all of the 2020 finalists gave exciting talks on their research, with two emerging as winners. EliseAnne C. Koskelo (Pomona College) and Nicholas Poniatowski (University of Maryland, College Park) both impressed the Apker Selection Committee with their undergraduate research. *APS News* caught up with Koskelo and Poniatowski, now both in graduate school, to look back at their Apker experiences.

EliseAnne C. Koskelo

Nicholas Poniatowski

Koskelo graduated from Pomona College with a BA in Physics and Math in May 2020 and is now pursuing a master's degree at the University of Cambridge as a Churchill Scholarship recipient. Her senior thesis research, exploring stochastic techniques to enhance the resolution of thermoreflectance imaging, formed the basis of her Apker-winning presentation.

In May, instead of having a graduation ceremony, Koskelo was hard at work putting the finishing touches on her thesis and a journal paper manuscript, which made their way into both her Apker application and formed the basis of her August talk.

"Preparing for the Apker presentation was just trying to put [my] manuscript into a short talk and making it interesting to a wide variety of physicists," says Koskelo,

APKER CONTINUED ON PAGE 7

DIVERSITY

APS Joins the CEO Action for Diversity and Inclusion Pledge

BY DAVID VOSS

On January 11, APS CEO Jonathan Bagger joined more than 1,600 other chief executives and organization presidents in signing the CEO Action for Diversity and Inclusion pledge (ceoaction.org). The pledge commits the signatories to advancing diversity and inclusion in the workplace through concrete action and accountability.

Specific actions listed in the pledge include establishing trust for difficult conversations about diversity and inclusion; expanding unconscious bias education in the workplace; sharing best practices as well as unsuccessful efforts; and creating strategic diversity and inclusion plans in concert with the organizations' board of directors.

In signing the pledge, CEOs are asked to offer examples of successful actions to advance diversity and inclusion in their organizations. Bagger pointed to three: (1) formation at APS of a Diversity, Equity, and Inclusion

Jonathan Bagger

Working Group to obtain employee input on actions APS can take to drive positive cultural and policy change within the Society; (2) on June 10, 2020, in the wake of the killings of George Floyd, Breonna Taylor, and others, APS closed for business to stand in solidarity with the Black community and asked employees to use the day to reflect and take action to eradicate

CEO PLEDGE CONTINUED ON PAGE 6

MEETINGS

March Meeting 2021 Hits the Web

BY LEAH POFFENBERGER

In lieu of the typical bustling March Meeting, packing thousands of physicists from around the world into a huge convention center, APS is taking the 2021 March Meeting online. From March 15 to 19, the same exciting, high quality physics content that attendees have come to expect will make its way into offices, living rooms, or anywhere with a computer, with new events designed for the online meeting experience.

The 2021 March Meeting will feature speakers and attendees representing 30 APS units and committees, with more than 10,800 abstracts submitted. Scientific sessions taking place from 8:00 am to 5:30 pm (CT) each day will mirror the usual March Meeting schedule, but the online format will introduce added flexibility to watch some sessions live and others on-demand.

Attendees can register for pre-meeting events taking place on March 13 and 14, including short

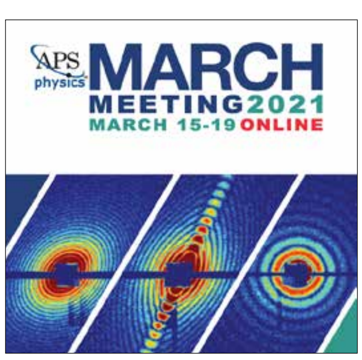

Image inspired by diffraction patterns of pure ^{3}He droplets shown on a logarithmic color, from Deepak Verma *et al.*, *Phys. Rev. B* **102**, 014504 (2020).

courses hosted by the APS Division of Polymer Physics and the APS Division of Soft Matter, and tutorials, ranging in topics from noisy quantum devices to data analysis and visualization. Also on March 14 is Women Make the World Go Round: A Pi Day Wiki Edit-a-thon,

ONLINE CONTINUED ON PAGE 7

CAREERS

Career Mentoring Fellows Empower the Next Generation of Physicists

BY MIDHAT FAROOQ

APS has identified the career and professional development of students and early career physicists as a priority. While the APS Careers team leads various projects, such as creating career guides, conducting webinars and workshops, and more, to support the next generation of physicists, we have found that mentoring works best on a smaller and more local scale. This idea led to the creation of the Career Mentoring (CM) Fellows program.

In Fall of 2019, applications were accepted, and an inaugural cohort of 24 CM Fellows was selected based on their mentoring experience, volunteer roles, interest in physics careers, and diversity, equity, and inclusion (DEI) statements.

The first major responsibility was to provide feedback on undergraduate student presentations at the APS March and April Meetings. To prepare the cohort for this important task, all mentors attended an implicit bias training session, which also covered best practices for giving constructive feedback. Due to the 2020 March Meeting cancellation, they were not able to attend the talks as planned. However, as APS staff worked hard to conduct the April Meeting online, two CM Fellows volunteered to provide feedback on the virtual talks and

Jenna Walrath

Jan Kleinert

three more served on career panels during the Meeting.

Another major component of the program is that Fellows give a career talk at a physics department of their choice. APS Careers created and provided training on a slide deck containing data on physics career paths, collected and analyzed by the American Institute of Physics and NSF, as well as career guidance resources developed by APS.

Despite the pandemic, the Fellows gave 14 virtual talks to a total of more than 200 students. Survey results indicate that both undergraduate and graduate students gained a broader understanding of career paths available to them, and a majority agreed that they felt better about choosing physics as their field of study and saw the impact physics training can have on the world. These outcomes directly align with the goal of APS Careers and we hope to continue the program to train more career mentors and reach more students and early career scientists in the coming years.

Jenna Walrath is a Technology Development Group Leader at Intel Corporation. After serving on the APS Committee on the Status of Women in Physics, Jenna continues to volunteer for programs benefiting the physics community. She shares comments on her experience as a CM Fellow with the first cohort:

When I heard about the Career Mentoring Fellows Program, I was excited to participate. As an undergraduate, I remember avidly seeking out every opportunity to learn about career paths, especially

CAREERS CONTINUED ON PAGE 5

JOURNALS

Uwe Täuber Selected as Lead Editor for *Physical Review E*

APS has selected Uwe Täuber, Professor of Physics and Director of the Center for Soft Matter and Biological Physics at Virginia Polytechnic and State University (Virginia Tech), as the new Lead Editor of *Physical Review E*. He started his tenure at the journal on January 1, taking over from the previous editor, Eli Ben-Naim (Los Alamos National Laboratory), who served in the position from 2012 to 2020.

"I am looking forward to working with Uwe in his new role. His broad background and experience will be invaluable in guiding the journal in the future." said APS Editor in Chief Michael Thoennessen.

"Uwe replaces Eli Ben-Naim who has served expertly in this role for more than eight years and I would like to thank him for his great commitment and dedication to the journal."

Täuber, an APS Fellow, received his doctoral degree from the Technical University of Munich in 1992 with a dissertation entitled "Coexistence anomalies in the dynamics of isotropic systems." After postdoctoral research at Harvard University and Oxford University, he joined the faculty of the physics department at Virginia Tech in 1998. Täuber was appointed Director of the Center for Soft Matter and Biological Physics in 2016.

Uwe Täuber

"I am honored and thrilled to assume the position of Lead Editor for *Physical Review E* during a time when scientific publishing is experiencing tremendous and challenging changes, with more unexpected developments likely in the wake of the COVID-19 pandemic." said Täuber.

"*Physical Review E* is a truly interdisciplinary journal whose profile extends well beyond the traditional physics realm to a broad research community in science and engineering. I look forward to collaborating with the journal's exceptional, dedicated staff and editorial board, as well as the American Physical Society's leadership to maintain the journal's eminent quality and reputation."

THIS MONTH IN

Physics History

February 5, 1963: Maarten Schmidt discovers first known quasar

In 2020, Roger Penrose shared the Nobel Prize in Physics for "the discovery that black hole formation is a robust prediction of the general theory of relativity." That work is directly linked to the study of quasars—the brightest known objects in the universe—in the 1960s. It was a flash of inspiration by an astronomer named Maarten Schmidt that yielded an explanation for the incredibly powerful sources of radiation astronomers had been seeing in the galaxy: matter falling into massive black holes.

Artist's rendering of the accretion disk in ULAS J1120+0641, a very distant quasar powered by a supermassive black hole with a mass two billion times that of the Sun. IMAGE: ESO/M. KORNMESSER

Schmidt was born in 1929 in Groningen, The Netherlands. His father was a government official who wound up being in charge of the national accountants at the Hague. When the Nazis occupied Holland during World War II, his father's profession helped spare the family the worst of treatment suffered by many of their compatriots, although both Schmidt's father and brother were among those forced to dig ditches for the German occupation. A failed Allied advance in late summer 1944 resulted in the Nazis dismantling the country's railroads, sending the iron to Germany. With the transport system destroyed, famine set in, claiming tens of thousands of lives.

Nonetheless, young Maarten fell in love with astronomy during that time. The enforced blackouts made it possible to see the night sky even in a big city, and Schmidt's father would often take him on nighttime walks so long as there were no air raid alarms. In 1942, Schmidt was even able to visit his uncle, Dik Schmidt, in the city of Bussum, who was an amateur astronomer.

"He showed me the sky through his telescope on an upper floor of his pharmacy," Schmidt later recalled. "I found a lens at my paternal grandfather's workshop and soon put my first little telescope together." Eventually, despite all the shortages of food and materials, he was able to polish mirrors for use in an improved telescope. Schmidt was also able to visit the local observatory, where he met an astronomer named Adriaan Blaauw, who later became a cherished colleague.

Canadian troops finally liberated the city of Groningen in April 1945. Schmidt recalled being caught between Canadian and German troops on the second day of battle, "in the firing line of the Germans. We spent much of the night on the kitchen floor in the back of the house—looking through the window we could see the sky, blood red as the center of Groningen was on fire." With the war finally over Schmidt was able to finish high school, and enrolled at Groningen University in 1946 to study physics, math, and astronomy.

After graduating, Schmidt served as an assistant to Jan Oort at Leiden University, but his tenure there was briefly interrupted when he was called into military service. Fortunately, the conflict in the Dutch East Indies that had precipitated that call ended quickly, and he was released from his obligation after a couple of months following basic training. He returned to Leiden and began studying the brightness behavior of comets, at Oort's urging, ultimately contributing to the discovery of what is now known as the Oort cloud of comets around our solar system. Schmidt also spent a year on an observational expedition to Kenya.

He completed his PhD in 1956, and he was offered a Carnegie Fellowship at Mount Wilson Observatory in Pasadena, California. He would eventually emigrate to America in 1959 to become a professor at the California Institute of Technology, and he was soon making observations with the Palomar 200-inch telescope, studying star formation, and how the abundance of heavy elements increased with cosmic time. His interest gradually shifted to radio sources in the night sky.

It was the advent of radio astronomy that led to the detection of the first quasars, objects that emitted large amounts of radiation across many frequencies but without any obvious optical

HISTORY CONTINUED ON PAGE 5

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OBITUARY

Jack Steinberger 1921-2020

BY DAN GARISTO

Jack Steinberger, a creative experimentalist who tackled a swathe of open questions in particle physics—from pion spin to strangeness to CP violation—died December 12 at the age of 99.

He was best known, though, for research on neutrinos. In 1962, using a novel design to create a beam of pure neutrinos, Steinberger and his colleagues observed that neutrinos came in not one, but two kinds, a finding that had monumental implications for particle physics and the subsequent development of the Standard Model. For the discovery, Steinberger shared the 1988 Nobel Prize in Physics with two colleagues, Melvin Schwartz and Leon Lederman. Steinberger was also a recipient of the National Medal of Science.

"He was a superb engineer as well as a superb physicist," said Norman Gelfand, a student of Steinberger. "He loved music. He would spend time [with] and give credit [to] anybody. He was not an elitist by any stretch of the imagination. He was passionate about his opposition to nuclear weapons."

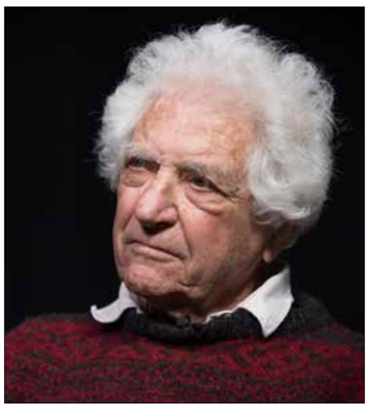
The son of a synagogue cantor and English teacher, Jack Steinberger was born Hans Jakob Steinberger in Bad Kissingen, Germany. When he was only 13, fears of anti-Semitism led his parents to send Jack and his brother Herbert to Illinois, where they stayed in foster homes until the family reunited. He attended New Trier High School, to which he later donated his Nobel medal.

In 1942, Steinberger received his bachelor's degree in chemistry from the University of Chicago and married his first wife, Joan Beauregard without pomp. There was no ceremony (their only wedding present was a candy bar), and he promptly joined the war effort with the Army Signal Corps at MIT. After the war, Steinberger returned to the University of Chicago to study physics under Enrico Fermi, where he was among the first to find that muons decayed into three particles—a finding that would foreshadow his later discoveries.

Steinberger, in his own words, had "leftist sympathies" throughout his life. But in Berkeley's Radiation Lab in 1950, as McCarthyism swept the country, he paid a price for it. Steinberger was asked to sign a loyalty oath against communism. He refused and was subsequently fired.

"His standing up for principle and not signing the loyalty oath tells you a lot about him as a person," Gelfand said.

Within the year, Steinberger found employment at Columbia University, where he would make some of his most important contributions to physics. During the 1950s, Steinberger put his engineering background to work and built several state of the art bubble chambers which he used to measure the strange decays of pions, which led to results like the discovery of the sigma hyperon.



Jack Steinberger

By the early 1960s, theory pointed toward the possibility that the recently observed neutrinos might come in multiple kinds. Steinberger, working with colleagues, developed a powerful way of producing the elusive particles. They fired 15 GeV protons at beryllium target, creating pions, which decayed into muons and neutrinos before slamming into 44 feet of steel from the decommissioned battleship USS Missouri. Only the neutrinos made it through the steel, into a spark chamber. In a landmark paper in *Physical Review Letters*, Steinberger and his coauthors concluded that "The neutrinos we have used produce μ mesons but do not produce electrons, and hence are very likely different from the neutrinos involved in β-decay."

It was also a tumultuous time in his personal life—Steinberger and his first wife separated, and he married Cynthia Alff, then a Columbia graduate student. They remained together for over a half century.

After a 1964 sabbatical at CERN working with Carlo Rubbia on CP violation, Steinberger and Alff—in part due to the Vietnam War—made the choice to move to Geneva, where he would spend the rest of his physics career. Steinberger's last experiment was ALEPH, a particle detector on LEP, which produced a number of critical results, including a fitting career capstone: the number of neutrino generations (2.990 ± .015 by 1995).

"He was somebody you could talk to," said Monica Pepe-Altarelli, a CERN physicist who worked on ALEPH. "But Jack could also be intimidating because he had these very piercing blue eyes and that very logical way of thinking."

Outside of physics, Steinberger was animated by social issues like climate change and nuclear nonproliferation and education. A passionate outdoorsman, he enjoyed sailing and rock climbing, in which he found parallels to physics.

Steinberger remained a fixture at CERN for years after retiring, showing up at his office to read papers, and attending talks which he would appear to sleep through, until the end, when he would ask perceptive, penetrating questions.

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

MEMBERSHIP UNITS

The APS Forum on International Physics

BY ABIGAIL DOVE

From climate change to cybersecurity to nuclear safety, physics principles are deeply tied to today's most pressing global issues. This is especially apparent in today's COVID-19 era, requiring an understanding of viral particle diffusion and the development of reliable and efficient mechanical ventilators. Against this backdrop, the APS Forum on International Physics (FIP) is a home for physicists who are passionate about advancing the international diffusion of physics knowledge and fostering collaborations among researchers across the world. Core to the Forum's mission is the understanding that global collaboration drives scientific innovation and that international cooperation and exchange in physics education and research is essential for strengthening science across the world.

FIP is a global community with significant participation of scientists abroad. Approximately 34% of FIP's nearly 4,000 members are based outside of the United States (compared to 23% of APS members overall), with members hailing from Canada, India, China, Japan, the United Kingdom, Germany, France, Switzerland, and Italy, to name a few. FIP also has considerable engagement from young physicists: 42% of FIP's members are graduate and undergraduate students or early career scientists (i.e., postdocs and junior professors).

According to outgoing FIP chair Luisa Cifarelli (University of Bologna), a unifying theme across FIP's activities in the near future is the promotion of physics for development. "I am convinced that FIP should increase and foster its engagement toward scientifically emerging countries," she remarked.

Incoming chair Alan Hurd (Los Alamos National Lab) explained that a great deal of FIP's early development work has been with a handful of specific partner countries—including Jordan, Iran, and Pakistan—which already have excellent institutions and research facilities in place. As FIP grows, the goal is to engage with an even wider array of developing countries, including those without a strong existing physics infrastructure.

Along these lines, one of FIP's major outreach programs is Physics Matters, an online colloquia series for students and early career scientists in developing countries. Newly launched in 2020, the first Physics Matters series consisted of five weekly seminars on topics ranging from the measurement of cosmic rays at unprecedented northern latitudes to the fundamentals of navigation systems and timekeeping to the 2019 redefinition of the SI base units (see *APS News* May 2019), all of which are still available to watch on FIP's Facebook page. A second Physics Matters series is slated for 2021, hopefully with the addition of live online colloquia to further increase engagement.

Cifarelli, who spearheaded the development of Physics Matters, explained that FIP's long-term goal is to enlarge the audience for Physics Matters to as many developing countries as possible, possibly in collaboration with other

APS forums such as the Forum for Early Career Scientists (FECS; see *APS News* January 2019), the Forum for Graduate Student Affairs (FGSA), and the Forum for Outreach and Engaging the Public (FOEP; see *APS News* October 2019).

FIP also sponsors a number of invited sessions at both the APS March and April Meetings, bringing awareness to the wider APS community about international perspectives on science, funding, organization, and international cooperation. Past sessions have highlighted examples of physics research conducted in the developing world, the importance of science diplomacy, and the role of physics in addressing global issues—often in collaboration with FECS and the Forum for Physics and Society (FPS; see *APS News* September 2020).

Additionally, FIP sponsors a number of travel programs to support and empower scientists in developing countries. For example, FIP recently more than doubled its contribution to the APS International Travel Award Program (IRTAP), which supports visits for collaborations among partners from developed and developing countries. Furthermore, FIP's Distinguished Scholars program provides financial support to bring outstanding students from outside the US to APS meetings, which, as Cifarelli pointed out, can be a "career-changing experience." FIP also sponsors the biennial Wheatley Award, which recognizes outstanding contributions to the development of physics across the globe.

Looking to the future, the FIP executive committee's goals are two-fold: Looking outward, to expand FIP's influence internationally; looking inward, to increase diversity within FIP's ranks.

On the former, Hurd described FIP's aspirations of establishing APS sections and chapters in scientifically emerging countries and working to convene international leaders of the physics community, especially other national physics societies and APS' European counterpart, the European Physical Society. To this end, FIP recently established an ad hoc Outreach & Communication Committee to improve FIP's visibility, promote its activities, and recruit members from institutions and research centers around the world. Furthermore, FIP's biannual newsletter was revamped in 2020 to facilitate online dissemination worldwide.

On the latter, both Cifarelli and Hurd underscored the need for greater diversity in FIP, particularly when it comes to gender (currently the group is composed of only 17% women). Of course, this issue extends beyond FIP to physics more broadly and STEM as a whole. "A major issue is the perception about the importance of science and of scientific education worldwide, [...] especially concerning women. This perception is far from being as wide as it should be," noted Cifarelli. "Analyzing international data on women in physics could be very illuminating," added Hurd, in order to identify the factors most associated with women's engagement in physics.

Overall, FIP stands out as an important bridge between APS and the global physics community, at a time when international collaboration is more crucial than ever. More information can be found at the FIP website (engage.aps.org/fip/home).

The author is a freelance writer based in Stockholm, Sweden.

PUBLIC ENGAGEMENT

APS Editing Activities Help Improve and Expand Wikipedia Articles in Physics

BY LEAH POFFENBERGER

On January 11, the APS Wiki Scientist Course kicked off its third six-week event, aimed at equipping physicists with the skills and know-how to edit and contribute to articles on Wikipedia. The first two Wiki Courses focused on improving biographies of women and minority physicists, who are often left out of Wikipedia. This course, however, is the first to tackle a specific topic area, covering quantum science.

APS partners with Wiki Education, a non-profit organization dedicated to improving Wikipedia to build a more informed public and to bring its Wiki Scientist courses to life. The courses, led by Wiki Education's experts, guide participants through the processes involved with editing, creating, and maintaining high-quality Wikipedia pages. The latest course, titled "Elevating the Visibility of Quantum Scientists on Wikipedia," also received sponsorship from the APS journal *PRX Quantum*.

"[Wiki Education] is the gold standard of teaching people how to edit, and once you know how to edit one Wikipedia page, you'll know how to edit most other pages," says Rose Villatoro, Public Engagement Coordinator at APS. "These courses teach you the basics of how to edit an article. You get an expert who comes and teaches you for an hour, breaks down the elements of how to edit—and how to edit ethically."

Wikipedia, which is celebrating its 20th birthday this year, allows almost anyone to write or edit its articles, but it maintains technical and procedural practices to ensure that the information is accurate and accessible. The APS Wiki Scientist Courses help attendees learn to navigate the ins-and-outs of these procedures, from how to create an account to how to add citations. The courses also represent an important opportunity for physicists to hone their abilities to communicate with the public and build trust for science.

The first Wiki Scientist Course, which took place last year, trained 14 editors who created 20 articles, made 890 edits on 109 articles, and added 567 references. The articles these editors created or updated have racked-up over 1 million page views. The current course drew in around 150 applicants for 20 available seats in the course, eager to supply their quantum knowledge to Wikipedia.

In addition to in-depth Wiki Courses, APS has also supported Wikipedia Edit-a-thons, short events to gather as many high-quality Wikipedia edits as possible in just a few hours.

"The courses are for working on editing maybe a single paragraph because you want to learn skills," says Villatoro, whereas "the edit-a-thon is for making as many edits as possible in two to six hours with a lot of other people."

Julia Dshemuchadse, an assistant professor in Materials Science and Engineering at Cornell University, and an alumna of the Spring 2020 Wiki Course, first got involved with Wikipedia editing through an edit-a-thon at the 2019 March Meeting in Boston.

"[Attending the edit-a-thon, I learned that] just a few hours aren't enough to do a lot of editing—if you're practiced, you can write a short article in just a few hours, but it's not enough if you're new," says Dshemuchadse. "I didn't fully dive into Wikipedia editing until APS did the [Wiki Scientist course] in 2020...I took the course and knew this was really something I wanted to keep doing."

Since participating in the Wiki Scientist Course, Dshemuchadse has continued her Wikipedia editing, both in her own free time while stuck at home during the pandemic, and in the classroom. In some classes, Dshemuchadse now includes Wikipedia editing assignments for her students to

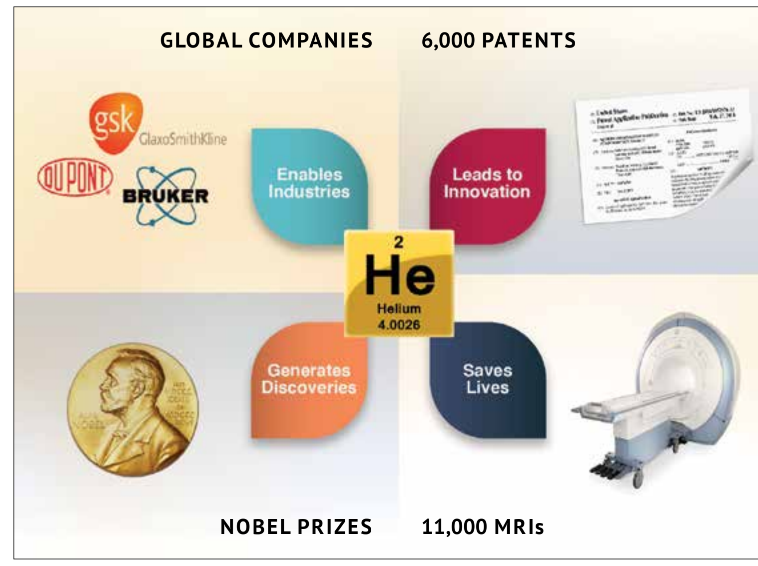
WIKI CONTINUED ON PAGE 6

GOVERNMENT AFFAIRS

Congressman Joe Neguse Plans to Re-Introduce 'Securing Helium for Science Act'

BY TAWANDA W. JOHNSON

At a time when Congress is confronting many unprecedented issues, US Rep. Joe Neguse (CO-D-2nd) plans to keep another important matter—helium policy—on its radar by re-introducing the "Securing Helium for Science Act" during the 117th congressional session. Neguse originally introduced the bill in December 2020.



If enacted into law, the legislation would provide researchers supported by federal grants the ability to continue to purchase helium from the Federal Helium Reserve at a discounted rate for eight years after its sale, which is scheduled to start in September 2021 and be completed one year later. The reserve is an underground storage facility outside of Amarillo, Texas, and was established by Congress in 1925 to address the strategic importance of helium. In passing the Helium Stewardship Act of 2013, members of Congress believed that completely privatizing helium production and sales would improve the marketplace for end users, but that has not been the case.

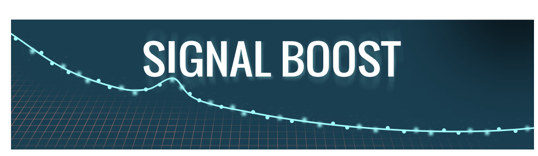
In fact, for the past several years, academic researchers have experienced unsustainable price increases and unreliable delivery of liquid helium. According to an APS survey of academic helium users nationwide, for example, the average price of liquid helium increased by nearly 25% from 2018 to 2019; some researchers' prices tripled during that time. Based on current projections, the reserve contains enough helium to meet the needs of federal users for the next decade or longer.

"Liquid helium is crucial to American research and innovation and utilized by many federal scientists at research labs across the 2nd Congressional District. Many are concerned that US helium shortages and the breakdown of the Federal Helium Reserve will add increased financial burden and detrimental impact on scientific research," said Neguse in a press release. "Our bill, Securing Helium for Science Act, will ensure that federal scientists in Colorado and across the country are able to access affordable helium by keeping the Federal Helium Reserve open past 2021 and continuing to offer discounted rates for federal researchers."

Neguse has indicated that he will re-introduce the legislation this year. His efforts follow the diligent advocacy of APS members with support from the APS Office of Government Affairs (APS OGA). In a letter to Congress signed by past APS President Phil Buckbaum and leaders of the APS Divisions of Condensed Matter Physics; Materials Physics; Atomic, Molecular, and Optical Physics; and Quantum Information, they wrote,

"For tens of thousands of scientists and engineers across our innovation ecosystem, with research ranging from quantum information science to next-generation energy materials to space

HELIUM CONTINUED ON PAGE 7



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

116th Congress Ends with Burst of Science Policy Action

BY MITCH AMBROSE

In the waning days of 2020, the outgoing 116th Congress passed a legislative package that provides roughly $900 billion in pandemic-response funding, finalizes federal agency appropriations for fiscal year 2021, and makes the most significant updates to federal energy policy in more than a decade.

The pandemic relief provisions do not contain funds to address disruptions to research projects, which a bipartisan group of lawmakers had sought to include, nor do they contain any of the billions of dollars in "emergency" stimulus spending on science facilities that House Democrats had proposed. The bill does provide $23 billion in general relief funds for higher education institutions, though that is much less than the $120 billion requested by university associations.

The bill's ordinary appropriations removed the threat of a government shutdown and yielded few surprises for science agencies. Most received level topline budgets or moderate increases near the amounts initially proposed by the House and Senate, with a few targeted boosts for priority technology areas. For example, Congress increased the National Science Foundation budget 2.5% to just under $8.5 billion for fiscal year 2021 while also endorsing the agency's proposals to significantly expand work in quantum information science and artificial intelligence.

The Department of Energy Office of Science budget was held essentially flat at just above $7 billion, with each of its six disciplinary programs funded at or just above their fiscal year 2020 levels. However, as with NSF, the legislation directs DOE to significantly expand funding for quantum information science and artificial intelligence, which could put some pressure on core research programs.

FYI SCIENCE POLICY NEWS FROM AIP

One exception to the general trend of steady toplines is that funding for the DOE's National Nuclear Security Administration surged just over $3 billion to $19.7 billion. Most of the additional resources are directed toward nuclear infrastructure modernization initiatives, such as reconstituting plutonium production capabilities at Los Alamos National Lab in New Mexico and the Savannah River Site in South Carolina.

The package's energy policy provisions, called the Energy Act, update congressional direction for

LEGISLATION CONTINUED ON PAGE 7

EDUCATION

Training Future Generations of Quantum Technologists

BY SOPHIA CHEN

Karen Jo Matsler wants more kids to learn quantum mechanics.

A former high school physics teacher, Matsler first learned about quantum technology through a workshop in 2012 at the Perimeter Institute in Canada. "I was blown away," she remembers when taking a tour of the labs at the affiliated Institute of Quantum Computing.

Matsler became convinced that students needed a better grasp on quantum concepts earlier in their lives. Since that workshop, Matsler, who trains future secondary school physics teachers as a professor at the University of Texas at Arlington, has become an advocate for more quantum curriculum in secondary education. In 2016, with funding from APS, she organized a camp in Texas for teachers to learn and practice teaching quantum mechanics. She has also facilitated conversations between policymakers and teachers to add quantum mechanics content to Texas's state science standards.

"Kids are fascinated by quantum science. They love it, and they want to learn it," says Matsler, who has taught students spanning seventh through twelfth grade. "But the teachers are scared to death of it."

As quantum technology tries to break into the mainstream, it struggles to break from intimidating, esoteric roots. "I find the resistance is from people who are just scared of the word 'quantum,'" says Matsler. "Seriously, if you use a different word, they're okay with it. It's almost like a four-letter word."

To make quantum science more accessible, Matsler has joined the National Q-12 Education Partnership, a collaboration between government, industry, academia, and professional societies. The partnership will work to incorporate more so-called quantum information science (QIS) into middle and high school science curriculum. The membership of Q-12, which includes APS, spans academia to professional societies to companies like Google and quantum computing startup Rigetti.

QIS is an interdisciplinary field at the intersection of physics, computer science, math, and other physical sciences. As described in a workshop that inspired the partnership's creation, QIS "exploits quantum principles to transform how information is acquired, encoded, manipulated, and applied," and its applications encompass quantum computing, quantum communication, and quantum sensing.

"There is a workforce shortage in the United States and globally, for quantum talent," says Corey Stambaugh of the White House Office of Science and Technology Policy (OSTP), who has been involved with the initiative since its inception.

By expanding the quantum curriculum to middle and high school students in the US, the initiative's partners aim to train a new generation to work in the growing quantum industry. These school years are pivotal to a student's academic trajectory. "There's a lot of data out there that suggests that as early as middle school, students are turned away from STEM," says Stambaugh.

In addition, college students choose their major based on their secondary school experiences, says Matsler. "Somewhere along the line, a teacher sparked that interest or asked the right questions, or provided some type of support," she says.

OSTP and the National Science Foundation announced the National Q-12 Education Partnership on August 5, 2020. At a kick-off event on October 7, various partners discussed their goals for the 10-year initiative.

Q-12 itself does not fund educational programs, acting instead as a network for the various players in quantum technology. "The whole partnership is about building a community," says Stambaugh.

APS is contributing outreach and career resources. For example, they are working to highlight individual career stories, to help people understand what a quantum career can look like, says Crystal Bailey, APS's Head of Career Programs. In addition, APS is producing an educational kit on quantum information science a part of its annual PhysicsQuest program. This kit will be freely available to schools, home school groups, science clubs, and after-school programs.

The partnership also wants to help make the quantum industry more inclusive. "QIS draws on some of the least diverse fields—physics, computer science, math, electrical engineering," says Emily Edwards of the University of Illinois at Urbana-Champaign, a co-principal investigator of Q-12.

These fields have long been stereotyped as white and male, which has deterred students of other demographics from participation. "It would be very easy for that stereotype to take hold given the fields that go into it," says Diana Franklin of the University of Chicago, the other co-PI of Q-12. "I think we have a chance to make sure the stereotype doesn't take hold."

To this end, Q-12 is helping its partners create video profiles of a diverse range of people working on quantum technologies, says Franklin. They also plan to support efforts to recruit more Black students into QIS, such as IBM's partnership with Howard University, announced in 2020.

Similar to classical mechanics curricula that don't use calculus, they are striving toward quantum curricula that require only high school-level math. "Most physics textbooks [require] linear algebra and proofs," says Franklin. But the mathematical formalism really isn't necessary to introduce students to quantum concepts, she says. "It's really interesting how far you can go only using algebra and matrix multiplication," says Franklin.

The partnership has their work cut out for them. While a handful of teachers have begun to experiment with quantum curricula, Q-12 has to develop materials almost completely from scratch, with teachers' practical classroom challenges in mind. "If you try to add new content to what teachers are doing, they're going to balk, because they've already got enough on their plate," says Matsler. To make it easier for teachers to get on board, she says the key is to weave quantum concepts into the existing curriculum structure. For example, teachers can explain Heisenberg's uncertainty principle in their existing lessons about momentum. They also must keep in mind that many middle and high school teachers are generalists, says Matsler. According to a 2011 U.S. Department of Education survey, only 47% of physics classes are taught by a teacher with a degree in the subject.

While the effort will take years, Edwards envisions a future of broader quantum literacy. "If quantum is introduced at an early age, then we can explore other topics, beyond 'What is a qubit?', and have a deeper conversation about the science," she says.

The author is a freelance science writer based in Columbus, Ohio.

CAREERS CONTINUED FROM PAGE 1

those outside of academia which were not as visible to me. I had the same questions I believe all students do: What are my options? How do I get there? And most importantly, how do I decide what I want? Many departments have taken up this mantle on their own with programs like career seminars, but a centralized set of career mentoring resources available nationally through APS has great potential to bolster these existing resources as well as provide new ones to students in all types of programs, regardless of their department's resources.

While it was disappointing that the in-person events were cancelled this year, I was grateful for the virtual opportunities still available. This year I participated in the April Meeting as a career panelist and gave a presentation on career paths in physics at Willamette University. In a period of immense uncertainty, I hope that these events helped calm some of the students' anxiety about the future, arming them with the knowledge to make the best individual choices for their careers based on their interests and values. It helps that the messaging here is overwhelmingly positive—the data from AIP show that physics graduates are generally highly sought-after, well-paid, and well-satisfied with their careers. The opportunities available are incredibly diverse, and so the question is not "What can you do with a physics degree?" but "What do you want to do with your physics degree?"

Jan Kleinert conducts research as a Fellow for the Equipment and Solutions Division of MKS Instruments, where he leads an interdisciplinary team and enjoys mentoring. Jan is part of the first cohort of CM Fellows and shares some observations about the program:

As a physics undergraduate I had my future life trajectory all figured out: go to grad school, get a PhD, and, eventually, become a tenured physics professor—easy! It turns out that this is a pretty common mindset among physics majors, because that is what we are predominantly exposed to. Once in grad school, I saw first hand what physics professors really do, and it was not for me. Time to reorient myself! But I had no roadmap on how to do that. What followed was a combination of dumb luck, coincidences, and a rather haphazard transition into industry, where I have been happily doing research ever since.

Talking to colleagues, I found that my transition experience is not at all unusual, even though there is no good reason for it to be so haphazard! So when the new Career Mentoring Fellow program was announced, I jumped at the chance to participate and provide some perspective to the next generation of professional physicists on how to navigate the transition from the ivory tower to the much larger and more diverse outside world. APS Careers collated a nice set of statistical data to show that the majority of physics majors actually end up in the private sector—eventually—and are generally highly satisfied with their career choices. And the way to approach the transition to the private sector is neither particularly hard nor complicated once you become aware of the resources available to you through the APS Careers program. This enabled me to embed my personal experience into a much larger and consistent context. When reaching out, I found undergraduate and graduate students, postdocs, and even faculty deeply curious and excited to get a first-hand peek behind the curtain. Well worth it for all involved!

Midhat Farooq is the APS Careers Program Manager and is in charge of overseeing the Career Mentoring Fellows program. For more information about this program, go to aps.org/careers/guidance/mentoring.cfm.

HISTORY CONTINUED FROM PAGE 2

source. Schmidt was intrigued by the quasi-stellar radio source 3C273, because it had an unusual spectrum: specifically, its emission lines didn't match any known chemical elements.

Eventually he realized that, in fact, hydrogen could account for the spectrum—provided there was a very high red shift. That could only mean that the object was roughly three billion light years away. And to be so far away, and yet still so visible to astronomers, it had to be shining with the light of around 2 trillion stars. Schmidt published that revelation in *Nature*, on March 16, 1963. Astrophysicist Hong-Yee Chiu coined the term "quasar" in a May 1964 article in *Physics Today*.

While not widely accepted right away, his insight had an immediate and significant impact. Black holes were first predicted as an unusual solution to the equations of Einstein's general theory of relativity by Karl Schwarzschild in 1918. Physicists initially assumed such exotic objects were purely theoretical. It was the discovery of quasars that gave physicists a means of verifying the existence of black holes, since the only reasonable explanation for the powerful radiation was matter falling into a massive black hole. That, in turn, convinced Penrose to seriously tackle the problem of demonstrating how black holes might realistically form in our universe. And over time, many lines of evidence have emerged supporting his conclusions.

Quasars continue to provide exciting insights into black holes and stellar formation, among other areas of research. At the 2021 virtual meeting of the American Astronomical Society, a team led by University of Arizona astronomers announced the discovery of the most distant quasar to date. Designated J0313-1806, the quasar is 13.03 billion light years from Earth and dates back to just 670 million years after the Big Bang. It is host to a supermassive black hole of about 1.6 billion solar masses. The quasar is also the first such object to show evidence of super-heated gas escaping from that black hole, at one-fifth the speed of light.

Further reading:

Chiu, Hong-Yee. (1964) "Gravitational collapse," *Physics Today* 17 (5): 21.

Greenstein, Jesse L.; Schmidt, Maarten. (1964) "The Quasi-Stellar Radio Sources 3C 48 and 3C 273," *The Astrophysical Journal*. 140: 1.

Schmidt, Maarten. (1963) "32 273: a star-like object with large red-shift," *Nature* 197 (4872): 1040.

WIKI CONTINUED FROM PAGE 4

help them improve both Wikipedia and their own writing.

"Some technical articles are super detailed and well-written, but other trivial topics—someone wrote about it and didn't know their stuff. A student can easily improve that," says Dshemuchadse. "The benefits are two-fold: students are improving the publicly available encyclopedia and students have writing tasks, something they don't often have in engineering or physics... Even a small editing task gives them practice."

Dshemuchadse is also involved with planning edit-a-thons, first helping to organize one on June 10, 2020 during the Strike for Black Lives, a day that encouraged researchers in STEM to stop business as usual and confront racism and discrimination within the scientific community. Jess Wade, a physicist who has been instrumental in diversifying Wikipedia, and several Cornell and MIT librarians joined Dshemuchadse in running the event.

Dshemuchadse is also helping to organize an up-coming edit-a-thon during the 2021 APS March Meeting focusing on editing and creating Wikipedia pages for women in physics. For new Wikipedia editors, especially those attending an edit-a-thon for the first time, Dshemuchadse offers advice: start small, and use Google.

"If you start fixing typos you start feeling better about just making a lasting change to something in the public domain. That's something that takes time to get used to. Start close to home, with something you feel comfortable writing about," she says. "Also make sure to take advantage of Google, especially for bios—there's so much knowledge about currently active scientists."

Each APS Wiki Scientist Course adds all of its attendees to a Slack community for editors, another feature Dshemuchadse credits with helping her learn the ropes of editing and adding to Wikipedia.

"It took me a while to get into proper Wikipedia editing because it's hard to get past certain obstacles in it—there are a lot of components to it that I wasn't prepared for without a structured class," says Dshemuchadse. "The Wiki education class did that—the structured environment and community was a big help...having an APS specific community where people aren't intimidated to ask questions and get started editing. You're not alone in trying to figure out how this works."

To sign up for the upcoming March Meeting Edit-a-thon, visit march.aps.org/events/women-make-the-world-go-round-a-pi-day-wiki-edit-a-thon/. For more information about Wiki Scientist Courses, visit aps.org/programs/outreach/wiki-course.cfm or e-mail villatoro@aps.org.

PLEDGE CONTINUED FROM PAGE 1

racism in science and academia; and (3) recognizing that no one set of holidays is meaningful for every employee, APS established a Days of Significance Calendar in which employees have more personal days to provide flexibility in how they use their time off.

Bagger is joined by the CEO of the American Institute of Physics Michael Moloney, and the CEOs of six other AIP member societies. The CEOs and leaders who signed the pledge are:

- Susan Fox, Acoustical Society of America
- Angela Keyser, American Association of Physicists in Medicine
- Beth Cunningham, American Association of Physics Teachers
- Kevin Marvel, American Astronomical Society
- Kristin Stevens, American Crystallographic Association
- Michael Moloney, American Institute of Physics
- Jonathan Bagger, American Physical Society
- Liz Rogan, The Optical Society

"The American Physical Society is proud to join its fellow AIP member societies in signing the CEO pledge." said Bagger. "Diversity, inclusion, and respect are core values of APS because they are foundational to social justice and essential to advance science itself. Committing to this pledge will strengthen APS and allow it to better serve the physics community, both at home and abroad."

For more information on the CEO Action for Diversity and Inclusion pledge, visit ceoaction.com.

EDUCATION

Effective Practices for Physics Programs Guide Makes its Debut

BY LEAH POFFENBERGER

The Effective Practices for Physics Programs (EP3) Project, led by the APS and the American Association of Physics Teachers (AAPT) and funded by a $2.3 million NSF award has just begun rolling out the EP3 Guide, which aims to help physics departments respond to opportunities and challenges with proven good practices. Starting this month, the project will begin introducing sections of the Guide to its website, offering a compelling, researched resource for anyone looking to improve or enrich their department.

The EP3 Guide is a collection of knowledge and experiences from experts in physics as well as STEM and physics education, designed to help leaders of physics departments create plans and practices to apply to their own institution's specific situations and needs. Sections of the Guide will cover topics ranging from recruitment and retention, to curricula and pedagogy, to advising and career preparation. About a quarter of the guide will roll out in February, with additional resources, such as a guide to departmental review, coming later this year.

"We're very excited about rolling out EP3. This is the first time the peer-reviewed Guide will be accessible, with about quarter of the planned sections—eventually we'll have over 30," says Kathryne Sparks Woodle, Project Development Manager at APS. "We've been working with hundreds of members of the physics community to gather original contributions which have been synthesized into sections by the EP3 taskforce—a leadership group that is composed of prominent physics faculty and educational researchers."

The EP3 Guide will be housed on an interactive website, designed to help users think through goals and possible solutions in a reflective manner, weighing specific departmental needs, climate, and resources with suggested effective practices.

"There are a lot of strategies that may be listed, but some of them might not be appropriate at your institution. These aren't things you have to do, but strategies you might want to consider for your specific issue or circumstance," says Michael Jackson, EP3 Task Force Co-Chair and Dean of the College of Science and Technology at Millersville University. "Those are the things we want to emphasize—this isn't a checklist or a to-do list, but a resource to look at. What are some things that I can do, within my ability? Context is very important."

Each section of the EP3 Guide contains contributions from two types of experts, drawn from the physics and education communities: content experts—someone who has conducted research in a particular topic—and implementation experts—those who know about a particular approach because they have used it successfully. Contributors were recruited by the EP3 Task Force members who used their connections within the physics world, including at APS and AAPT, to seek out suitable expertise.

"There's all this information out there in the community—from information on education diversity and inclusion to retention to pedagogy—and it's overwhelming for someone to think about one of these things, let alone all of them together," says David Craig, EP3 Task Force Co-chair and Associate Department Head in the Oregon State University physics department. "There is so much the community knows about how to do things—how do we put this together? That was the beginning of EP3—tapping into community expertise and making it easy to use. That's a real strength of this project."

Harnessing expertise from across the physics community and subsequently turning that knowledge into an easily accessible resource meets a need that was identified by a 2012 APS Committee on Education (COE) survey. Both Jackson and Craig, former members of COE, were keenly aware of the importance of such a project from their own institutional experiences. Jackson benefitted from access to the APS Strategic Programs for Innovations in Undergraduate Physics (SPIN-UP) report as chair of his physics department. When he became an academic dean, he saw a need to provide chairs with the means to make informed requests on behalf of their departments.

"I was fortunate to come from one of those departments in [the SPIN UP] report, and I was familiar with a number of strategies that a department could implement if they wanted to achieve some of the goals," says Jackson. "Now as a dean, people come with these requests [to improve their departments], and I wanted them to be prepared to make requests that I could support and advocate for."

When Craig was tasked with rebuilding a newly-closed physics department into a now-thriving program, he was largely unaware of the SPIN-UP report, which he says, after reading it later, would have made his task much simpler. Now he sees an opportunity for EP3 to keep other physics faculty from having to improve.

"Mike mentioned the SPIN-UP report, which was a real landmark in physics and which helped shape EP3," says Craig. "One of the early components of our vision was to not come up with a report that will then get shelved, we wanted to come up with a resource that stays current. How do we create a structure and a process, a living guide that is updated as new research comes in and attitudes change?"

When the EP3 Task Force formed in earnest in 2016—first known as BPUPP or Best Practices in Undergraduate Physics Programs—a major component of their work was not only capturing best practices but creating processes of their own so they may continue to disseminate new information.

"As we're developing content and the process of how it's developed and reviewed and disseminated, we're reviewing that strategy to see how we can use it for the years to come to regularly review the content that's been developed, revise it accordingly, and identifying new areas that the physics community needs," says Jackson.

For the past four years, the EP3 Guide has been taking shape through a rigorous process, beginning with the Task Force identifying relevant section topics, and moving through contributor recruitment to content undergoing both editing and review. Alongside the launch of the Guide, a pilot program, the Departmental Action Leadership Institutes (DALIs), which was recently awarded supplemental funding by the APS Innovation Fund, will train teams at different institutions to use EP3 effectively.

The rollout of the EP3 Guide represents a huge milestone for the project, but as the Guide continues to grow and evolve, Task Force leaders hope to see physics emerge as a leader in promoting effective practices to other STEM fields.

"One of the reasons [this project] is so important is that physics is always under the microscope from a resource perspective," says Jackson. "As a result, we want to help departments not only survive but thrive. We also want to help them be leaders on campus, to let other people look up to them on how to run a department."

For more on the EP3 project, visit aps.org/programs/education/ep3/.

EP3
Effective Practices for Physics Programs

APKER CONTINUED FROM PAGE 1

recounting her experience leading up to the Apker selection meeting. "Before the talk, I tried to think about what kinds of questions I'd be asked. It helped me think broadly about my research: Where does this apply to other fields? I wanted to explain the material to the interviewers in a way they could relate to.

In a 30-minute talk, given to the Apker selection committee made up of 11 distinguished physicists from various backgrounds, Koskelo showcased her expertise and research on an interesting applied physics problem: turning noise in CCD imaging devices into a tool instead of a hindrance. Koskelo came upon the problem in her earlier research, necessitating clever techniques to overcome noise for signal detection, but the idea that noise could be useful in certain types of detectors intrigued her.

"I was fascinated by the fact that noise could be useful—I got hooked on the problem from that perspective—how can we use a random phenomenon to produce something controlled and useful?" says Koskelo.

Koskelo's research culminated in an experimentally-validated model of stochastic resonance in thermoreflectance imaging systems, and she found that noise can improve thermal resolution in CCD imagers by an order of magnitude or greater, overcoming limits of digital resolution. Now, in graduate school, she's hoping to combine her expertise with a love of quantum mechanics in research into frustrated magnetic systems.

Fascination with quantum mechanics was, in fact, a driving force behind Koskelo diving into a career in physics, a pivot from an earlier desire to pursue engineering.

"I started out as an 11-year-old interested in architecture, but then I became interested in engineering because of my love of math," says Koskelo. "Then in college, I took a physics class, fell in love with quantum mechanics, and pursued it passionately after that."

For other young physicists or would-be Apker winners, Koskelo offers a piece of advice: "Start research early and feel free to move between groups to find what interests you," she says. "Find a way to connect your classes to the research you're doing to get a holistic view of that area."

Koskelo also stressed the importance of finding support and guidance from mentors, as she credits her own—Janice Hudgings in the Physics and Astronomy Department, and Ami Radunskaya of in Math Department at Pomona—with driving her success. After completing her master's in physics at Cambridge, Koskelo will pursue a PhD at Harvard with the support of an NSF fellowship.

Poniatowski, also pursuing a PhD in physics at Harvard as a National Defense Science and Engineering Graduate Fellow, impressed the Apker committee with his research conducted during his undergraduate studies at the University of Maryland. His work focused on exploring a fundamental physics problem in the non-superconducting state of copper-oxide-based superconductors.

Poniatowski describes his Apker experience as "tremendously fun," despite meetings taking place over Zoom this year, and cited the interaction with panelists as one of his favorite aspects.

"I found it exciting that the audience had such a wide range of interests across the spectrum of physics," says Poniatowski. "Trying to translate this esoteric problem I'm interested in to a broad audience, and doing that in a somewhat successful way, was really fun to prepare, and it was really gratifying to actually give the talk and interact with some really inspiring physicists."

Poniatowski's Apker-winning research comes from work he did in collaboration with Richard Greene at UMD, studying copper-oxide-based, high temperature superconductors. However, Poniatowski's research involved the non-superconducting state of these materials, hoping to further understand their behavior.

"The behavior of these materials is an interesting fundamental physics problem because it defies expectations of what a metal is and how it should behave," says Poniatowski. "It's also a practical problem in that it's a natural stepping stone to understanding high temperature superconductivity and could open the door to making even higher temperature superconductors." Now at Harvard, Poniatowski is continuing research in condensed matter physics with a focus on developing new ways to probe exotic materials.

Poniatowski describes his attraction to going into a scientific field "inevitable," crediting his mother, who worked for NASA, as an inspiration.

"Growing up, I spent a lot of time going to launches and interacting with people in the space community, so like any child in that situation, I wanted to be an astronaut," says Poniatowski. "By the time I was nine or ten, I was self-aware enough to realize this probably wasn't feasible, and inexplicably concluded that the next best career was to become a physicist."

Like Koskelo, Poniatowski credits much of his success in achieving his goals in physics to mentors and advisors throughout his undergraduate career. He names Greene, as well as Sankar Das Sarma, Johnpierre Paglione, and Tom Cohen, as influences on his approach to physics. For future Apker applicants, Poniatowski again joins Koskelo in advising others to dive into research as soon as possible.

"It's never too early to start," he says. "I was very apprehensive about approaching professors for research opportunities during my freshman year. Having no prior laboratory experience, I felt I had very little to offer. In reality though, you end up learning everything that you need to know in real time, so there is no excuse not to get started and dive in."

Both Apker winners will be presenting talks at the 2021 APS March Meeting. The LeRoy Apker Award recognizes outstanding achievements in physics by undergraduate students and provides encouragement to students who have demonstrated great potential for future scientific accomplishment.

The 2020 Selection Committee members were Roger Falcone (Chair), David Gross (Vice-Chair), Nima Arkani-Hamed, Sujit Datta, James Eckert, Eun-Ah Kim, Shelly Lesher, Geoffrey Lovelace, Paul Miller, Stephanie Moyerman, Talat Rahman.

For more about the award or to find out how to apply, visit aps.org/programs/honors/prizes/apker.cfm.

LEGISLATION CONTINUED FROM PAGE 4

DOE's applied energy offices and fusion research program. The act recommends particularly large budget increases for carbon management R&D, advanced reactor technologies, and the Advanced Research Projects Agency–Energy. While this funding is contingent on future appropriations, the act also sets goals for large-scale technology projects that prefigure new funding opportunities for commercial ventures in addition to continued support for R&D at universities and DOE's national labs. For instance, it directs DOE to pursue six major carbon capture technology demonstration projects within five years and to create a fusion technology development program that reimburses participants only after they achieve specific project milestones.

Passing the Energy Act was a high priority for Sen. Lisa Murkowski (R-AK) as she served her third and final term as chair of the Senate Energy and Natural Resources Committee. She has cast the legislation as a long-overdue successor to the Energy Independence and Security Act of 2007. Committee Ranking Member Joe Manchin (D-WV) worked closely with her on the effort, and with Democrats now taking over the Senate, he will take her spot as chair.

A number of congressional Democrats framed the act as a prelude to more aggressive steps. House Science Committee Chair Eddie Bernice Johnson (D-TX) called it a "down payment," while incoming Senate Majority Leader Chuck Schumer (D-NY) welcomed it as a climate policy win in a "difficult political environment." He argued, though, that the legislation is inadequate against the threats of climate change and said he plans to work with the Biden administration to "deliver bold climate action in the Senate."

The author is Director of FYI.

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ONLINE CONTINUED FROM PAGE 1

an exciting opportunity to create and improve Wikipedia pages that highlight the accomplishments of women and other gender-minority physicists.

On Monday, March 15, the March Meeting begins in earnest with a full day of scientific sessions and a tutorial for authors and referees from 12:00 pm to 1:00 pm, providing an opportunity to learn from APS journal Editors. Capping off the first day, the traditional Kavli Foundation Special Symposium will run from 6:00 pm to 9:00 pm, featuring an exciting slate of speakers: Michelle Girvan (University of Maryland, College Park), Eun-Ah Kim (Cornell University), Roger Melko (University of Waterloo), John Preskill (Caltech), and Patrick Riley (Google). This year's Kavli theme is quantum computing and machine learning in the physical sciences.

Tuesday, March 16 will include another opportunity to hear from and interact with APS Editors at a meet-and-greet session from 12:00 pm to 1:00 pm. The APS Job Expo will also run from 12:00 pm to 3:00 pm on Tuesday, Wednesday, and Thursday, giving attendees ample time to meet with prospective employers from a wide variety of companies and institutions. Student members of APS are invited to a special networking event from 6:00 pm to 8:00 pm. The Student Networking and Game Night: Physics Crossing—A Virtual Physics Odyssey will give students an opportunity to network with each other and with representatives from various companies and laboratories in a video-game-inspired and interactive setting.

A number of networking opportunities will also be available on Wednesday, March 17, including a Graduate School Fair, from 1:00 pm to 4:00 pm, and an LGBT+ Roundtable from 4:00 pm to 5:00 pm. The National Society for Black Physicists (NSBP) and the National Society of Hispanic Physicists (NSHP) will both be hosting meetups, with NSBP meeting from 5:00 pm to 6:00 pm, and NSHP meeting from 6:00 pm to 7:00 pm.

Thursday, March 18 will feature another opportunity for students or other job seekers: Career coach and author Peter Fiske will provide advice and strategies for physics job searching in the session Building Your Physics Career: How to Put Your Science to Work, from 2:30 pm to 5:00 pm.

Registration for March Meeting 2021 is open through February 25. To register and to browse the scientific program, visit march.aps.org.

HELIUM CONTINUED FROM PAGE 4

exploration, helium is essential to performing their work. Helium is also a critical component of medical devices and treatments, including MRI machines, that Americans depend on every day."

Joseph DiVerdi, Associate Professor of Chemistry at Colorado State University, outlined his concerns regarding the helium issue in a widely circulated op-ed in *The New York Times*. He discussed those concerns during an in-person meeting with Neguse that was also attended by Mark Elsesser, Interim Director of APS OGA.

"I wholeheartedly thank US Rep. Joe Neguse for his support of this important bill that will ensure that scientists can continue to conduct critical research that has implications for a broad range of fundamental and applied technologies, including NMR investigations, MRI scanners and quantum computing." said DiVerdi.

Bucksbaum added, "APS commends US Rep. Joe Neguse for introducing this critical piece of legislation that will help ensure the scientific community has reliable access to helium for the next several years. A reliable helium supply strengthens our nation's scientific enterprise and enables discoveries that will lay the foundation for a robust economy going forward."

Elsesser also offered thanks to Neguse and noted that APS members looked forward to the bill's passage.

"APS, with support from its dedicated members, has pushed policymakers to help address the helium crisis for several years, and we are grateful that US Rep. Joe Neguse has taken the lead on a critical issue that impacts the scientific community and the future of US innovation," he said.

In a related matter, APS OGA is also working to have language included in a National Science Foundation reauthorization bill that would significantly expand its modest and successful helium recycling program. Transitioning researchers to systems that recycle helium would significantly decrease the federal government's helium expenditures over time, allowing more funds for research.

The author is Senior Press Secretary in the APS Office of External Affairs.

THE BACK PAGE

Inclusive Mentoring: The Mindset of an Effective Mentor

BY CHANDRALEKHA SINGH

Mentoring is the process of forming, cultivating, and maintaining relationships that support and advance mentees in their pursuits [1-2]. As physicists, we mentor undergraduate and graduate students in diverse settings: when we teach them in various courses, when we advise students in their research, or when we counsel them about academic and non-academic issues. For example, we give advice on what courses to take, whom to do research with, how to live a balanced life while managing academic and non-academic responsibilities, and how to apply for financial support, scholarships, and jobs.

While effective mentoring can improve the outcome for all students in research and education, appropriate mentoring of students plays a critical role in ensuring that students from underrepresented groups (e.g., women and racial and ethnic minority students) thrive since physics is one of the least diverse STEM disciplines with stereotypes related to who can excel in it [3-11].

Research suggests that there is no single mentoring style that impacts effectiveness [2]. However, there are several aspects critical to successful mentoring: showing genuine concern for the mentee; boosting their sense-of-belonging and self-efficacy [4-6]; inculcating a growth mindset (intelligence is not immutable since your brain is like a muscle and can grow with hard work) [7,11]; supporting students in learning to use effective strategies for growth that build on their current knowledge meaningfully; encouraging them to take advantage of their peers and mentors; and helping them embrace their struggles as stepping stones to learning. It is important for mentors to convey to students that they have high expectations of them, they know that they have what it takes to excel if they work hard and work smart (which entails using effective approaches) and they are there to support them as needed.

Good mentoring means that mentees are more likely to succeed in their course work and in their research, be visible compared to others at a particular stage of their career, and to have a career plan. Mentees are also more likely to be happy with their work because mentoring helps shape their outlooks positively [1,2]. Mentoring can support growth in physics knowledge and skills as well as development of leadership skills while creating a climate of positivity, sense of competence, and a "you can do it" attitude [1,2].

Keeping in mind the role of mentors, a crucial characteristic of effective mentoring relationships in both teaching and advising contexts is that the mentors have a "growth" mindset in order to help their mentees embrace struggles with physics and learn how to react to challenges and adversity. A research study involving the fixed vs. growth mindset of STEM instructors of undergraduate students was carried out at a large research university in the US in which 150 instructors from 13 different science disciplines including physics participated [11]. Instructors were asked to respond to the following two questions on a Likert scale (strongly agree, agree, disagree, strongly disagree etc.): "To be honest, students have a certain amount of intelligence, and they really can't do much to change it" and "Your intelligence is something about you that you can't change very much." Instructors who agree with these statements have a "fixed" mindset about their students' ability, and those who disagree with these statements have a "growth" mindset about their students' ability.

The study found that STEM instructors who had a fixed mindset about students' ability, in that they believed that students in their courses came with fixed abilities, had larger achievement and motivation gaps. In particular, compared to instructors with growth mindsets, classes taught by instructors with fixed mindsets had achievement gaps between the racial and ethnic minority students and white students that were twice as large, and underrepresented students had worse motivational beliefs.

It is not surprising that instructors, research advisors, and others in mentoring roles who have a fixed mindset about their students' abilities are unlikely to inculcate a growth mindset amongst their students, as students will likely maintain the idea that intelligence is fixed and cannot grow, regardless of hard work [7,10]. On the other hand, good mentors can shape the ways that mentees react to challenges and ensure that the mentees embrace struggling as a normal, unavoidable part of solving physics problems or conducting physics research. Mentors can help mentees see such challenges as opportunities for developing expertise using deliberate strategies and building on their prior knowledge and skills effectively [7]. A good mentor can disambiguate student experiences in challenging situations, promote growth mindsets, and emphasize the importance of struggling in learning and excelling [7]. In particular, only when we as mentors have a growth mindset and truly believe that the students we are mentoring can overcome challenges and excel by working hard and using effective strategies will students develop a mindset that challenges are not unique to them or permanent but universal and temporary [7].

Chandralekha Singh

As mentors, we should set high expectations for students but also provide assurances that students can reach those expectations by working hard while using effective approaches, struggling at tasks, and using their struggles as learning opportunities while we continue to support them. Also, we should simultaneously help students learn effective cognitive and meta-cognitive strategies to scaffold their knowledge and skill development. What is important to recognize is that setting high standards without providing assurance that all students in a physics course or in a physics research lab can achieve them by working hard while using effective strategies can hurt those from underrepresented groups the most. Due to the stereotypes associated with physics, without assurance from the mentor, those students are more likely to attribute struggling to a lack of ability as opposed to a normal part of developing expertise [7].

Mentors should also positively recognize and praise students for making progress, even if the mentor perceives them to be small steps, otherwise, lack of recognition is more likely to negatively impact students belonging to groups that are underrepresented in physics. Since physics is a field with strong stereotypes about who can succeed in it, these micro-affirmations are particularly important. Lack of positive recognition is known to have negatively impacted the entry and retention of underrepresented students, such as women and racial and ethnic minority students, in physics related disciplines for decades [3-7].

Eileen Pollock, the first woman to get a BS degree in physics at Yale University, decided to pursue graduate work in English and became an English professor at the University of Michigan despite finishing her physics undergraduate degree summa cum laude. In her memoir [12], she recounts the negative impact of lack of positive recognition from her thesis advisor: "Not even the math professor who supervised my senior thesis urged me to go on for a PhD. I had spent nine months missing parties, skipping dinners, and losing sleep, trying to figure out why waves—of sound, of light, of anything—travel in a spherical shell, like the skin of a balloon, in any odd-dimensional space, but like a solid bowling ball in any space of even dimension. When at last I found the answer, I knocked triumphantly at my advisor's door. Yet I don't remember him praising me in any way. I was dying to ask if my ability to solve the problem meant that I was good enough to make it as a theoretical physicist. But I knew that if I needed to ask, I wasn't." She adds, "[I was] certain this meant I wasn't talented enough to succeed in physics, I left the rough draft of my senior thesis outside my advisor's door and slunk away in shame. Pained by the dream I had failed to achieve, I locked my textbooks, lab reports, and problem sets in my father's army footlocker and turned my back on physics and math forever."

This example illustrates a missed opportunity in which an undergraduate thesis mentor failed to positively recognize the accomplishment of a woman in physics, and she went from feeling "triumphant" about having solved her thesis problem to feeling she wasn't talented enough to succeed in physics, otherwise her advisor would have praised her for her successful solving of the problem. What is also worth reflecting upon is that decades later while writing her book, when Pollock asked her thesis advisor what he thought of her thesis, he noted, "It's very unusual for any undergraduate to do an independent project in mathematics. By that measure, I would have to say that what you did was exceptional." She then asked if he ever specifically encouraged any undergraduates to go on for PhDs; after all, he was then the director of undergraduate studies. He said he never encouraged anyone. Lack of encouragement and positive recognition as someone who can excel in physics is particularly detrimental to underrepresented students, including women like Pollock, because they likely do not have many peers and role models and may be struggling with the idea of whether they have what it takes to excel in physics—or if they belong in physics at all.

Due to the pervasive societal stereotypes associated with who belongs in physics and who can excel in physics, many students from the underrepresented groups question whether they have what it takes to be a successful physicist [13, 14]. Depending upon students' backgrounds and privileges, they may come to our classes and to our research labs with different motivational beliefs and prior preparations. Mentoring plays a critical role in ensuring that all students—especially those from the underrepresented groups—receive adequate guidance, support, recognition, and assurance to participate and excel in physics. Developing the mindset of an effective mentor requires us to be reflective and introspective and is crucial to ensuring that our students develop a growth mindset, embrace their struggles in physics, use effective approaches to overcome those struggles, and excel in physics.

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