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RESEARCH

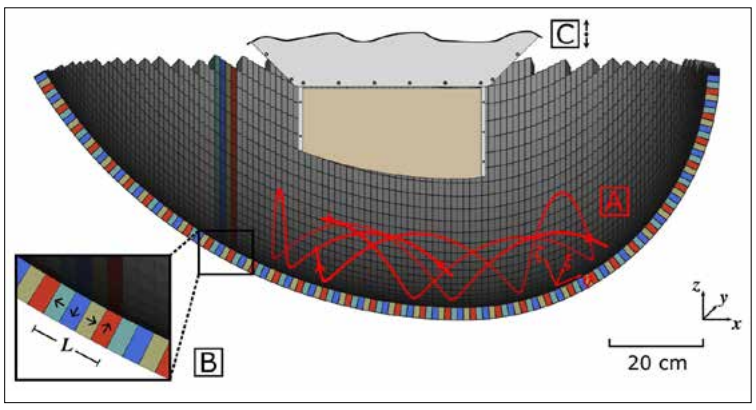
Neutron Lifetime Measurement Could Help Probes of the Standard Model

BY DANIEL GARISTO

Nestled in the nucleus of a stable element, a neutron can live indefinitely. But released as a free particle, a neutron decays—according to the latest and most precise measurement—in 877.75 seconds.

The findings, reported in *Physical Review Letters* October 13 by the UCNτ Collaboration, more than doubles the precision of previous neutron lifetime searches to about a third of a second. Precise measurements of the free neutron lifetime can help physicists model element formation in the early universe. More broadly, beta decays have become an increasingly popular way to probe the Standard Model in recent years.

"Historically, beta decays were absolutely essential, because they gave us a hint about the structure of the Standard Model," said Adam Falkowski, a theorist at the University of Paris-Saclay. In the 1930s, observations of missing momentum in beta decays allowed Wolfgang Pauli and Enrico Fermi to predict the existence of the neutrino.



A simulated neutron trajectory inside the UCNtau trap. The inset shows the polarization of magnets in the Halbach array. UCNTAU COLLABORATION

Today, particle physicists use beta decays to check values of the CKM matrix—a key component of the Standard Model that governs quark flavor transitions. If free neutrons take too long to decay, the values of the CKM matrix would be off, suggesting new physics. While the latest UCNτ Collaboration results agree with the Standard Model, they only heighten a dis-

NEUTRON CONTINUED ON PAGE 6

JOURNALS

Fluid Dynamicists Rise to the Challenges

BY DAVID BARNSTONE

In January 2019, dozens of researchers gathered near the base of Mont Blanc in Eastern France to discuss some of the most pressing and consequential issues of our time. The aim of the workshop at the Les Houches School of Physics was to galvanize the fluid dynamics community to use their scientific talents to advance the Sustainable Development Goals of the United Nations.

"Environmental fluid mechanics actually underlies a lot of the challenges society is facing [right now]," said Tom Peacock, professor of mechanical engineering at MIT and one of the workshop's organizers. From climate and weather modeling to addressing oil spills and microplastics in the ocean, fluids researchers have an important role in addressing these challenges. Peacock and his colleagues, for example, recently conducted field work assessing the environmental impact of deep sea mining operations in the Pacific Ocean.

The workshop focused on five key areas outlined in an invited paper published in *Physical Review Fluids* and discussed by the authors in an online journal club hosted by APS.

Nathalie Vriend, Royal Society University Research Fellow at the University of Cambridge's BP Institute, presented research on multiphase flows, which are happening all around us and have a direct impact on people's lives and livelihoods: precipitation, avalanches and mudslides, and sediment transport in bodies of water, to name a few.

"We're looking at a very complex rheology," says Vriend. "This is not a simple Newtonian flow because

FLUIDS CONTINUED ON PAGE 5

Martin Blume 1932–2021

BY DAVID VOSS

Martin Blume, former Editor in Chief of the APS *Physical Review* journals and former Deputy Director of Brookhaven National Laboratory, died on October 6, 2021, in South Setauket, New York. Among his accomplishments, Blume, 89, was instrumental in moving the APS journal operations from the world of paper manuscripts to fully electronic publishing.

"Marty Blume deserves enormous credit for leading APS publishing into the digital age," said APS CEO Jonathan Bagger. "I could write about his many accomplishments, but for me the most important one is personal: It was Marty who first roped me into APS activities, and for that I am truly grateful. He made a difference in my life, as he did in the lives of so many others in physics and beyond. His legacy lives in the people he touched and the journals he led with such vision and skill."

Blume was in charge of the APS Journals at a critical time, when Paul Ginsparg first made preprints of articles easily available on the arXiv preprint server, which could have threatened APS subscription revenues. "He was present at some of the early international meetings debating how to fund journals and one of his favorite lines was 'APS is not-for-profit, but it is also not-for-loss,'" said former APS Editor in Chief Gene Sprouse, who took on the role after Blume's retirement in 2007. "Marty led the APS to embrace open access and coexist with the arXiv which provided quick access to new research while the journals provided the necessary peer review for authentication of the work."

Added Sprouse, "his leadership of the Editorial Office was exemplary and led to high morale, and he hired great people and let them manage their areas. He developed an outstanding information technology group that grew eventually to support all of APS's information activities."

BLUME CONTINUED ON PAGE 3

CAREERS

APS Hosts Quantum Crossing Event to Educate Students about Quantum Careers

BY TAWANDA W. JOHNSON

APS recently hosted Quantum Crossing, a virtual event for middle and high school students to showcase the unique careers available in Quantum Information Science and Technology (QIST). The event was also supported by the National Q-12 Education Partnership and the NSF-funded program Q2Work.

"I am thrilled that APS is able to provide these young people with an opportunity to learn about careers in quantum information science and technology," said Crystal Bailey, Head of Career Programs at APS. "There is no limit to the problems that these new approaches can solve; the key challenge will be achieving a large enough workforce to fill the demand in this field. Programs like Quantum Crossing help to meet that challenge by getting quantum on the radar of the next generation of scientists, as early as possible."

Quantum Crossing was featured on a colorful virtual reality platform called Gather, where avatars representing students, teachers, and corporate executives interacted with each other during tours, question-and-answer sessions, and game experiences. A combined total of 406 students and teachers registered for the event, and these companies participated: Lockheed Martin, IonQ, Microsoft, IBM Quantum, and Quarks Interactive.

"The Quantum Crossing event was very interesting. It opened new doors for me that I didn't know existed. The subject of quantum computing was entirely new to me, but now I feel like I have an (albeit extremely basic) understanding of how it works," said Dylan Gobrogge, a student from Toledo, Ohio.

Gobrogge added, "The thing that amazed me was the versatility of quantum computers, the way they can be used in almost anything for a wide range of results. I think the platform of Gather really helped with the learning because you could watch videos, participate in Q&As, etc. at your leisure. You were free to do whatever you felt like doing at the moment. I came away feeling excited about the possibilities of this relatively new tool and hope that I can help integrate quantum computing into whatever I end up doing with my life."

Mark Tsang, Senior Program Manager at Microsoft, suggests that to prepare for a career in QIST, students can leverage open-source learning tools (like the Quantum Katas), participate in summer schools and workshops, and take STEM courses. Getting involved in computer science and quantum clubs can also help in learning how to join and foster communities. Quantum hackathons and open source contributions are also a good way to gain experience with quantum platforms and to get noticed by industry representatives.

"Quantum computing is a technical field, and having a background in physics, mathematics, or engineering will go a long way in preparing you to be successful," he said, adding that Microsoft currently has a platform called Azure Quantum where students and researchers can access quantum simulators and real quantum hardware.

APS's support of the Quantum Crossing event is consistent with the Society's belief that QIST will

QUANTUM CONTINUED ON PAGE 4

WOMEN IN PHYSICS

New Grant Seeks to Provide Professional Development to Future Physics Leaders

BY LEAH POFFENBERGER

For the past decade, APS has organized the Conference for Undergraduate Women in Physics (CUWiP), positively impacting hundreds of students across the country each year. Now, with the help of a grant from the Heising-Simons Foundation, APS is launching the Advancing Graduate Leadership (AGL) initiative aimed at positioning graduate and postdoc women and other individuals who do not identify as male in leadership positions in physics and astrophysics.

AGL hopes to expand networking, strengthen retention, and provide opportunities for future research and other collaborations for women throughout the physics community; provide mentor training and professional development; and support women in seeking leadership roles at their own institutions and in the broader community, where they train others and are recognized for their efforts.

Three primary AGL activities will be funded with the grant of over $375,000: APS is hosting eight virtual workshops on developing professional skills, two virtual research mentor training workshops in partnership with the Center for Improvement of Mentored Experiences in Research (CIMER), and a two-day in-person conference held in conjunction with the March Meeting.

"The main goal of AGL is to help women and people who don't identify as male get into positions of leadership and to provide guidance for the people who are already in them," says Farah Dawood, Chapters Program Manager at APS.

The professional skills development workshops are set to run from December 2021 to mid-summer 2022, with the first workshop set for December 9 featuring Kristen Burson (Hamilton College). "These virtual workshops will be open internationally—not just for people in the United States," says Dawood. "Our hope is that we can reach as many people as possible from all over the world."

The CIMER workshops will also be held virtually, but for smaller groups: the idea is to train 24 individuals per workshop who can serve in leadership positions at other AGL events, such as the AGL conference. The conference will be held from March 12 to 13, and will be hosted by Argonne National Laboratory.

"By holding the AGL conference the weekend before March Meeting, graduate women will have an opportunity to build valuable professional skills and put them into practice at the nation's largest physics conference," says Dawood.

The Heising-Simons Foundation selected APS for this grant opportunity in part due to successes in previous initiatives to promote women in physics, including CUWiP.

"The Heising-Simons Foundation has set out to provide support to graduate women and they felt APS was the perfect partner in this endeavor," says Dawood. "We're really hoping to be successful in supporting women to achieve leadership roles and thrive."

THIS MONTH IN

Physics History

December 1945: Introduction of the Atomic Energy Act of 1946

BY DANIEL GARISTO

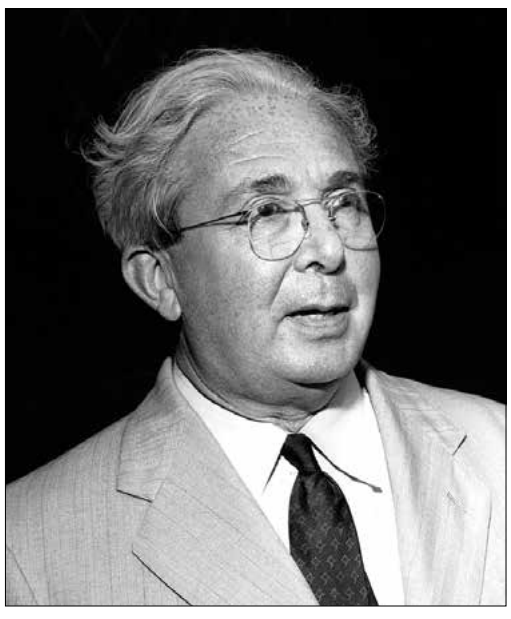
When the Second World War ended in the ashes of Hiroshima and Nagasaki, American scientists were confronted with the uneasy question they had been avoiding: Who would control the power to split the atom?

The Truman administration, senior scientists like Robert Oppenheimer, and the military had prepared an answer—they would. In October 1945, the May-Johnson bill was introduced in the House and Senate. The bill would have created a commission composed of military and civilian experts to control all forms of atomic energy. It would also have enforced strict secrecy measures on atomic knowledge with penalties of up to a decade imprisonment and $10,000 fines (roughly $150,000 today).

Scientists who worked on the Manhattan Project were aghast, and many physicists believed that the May-Johnson bill threatened their entire discipline. In response, the scientists organized a coordinated assault on the bill. That fall and winter, they engaged in an unprecedented public relations campaign and an extensive lobbying effort in Washington, DC. The scientists had three main arguments: control of atomic energy should be civilian, secrecy regulations would damage the work of science, and international control of atomic weapons was needed. They also hoped to educate the public about the nature of this new scientific frontier. The ideological goals of this "Scientists Movement" were summed up in a somewhat ambiguous slogan: NO SECRET; NO DEFENSE; WORLD CONTROL!

Histories of the movement have acknowledged how unusual it was. "It was the first large confrontation of scientists and politicians in American history, and perhaps the only sustained organized political activity by scientists as such in world history," wrote the historian Donald Strickland in his 1968 monograph, *Scientists in Politics*. Contemporary scientists have become far more linked to politics through the government funding of research. Scientific communities have engaged in other political activities, from physicists lobbying against missile weapons programs to climate scientists testifying about the dangers of climate change, but the Scientists Movement was first and remains an outlier for its level of coordination and involvement.

The Scientists Movement didn't come out of whole cloth; it was set in motion by a legacy of pre-war labor activism and wartime organization by the military. Like the rest of the country, American scientists were deeply impacted by the Great Depression. During the 1930s, they suffered severe unemployment and experienced disillusionment with capitalism.



Leo Szilard advocated against the use of the atomic bomb and lobbied for the Atomic Energy Act of 1946. APS established an award in 1974 in remembrance of his advocacy. WIKI COMMONS

In 1938, the American Association of Scientific Workers established its first chapter in Boston. Unlike its preexisting sister organization, the American Association for the Advancement of Science (AAAS), AASW was an explicitly political organization on the verge of a trade union. Its stated aim was "to promote and extend the applications of science and the scientific method to all problems of human welfare." Early members included researchers with openly communist sympathies, including Oppenheimer. But when the Soviet Union signed a treaty with Nazi Germany and war loomed on the horizon for the US, the AASW splintered, and physicists—even some who had urged anti-capitalist pacifism—were drafted into military efforts, including the Manhattan Project.

Throughout the war, Manhattan Project scientists were integrated with the military in an unprecedented way. Researchers, used to the pursuit of esoteric knowledge, chafed under military control exemplified by General Leslie Groves, whom they felt was an anti-intellectual authoritarian. An April memorandum by the eminent physicist James Franck captured concerns about secrecy regulations which would "become intolerable if a conflict is brought about between our conscience as citizens and human beings and our loyalty to the oath of secrecy."

Additionally, by grouping scientists in labs—at Oak Ridge, Chicago, Hanford, and Los Alamos in

HISTORY CONTINUED ON PAGE 4

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BLUME CONTINUED FROM PAGE 1

Blume was born on January 13, 1932, in Brooklyn, New York and received his AB degree from Princeton University in 1954. He obtained his PhD degree in physics from Harvard University in 1959. From 1959 to 1960 he was a Fulbright Research Fellow at the University of Tokyo and went on to become a Research Associate at the Atomic Energy Research Establishment in Harwell, UK, from 1960 to 1962.

For the next 34 years, Blume conducted research at Brookhaven National Laboratory, rising to the position of Associate Director of the lab (1981–1984) and then Deputy Director (1984–1996). During this period, Blume was also on the faculty of the State University of New York at Stony Brook (1972–1980).

Blume's research interests included theoretical solid-state physics, magnetism, phase transitions, slow neutron scattering, and synchrotron radiation. He served as chair of the APS Panel on Public Affairs and the APS Nominating Committee and had been a member of the APS Council and Executive Board. He also served on the editorial board of the *Physical Review*. In his personal life, he was a devoted lover of opera and classical music.

In January 1997, Blume became APS Editor in Chief with responsibility for the APS *Physical Review* journals. Among his first achievements was making the journals available in full electronic form, which built upon the work of his predecessor Benjamin Bederson and the APS editorial staff. He also oversaw the launch of the first all-electronic journal series, *Physical Review Special Topics* (now the open access journals *Physical Review Accelerators and Beams* and *Physical Review Physics Education Research*).

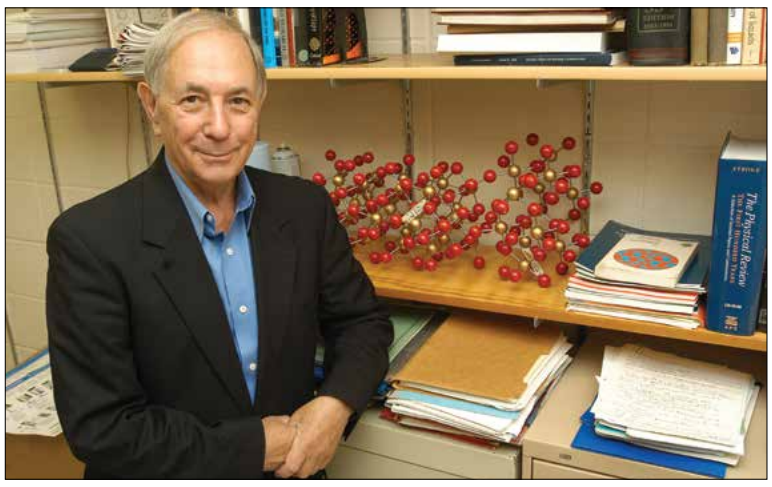
"Having served as Deputy Director of Brookhaven National Lab, Marty had a very wide range of knowledge of physics as a whole," said former APS Executive Officer Judy Franz. "This enabled him to bring a new sense of excitement, vigor, and unity to the APS publishing enterprise. He was the first Editor in Chief to be a full-time, on-site staff member and was intimately involved in moving the journals from their predominant paper form to the electronic world."

Added former APS CEO Kate Kirby, "APS is very grateful for Marty Blume's leadership of the journals, as Editor in Chief. Among other things, Marty saw the need to transition the work of the Editorial Office from 'paper- and print-based' to electronic—a huge task, which occurred with his oversight over a period of several years."

He is survived by Sheila Blume, his wife of 66 years, by his son Frederick Blume, his daughter Janet Blume, his son-in-law Allan Bower, and his grandchildren Jasper Blume, Kimi Blume, Nicholas Bower, and Andrew Bower.

For more on Blume's leadership of the journals and electronic publishing see APS News (April 1998).

The author is the former editor of APS News.



Martin Blume BROOKHAVEN NATIONAL LAB

PROFILES IN VERSATILITY

Harvesting a Career in Soil Physics to Serve Humanity

BY ALAINA G. LEVINE

At the end of the famed Silk Road is Aleppo, a city of great historical significance and an agricultural and economic center in Syria. The city is filled with bustling souks and fragrant gardens surrounded by mountains and is the birthplace of countless scholars and scientists, including Zouheir Massri, a soil physicist, whose distinctive research career was influenced by his upbringing in this storied place. The importance of agriculture, symbolized by a beautiful grape tree in his yard that his family enjoyed pruning, rooted Massri's childhood. "In such rich history, I inherited my proud authenticity and motivation to do something unparalleled and unique, just like my ancestors," he says.

Massri, a research scientist in sustainable agriculture and soil health at Michigan State University (MSU), is an expert in soil physics—the study of the soil physical system and its processes and properties. These processes "deal with the dynamics of physical soil components and the dynamic entity phases of the solids, liquids, and gases in an equilibrium state," he says. Soil processes are intimately tethered to the chemical and biological components of the soil and have a host of agricultural, hydrological, and environmental significance. Soil physics influences soil and water sustainability, crop yield, plant, animal, and fungi health, and many other factors.

"Soil processes and crop production are strongly controlled by physical processes such as soil water flow, soil structural stability, irrigation and drainage, heat, and aeration," Marssi explains. By understanding soil physics, soil can be better optimized to improve crop yield and resiliency thus creating mechanisms for combating food insecurity due to climate change, for example. "Soil physics has a three-dimensional nature, casing all the soil systems in one volumetric structure as a mother embraces her young," he says. "Understanding the physical properties of soils is important to proper soil and agronomic management…the importance of soil physics to the nexus of food, energy, and water is highly recognized."

Massri was drawn to soil physics because he wanted to help his fellow humans and make a difference in our environment. His early life was a continuous celebration of knowledge and discovery. "I thrived in a world of history and education and in a home with bookshelves full of science books, magazine series, collections of scientific encyclopedias, photography, art, and poetry that I had the privilege to read," he recalls. Observing the farms near his home, Massri began to realize the significance of agriculture: it produces food, but also health, and security. And he wanted to be a part of this. His undergraduate degree at Aleppo University was in agricultural science with a focus on the changes of soil structure and properties of red-brown earth under different farming systems. He then pursued a postgraduate diploma in agricultural history at the Institute for the Heritage of Arabic Science at the same university and a Master's in soil fertility through the International Center for Agricultural Research in the Dry Areas (ICARDA) at an institution in Italy. In 1996, Massri received his doctorate in agriculture and soil physics from Kuban State University in Russia.

As he built his research career, Massri worked with numerous organizations worldwide. He was a Fulbright Scholar at South Dakota State University, and also served as the Soil Physics and Fertility Research Manager at AgroLiquid, a plant nutrition manufacturer. He came to MSU in 2013 for two years as visiting scientist, and following his stint in industry, joined the Biosystems and Agricultural Engineering Department at MSU in 2020.

For many years, Massri has sought to understand how to assess the soil in various ecosystems, including wetlands. The soil in one of his wetland projects presents a thought-provoking series of scientific questions and is emblematic of the fact that soil systems vary widely. "This soil developed over thousands of years and is not like other soil," he explains. "These soils have permanent water. For most of the year, they have anaerobic conditions, so evaluating the complex ecological condition of wetlands is very interesting."

His knowledge of physics endows him with an advantage as an agricultural researcher. "It is critical to establish measurements and standards that reflect the actual capacity of the soil, relative to its potential, to respond to agricultural management," he says. Recently, Massri started a project with the Institute of Water Research at MSU to address soil nutrient transport. "The measurements, likely, will bring new insights to in-soil processes, their relationships, dynamics, and thresholds using new computational technologies," he says. His latest research is a real-time nutrient probe that can sample a soil solution and measure the ionic soluble forms of nutrients present.

Massri finds soil physics fascinating for many reasons: as scientists endeavor to comprehend the holistic nature of soil and improve its ability to grow plants, the disciplines of biology, chemistry, agricultural sciences, plant sciences, microbiology, hydrology, and physics swirl together and integrate. This creates ideal conditions for someone like Massri who has cultivated the knowledge in each of these realms to solve problems. His research in how soils hold carbon is an example of this. "Carbon sequestration is not only the driving component of improving the structure of the soil and reducing global warming, it is also the food for the microbes," he says. "There is always difficulty in finding balance in the soil—how to balance crop residue, using crop rotation. All of these components should be integrated into the soil health."

One of his areas of concern involves understanding what drives soil health to ensure soil is getting the right nutrients. "My investigations in soil physics are based on hypothesized and rationalized objectives and materialized methods and research tools," says Massri. "The advanced scientific and technological work I developed on soil quality and soil health indicators have [helped us address] important soil resilience from a sustainability perspective."

Zouheir Massri

The advancement of soil science, and soil physics in particular, has diverse ramifications. For example, if we can increase the water hoarding capacity of the soil, we have a potential means for fighting drought and encouraging the growth of healthier foods. But there are still many challenges that have not been farmed in this field. While many of "soil's physical parameters are profoundly standardized," he says, "assessment of a few physical properties and processes of soil are not as commonly done and their importance receives insufficient attention. The questions are how to elaborate, understand, and function the interactions among soil physical, chemical, and biological processes, and elevate their delivery to ecosystem services."

Challenges remain in how to integrate our knowledge of the physical processes and properties with new research in soil chemistry and biology, as well as how to leverage novel approaches to characterizing soil physics inspired by other fields. New technologies will aid in this quest. But all of this technical knowhow comes down to very practical, societal-driven questions. "In other words, how to enhance water quality, build resilience to drought, increase carbon sequestration, and reduce greenhouse gas emissions, while using economically viable practices that sustain our rural landscapes," he says.

Massri, who has worked in dozens of nations around the world and speaks English, Arabic, and Russian fluently, often thinks back to his idyllic childhood in Syria. His city, Halab in Arabic, is one of the oldest continuously occupied areas in the world. The smell of the fruit trees, the feel of the soft soil between his fingers, the hum of intellectual pursuits, all contributed to him building a career in support of humanity. "I was always an international dreaming guy. I wanted to see the world. Agriculture would give me that chance," he says. "If I had done medicine, I would have stayed and served in my country because they need me. But I was thinking of how I can expand my knowledge everywhere. Agriculture and soil were my gateway. I'm proud to be a soil physicist because I think what I did for humanity was so positive and I am so happy. I am the luckiest person in the world."

HISTORY CONTINUED FROM PAGE 3

particular—the military created a network of researchers who were connected like never before. With some exceptions, such as Leo Szilard's petition against the use of the weapon, the atomic scientists initially supported the bombings of Hiroshima and Nagasaki. As Strickland put it, they reacted "first with elation and then with remorse, to the use of the bomb, and they felt it was their civic duty to educate the country."

When the May-Johnson bill was introduced on October 3, 1945, the atomic scientists were primed to respond. Across the country, scientists at different labs were in contact. Scientists in Chicago sent telegrams to scientists in Los Alamos; researchers at Oak Ridge called researchers in New York. All were debating the new bill and the future of atomic energy. The fiercest debate was at Los Alamos, where there was a great deal of loyalty to Oppenheimer, who supported the bill. On October 16, Willy Higinbotham wrote to the Chicago group: "We are discussing the Johnson Bill for all we are worth. There is no unanimity of opinion here yet." By the end of the month, the four main Manhattan Project sites had agreed to send representatives to Washington and meet with senators three times a week to explain "just what is at stake."

A string of scientists thus came and went from Washington to wine and dine and win politicians to their cause. Their work paid off—before the end of November, Truman withdrew his support for the May-Johnson bill. They had also gained a powerful ally in Brien McMahon, an ambitious young senator from Connecticut.

Members of Manhattan Project site at the University of Chicago, including Leo Szilard (first on the right, middle row)." ATOMIC HERITAGE FOUNDATION

On December 20, 1945, McMahon introduced a new bill designed to prevent military control over atomic energy. The McMahon bill also included language supporting "the dissemination of scientific and technical information relating to atomic energy"—just the kind of reassurance scientists were looking for.

Though a spying incident in February caused some changes to secrecy provisions, and there were further attempts to push for military control, the McMahon bill eventually became the Atomic Energy Act of 1946. Through their concerted political activity, the physicists of the Manhattan Projects shaped the next half-century of science in government.

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

QUANTUM CONTINUED FROM PAGE 1

play an integral role in the development of new jobs and industries that will strengthen the nation's economy.

For example, the Society helped found the Quantum Economic Development Consortium (QED-C), supported the National Quantum Initiative Act (NQI), and launched the APS Division of Quantum Information.

The QED-C is a consortium that aims to enable and grow the US quantum industry. QED-C was established with support from the National Institute of Standards and Technology (NIST) as part of the federal strategy for advancing quantum information science and as called for by the National Quantum Initiative Act enacted in 2018.

In an earlier *APS News* article (see *APS News*, June 2021), Dan Pisano, Director of Industrial Engagement at APS, stated, "We believe that quantum science is first and foremost a physics phenomenon, and physicists continue to play an important role in the development of quantum systems."

There is great potential in the QIST field, and APS members recognize it. According to a *Harvard Business Review* article, quantum information science is expected to be a multibillion-dollar industry by 2030. Moreover, the APS Division of Quantum Information has seen the number of members in its unit increase by 15 to 20 percent per year. Its mission: "to promote the advancement and diffusion of knowledge concerning the physics of quantum information, computing, fundamental concepts, and foundations."

"I'm thrilled that APS is playing a leadership role as a scientific society in growing the QIST field, and the Quantum Crossing event was a wonderful way to develop the pipeline of the next generations of leaders in this field," said Francis Slakey, Chief External Affairs Officer for APS.

GOVERNMENT AFFAIRS

APS Makes Progress on Balanced Approach to Research Security Concerns

BY TAWANDA W. JOHNSON

Since the release of an APS Board Statement in February 2020, the Society has advocated for the federal government to take a balanced approach to address its concerns regarding research security and foreign influence. These efforts are paying off based on recent meetings with—and actions taken by—federal government officials.

APS strongly supports the open exchange of information and maintaining the United States as a destination of choice for global talent—both are essential to strengthening the US scientific enterprise. However, national security concerns, such as those expressed in a bipartisan 2019 Senate report, have led to federal policies that: restrict who can participate in certain areas of US-based research; limit US-based researchers ability to engage in international activities; and create a perception that the United States is unwelcoming to international students and scholars—all of which jeopardize the nation's leadership in research and innovation.

"APS recognizes that there are legitimate national security risks involving the unauthorized transfer of US-based knowledge and technical expertise to other countries. We believe these threats are best addressed through a partnership between the federal government and the scientific community that is based on adhering to principles of openness and responsible stewardship," said APS President Sylvester James Gates, Jr. "Moreover, the future of our research enterprise is at stake. The key to keeping it strong is to ensure that science remains open and that the US continues to attract highly talented international students."

The US government's current approach to addressing research security concerns is weakening, not strengthening, the US scientific enterprise, according to new data from an APS September 2021 survey of more than 3,200 physics professionals and students. The survey highlights the urgent need for a new approach that thoughtfully protects the nation against evident security risks, while also welcoming international talent and promoting beneficial international collaborations.

The report states that nearly one in five physics professionals (non-student APS members) in the United States have either chosen—or been directed—to withdraw from opportunities to engage in professional activities with colleagues based outside the United States due to current research security guidelines.

Additionally, more than 43 percent of international physics graduate students and early career scientists—that is, PhD graduates with fewer than five years of experience —perceive that the United States is an unwelcoming country for international students and scholars. Moreover, at least 40 percent of international early career scientists who chose

to come to the United States to study or work believe that the US government's current response to research security concerns makes their decision to stay in the United States long term less likely or much less likely.

The APS survey data was included in the recent written testimony of Xiaoxing Xi, a physics professor at Temple University, who told the House Science Committee about his harrowing experience of being falsely accused of passing US trade secrets to China.

"Let me be clear: a policy that targets Chinese scientists and cracks down on openness in fundamental research does not protect America's research security. It makes the US less competitive in innovation and less attractive to talents around the world. It threatens the US leadership in science and technology. It must stop," stated Xi during his testimony.

SECURITY CONTINUED ON PAGE 7

FYI: SCIENCE POLICY NEWS FROM AIP

White House Driving to Promote Equity in Science

BY ADRIA SCHWARBER

Diversity and equity in science have become a high priority in the Biden White House. Presidential Science Adviser Eric Lander is championing the issue and sociologist Alondra Nelson leads a new "science and society" division in the Office of Science and Technology Policy that is intensely focused on it.

As part of this initiative, OSTP has held a series of five private roundtable meetings under the title "The Time is Now," devoted respectively to women and people with gender-expansive identities, people with disabilities, underrepresented racial and ethnic groups, community-centered research, and institutional settings. The office also launched an "ideation challenge" to solicit input on how the federal government can address the question, "how can we guarantee all Americans can fully participate in, and contribute to, science and technology?" President Biden posed that question to Lander in a letter setting out an agenda for him in January.

Speaking at the American Association for the Advancement of Science's annual Science and Technology Policy Forum on October 12, Lander and Nelson discussed takeaways from the roundtables.

Lander said the STEM ecosystem needs more "on-ramps and bridges" for people from underrepresented groups to enter STEM fields. He cited the successes of efforts such as the Meyerhoff Scholars Program at the University of Maryland, Baltimore County, which helps minority students bridge the transition from undergraduate to graduate school. Observing that the program has "ended up being the single largest producer of Black students who go on to PhDs" in STEM fields in the US, he remarked, "Why don't we have 20 times this program across the country?"

Nelson commented that the roundtables had also included people from outside academia who conduct research to address local priorities. "And so we have to think of building these bridges and on-ramps beyond the Ivory Tower, onto Main Street, or onto Martin Luther King Boulevard," she said.

Another theme Lander and Nelson highlighted was the value of embracing a "whole-of-self strategy" that acknowledges the particular challenges many individuals face.

Lander observed, "The National Institute of Allergy and Infectious Diseases has a program for [grant] supplements for critical life events—childbirth, adoption, caregiving

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FLUIDS CONTINUED FROM PAGE 1

of the interaction between particles and fluids." Fortunately, recent advances in experimentation, high-speed cameras, computation, and machine learning are helping researchers tackle these questions with unprecedented precision.

Another type of flow relevant to several Sustainable Development Goals—particularly Clean Water and Sanitation, Vulnerable Cities and Communities, Climate Action, and Life Below Water—is the transport of heat through the layers

of the atmosphere and ocean. A "gigantic" amount of heat—on the order of petawatts—is moved through the planet in this way, according to C.P. Caulfield, also at Cambridge, who says understanding stratified mixing is essential for ensuring the sustainability of life on Earth.

Of course, our oceans are not only transporting heat. Nadia Pinardi, an oceanographer at the University of Bologna, presented research on how environmental contaminants like plastics and oil are moved by ocean eddies. Studies of the transport—and ultimately the collection—of pollutants in the oceans are critical for planning adaptation and mitigation efforts.

Pollutants also disperse through cities, which are expected to house about two-thirds of the world's population by 2050. Urbanization presents unique challenges to modern life that fluid mechanics researchers can address through research into urban wind patterns, building ventilation, and "heat islands," says Stanford University civil engineer Catherine Gorle. "It's really important for us to think about how we actually use these predictions to then have that impact" by combining our data sources—field work, simulations and laboratory experiments—and working with key stakeholders, including the people living in cities, building owners and operators, and municipalities to implement changes. "Often times that is really the big challenge."

A common challenge across these areas is reducing uncertainties and processing ever growing amounts of data. Nowhere is that challenge clearer than in weather and climate modeling. Peter Bauer of the European Centre for Medium-Range Weather Forecasts calls this an "extreme computing problem." The ultimate goal would be to develop a digital twin of Earth that would provide an interactive tool built on a reliable information system of both simulation and observational data. All of this relies on a "proper representation of the Earth system, at the core of which sits proper fluid dynamics."

Claudia Cenedese, senior scientist at the Woods Hole Oceanographic Institution, concluded the discussion: "Scientists can help society by tackling these Grand Challenges but they need to collaborate, interact, and engage with experts in other fields and policy makers."

To view a recording of the journal club, visit https://www.youtube.com/watch?v=1ULAG75O6vM.

The author is APS Head of Public Relations.

FYI CONTINUED FROM PAGE 4

responsibilities—acknowledging that those things are part of people's lives, and it's not supposed to be something you leave at the door and say, 'well, it's not really part of our concern.' If we're going to prevent people from leaving science, then science has to be here to recognize that events like that happen and provide support."

Turning to the subject of evaluation metrics, Nelson said that to be successful future efforts will require better data on diversity in the STEM community. She said the White House's Equitable Data Working Group, which she co-chairs, has discussed ways to improve the granularity of the data federal agencies collect in order to improve understanding of different groups' experiences in STEM.

Nelson also said such data could be used to track the successes and failures of federal efforts, pointing to the example of the Campus Pride Index, which was launched in 2007 and gathers data from academic institutions on their LBGTQ inclusion policies in order to compare learning environments across institutions.

Looking ahead to immediate next steps, Lander said, "Our goal is to converge…around evidence-based best practices, to highlight equity champions — institutions that have shown us what's possible, suggestions that can inform policy."

The author is a science policy analyst for FYI.

STRATEGIC PLAN

APS Innovation Fund Helps Bolster the International Physics Community

BY LEAH POFFENBERGER

In 2019, APS launched a new strategic plan, and with it, the Innovation Fund to advance collaborative projects between APS members and staff that align with the Strategic Plan. Since its inception, the Innovation Fund has awarded 11 projects that support the APS mission "to advance and diffuse the knowledge of physics for the benefit of humanity, promote physics, and serve the broader physics community."

As part of that mission, the Innovation Fund has awarded projects meeting needs in a variety of areas of physics, from promoting diversity and inclusion with APS-IDEA (see *APS News*, September 2021) to supporting physics departments at risk of closure with the Toolkit for Departments Under Threat. Among the successful, on-going Innovation Fund projects are initiatives aimed at reaching the physics community on an international scale, particularly in Africa and Latin America.

The US–Africa Initiative in Electronic Structure (USAfrI), which received an award from the Innovation Fund in its first cycle in 2019, aims to strengthen the collaboration between US and African physicists. Through workshops in the field of electronic structure and also through research exchange programs, the goal of USAfrI is to enable African physicists to bring high-quality physics research to their home countries.

USAfrI was born in part out of another successful initiative to advance physics in Africa, the African School on Electronic Structure: Methods and Applications (ASESMA). ASESMA provided an opportunity for students to come for two weeks to attend lectures and build their research skills. While the school has helped a number of graduate, a component was missing: a connection to international collaborators.

"We have many people in Africa who have gone through ASESMA… and we've taught them a lot, but they need to do research at the highest level, and in order to do that, it takes someone collaborating with them," says Omololu Akin-Ojo, director of ICTP-East African Center for Fundamental Research and International Councilor for APS. "This is one impact USAfrI is having: collaborating with researchers in the US in such a way as to increase the level of research we are doing in Africa."

Renata Wenztcovitch, a professor at Columbia University who had also been involved with ASESMA, had been looking for ways to expand US support for African physicists in the area of computational materials science, when she learned about the launch of the Innovation Fund.

> "Students around the world are interested in modern physics—it's not hard to get students interested in black holes. But most don't know the math—they don't have the background to understand what people are talking about. This is for them."

"At the time I was chair of the Division of Computational Physics when I learned about this auspicious opportunity," says Wenztcovitch. "[USAfrI] seemed to converge with the mission of APS…essentially to strengthen the relationships between APS and physical societies outside of the US, so that was a very special opportunity."

Originally, USAfri was set to kick off with two in-person workshops in 2020, one in the United States and one in Africa, but due to the COVID-19 pandemic, the events were postponed and moved online. The workshops were held this year—one in March, directly before March Meeting, and another in June—and drew in 75 and 103 participants, respectively.

"We went remote because of COVID and that's not ideal for lots of reasons. It is better to collaborate and meet people in person, but I think we actually pulled it off," says Sinead Griffin, a staff scientist at Lawrence Berkeley National Laboratory and a project leader for USAfrI. "The bonus of that was we were able to involve a lot more people than we would have been able to otherwise…I think we probably had more than double the number that we would've been able to support in person."

USAfrI will also hold its first in-person workshop at Columbia University in 2022, with the opportunity for students and researchers from Africa to visit US research centers following the workshop.

In addition to workshops, USAfrI organizers are hoping to further bolster collaborative relationships between the US and Africa with a peer program for students and early career researchers.

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"A challenge for USAfrI for the future is to find support to continue and strengthen this network that's being developed right now," says Wenztcovitch. "Of course, it's important to do things in person to trigger new relationships. I think at least we should try to keep these workshops going as long as possible, and find support for these workshops, introduce new people in person. Hopefully we'll be able to continue doing workshops after the end of the innovation fund from APS."

Another Innovation Fund project, selected during a special COVID award cycle in 2020, is seeking to improve physics education in high school physics classrooms in Latin America. Modern Physics in the Latin-American Classroom is an initiative to translate materials created by the Perimeter institute for Theoretical Physics into Spanish and train teachers in how to use them to promote student interest in physics.

Nathan Berkovits, a professor at Sao Paulo State University and Director of the ICTP South American Center for Fundamental Research, had the idea about six years ago to start translating the Perimeter Institute's library of teaching materials. His first endeavor was to make the materials available in Portuguese for workshops held at the ICTP center.

"The Perimeter Institute has a huge outreach program with a whole library of materials to teach high school teachers to use in their classroom—they have 15 to 20 volumes on all different areas of physics, from quantum mechanics to climate change," says Berkovits. "Six years ago, we invited their outreach director to visit the ICTP center and he gave a workshop for teachers in Brazil—in English. We then decided to translate the material into Portuguese...which are now used in workshops at the center."

Now, with the help of the Innovation Fund, the Perimeter Institute's materials are available to even more teachers and students in Latin America, as it has now been translated into Spanish. Berkovits hopes that these materials can be used to build a network of high school teachers who are equipped to teach high-level physics concepts and bolster the number of future physicists in Latin America.

While the COVID-19 pandemic stopped efforts to hold in-person workshops with teachers, the program has been able to reach teachers through online efforts.

"In Latin America, there is a huge disparity between public and private schools. Private schools are able to teach physics at the level of physics in the US, but public schools are way behind. The main goal of this network is to build up a pool of high school teachers, mostly public-school teachers, who can teach this material." says Berkovits. "Students around the world are interested in modern physics—it's not hard to get students interested in black holes. But most don't know the math—they don't have the background to understand what people are talking about. This is for them."

Berkovits hopes to build a network of teachers across Latin America by training teachers who can then further distribute the Perimeter Institute's materials to other teachers and their classrooms. "These materials are attractive because they're easy to teach online and they're attractive to the teachers because they get the attention of students," says Berkovits.

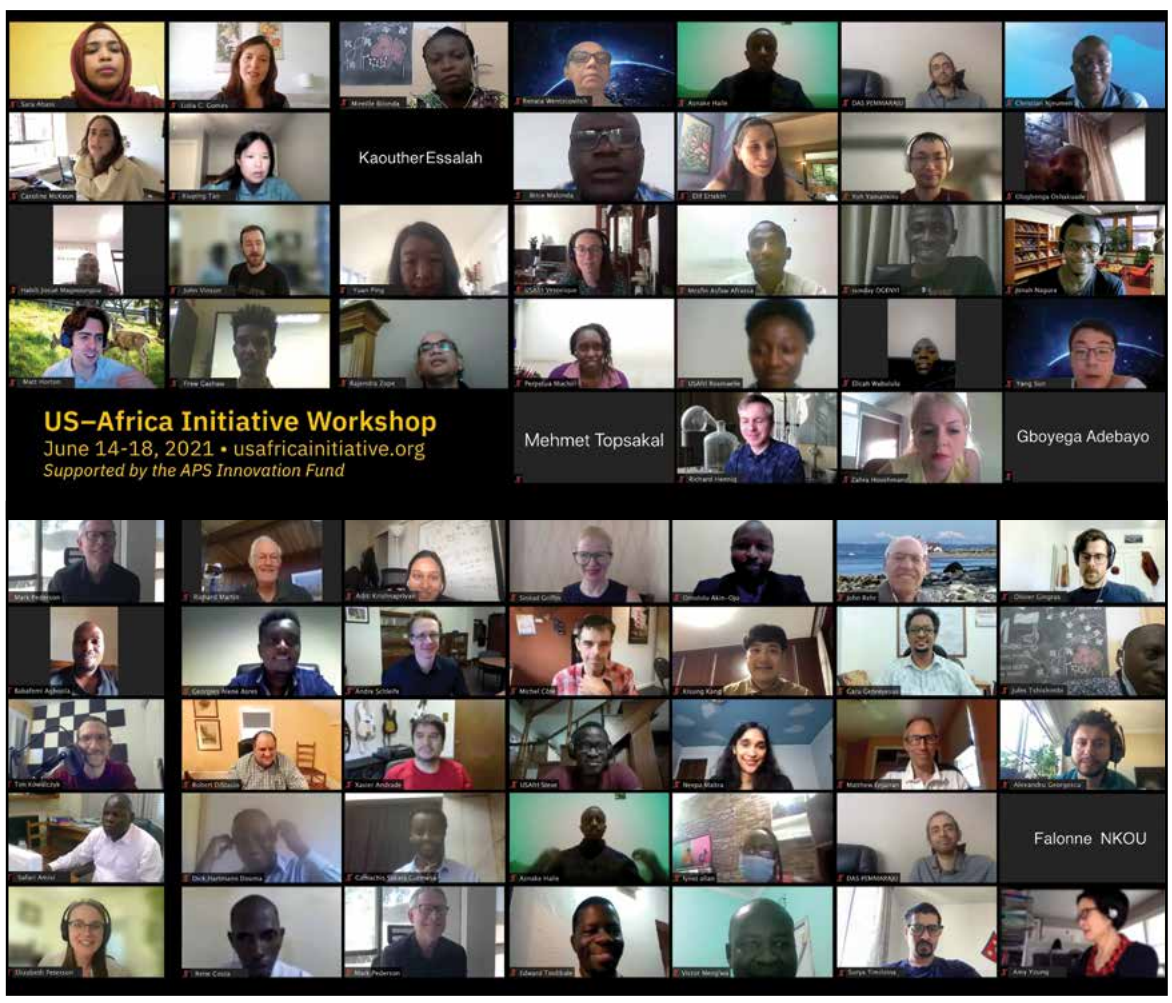
While the COVID-19 pandemic stopped efforts to hold in-person workshops with teachers, the program has been able to reach teachers through online efforts.

"For online workshops in Portuguese, we had maybe thousands of teachers. In Spanish, we have reached in the hundreds because we just started in January," says Berkovits. "The way the program works is we ask teachers... which activity they want to do. Each activity is based on a different modern physics topic. Each meeting has about 30 teachers involved. Teachers break out into rooms on zoom and then teachers play the role of students. The idea is that eventually the teachers will become a monitor and show other teachers how to use the material."

While the program has been successful so far, Berkovits is keenly aware of challenges teachers face, such as strict requirements on what teachers are allowed to teach.

"The educational system in Brazil and Latin America is very bureaucratic, teachers have to teach the material that is pre-decided. That's frustrating. They're bored and so are their students," says Berkovits. "But things are starting to change."

A longer version of this article, including another Innovation Fund project, Women Supporting Women in The Sciences, is available in the online edition of this issue.



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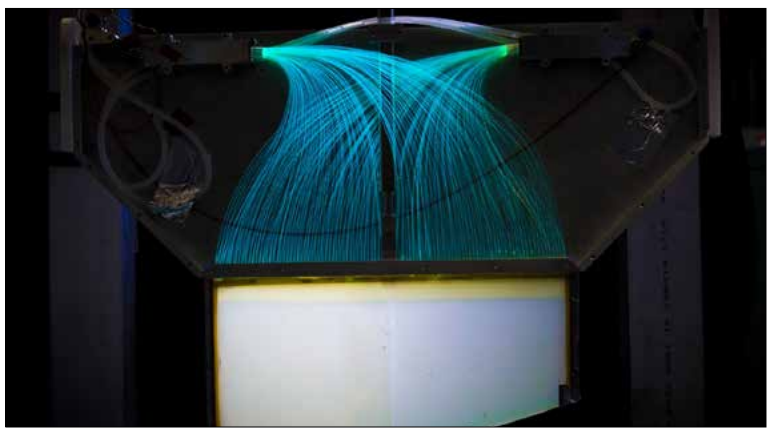


The main UCN detector in the UCNtau experiment. LOS ALAMOS NATIONAL LAB, MICHAEL PIERCE

crepancy among previous neutron lifetime measurements. Different methods of measuring the neutron lifetime consistently give different results: "beam" experiments find a neutron lifetime about 10 seconds longer than "bottle" experiments.

In bottle experiments, like that of the UCNτ Collaboration, ultracold neutrons are placed in a trap and counted after time passes. Beam experiments, on the other hand, involve sending ultracold neutrons down a beamline and inferring the lifetime by precisely detecting the decay products.

"One of my colleagues likes to say that the bottle experiment sounds easy and is hard, and the beam experiment sounds hard and is hard," said Shannon Hoogerheide, a physicist at NIST who was not involved with the latest results. One of the main difficulties for both methods is producing large numbers of ultracold neutrons that have energies less than 200 neV.

Advancements in producing ultracold neutrons for the bottle method and several iterations of the experiment have pushed it to higher precision than the beam method. Falkowski said he places more value on bottle results because they agree better with the Standard Model and the experiments are more recent—the last beam measurements were taken almost two decades ago.

"At the moment, I think the most likely explanation is that this is just an experimental problem," he said. "But if there is some other decay channel, for example, neutrons can decay to some exotic particles." Possible culprits include leptoquarks and Z', which phenomenologists have also conjectured may be behind the b-decay anomalies and muon g-2.

More data are needed to resolve the tension between neutron lifetime measurements. Hoogerheide and her colleagues at NIST are redoing the beam experiment to corroborate the bottle results.

Other techniques are also starting to enter the picture. At J-PARC, an experiment similar to the beam method detects decaying electrons instead of protons. The J-PARC measurement of the neutron lifetime is consistent with both beam and bottle methods because of large uncertainties, but the experiment could function as an independent check if it becomes more precise. Last year, a Johns Hopkins-led team used old data from NASA's MESSENGER mission to Venus in another attempt to measure the neutron lifetime. By scanning detections of neutrons produced by cosmic rays, they were able to roughly estimate neutron lifetime to 780 seconds, with an uncertainty of about 130 seconds.

While Falkowski and other particle physicists admit they would prefer a new collider to check for physics beyond the Standard Model, neutron lifetime measurements are available here and now.

"I think when they started, it was more like, 'this is something that we can measure,'" said Hoogerheide. "The lifetime discrepancy has been around for quite a long time, but interest has really ramped up more recently."

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

SECURITY CONTINUED FROM PAGE 4

APS is calling for a balanced approach to address research security concerns. Its 2020 Board Statement states that the US government should continue to abide by Presidential Directive NSDD-189, which notes that fundamental research should remain unrestricted "to the maximum extent possible." The mechanism should be "classification," if control of particular fundamental research is required for national security.

As for scientists, the statement calls for them to intensify their commitment to the elements of research integrity: objectivity, honesty, openness, accountability, fairness, disclosure, and stewardship. APS has also revised its ethics guidelines to enable the Society to address violations of research integrity by its members.

APS's efforts to persuade the federal government to move to a more balanced approach to addressing research security concerns are starting to have a positive effect.

For example, in a letter addressed to Biden Administration officials, Gates outlined a series of recommendations for adjusting the China Initiative—a targeted effort that is sowing fear among some APS members, restricting legitimate international scientific collaboration, and hindering the US in the race for global talent—that could both protect against national security risks and strengthen the US research enterprise. Following the letter, Society leaders and APS Government Affairs staff met with Department of Justice officials regarding the China Initiative and its potential reformulation.

Furthermore, during a recent meeting with the FBI, staff described the agency's plans for a research security "pivot," which involves a rebalancing of investigations where the FBI focuses on intentional, malign activity and federal agencies handle non-disclosure cases that are administrative or inadvertent in nature.

In addition, Secretary of State Antony Blinken signed a delegation of authority on August 25, 2021, stating that Chinese students could obtain a visa to study and conduct research in the United States if their entry is deemed "in the national interest." The delegation of authority gives the US consulates abroad who provide visas the ability to make exceptions to Presidential Proclamation 10043, which bars Chinese students and scholars who allegedly have ties to China's "military-civil fusion strategy" from studying and conducting research in the US. The Trump Administration issued the proclamation, which remains the current policy.

In addition to meeting with government officials, APS has held webinars addressing research security issues and convened a series of meetings between US physicists and their counterparts in China to discuss the concerns.

"Although our nations are competitors, we recognize the importance of coming together to support ethical conduct within science," said Philip H. Bucksbaum, APS Past President.

APS leaders and Government Affairs staff remain buoyed by other productive meetings with the Department of Energy, State Department, and the Office of Science and Technology Policy.

"APS is encouraged by the conversations and the initial changes that are underway," said Mark Elsesser, Director of Government Affairs. "We remain committed to working toward additional positive outcomes."

Francis Slakey, APS Chief External Affairs Officer, said the Society will continue to focus on the federal government taking a balanced approach to research security because "science must remain open to the maximum extent possible in order to ensure that fundamental research can thrive—attracting international talent is key to making that happen."

The author is APS Senior Public Relations Manager.

Reviewing Peer Review

BY KATHERINE WRIGHT AND MATTEO RINI

Peer review—the evaluation of scientific work by experts in the field—is the main method by which papers are published, grants assigned, and scientific laurels won. As the old joke goes, peer review is like democracy: a flawed system that's the least worst of all options. Celebrating the importance of peer review and working on its failings are the goals of **Peer Review Week**, a yearly event inaugurated in 2010 that brings together learned societies, publishers, researchers, funding agents, and other actors involved in scholarly publishing.

This year's Peer Review Week addressed the role of identity in peer review: how personal and social identities affect the process. The question of identity is related to an often-voiced concern about peer review—that the presence of a bias might disfavor certain groups of people, such as women, people of color, researchers from lesser-known institutions, or those from less developed countries. Here is a sample of what *Physics Magazine* heard at the sessions that took place over the week.

Confidential or Transparent?

Presently, the dominant peer review model for the physical sciences is "single blind," meaning that the referees are kept anonymous but the authors are not—their names are visible to the referees. Many scientists, however, say that this system is susceptible to unfair bias—papers may be judged, consciously or subconsciously, based on the pedigree of the authors, on their geographical information, and even on their ethnicity. "Researchers move from Oxford to Kenya and suddenly struggle to publish," says Rebecca Lawrence, the Managing Director of F1000—an open-access publisher of life sciences.

Lawrence spoke at **a session organized** APS, which discussed the pros and cons of blind, or confidential, peer review and of alternative approaches based on transparency.

Lawrence said that F1000 follows a fully transparent approach, disclosing referee names, referee reports, and other details of the editorial process. "A lot of evidence suggests that transparency makes peer review more constructive," she said. With everything laid out in the open, "people feel they have to behave a little better," so they keep their biases at bay and deliver higher-quality reviews. Lawrence said that many researchers in Africa chose transparency exactly because "they want to be treated on equal footing as everyone else."

Beverley McKeon, a professor of aeronautics at the California Institute of Technology and co-Lead Editor of *Physical Review Fluids*, said that the main concern about transparency is that it may favor established researchers. "In an ideal world everything is transparent and fair, but will junior researchers feel confident in a transparent peer review?" Fear of retaliation, for instance, may prevent a junior researcher from rejecting the work of more senior scientists.

Dan Kulp, Editorial Director of the American Chemical Society, said that his organization is initiating various pilot projects to test new forms of peer review. He finds that transparency has many advantages. "The change, however, cannot happen overnight," he said. A first step could be a compromise, such as making the referee reports public, while keeping the referee anonymous.

All panelists agreed that—transparent or confidential—the peer review system must be urgently upgraded by making the reviewer pool broader and more diverse. One way to do that is to provide editors with AI-based search tools for recommending referees in a way that could be less prone to personal biases and to "homophily"—the tendency of people to seek out those who are similar to themselves.

Session chair Daniel Ucko, an editor with *Physical Review Letters*, took the pulse of the audience with polls asking attendants whether they felt transparency or confidentiality was the more important value. The discussion appeared to change the audience's sentiment, with an initial, clear majority of votes going to confidentiality turning into a tie by the time the session ended.

What's in a Name?

Biomedical engineer Elsie Effah Kaufmann of the University of Ghana goes by many names. Some days it's Elsie, others it's E. E. Kaufmann, and on yet others it's E. A. B. E. Kaufmann. In Ghana, where Kaufmann was born, "we generally are named after the day [of the week] that we are born," said Kaufmann, who spoke at the session **Identity in Peer Review** organized by IOP Publishing. "That leaves a lot of people with the same name." Ghanaians add and drop names when they get married, distinguishing themselves from others. But, Kaufmann noted, this cultural norm can cause problems for her and her academic colleagues.

In academia, a person's identity is typically tied to the name that they use when they start their PhD or publish their first research paper, something, she said, that many students fail to recognize until it's too late. "Our training in becoming researchers doesn't orient us to understand that our identity is tied to this name."

Having multiple names is also true for other cultures, such as Western countries where women often change names after marriage. These practices can cause issues for peer review, as it can make it hard for editors to track the person's publications and determine their expertise. If they can't track that work, that person may not get invited to be a referee or sit on a journal's board. There are ways around this problem, such as creating a profile on a platform such as ORCID, which Kaufmann said she now advises all her colleagues to do.

Others in the same IOP session also extolled the importance of having an ORCID profile for participation in peer review. "If Elsie wants to use 12 versions of her name, [ORCID gives her] one identifier for all her science, keeping it together and making sure [journals] know who she is as an individual," said Jasmine Wallace, who manages peer review for journals published by the American Society for Microbiology.

Naming traditions aren't the only obstacles facing Kaufmann and researchers like her who focus on local issues, such as public health and engineering problems. Editors and reviewers have told Kaufmann that these studies "aren't of interest to our readers," and that she should submit her work to "local journals," despite there being no Ghanaian-owned academic publishers. Researchers need to "have some empathy," she said. "I am all for improving the quality of research, but the variety of research should also count."

Involving Early Career Researchers

Early career researchers (ECR) are the future of science, but this role isn't appropriately reflected in their participation in peer review, according to Smita Jain of Cactus—a company that offers editing services for researchers. Jain chaired the session **Should Early Career Scientists Become Referees?** which discussed why ECRs should be part of peer review and what gaps hinder their participation.

First and foremost, "ECRs are good for science," said Thomas Agbaedeng, a biomedical researcher at the University of Adelaide in Australia. These researchers come in with "fresh ideas and perspectives," which could help support innovative research directions, said Agbaedeng. Compared to more experienced researchers, ECRs are generally less attached to the "status quo" and better able to judge papers independent of the authors' pedigrees, said Asli Telli, an outreach specialist at the University of Siegen in Germany. Participating in peer review will also be very beneficial for the researchers themselves, as judging others' work helps them "develop an external eye for their own research," Agbaedeng said.

Several barriers, however, prevent ECRs from becoming referees. Some may not be sufficiently confident in their scientific or English-speaking skills. They may also be unfamiliar with the review process. Finally, they are typically less visible to editors and editorial board members than more senior researchers.

Addressing these gaps requires a "change of culture around ECRs," Jain said. She, Agbaedeng, and Telli offered several ideas for increasing ECR input. Journals, for instance, should offer peer-review training resources and seek to include more ECRs in their editorial boards. Senior researchers should involve ECRs by offering them the possibility to write joint reports. Agbaedeng also urged less experienced researchers to be proactive and become more visible through social media or through services like Publons, which tracks a scientist's review and editorial activity. "You've got to get out there, spread your wings and fly," he said.

A longer version of this article was originally published by Physics Magazine *on October 1, 2021.*

Katherine Wright is the Deputy Editor of Physics *Magazine. Matteo Rini is the Editor of* Physics *Magazine.*

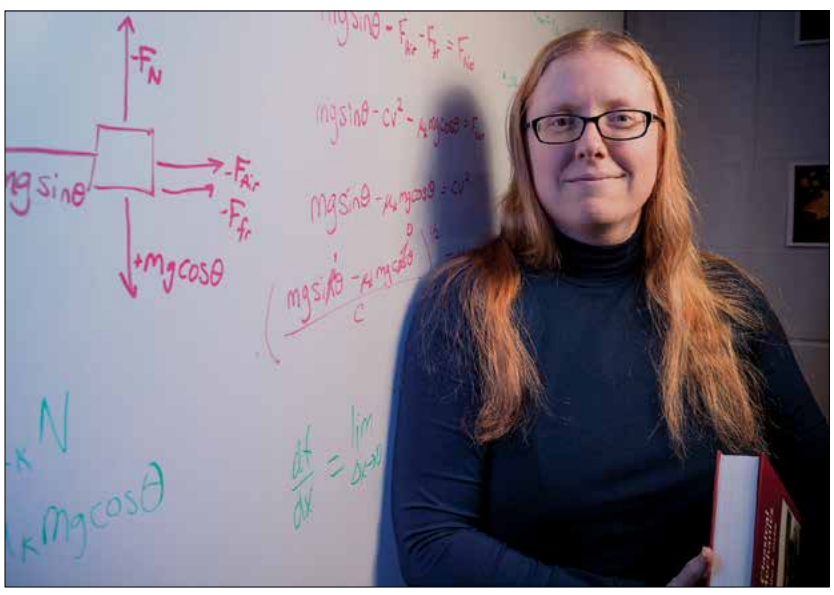
THE BACK PAGE

Faculty Response to Remote Teaching During COVID

BY ERIC BREWE AND ADRIENNE TRAXLER

March 13, 2020 was right around the time that universities made a rapid transition to teaching classes online due to COVID-19. Many schools extended their spring breaks to give faculty an extra week to plan for how to teach online. This challenge, among the many challenges presented by COVID, was particularly daunting because the majority of faculty lacked any experience with online teaching. Based on our own experiences and our social media, we planned a research project to investigate how physics faculty dealt with this transition—and to what extent it had lasting effects on their teaching. We sent electronic surveys to physics faculty from across the country, ultimately receiving 662 responses from people teaching physics during the spring of 2020 (Brewe, Traxler, & Scanlin, 2021).

Additionally, we did follow-up interviews with 15 faculty members who graciously donated their time. The survey and interviews focused on what tools and technologies faculty adopted, how they drew on informational resources about online teaching, and how they responded to this crisis transition—particularly how they made instructional decisions during the pandemic.



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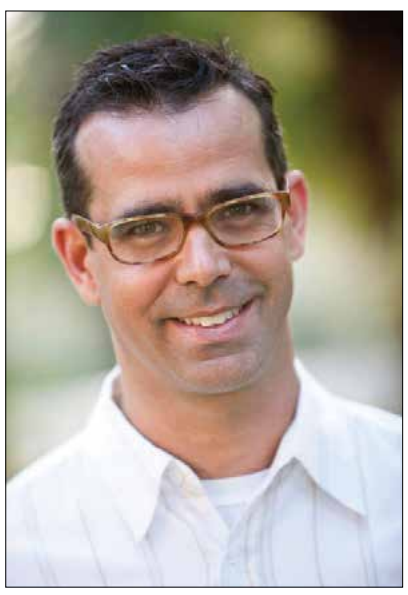

Eric Brewe

Tools

On March 17, the term "asynchronous" hit an all-time high according to Google trends (a new all-time high corresponded with the beginning of instruction the following fall). At this point in time, schools were extending spring break and shifting from in-person instruction to remote. Part of this shift led instructors to investigate new tools for teaching classes. We asked faculty about the tools they chose to utilize during the spring of 2020. Overwhelmingly, and not surprisingly, faculty reported using Zoom or other video conferencing software (89%).

The pandemic dramatically disrupted teaching and learning, and disruption is critical to educational change. Kurt Lewin theorized that large-scale institutional change required a three part process, first an unfreezing of the status quo, followed by change, and ultimately ending in refreezing. The pandemic's impact on teaching is akin to what Lewin (1947) describes as an unfreezing because so many established practices became impossible in online settings. To better understand how faculty in physics changed, we also asked about additional tools that were newly incorporated into online teaching. Among the most popular were features of institutional learning management systems—such as Blackboard, Moodle, or Canvas which can be used to assign and collect homework assignments or administer quizzes and tests (LMS, 42%), online demonstrations and simulations—such as PhET or Physlets (21%)—and pre-recorded lectures from external sources such as YouTube and Kahn Academy (16%).

One of the biggest challenges faculty faced was remotely administering assessments, such as tests and homework. Some faculty used test administration systems that monitor or lock students' computer screens during exams, such as Respondus (19%). Faculty also incorporated online homework systems such as Mastering Physics or ExpertTA (14%). Online grading systems, such as Gradescope, were somewhat prevalent (9%). While not clearly represented in our dataset, it is likely that much of the new use of institutional LMS functionality also was for the purposes of assessment.

Finally, as faculty begin to return to classes and in-person teaching, a pervasive question arises of whether new approaches employed while teaching remotely will have staying power. Will the tools continue to be used, or will instruction largely return to pre-pandemic approaches? In a follow up survey, we returned to faculty for insight about how their teaching had changed during fall 2020, when they had a summer to prepare for new instructional conditions. We compared themes in open-response data from the spring 2020 survey to fall 2020. In the spring of 2020, instructors were simply trying to figure out the basics of what online instruction requires, focusing on technologies. As instructors became more familiar with online learning themes included laboratory instruction, cheating, and how to optimize the use of technology in teaching. Further, longitudinal work is needed in order to better understand long-term impacts of the changes in tools, informational resources, and practices.

Resources

When asked what resources they drew on to help with online teaching, faculty overwhelmingly reported talking to others in their departments (79%), then to teaching centers at their schools (43%), then consulting their institutional learning management software (33%). Next are non-physics faculty at their institution (24%) or physics colleagues at other schools (19%), who were roughly as popular as Google (19%). Initially, we had expected internet resources to be much more popular. Despite the large number of education-related Facebook groups (e.g. STEM Faculty Blundering through Online Teaching in a Pandemic) and other online education communities, such as those using the #Iteachphysics hashtag on Twitter, few faculty reported these as resources

> **"The pandemic dramatically disrupted teaching and learning, and disruption is critical to educational change."**

(about 5% each for Facebook and Twitter). Instead, faculty mostly looked for guidance with their immediate circle of peers. This makes good sense in several ways, as nearby faculty will be the most familiar with the student population and course requirements. However, most of these colleagues had little experience with online instruction, so many of these conversations may have lacked access to key information about teaching and learning in this environment. This may be why campus teaching centers with dedicated faculty development staff were such a popular second choice. Familiar with local student needs, but also more likely to have expertise in online tools and pedagogy, teaching centers are a valuable bridge between familiar and new educational approaches.

Groups like the American Association of Physics Teachers (AAPT) and PhysPort sent curated lists of resources that could be used to take courses online while preserving active learning as a goal. Though these guides were distributed widely via email, they did not figure large in survey responses (9% for AAPT and 6% for PhysPort). Despite being physics-specific and rooted in research on teaching and learning, these resources were either unknown to or unused by many of the faculty they were intended for.

Anxiety

Because this pandemic has been challenging for a huge proportion of the population, we asked about the levels of anxiety experienced while teaching. The majority of respondents reported greater levels of anxiety about teaching online versus in person. Though the anxiety we measured was related to classroom practice, we believed that out-of-class factors were highly likely to creep into the classroom setting. Particularly, we anticipated that faculty were experiencing anxiety related to job security as the impacts were not yet clear (and remain unclear). We found that the bulk of the respondents did not have job security based anxiety, but that the anxiety around teaching during spring 2020 was greater for remote settings than in person.

This work was done in the context of a global pandemic, to study one small part of the effects of that pandemic. A week after the survey was sent, George Floyd was murdered. About half of the survey responses came after that event, during the ensuing protests and unrest. It's impossible to say exactly what effects this had on the anxiety of respondents, though we did separate the pre- and post-May 25 data to check for differences and found none. We are deeply appreciative of all the faculty who took the time to respond, many in the midst of stressful personal circumstances.

Empathy

One of the themes that emerged from the qualitative data (where analysis is ongoing) is empathy. Many faculty expressed concern for their students, reflected on the possible tradeoffs of instructional choices, and changed their courses or grading schemes to support student success. This concern for others, while not a stereotypical trait of physicists, is a very human response. In the coming decades, there are likely to be more global pandemic events, as one of the predicted consequences of climate change.

Thus, while we can hope that the 2020 crisis transition to online teaching was an isolated event, there is a real chance that lessons from this period will be directly applicable in the near future. We may all have to draw on our nearby colleagues, trusted online resources, and our concern for those around us to weather these changes in the educational landscape.

Conclusion

Based on the foundation of this work, we are continuing to explore the lasting impacts of the pandemic on physics faculty and their teaching. Of particular interest is the question of how faculty's teaching changed when they had more than the average two weeks to prepare for the fall term of 2020, and what tools they continue to use as they return to the classroom.

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