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APS NEWS

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GOVERNANCE

New APS Ethics Committee Holds Inaugural Meeting

BY LEAH POFFENBERGER

In 2002, the physics community was shocked by two high-profile cases of data fabrication—the Schön scandal and controversy surrounding the discovery of element 118—spurring calls to more effectively confront ethical issues in the practice of physics. Then two years later, an APS task force identified other issues in physics beyond faulty data collection, including poor treatment of subordinates.

As a result, APS began releasing ethics statements over the years to promote best practices in physics. The chair line of the Panel on Public Affairs (POPA) at APS has been traditionally responsible for evaluating issues of ethics and reviewing ethics statements, but a new Ethics Committee, which convened for the first time on June 6, will now lead the charge for promoting ethical practices by APS members.

The eleven-member standing committee includes the past chair of POPA and representatives from the Committee on the Status of Women in Physics, the Committee on Scientific Publications, the Committee on Minorities, and the Committee on Education, and six other voting members from a variety of backgrounds.


Frances Houle


Michael Marder

"We tried to draw pretty broadly across APS for stakeholders and expertise, in particular on matters that come up in ethics," says Frances Houle, a member of the committee. "That is, matters having to do with treatment of people and having to do with preservation and protection of the scientific record."

Houle's involvement with ethical issues at APS dates back to the 2004 Task Force on Ethics, which she served on alongside Kate Kirby, now CEO of APS. Together they wrote an article for *Physics Today* (November 2004) titled "Ethics and the Welfare of the Physics Profession," detailing the results

APS ETHICS CONTINUED ON PAGE 6

INTERNATIONAL PHYSICS OLYMPIAD

The 2019 U.S. Physics Team Gets Ready for Israel

BY LISSIE CONNORS

After 10 intense days of training at the University of Maryland, five students have been chosen to represent the U.S. at this year's International Physics Olympiad. This July, high school students Vincent Bian, Sean Chen, Albert Qin, Sanjay Raman, and Edward Lu will compete against teams from 79 countries in Tel Aviv. This traveling team was selected from 20 students chosen from high schools around the country.

Sitting and laughing together at a ceremony on June 7, the teammates looked like the closest of friends, even though they had just met a week before. When the final travel team was announced, the loudest cheers weren't coming from the crowd, but from their fellow teammates. While the days were long and challenging, the numerous silly photos displayed at the closing ceremony illustrated that the students had truly enjoyed their time.

The team's days at Maryland were packed with rigorous physics lectures, problem-sets, labwork, and tests, where the high school students were tasked with digesting college-level material at a swift pace.

"The camp elevates their physics knowledge to a whole new level," remarked Jiajia Dong, the team's new academic director and an associate professor at Bucknell University. While this is her first year serving as director, Dong has worked with the team for years as a coach and as co-director, finding it rewarding each year to work with the students.

"It's important for these students to find community here, to study together, and spread the love and joy of physics," said Dong.

The training camp is sponsored annually by the American Association of Physics Teachers (AAPT) along with APS, the

OLYMPIAD CONTINUED ON PAGE 6

MEMBERSHIP UNIT PROFILE

Vibrant Networking in the Far West Section

BY ABIGAIL DOVE

Three thousand members strong, the Far West Section (FWS) is the largest geographical section in APS, forming a home for researchers based in California, Nevada, and Hawaii. Given the lively academic and industrial climate in the far west, it should come as no surprise that FWS is one of the most vibrant geographical sections in the Society's ranks.

Geographical sections are an important part of the APS ecosystem: In addition to acting as a networking platform for physicists in different fields and at different stages of their careers, they also provide a vehicle for interactions between nearby academic institutions (from small liberal arts colleges to large research universities), government laboratories, and industry.

FWS was established in 2000 as the California section—one of the first to be founded as part of an APS initiative to build a bigger grassroots presence across the country. Nevada was added to the constituency in 2009, followed by Hawaii in 2013. At present, geographical sections have expanded to encompass the entire U.S.: In addition to FWS these include Four Corners (4CS), Mid-Atlantic (MAS), New England (NES), New York State (NYSS), Northwest (NWS), Ohio-Region (OSAPS), Prairie Section (PSAPS), Southeastern (SESAPS), and Texas (TSAPS).

FWS chair Patti Sparks (Harvey Mudd College) characterized involvement in a geographical section as a valuable form of "continuing education" for APS members. For students, early career researchers, and senior staff alike, geographical sections foster opportunities to learn about research at other institutions and—in contrast to more discipline-centered membership units like divisions, topical groups, and forums—can provide unique exposure to other areas of physics outside of one's particular field.

This is especially true for FWS: The section features researchers with notable strength in astrophysics, high energy physics, and nuclear physics. In Sparks' estimation, a major reason for this broad expertise is the section's backbone


Patti Sparks

of state universities and small undergraduate-focused institutions, which tend to specialize in areas that don't require expensive and elaborate equipment. With the arrival of members from Nevada, FWS has broadened its strength in plasma physics, AMO (atomic, molecular, and optical physics), atmospheric science, condensed matter, and high pressure physics.

A particular point of pride for FWS is its Annual Meeting—hailed as a kind of "mini-March Meeting" for APS members in the far west part of the country. The FWS Annual Meeting involves plenary sessions with leaders in their respective fields along with contributed talks and a poster session. Many of the presenters are undergraduates and graduate students having their first experience of discussing their work at a

FAR WEST CONTINUED ON PAGE 7

SEXUAL HARASSMENT

APS Joins Consortium Aimed at Ending Harassment in Science

BY LEAH POFFENBERGER

A 2018 study by the U.S. National Academies of Sciences, Engineering, and Medicine revealed the continued presence of sexual and gender harassment in the sciences: More than 50 percent of women faculty and 20 to 50 percent of women students have experienced some form of sexual harassment.

In response to this report, organizations in the fields of science, technology, engineering, mathematics, and medicine (STEMM) are banding together to combat this widespread issue. The Societies Consortium on Sexual Harassment in STEMM now includes representatives from more than one hundred organizations, including APS.

"[The Consortium] is looking at the issue of sexual harassment very broadly and coming together, pooling our resources or knowledge or expertise, to develop shared tools and resources that we can use—that's the first benefit," said Monica Plisch, Director of Education and Diversity Programs at APS. "The other benefit is to create a network of organizations that are doing this work together and can learn from each other."

The Consortium was launched by the American Association for the Advancement of Science, the Association of American Medical Colleges, and the American Geophysical Union. APS joins the

CONSORTIUM CONTINUED ON PAGE 7

Revised 07/10/19

Murray Gell-Mann 1929-2019

BY DANIEL GARISTO

Murray Gell-Mann, who laid the groundwork for modern theoretical particle physics, died May 24 at his home in Santa Fe, New Mexico. He was 89.

In addition to the Nobel Prize in Physics he won in 1969 for "for his contributions and discoveries concerning the classification of elementary particles and their interactions," Gell-Mann was also awarded prizes for his environmentalism and humanism. He was an early member of the independent advisory group JASON, a member of the National Academy of Science, and a Fellow of APS.

"For me as a young physicist, Murray was both inspiring and intimidating," said 2019 APS President David Gross. "He professed to know everything about everything and was usually correct."

Almost no part of today's Standard Model was unaffected by Gell-Mann's contributions. At a time when new particles seemed to pop up weekly, he brought order to the chaotic zoo of hadrons and mesons by reducing them to their fundamental constituents.

"There's nothing more satisfying to a physicist than to find the hidden order beneath all the chaos," said Sean Carroll, a theoretical physicist

Murray Gell-Mann

at Caltech. "And he was better than anyone in the world at doing that."

Gell-Mann had not always wanted to become a physicist. Physics was a compromise with his father, who thought engineering would be a more stable source of income than his other interests in linguistics, archaeology, and evolutionary biology. Later on, these passions would lead to Gell-Mann's work co-founding the interdisciplinary Santa Fe Institute, where he was finally able to blend simple principles of physics to explain complexity in other realms.

A perfectionist, Gell-Mann was well-known for his insistence on

GELL-MAN CONTINUED ON PAGE 6

THIS MONTH IN

Physics History

July 1915: William Lawrence Bragg Works on Sound Ranging for Artillery Detection

During World War I, it proved difficult for British forces to pinpoint the location of enemy artillery—at least until the development of a technique called sound ranging, which employed microphones to pick up the boom of the heavy guns firing. The leader of the group that developed it was a newly minted Nobel Laureate named William Lawrence Bragg.

Born in Adelaide, Australia in 1890, young William Lawrence came by his passion for science and math quite naturally, given that his father, William Henry Bragg, was a physicist at the University of Adelaide. In fact, when young Lawrence fell off his tricycle and broke his arm, his father used x-rays—then newly discovered by Willem Roentgen—to image the break, the first time x-rays were used for medical purposes in Australia. Bragg graduated from University of Adelaide in 1908, just as the family was moving to England so his father could chair the physics department at the University of Leeds. This enabled him to pursue advanced studies at Cambridge University, finishing with top honors in physics in 1911, becoming a fellow of Trinity College three years later.

Meanwhile, physicists around the globe were enthusiastically researching the properties of x-rays and exploring their potential for scientific applications. Bragg was inspired during a riverside stroll with an insight into the diffraction experiments conducted by Max von Laue involving x-ray beams scattering off a crystal. He realized that this diffraction would be affected by both the wavelength of the x-rays, the angle at which the beam hit the crystal, and the distance between the crystal's atomic sheets, which he expressed mathematically as the Bragg equation.

Bragg the elder devised an experimental apparatus to confirm Bragg junior's equation. Unfortunately, his father gave only passing (unnamed) credit to "his son" for the equation in the resulting paper, but did not list him as a co-author, hurting Bragg deeply. Nonetheless, he shared the 1915 Nobel Prize in Physics with his father, "For their services in the analysis of crystal structure by means of x-ray." He remains the youngest recipient of the physics Nobel to this day, and his work with his father laid the groundwork for the development of x-ray crystallography.

That same year, both Bragg and his brother Robert enlisted to fight for Great Britain in World War I. Tragically, his brother was killed in September, just before Bragg and his father received the Nobel Prize. Bragg started out in the Royal Horse Artillery, but that summer he was sent to the Royal Engineers and assigned the task of developing sound ranging to locate enemy artillery. Prior attempts had proved unsuc-

William Lawrence Bragg

cessful, in part because the heavier guns fired at such a low frequency the microphones couldn't detect them.

Bragg joined forces with astronomer Charles Nordmann and Lucien Bull, a medical researcher investigating how to record heart beats. Together they devised a solution: using microphones built out of ammunition boxes that were better at picking up the low frequencies of the guns firing, and wrapping the microphones in fabric, thereby reducing noise from the wind. They also employed a "harp" galvanometer to record signals from several microphones positioned across a kilometer range. When the microphones picked up the sound of artillery, the electrical current they produced would flow through the galvanometer wires placed in a magnetic field, causing the wires to vibrate. The shadows of the moving wires were recorded on a continuous roll of film that could be developed in minutes, enabling quick calculations of the enemy's location.

After World War I, Bragg joined the faculty of the Victoria University of Manchester, replacing Ernest Rutherford, who was moving to Cambridge. He continued his work in crystallography, focusing on inorganic compounds to avoid direct competition with his father's research into organic crystals. Along with R.W. James, he figured out how to measure the number of electrons in the reflecting

BRAGG CONTINUED ON PAGE 3

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DEVELOPMENT

Holocaust Survivor George Zimmerman leaves Legacy to APS

George Zimmerman, who passed away in May, led a life of distinguished service in physics and education. His wife of 54 years, Isa, also an accomplished educator, says that he was a remarkable man with a remarkable story.

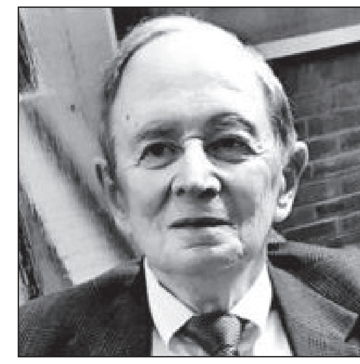
Born in 1935 in Katowice, Poland, George's family hired a guide to help them escape Hitler's regime, but the guide took their money and turned them over to the Nazis at the border. From there, the family was split up and George and his father were transported to the Auschwitz concentration camp. George survived by a quirk of fate—he had contracted scarlet fever and was quarantined at the camp clinic. He was still there when the camp was liberated.

After the war, he found his mother and was adopted by a distant relative. They were moved to New Haven, Connecticut. George went to Yale University and received his PhD in 1963 in condensed matter physics, after which he joined Boston University as a professor of physics and later Department Chairman. Until he became emeritus professor at BU in 2001, his research focused on superconductivity, magnetoresistance, and various aspects of low temperature physics. In the 1990s, he founded and led the ZerRes Corporation, which fabricated specialized materials for high-temperature superconductor applications.

"George's lab was like the United Nations," says Isa. "At one point, he had about half a dozen students and they were from all over the world." In addition, he ran a summer program for high-school students who had taken physics in their junior year. The program still exists, thanks to NSF funding and Boston University's adoption of it, she says.

Isa Zimmerman has been an educator, with experience spanning 50 years and is president of IKZAdvisors, a STEM education consultancy. She has been a superintendent, a high school principal and an assistant principal, junior high school teacher, division director of the Technology in Education Program, and an associate professor at Lesley University. She was senior fellow for STEM at the University of Massachusetts Donahue Institute and the UMass President's Office. She was a member of both the Massachusetts and Iowa Governor's STEM Advisory Councils.

As part of their estate planning before George passed away, he and Isa chose APS as one of the organizations they wanted to support and joined the APS Legacy Circle. "He was very active and cared a lot about the organization," says Isa. "My advice is, if you are a physicist and want to leave a legacy for the future, APS is a good organization to work with."


George Zimmerman

For more about George Zimmerman, see "*The Triumph of Wounded Souls: Seven Holocaust Survivors' Lives*," by Bernice Lerner (University of Notre Dame Press, 2004).

Planned giving (aps.org/about/support/planned.cfm) is one of many ways you can donate to APS. Please also consider joining the APS Legacy Circle (aps.org/about/support/legacy.cfm) as a way to support the work of APS. For more information, contact Irene I. Lukoff, Director of Development, at 202-209-3224 or lukoff@aps.org.

BRAGG CONTINUED FROM PAGE 2

targets used in the scattering experiments, enabling them to determine the structures of silicates and other more complex crystals. From 1937 to 1938, he briefly served as director of the National Physical Laboratory in Teddington but was unhappy with how much administrative duties kept him from doing research.

Then Rutherford died, and Bragg was selected to replace him as director of the Cavendish Laboratory at Cambridge. While its stellar reputation had been built on atomic physics, Bragg proved an able administrator and set up a small research group in crystallography. Among his early students: an Austrian refugee named Max Perutz, who went on to use x-ray diffraction to unlock the structure of large biological molecules like myoglobin and hemoglobin. Perutz shared the 1962 Nobel Prize in Chemistry with John Kendrew for that work. In total, there have been 28 Nobel Prizes for research using some form of x-ray analysis.

When World War II broke out, Bragg shifted focus to the structure of metals, as well as consulting for the military on sonar and sound ranging technologies. He was knighted in 1941, one year before the death of his father. He also began a long affiliation with the Royal Institution, eventually succeeding his father as a resident professor in 1953, and serving as director from 1965-1966. He died near his Ipswich home on July 1, 1971 and is buried in Trinity College.

Further Reading:

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APRIL MEETING

Sorting Out the Neutron Lifetime

BY SOPHIA CHEN

For over a decade, physicists have puzzled over the neutron lifetime: how long, on average, it takes the isolated particle to decay into a proton, electron, and antineutrino. Counting the number of neutrons in a container over time, they measure the half-life to be about 14 minutes and 39 seconds. Using a different experimental method where they count one of the neutron's decay products, they measure the lifetime to be about 8 seconds longer.

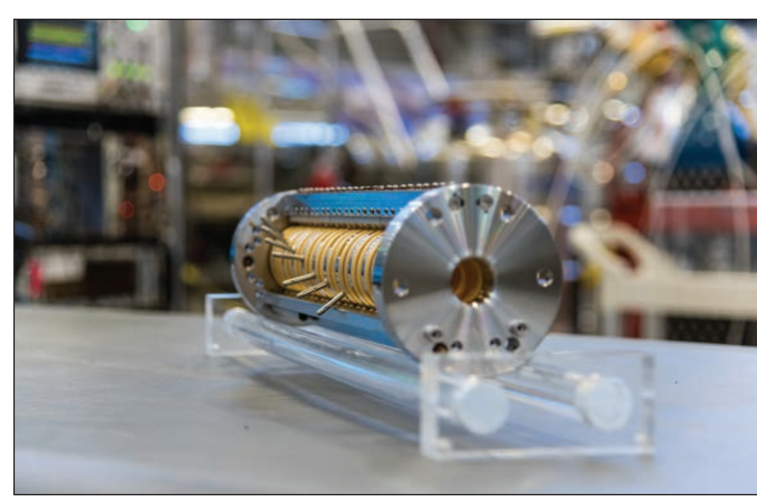
"It's an exciting time to work in the field," says Shannon Hoogerheide of the National Institute of Standards and Technology (NIST). In 2018, three independent teams of physicists have published new measurements of the neutron lifetime, which have improved precision but preserve the discrepancy.

During a mini-symposium at this year's APS April meeting in Denver, experts gathered to develop strategies for resolving the discrepancy, including a tantalizing theory involving dark matter decay.

But the discrepancy could still be the result of systematic uncertainties, so some groups are working to make better measurements.

"We've taken more lifetime data this year, and we're analyzing it right now," says Kevin Hickerson of the Ultracold Neutron Tau (UCNτ) experiment at Los Alamos National Laboratory.

Hickerson's method, a so-called bottle experiment, involves counting neutrons over time and results in the shorter measured lifetime. He and his colleagues trap ultracold neutrons at a temperature of about a millikelvin inside a one-meter diameter container—"the bathtub," they call it.


NIST proton trap for measuring neutron lifetime. A free neutron entering the trap as part of a beam will decay into a proton, an electron, and an antineutrino. The number of protons detected can be used to calculate the neutron lifetime. IMAGE F. WEBBER/NIST

"We fill it with neutrons, and then we count," he says. "And we fill it again, wait longer, and count again. Then we fit an exponential to that decay." The three 2018 measurements, one made by Hickerson's group, were all bottle experiments, albeit with slightly different setups [*Science* 360, 627 (2018)].

The other method, known as a beam experiment, involves counting the protons that the neutrons decay into. At NIST, researchers send a beam of neutrons through an electromagnetic field, which traps and then deflects any proton decay products, explained Hoogerheide. NIST's experiment yielded the most recent beam result in 2005. Using the same data, they updated those results with better calibration in 2013, and her team is currently working to improve that measurement.

Researchers were particularly excited to discuss whether the discrepancy arose from an unknown dark matter decay product. This theory, proposed by Bartosz Fornal and Benjamin Grinstein of the University of California, San Diego, has the neutron decaying into a dark matter particle 1 percent of the time. This particle would have a mass of about 1 GeV, about 100 times lighter than the weakly interacting massive particles usually predicted by supersymmetry. If neutrons occasionally became dark particles, that would explain why neutrons disappear more quickly in the bottle experiment than proton decay products appear in the beam experiment. "If this turns out to be how nature works, this would turn out to be a very inexpensive way of trying to probe dark matter," says Fornal.

NEUTRON CONTINUED ON PAGE 5

OUTREACH AND PUBLIC ENGAGEMENT

PhysicsQuest Reaches New Heights

BY LEAH POFFENBERGER

For the past 14 years, APS has sent comic books featuring the escapades of Spectra, a superhero with laser powers, and PhysicsQuest teaching kits linked to the books' physics concepts to classrooms around the world. The outreach team at APS has traveled to venues like Comic-Con International in San Diego to spread the word and interact with fans of all ages. Now, Spectra and PhysicsQuest have hit the Mile-High City, with an exclusive workshop at the Denver Pop Culture Con this past May.

James Roche, APS Outreach Programs Manager, headed up the workshop on May 31, assisted by Rebecca Thompson, author of the *Spectra* comics. For an audience of teachers and science fans, Roche and Thompson explained how to best use the PhysicsQuest kits in a classroom and demonstrated an experiment from *Spectra's Energetic Escape*.

"Any time there is opportunity to connect our programs to new audiences, we get excited. The *Spectra* comics and the PhysicsQuest program are natural fits at comic conventions, and the Denver Pop Culture Con was no exception," says Roche. "The glowing reception from the thousands of attendees who stopped by the *Spectra* booth and the subset that attended the PhysicsQuest workshop is exactly what drives us to push forward."

The APS PhysicsQuest program has been sending comic books and accompanying kits, which include a teacher's guide and materials for original physics demos, to middle school classrooms since 2005. *Physics Quest: Spectra's Energetic Escape* is the 13th kit produced by APS and accompanies the 10th issue of the *Spectra* series.

Each issue of *Spectra* incorporates a set of physics concepts into the adventures of Lucy Hene—alias Spectra—a middle school student with the power to turn into a human laser beam. *Energetic Escape* sees Spectra and friends using their knowledge of pendulums, friction, and potential and kinetic energy in a competition for concert tickets that turns dangerous.

Roche and Thompson demonstrated a pendulum experiment from last year's kits, bringing the concepts from the comic book to life. As Roche demonstrated the experiment, Thompson discussed ways students could gather both qualitative and quantitative data from the experiment in a classroom.

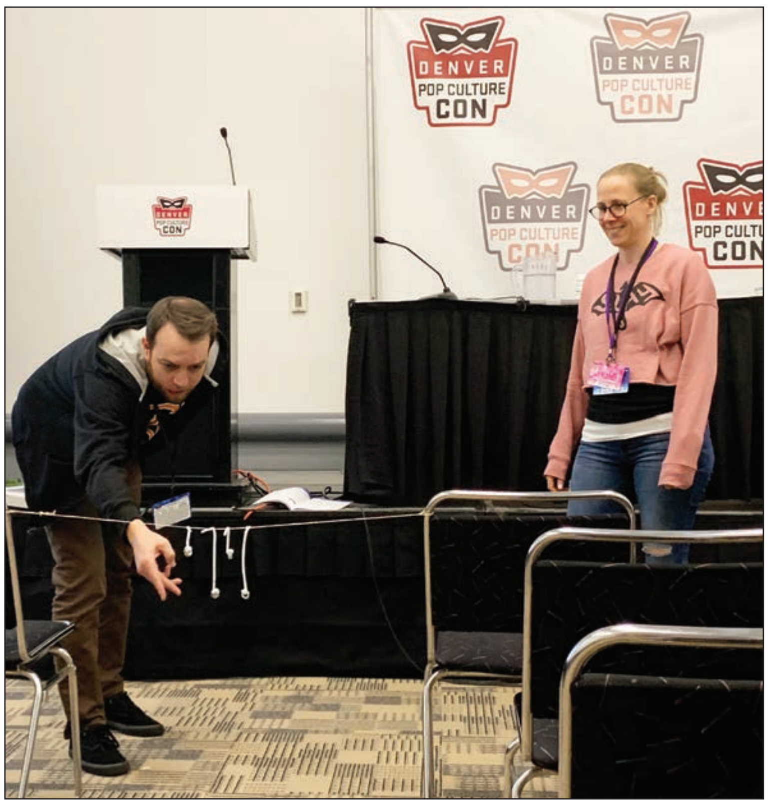
"Pendulums are a great experiment when working with potential and kinetic energy, and there's all kinds of things you can have students measure," Thompson explained during the session. "You can have them record frequency and find the period of the pendulum with a stopwatch, and they can also experiment with different pendulum lengths or using multiple pendulums."

A chain of rubber bands, stretched between two chairs, supported four pendulums, made from metal nuts and pipe cleaners of two different lengths. By having sets of pendulums at these different lengths—one set at six inches and the other at two and a quarter—the experiment goes beyond just measuring the frequency or period of a single pendulum, but also delves into the resonant energy transfer that goes on between pendulums of the same length. Swinging one six-inch pendulum will eventually cause the other—but not the shorter pendulums—to swing too.

The PhysicsQuest Teacher's Guide includes a full explanation of this experiment and three others: Friction Fun, Straw Rockets, and Pinwheel Power. Student guides are also included with instructions for conducting the experiment, collecting data, and analyzing the results. A new PhysicsQuest kit covering thermodynamics will be available this year, thanks in part to funding from Google, and a special LIGO edition of *Spectra* on gravitational waves is also in the works.

"PhysicsQuest continues to be an integral part of our public engagement," says Roche. "Over the past year, we've strived to evaluate and improve the program to better serve the students and educators that have made it such a success."

For more on the Spectra series and the PhysicsQuest program visit physicscentral.com/experiment/physicsquest/.



APS Outreach Programs Manager James Roche and *Spectra* author Rebecca Thompson demonstrate energy transfer in pendulums.

GOVERNMENT AFFAIRS

International Students Key to Colorado Economy

BY NOAH FINKELSTEIN

America has been a destination for the best and brightest students in the world who contribute to our cutting-edge research projects. Unfortunately, we're losing our draw as many international students confront challenging legal paths to study in the U.S. Many of these world-class students are now going elsewhere, to the benefit of other countries. Thankfully, U.S. Senator Cory Gardner is in a position to help preserve our country's global science leadership.

It's no secret that part of America's economic success comes from the contributions of immigrants. My grandparents and great-grandparents came to this country and helped build the cities and towns they lived in, creating better lives for themselves and our society. From construction to technology to pharmaceutical companies, immigrants—students in particular—have played crucial roles in building the businesses that strengthen the U.S. economy.

But our nation is now at high risk of no longer attracting the best students around the world. Last year, the percentage of international students applying to graduate physics PhD programs at U.S. institutions declined by an alarming 12 percent. This decline has also happened here in Colorado. And while we've been facing declines, other countries such as China, Australia, Canada, and Germany all experienced increases.

We must take immediate steps to once again make the U.S. the top destination for the best international students in the world to come, study and then build their ideas and businesses here.

Despite the complexities surrounding immigration, at least one issue has garnered the support of the White House and members of both parties of Congress. Attracting and retaining "the best and brightest" students to America is one of the major goals of the recently unveiled White House immigration plan.

Whatever immigration plan Congress passes, it should make the F-1 student visa "dual intent" and provide a path to citizenship for international STEM graduate students. That would be a transformative step to attracting the best

Noah Finkelstein

students to our Colorado institutions. Right now, the F-1 is single intent—students can come here to study, but they must state that they intend to leave the U.S. after completing their degree. That needs to change. Why would we train international students and not encourage them to stay and invest their talents in the country that invested in them?

Supporting legislation that makes the F-1 visa dual intent and creates a path to citizenship

IMMIGRANTS CONTINUED ON PAGE 7

FYI: SCIENCE POLICY NEWS FROM AIP

Looming Lab Workforce Shortfall Worries Top Appropriator

BY JONATHAN BEHRENS

Just before House appropriators advanced spending legislation for the Department of Energy (DOE) this spring, Rep. Marcy Kaptur (D-OH) announced her interest in addressing the impending wave of retirements at federal laboratories. Kaptur has considerable influence over DOE's 17 national laboratories as chair of the subcommittee that prepares the House's spending proposals for the department. She also raised more general concerns about the ability of the U.S. to develop its domestic scientific workforce.

"I just wanted to say to the entire committee, there's one area I'm really uncomfortable with," she began. "We didn't address it heavily in this bill because I don't have the formation of the idea complete in my mind, but just know I'm deeply worried, as one member, about the ability of our country to recruit Americans to work at the highest levels of science in this country."

Citing conversations with directors of federal laboratories, she said that "30 to 40% of their highest-level scientists" are nearing retirement age, representing a serious recruitment challenge that is exacerbated by the private sector's ability to offer higher salaries.

"So I am looking for ideas," she continued. Pointing to the military academies such as West Point as one potential training model to consider, she added, "Why couldn't the country think about how to piece together an initiative that would help to draw young people into the sciences using the power of our research labs?"

Among the federal labs facing significant staffing challenges are the three overseen by DOE's National Nuclear Security Administration (NNSA): Los Alamos, Lawrence Livermore, and Sandia National Laboratories. Together they certify the safety and reliability of the current nuclear weapons stockpile and support a broad portfolio of scientific research.

NNSA Administrator Lisa Gordon-Hagerty has stressed the labs' growing workforce needs at several congressional hearings this year. Speaking before the Senate Armed Services Committee in May, she noted that more than 40% of NNSA's workforce will be eligible for retirement over the next five years at a time when the agency is facing its heaviest workload since the end of the Cold War.

"Los Alamos is looking to hire 1,000 people this year. Sandia is looking to hire 1,000 this year. Livermore is looking to hire 500 people," she told the committee. "We're talking about really thousands of people in our workforce, not only in the next five years, but now, in order to handle the increasing workload that's on us."

NNSA is currently undertaking a comprehensive modernization of the nuclear security enterprise to address shortfalls stemming from aging infrastructure across the weapons complex. Through its Nuclear Posture Review, the Trump administration has also directed the agency to develop a weapons workforce and production infrastructure that is more "responsive" to potential shifts in the geopolitical or technical landscape.

Gordon-Hagerty said it is crucial that NNSA develop a new paradigm for recruiting given the magnitude of its staffing needs. She explained the agency is experimenting with new mechanisms to attract and develop technical talent. These include partnering with universities to develop training programs for specific areas of need, such as radiological technicians, and holding much larger recruitment fairs that leverage rapid hiring procedures.

"We're finding different ways of trying to resource, if you will, or source the next generation, the best and brightest. And those are scientists, those are engineers, those are technicians," she said.

The author is a Science Policy Analyst with FYI.

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EDUCATION AND DIVERSITY

STEP UP: Changing the Face of Physics

Do you know any high school physics teachers? Did you know that they are the most cited source of inspiration for young women pursuing a physics degree in college? Although half of high school physics students are women, they go on to make up only 20% of physicists at the undergraduate, graduate, and early professional levels. This is why APS and its partner institutions have spent the last two years in a new, but vital, venue for changing the face of physics: high school physics classrooms.

The STEP UP project has built a national consortium of physics educators, researchers, and professional societies to optimize two self-contained lessons for physics classrooms. STEP UP's lessons have shown great effects, especially for young women, of increased student interest and likelihood to pursue a career in physics. Now, these lessons need to be adopted by high school physics teachers to lead to a nationwide boost in women's interest in physics when declaring college majors.

This is where you come in! Ask a teacher to register with STEP UP at STEPUPphysics.org. Sign up yourself to continue to support the STEP UP movement. Reach out to local high school physics teachers or other networks of physics teachers and recruit them to join the campaign. Together, we can be sure that future generations of physics majors include the rich diversity that the country has to offer.

Save the Date!

National Mentoring Community Conference 2020, February 6 – 8, 2020, University of Central Florida, Orlando, Florida

Join us for the APS National Mentoring Community Conference 2020, held in partnership with the National Society of Black Physicists and National Society of Hispanic Physicists.

We encourage undergraduate physics students from underrepresented groups, faculty interested in discussions of diversity and mentoring within physics education, representatives from summer research internship programs, and other physics professionals to attend.

Travel and housing funding will be available for NMC Mentors and Mentees.

For more information visit the conference website at aps.org/programs/minorities/nmc/conference/

Save the Date!

2020 PhysTEC Conference to be held February 29 – March 1 in Denver, Colorado.

Join us at the nation's largest meeting dedicated to the education of future physics teachers, immediately preceding the APS March Meeting 2020, and attend workshops on best practices, panel discussions by national leaders, and excellent networking opportunities for physics teacher educators. Visit the PhysTEC conference site at phystec.org/conferences/2020/.

Funding for New PhysTEC Sites

PhysTEC expects to award Recruiting Grants to up to five new sites. Awardees will receive $25,000 to implement a two-year improvement plan that focuses on implementing some of the best practices found in the PTEPA Rubric. Funding is set to begin on July 1, 2020. The rubric, the full Request for Proposals, and submission instructions are available on the PhysTEC website at phystec.org. Proposals are due September 27, 2019 at 5 p.m. local time.

INTERNATIONAL AFFAIRS

APS Offices Partner on U.S. Visa Policy Survey

BY TAWANDA W. JOHNSON

The APS Office of Government Affairs (APS OGA) and the APS Department of International Affairs have partnered to survey graduate students' opinions about issues related to U.S. visa policies.

Specifically, the anonymous survey, which will circulate to members of the APS Forum on Graduate Affairs (FGSA) during July, will ask students whether they've experienced difficulties obtaining an F-1 student visa, which allows them to enter the United States to study at American universities. Participants' identifying information will not be included in the survey results.

"This is, to my knowledge, the first time a widespread, systematic approach has been taken to understand visa issues encountered by physics students who wish to study in the U.S.," said Amy Flatten, APS Director of International Affairs. "We hope that the survey will yield some quantitative data that can be shared with policymakers, along with compelling stories, to better illuminate the damage of visa issues to the United States's reputation as an attractive place to study."

Added Francis Slakey, APS Chief Government Affairs Officer, "We're stepping up our use of data to make a more effective case for our science policy initiatives, and we plan to use the information to ultimately help continue to attract the best and brightest students to the U.S."

Allen Hu, APS Policy Analyst, said the FGSA survey will include questions such as:

- Did you have any issues with initially obtaining a student visa to study in the United States?
- Did you have any issues renewing your student visa to complete your program of study?
- Have you dealt with any issues while transitioning from an F-1 student visa to an H-1B visa?

In contrast to the F-1 student visa, which requires a full-time academic load but prohibits off-campus employment, the H-1B visa allows U.S. employers to temporarily hire foreign workers into specialty occupations.

Last year, a survey conducted by APS OGA of 49 of the largest graduate physics programs in the U.S. revealed that the percentage of international students applying declined by an average of 12 percent from 2017 to 2018. In response, APS members worked with APS OGA to write op-eds and meet with congressional staffers, both locally

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NEUTRON CONTINUED FROM PAGE 3

However, new analyses have already constrained some of Fornal and Grinstein's suggested experimental signatures, including a scenario that releases telltale gamma ray and one that produces an electron-positron pair.

At the meeting, theorists debated whether this dark matter decay product is consistent with observed neutron stars. Some theorists had suggested that this dark matter particle would render neutron stars at observed masses unstable. They have largely resolved the issue, according to Fornal, by introducing the possibility that the dark matter could be self-repulsive. This would allow for the observed neutron star masses.

The neutron lifetime has important implications for cosmology. For example, it helps determine the amount of light elements, particularly helium atoms, that formed from hydrogen right after the Big Bang. "Helium is made by protons capturing neutrons," says Hickerson. "So the rate at which neutrons disappear from the early universe determines how fast they can [combine with] protons to form helium."

Hickerson and his colleagues have created an open-source code called AlterBBN to simulate the production of light elements, in which the neutron lifetime is a variable. They then compare the elemental abundances produced in the simulations to spectroscopic observations of low-metallicity clouds of gas from the early universe (astrophysicists call elements heavier than hydrogen and helium "metals"). The astrophysical observations and simulations should agree with each other within their range of uncertainties, but the neutron lifetime is the limiting factor, says Hickerson. So if they can zero in on a more precise neutron lifetime, it could motivate astronomers to take a closer look at these gas clouds.

The UCNτ collaboration is planning to build an experiment where they count neutrons and their decay products simultaneously. "It's basically like doing a beam and a bottle experiment at the same time," says Hickerson. They want to include a neutron counter, proton counter, and electron counter in this experiment so that it would be sensitive to Fornal's proposed neutron dark decay.

The beam experimentalists, meanwhile, are improving their proton counting and investigating their major systematics. Hoogerheide has high hopes for the future. "Given the number of projects working on it, we should have a resolution to this within the next five to ten years," she says.

The author is a science writer based in Tucson, Arizona.

APRIL MEETING

Particle Physics on a Tabletop

BY SOPHIA CHEN

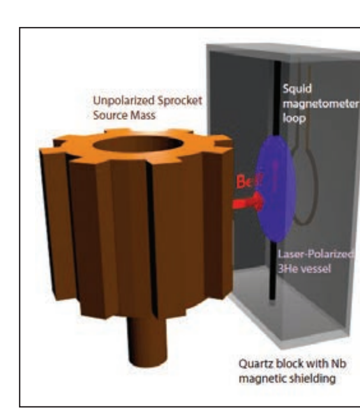
The Large Hadron Collider may be the flashy face of particle physics, with its gargantuan tunnel and the attention of thousands of researchers. But smaller teams of physicists are quietly chipping away at similar fundamental particle physics questions using less expensive equipment. These tabletop experiments are small enough to fit in a single university lab and cost a mere several millions of dollars, as opposed to the LHC's billions. At the APS April Meeting in Denver this year, researchers discussed their progress hunting for hypothesized exotic particles using these humbler setups.

Unlike, collider physicists, who investigate the bits and pieces left over from high energy particle collisions, tabletop experimentalists probe low-energy systems. These physicists look for any deviations from the Standard Model in parts per billion and smaller. Deviations, if they spot them, might hint at the existence of new particles.

Elongated Electrons?

Along with John Doyle (Harvard) and Gerald Gabrielse (Northwestern University), David DeMille of Yale University co-leads a collaboration to measure how round the electron is—the so-called electron electric dipole moment (EDM). This quantity describes how the particle's negative charge is distributed. A nonzero value would mean that the charge is not spread uniformly.

In the Standard Model, the electron is a point particle with zero EDM. But under real-world conditions, quantum field theory predicts that an electron constantly emits and reabsorbs virtual particles, which would make its charge distribution appear egg-shaped. Theory predicts that this asymmetry is so subtle that it cannot be detected with any conceivable experiment. So if DeMille's team did discern a slight elongation to the electron, that would be evidence of new particles outside the Standard



The ARIADNE experiment seeks to detect axions with a rotating mass interacting with spin-polarized helium nuclei. IMAGE: ARIADNE

TABLETOP CONTINUED ON PAGE 7

VISA POLICY CONTINUED FROM PAGE 5

and in Washington, D.C., in an effort to persuade lawmakers to address the issue.

Additionally, APS leadership has met with key officials representing various agencies, including the State Department, Office of Science and Technology Policy, National Security Council, Department of Energy, National Science Foundation, Commerce Department, Department of Defense, FBI and the Office of the Director of National Intelligence.

APS is also supporting the Keep STEM Talent Act of 2019, which has been co-sponsored by U.S. Sens. Dick Durbin (D-IL); Richard Blumenthal (D-CT); Kamala Harris (D-CA); Amy Klobuchar (D-MN); and Ron Wyden (D-OR). The bill would remove barriers for international students who pursue advanced STEM degrees at U.S. institutions and provide green cards to students who earn advanced STEM degrees from U.S. institutions and secure job offers from U.S. companies.

"America should always be looking to maintain a strong STEM workforce because it will help us compete in the global economy," said Durbin in a joint press release with the bill's co-sponsors. "By denying international students with STEM degrees a chance to continue their work in America, we are shipping their talents overseas and won't see the positive impacts of their American education. We think this bill represents a common sense idea that the Senate should take seriously."

Added Harris, "Ours is a nation of immigrants, and our strength has always come from our diversity and our unity. We have invested in these students who have learned at our universities, and we must do everything we can to keep their talent here. I am proud to join my colleagues on this important legislation, which will ensure the U.S. remains competitive in the global economy, and hardworking students are welcome on our campuses and in our country."

APS President David Gross hailed the FGSA survey as a crucial tool to gather pertinent information about the F-1 visa issue.

"International students are an important part of the STEM education and workforce pipelines, and working alongside American students, they offer diverse perspectives on some of the nation's most challenging scientific research. This survey will help us better understand the issues international students face as they strive to study and work in the United States," said Gross.

To participate in the anonymous FGSA survey go to surveymonkey.com/r/QL8NVNX. To tell your senator to support the Keep STEM Talent Act of 2019, visit aps.org/policy/issues/immigration.cfm.

The author is the APS Senior Press Secretary.

APS ETHICS CONTINUED FROM PAGE 1

of surveys the task force conducted.

"The task force had the charge of understanding how ethics are taught in the physics curriculum and what people learned from it," says Houle. "We did a bunch of surveys and short answer is that it isn't—ethics are not taught."

The 2004 *Physics Today* article primarily focused on the experiences of early career members of APS and highlighted ethical issues involving mistreatment of graduate students and early career scientists.

"Since then, I think those who were aware of the problems that were brought up thought that there should be a sustained set of actions to take care of these issues," says Michael Marder, professor of physics at the University of Texas at Austin and chair of the new Ethics Committee. "These actions would be efforts to educate physicists on good practices for treatment of graduate students, guidelines on work-life balance, and ways to respond to different forms of harassment."

The establishment of an Ethics Committee was in part motivated by several APS Ethics Statements that came up for review by POPA in 2017 and an effort to consolidate these statements into a single guiding document.

"In 2017, the ethics statements came up for review, and I've always thought it was a problem that they were fragmented, that there wasn't a coherent single document that you could go to," says Houle, who was chair of POPA at the time. "But part of the conversation among the group working on this was that we really need an ethics committee to keep this guidance document current, to correct it, to update it as needed."

New sections were added to the APS ethics guidelines, covering issues in publishing such as redundant publication; addressing explicit, systemic and implicit biases including harassment; and laying out professional guidelines for use of social media, use of public funds, and conflicts of interest. These additions were extensively reviewed and presented to APS members for comment before their approval by the APS Council in April 2019.

The Ethics Committee, officially established in November 2018, was also made possible by Houle and Marder's mutual belief in the importance of continued focus on addressing ethical issues. As the successor to Houle as chair of POPA, Marder was able to continue her efforts.

"The committee was something that the previous chair [Houle] had already put a huge amount of work into—a single year was not enough time to complete the work," says Marder. "It was really quite necessary that I put the effort into making sure that this went through. I was convinced that the ethical standards of the community are really an essential foundation on which physics has to rest."

In addition to overseeing implementation of ethics policies and updating the ethics guidelines, the Ethics Committee will provide resources to promote ethical best practices through educational programs and events organized at APS meetings. At the inaugural meeting of the Ethics Committee, a subcommittee was tasked with creating resources for the new Committee website, with the vision of it becoming a hub for the physics community to access materials to promote ethical practices.

Another task of the Ethics Committee will be to create a policy for revocation of membership or honors based on instances of ethical misconduct or harassment.

"Part of our charge is to consider the way that we're going to respond to allegations of different forms of harassment," says Marder. "We'll have to consider the question of whether there may be circumstances where revocation of APS membership might be appropriate, where individuals might not be eligible for APS awards and offices—there are members of the APS who feel this is an urgent matter to consider and the committee is considering what we should do."

For more on the new APS Ethics Committee, visit aps.org/about/governance/committees/ethics/. The full text of the ethics guidelines adopted by the APS Council is available at aps.org/policy/statements/guidlinesethics.cfm.

GELL-MAN CONTINUED FROM PAGE 2

accuracy in all things and unstinting criticism.

"Working with Murray was delightful," said economist Ole Peters, a professor at the Santa Fe Institute. "One time we had thought about a particular problem, written down some equations, and convinced ourselves that this was the way to do it. I felt a sense of achievement, leaned back and put my pen down. Murray said: 'OK, so why is this wrong?'"

But many found him irascible and tough to work with.

"I think the difficult aspect of his personality was his pride in his own intellectual achievement, which he certainly merited," said theoretical physicist Helen Quinn. "Somehow he held onto it tighter than he needed to when everybody was recognizing it."

Murray Gell-Mann was born September 15, 1929 in Manhattan to Pauline (Reichstein) and Arthur Isidore Gell-Mann, Jewish immigrants from Europe. As a child, Gell-Mann and his older brother Ben explored the flora and fauna of New York City, which they regarded as a forest that had simply been "over logged." He became fascinated with his father's books on etymology and language—an interest he never let go.

After graduating as high school valedictorian at 14, Gell-Mann earned a scholarship to Yale. For his PhD, Gell-Mann moved on to MIT, where his supervisor was Victor Weisskopf. In 1955, after a number of visiting professorships, Gell-Mann settled down at Caltech, where he would remain until 1993.

Although their rivalry was later infamous, Gell-Mann worked with his colleague Richard Feynman to explain the weak interaction. (Though they were beaten to the punch by Robert Marshak and George Sudarshan.)

Gell-Mann's most notable work was on the classification of particles. To explain the long decay times of kaons and hyperons, Gell-Mann and Abraham Pais developed a conserved quantity—strangeness—which was only not conserved in the infrequent weak interactions.

In 1961, Gell-Mann introduced a tongue-in-cheek name for a classification scheme that would revolutionize the way particles were organized: the Eightfold Way. Organizing particles by their symmetry, he (and Yuval Ne'eman, independently) were able to predict the omega-minus, which was discovered in 1964.

That year, Gell-Mann and George Zweig independently proposed that hadrons were composed of constituent particles, then little more than mathematical constructs. Taken from a line in James Joyce's *Finnegan's Wake*—"Three quarks for Muster Mark!"—Gell-Mann's name for the new particles stuck. To better organize the quarks and gluons he'd postulated, Gell-Mann put forward the concept of color charge with Harald Fritsch, in 1972.

As experimental discoveries rolled in throughout the 1970s and 1980s, they substantiated the theoretical foundations that Gell-Mann had laid, which had become the Standard Model. With his stature in the field, Gell-Mann was able to give support and legitimacy to a then maligned subfield: string theory.

In 1984, he co-founded the Santa Fe Institute to pursue old interests. For Gell-Mann, the simple in particle physics was deeply related to the complexity of organisms and languages. The title of a book he wrote about this relationship—*The Quark and the Jaguar*—was taken from a poem by Arthur Sze: "The world of the quark has everything to do/ with a jaguar circling in the night."

Gell-Mann spent his later years at the Santa Fe Institute, where he worked on unsolved problems in complex adaptive systems until his death.

"I think his greatest characteristic was not just that 'he knew everything.' But he somehow was able to integrate a lot of things," said physicist Geoffrey West, former president of the Santa Fe Institute. "And I think out of that came this extraordinary ability to ask, so to speak, the right question."

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OLYMPIAD CONTINUED FROM PAGE 1

American Institute of Physics, and its member organizations, providing a challenging but exhilarating experience for the high schoolers. The program is designed to encourage all students to study physics and gives team members a unique chance to travel internationally. To qualify, students on the team had to show exceptional performance on a series of exams administered at secondary schools all across the country.

Since 1986, when the U.S. first participated in the International Physics Olympiad, the team has consistently ranked in the top ten, and they hope to bring home more medals this year.

The author is a Science Communication Intern at APS.

The full 2019 U.S. Physics Team at the closing ceremony at the American Center for Physics (ACP) in College Park, Maryland. IMAGE: AAPT

TABLETOP CONTINUED FROM PAGE 5

Model. In particular, these particles would have to violate charge-parity symmetry, which means that they could help explain why matter outnumbers antimatter in our universe.

The research team measures the electron EDM within molecules of thorium monoxide (ThO). This experiment, known as the Advanced Cold Molecule Electron Electric Dipole Moment Search (ACME), takes place in a basement laboratory at Harvard University. They vaporize ThO molecules within a cryogenic chamber, which exit to form a beam at 4 kelvin. Then, using lasers, they align the spins of the electrons in the ThO molecules. Electric and magnetic fields apply a torque to these spins, which causes the molecules' spins to precess like wobbly tops, at two different rates depending on whether they are in one of two quantum states. As the molecules fly through the apparatus, this slow precession accumulates to change the direction of the electrons' spin axes. Using fluorescence techniques, they can measure how the electron spin axes change in time. Molecules in different quantum states precess at different angles, and the difference in angle reveals the magnitude of the electron EDM.

In their latest measurement, published in October 2018 in *Nature*, the electron charge still appears perfectly round and uniform. This result, the most precise to date, is almost nine times more precise than their previous measurement published in 2014. DeMille characterizes ACME's sensitivity this way: if an electron were the size of Earth, the experiment would be able to detect a three-nanometer-thick slice taken from the northern hemisphere and pasted on the southern hemisphere.

They are currently working to make an even more precise measurement by improving their statistical uncertainty by measuring more ThO molecules at a time, says DeMille. "ACME anticipates improving our statistical uncertainty by another factor of ten to twenty within five years," he says.

A Finer Value for Alpha

Holger Müller of the University of California, Berkeley, has been conducting a tabletop experiment to measure the fine structure constant, or alpha. This dimensionless number, equal to about 1/137, characterizes the strength of the electromagnetic interaction between elementary particles. Our universe looks the way that it does, in part, because alpha is what it is, says Müller. "It's a huge puzzle in physics as to why the fine structure has this value," he says. "It's very important that it's so small."

The fine structure constant also relates the rest mass of an atom to its ground state energy. Müller measures the fine structure constant using this relationship: he finds alpha indirectly by measuring the mass of a cesium atom via atom interferometry. In the experiment, he uses a laser photon with a known momentum to kick a cesium atom that is in a superposition of two states. Of this superposition, only one receives the photon's momentum; the other reflects it. Müller then lets the two states of this single atom interfere, and the resulting interference pattern reveals the cesium atom's kinetic energy, which he can use to calculate its mass. He then uses this mass to calculate alpha.

Müller's alpha measurement requires very few theoretical assumptions. "You only need very basic assumptions like momentum conservation," he says. In contrast, the next best measurement of the fine structure constant is extremely indirect. Researchers calculate it from measurements of the electron magnetic moment, a calculation that involves the entire Standard Model and requires some 10,000 Feynman diagrams. The level of discrepancy also places bounds on the properties of several hypothesized particles, including one known as a dark photon. "If the dark photon exists, it must be extremely heavy or it must be weakly coupled to electrons," says Müller.

Their latest measurement, published in April 2018 in *Science*, agrees with the next best result to about 2.5 sigma. But they plan to improve their experimental precision by better controlling the laser photons used to kick the cesium atoms, says Müller.

Elusive Axions

Andrew Geraci's experiment, on the other hand, is just getting off the ground, having received full funding last year. The Northwestern University physicist is currently building a tabletop experiment for detecting axions. This hypothesized particle has two theoretical motivations: it explains why strong interactions preserve charge-parity symmetry in quantum chromodynamics, and it is also a candidate for dark matter.

The axion is supposed to mediate a tiny force that couples the mass of an object to an atom's nuclear spin. Other tabletop experiments use various methods to search for axions, but Geraci's experiment involves bringing a heavy tungsten wheel within tens of microns to a collection of helium nuclei. If the axion exists, it would cause the helium nuclei's magnetic moment to precess. Geraci's team will shield the apparatus from all other external magnetic fields and try to detect this tiny spin precession.

Geraci's experiment should help determine the mass of the axion. "The axion mass determines how far the interaction can occur," he says. So even if he doesn't see the axion, he can place bounds on its mass. Currently, theory predictions are vague; the axion could exist over a mass range spanning nine orders of magnitude. Other researchers, such as those at the Axion Dark Matter Experiment, are probing a different mass range than Geraci.

Like their particle collider siblings, these tabletop experiments have not found compelling evidence for particles beyond the Standard Model. But DeMille is optimistic: these experiments seem poised to improve their precision steadily over the next few years.

DeMille's EDM experiment is now sensitive to certain types of particles in the 30 TeV mass range, more than twice the highest collision energy achieved at the LHC. In this sense, they are paving the way for collider physicists. Tabletop experiments won't replace collision experiments, as they are sensitive to different particle properties, but DeMille thinks that they can help guide collision experiments toward more fruitful research questions. "We're going to be the advanced scouts for particle physics," he says.

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IMMIGRANTS CONTINUED FROM PAGE 4

for international students would only help Colorado's economy. According to the Center for American Entrepreneurship, as of 2017, 30 percent of Fortune 500 companies based in the state were founded by immigrants or their children. Ball Corp., a Broomfield-based metal packaging company with a major aerospace division, is one example. Founded in 1880, the company employs more than 17,500 people throughout the world. And last year, it boasted net sales of $11.6 billion.

Moreover, businesses owned by immigrants or their children are doing their part to create jobs in our state. According to the New American Economy [organization], 102,298 people in Colorado are employed by immigrant-owned firms. And, immigrant-owned businesses in our state generated $566.4 million in business income in 2014.

Changing the F-1 provision and providing a path to citizenship is something that Gardner should support, given his strong history of backing legislation that promotes America's scientific global competitiveness, including the American Innovation and Competitiveness Act, which was signed into law in 2017. He knows just how much this matters to our state: "In Colorado, scientific research is a major economic driver... (and) ... it's an embrace of the spirit of America that encourages us to continue to dream big," Gardner previously stated.

Immediate steps need to be taken to ensure that scientific research continues to be that driver of the Colorado economy. As Congress wrestles with the various immigration issues, Gardner needs to support the visa changes that can keep us the destination of choice for the best and brightest students in the world.

Noah Finkelstein is a professor of physics and a Presidential Teaching Scholar at the University of Colorado. He is also involved in various state and national STEM education initiatives. This op-ed was first published in The Gazette *(Colorado Springs) on May 20, 2019.*

To read more about the F-1 visa issue and to participate in an anonymous survey, see page 5.

FAR WEST CONTINUED FROM PAGE 1

professional meeting. Past plenary topics included such diverse areas as neutrino physics, nanoscience and nanotechnology, dark energy in the universe, science communication, biofuels, comet dust, and solar power.

The FWS Annual Meeting organizers stress the breadth of participation at this event: Industrial physicists are an integral part of the FWS community and are prominently featured as speakers, and high school physics teachers are actively encouraged to attend. FWS also works hard to capture the range of physicists in all stages of their careers at the Annual Meeting. The event additionally features ample career development advice for students and early-career researchers, including a Saturday panel discussion that focuses specifically on career paths outside of academia—a domain that is often unfamiliar to young scientists. This year's FWS Annual Meeting is slated for November 1 and 2 at Stanford University.

In parallel with the Annual Meeting, FWS also held a one-day symposium at the University of Hawaii to reach out to the physics community in the very Far West. To further increase these interactions, FWS is planning to hold its 2020 Annual Meeting in Hawaii.

As further evidence of the section's focus on mentorship for young physicists, the past-chair Hendrik Ohldag (Lawrence Berkeley Laboratory) organized a very popular Career Workshop at the SLAC National Accelerator Laboratory last summer (see *APS News*, November 2018). The one-day workshop offered professional development advice tailored to undergraduates, graduate students, and post docs and featured opportunities to network with established physicists.

As chair, Sparks' wish for the FWS is to "increase an awareness of the importance of the APS to physicists in the far west area, and vice versa." She added that FWS—particularly its Annual Meeting—provides a vehicle for APS to hear from physicists who might not otherwise attend the larger March Meeting or April Meeting. Geographical sections like FWS therefore play an important role in representing the needs of industrial physicists, students, and the faculty at "non-R1" institutions, and can in turn help make APS more important in their professional lives.

Overall, FWS stands out as an active and community-driven geographical section, with plenty to offer members in terms of mentorship, professional development, and diverse learning opportunities. More information on this unit can be found at aps.org/units/fws.

The author is a freelance writer in Helsinki, Finland.

CONSORTIUM CONTINUED FROM PAGE 1

three originating societies and six other societies on the Consortium's Executive Committee, which will help steer the direction of the Consortium. The Consortium is also working closely with EducationCouncil, an organization that provides policy and law support to improve education on all levels.

"EducationCouncil is managing the work of the consortium. They're doing the work of producing tools and resources and gathering information, but we provide the oversight, we provide the steering," says Plisch. "[Being on the executive committee] is a particularly important role as the Consortium is getting launched to see that it gets launched in the right direction."

One of the Consortium's first priorities was to create a model policy for revoking or withholding honors, drawing on experience from organizations within the Consortium and legal guidance from EducationCouncil. This model policy can be used as a starting point for leadership at organizations to create their own policies regarding consequences for ethical violations such as sexual harassment. The policy was presented at the June 6 meeting of the Society's new standing Ethics Committee (see article on page 1).

Another priority for the Consortium is the implementation of a survey to learn what its 108 member societies are doing to address sexual harassment in their respective fields.

"Many of the members are looking for resources at this point and have just started to implement a code of conduct at society meetings, but not a lot of societies have gone beyond that," says Plisch. "We're all looking to each other for how to move forward."

In September, delegates from each of the member societies will gather for the first time to build a society network and discuss tools, survey results, and exchange experiences.

"The National Academy report that came out last summer made it really clear that issues of sexual harassment are still pervasive throughout the sciences and something needs to be done because we are losing talent—sexual harassment is an issue that significantly impacts the enterprise of science," says Plisch. "I think our greatest hope would be that by coming together and pushing in the same direction, we actually might be able to make significant progress toward eradicating sexual harassment in the sciences. And that's a big dream, but it's also something we have to do."

For more information, visit educationcounsel.com/societiesconsortium/

THE BACK PAGE

The Future of APS: Engaging Early Career Members for Equity and Inclusion

BY JULIA GONSKI

Over 40% of current APS membership is composed of student or early career members [1]. This group encompasses an incredible variety of physicists, from attendees of the Conferences for Undergraduate Women in Physics all the way to junior faculty. As the sole graduate student on the APS Council for the past four years, I have learned that it's not an easy task to provide tailored and effective support to such a diverse constituency. But it is an important one.

APS considers early career members to be students or scientists within five years of receiving their PhD degrees. These typically young physicists are often drawn to the Society by professional opportunities (think meetings or journals), with perks like travel grants and career resources providing a crucial added value. And it's a good thing that they do. Not only are our early career members vital to APS at present, but they represent the future leadership of the organization.

So how can we attract even more young scientists to APS? And are we doing all that we can to support them? When I attended my first APS Council meeting in 2016 as the Forum on Graduate Student Affairs (FGSA) Councilor, these were hot discussion topics. Given that I had an ear to the ground of the student community, I was aware of certain problems that keep resurfacing for this group, problems that everyone knows are occurring, but no one knows quite how to solve.

These thorny issues are linked to power dynamics in academia, where those at the top hold immense sway over more junior participants. In this regard, there are strong connections between the experiences of young scientists and those of scientists from underrepresented demographics. For one, young scientists are generally the most diverse group within physics. But even further, in academic power structures both groups are underempowered, in that their outcomes are disproportionately influenced by forces outside of their control.

> "Race-based discrimination, unreasonable work expectations, and ethical violations in research committed by an adviser can all have catastrophic effects."

There's no shortage of recent literature about the prevalence and effects of sexual harassment in the physics community. But this is just one example in which an improperly wielded power structure can unfairly hinder an individual's progress in physics. Race-based discrimination, unreasonable work expectations, and ethical violations in research committed by an adviser can all have similarly catastrophic effects. Given the challenges of pushing back against abuses in such a hierarchical structure, APS stepping to the forefront on these issues would truly be a game changer for the early career community.

In bringing these issues to light with APS leadership, I found that a general consensus quickly emerged: something had to be done. We planned to hold an early career session at the November 2018 Council meeting, dedicating four hours for Councilors to learn about the issues affecting students and junior physicists, discuss their impacts, and brainstorm solutions. To provide a comprehensive picture of the climate, several early career scientists were invited to participate, and The Greater Us consultancy [2] was hired to mediate the conversation.

APS early career members were directly surveyed before the session, to motivate topic coverage and amplify the voices of young scientists in the process. Survey questions covered topics such as participant demographics, ethics and harassment in physics, structural support for problem resolution, and the role of APS in the process of career development. Nearly 600 survey responses were recorded, approximately 80% of which came from students or postdocs.

The survey results paint a grave picture. About 70% of female respondents felt "excluded, unsafe, or treated differently because of their gender," with examples of specific hostile behaviors shown in Figure 1. Over a quarter of respondents reported bystander observations of gender and race-based discrimination. These statistics, while disheartening, are now well-known and essentially consistent with

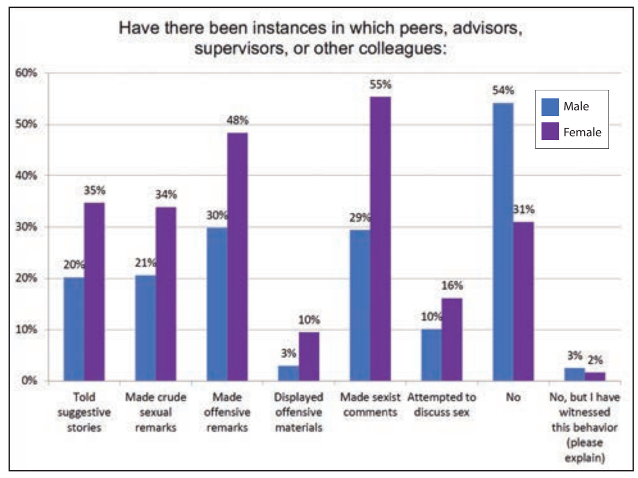

Figure 1

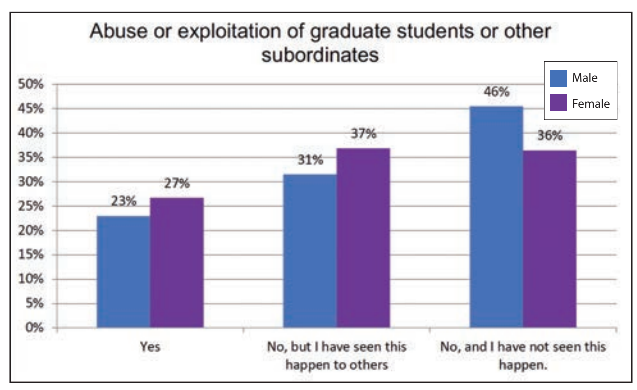

Figure 2

concurrent studies of the field [3,4]. But since our survey was not limited to identity-based harassment, it was able to shed light on even more undiscussed abuses. It's therefore perhaps even more shocking that substantial fractions of respondents reported general abuse of graduate students or exploitative treatment of subordinates (Figure 2).

The unifying root cause of both identity-based harassment and student exploitation? Power dynamics. Many respondents emphasized in free response sections that accountability was lacking for those in positions of power, often because individual universities simply "protect their own." The emotion and frustration in these anonymous personal testimonies is striking. It emphasizes the potential for APS, as a national society with influence across university lines, to create top-down change.

> "One early career member stated that 'Meeting Council members who seemed to genuinely care about my experiences made me optimistic about the future of APS."

With this backdrop, we had our work cut out for us. The early career Council session held in November 2018 was an invaluable opportunity for both large-scale discussion and interpersonal interaction. Participants cited "passionate volunteers" and a culture that values "open expression of opinions" as strengths of APS, which uniquely position it to help mitigate barriers for junior scientists. One invited early career member stated that "I had been pessimistic that these issues would ever be addressed, or that I even fit in and had a place within the physics community. But meeting Council members who seemed to genuinely care about my experiences made me optimistic about the future of APS."

Following the survey and session, The Greater Us prepared a report to document the results of recent efforts and offer recommendations based on these findings. First and foremost, it was recommended that APS fully commit to the support of all early career physicists, regardless of identity or origin, and to back up this commitment with concrete actions. Examples of such actions include offering workshops or training sessions to APS members, particularly those in mentorship roles, to improve understanding of inclusion, equity, and harassment prevention. Another is to ensure that the ethics policies of APS are robust and consistent with the membership's expectations [5], potentially via an organization-wide code of conduct in addition to the current one that covers meetings only (aps.org/meetings/policies/code-conduct.cfm). The report also recommended that APS simply give early career members a greater role in the organization's governing structure, ensuring that students themselves can effect the change they wish to see.

With a session in the books and with the report in hand, the Council was ready and able to act. In April 2019, we revisited the topic of junior member empowerment, incorporating the report recommendations, and passed two critical motions. The first was to mandate an early career member on all APS Unit executive committees, an enormous step for young physicist representation in society leadership. Second, the Council tasked a joint working group of the Committee on the Status of Women in Physics and the Committee on Minorities with exploring an expansion of the popular Climate Site Visit program (aps.org/programs/women/sitevisits/).

Specifically, the site visit program should incorporate requests from students or junior members of a physics program, rather than solely from the department's chair. This represents a huge opportunity for students working in harmful university environments and unsure of where to turn for assistance. Though ultimately a site visit cannot proceed without the consent of the department, allowing requests from those in lower positions of power helps APS allocate its resources to the students who need them most. In conjunction with the new standing Ethics Committee (see page 1), this holds promise for a future in which all young physicists are empowered to demand the treatment, environment, and career in physics that they deserve.

On a personal level, I am incredibly excited about the energy I've seen for tackling these issues, from all corners of APS, during my term as Councilor. And I can tell that this energy has already made a difference. Between the member survey, Council session, and follow-up report, we learned that our society can be a haven and an impactful resource for young scientists. This especially holds true in an environment where students can be driven from physics for reasons unrelated to their capability. Taking action increases young member recruitment and retention, so it is mutually beneficial for both APS and the broader early career physics community. The past few years have made it all the more clear that this is the right course, and now is the time to step up.

The actions I've mentioned here are truly just the tip of the iceberg for addressing equity-related issues and increasing early career scientist representation in APS. The coming years will see an increasing variety of new opportunities for junior members, in both established programs like Congressional Visits Day or the Forum on Early Career Scientists, and novel ones like the Student Ambassadors program. Serving in any of these capacities is a great professional development opportunity, providing a way to gain leadership skills and network with top physicists around the world. So if you're reading this as an early career member, I highly encourage you to get involved. APS is our society, and together we can make it work for you!

The author is a postdoc at Columbia University, having recently obtained her PhD in high energy experimental physics from Harvard. Her physics interests focus on the search for beyond the Standard Model physics using the ATLAS Experiment at the Large Hadron Collider. Outside of research she is active in science policy and outreach, and she serves on the APS Council as the Councilor for the Forum on Graduate Student Affairs and the Forum on Early Career Scientists.

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2. The Greater Us. thegreaterus.com.
3. "Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine", National Academies of Science. 2018.
4. "Yes, Sexual Harassment Still Drives Women Out of Physics", J. Libarkin, *Physics 12, 43 (2019)*.
5. On April 10, 2019 the APS Council approved a new comprehensive set of ethics guidelines: *aps.org/policy/statements/guidlinesethics.cfm*.