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APS NEWS

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EDUCATION

Bouakham Sriri-Perez Named 2020 PhysTEC Teacher of the Year

BY LEAH POFFENBERGER

The Physics Teacher Education Coalition (PhysTEC), a project aimed at addressing the shortage of qualified physics teachers, annually recognizes outstanding physics educators with the PhysTEC Teacher of the Year award. The 2020 PhysTEC Teacher of the Year is Bouakham Sriri-Perez, who teaches physics at Duncan Polytechnical High School in Fresno, CA.

PhysTEC is a partnership between APS and the American Association of Physics Teachers (AAPT) with a mission of improving physics teacher education programs to increase the number of highly qualified physics instructors in the US. The Teacher of the Year award, which has one national winner and four local winners, is an effort to highlight alumni from PhysTEC member institutions who embody the best in physics teacher preparedness.

Sriri-Perez, a graduate of California State University, Fresno—a PhysTEC institution—has spent her 20-year career as a physics educator striving to create accessible and exciting classroom experiences for her students. At McLane High School, where she taught before Duncan Polytechnical High School, Sriri-Perez doubled the number of physics classes. At Duncan, she was responsible for building the school's physics program, resulting in physics becoming a required—and appreciated—subject.

A hallmark of Sriri-Perez's teaching is her efforts to decrease the "phear of physics" many of her students have when entering a physics class for the first time. Her strategies of recruiting and connecting with students in the classroom has inspired a number of her students to go on to study physics at Fresno State.

Sriri-Perez has shown a dedication to improving her own teaching and classrooms, often seeking further training to improve her

Bouakham Sriri-Perez

skills as a physics educator and pursuing grant opportunities for classroom equipment. She also has served as a Master Teacher in the Fresno Teacher Residency Program and mentors student teachers who go on to become physics instructors.

The PhysTEC Teacher of the

TEACHER CONTINUED ON PAGE 2

INDUSTRIAL RELATIONS

APS Seeks to Better Serve Industrial Physicists

BY TAWANDA W. JOHNSON

Attracting more industrial physicists to become APS members is a long-term goal of the organization, and Dan Pisano, Director of Industrial Engagement, is committed to making that happen.

"The key to achieving this goal is to make APS a part of the lives of physics students and early career physicists," said Pisano, who earned his PhD in nuclear physics at Yale University.

"The more we can offer this group in helping them be successful in their careers, the more likely they are to stay with APS throughout their careers. With more than 70 percent of physics graduates going into industrial careers, there is a big pool of talent to attract to APS. Virtually all who go on to academic careers are lifetime members of APS, and we can get there, too, with physicists who go into industry."

With a strong technical background and extensive business

Dan Pisano

experience, Pisano is more than well-suited for his role, which he began in April.

"Most of the positions I have held required that I interact with customers around the world. I developed a skill in recognizing the differences in doing business

INDUSTRIAL CONTINUED ON PAGE 6

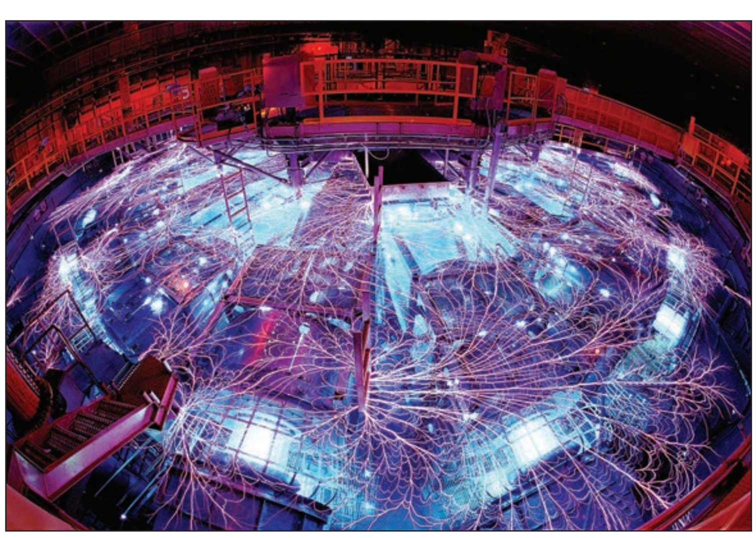
MEMBERSHIP UNITS

The APS Division of Plasma Physics

BY ABIGAIL DOVE

With 2,500 members, the APS Division of Plasma Physics (DPP) is a home for physicists involved in understanding and developing applications for plasmas. Research within plasma physics encompasses everything from the study of the fundamental interactions of particles and light in plasmas to the study of astrophysical plasmas in planetary cores and stars to practical applications of plasma for energy, medicine, and manufacturing.

As DPP chair-elect Michael Brown (Swarthmore College) put it, "virtually everything you see with a telescope is plasma. Anything you can see in nature that's glowing is a plasma that has a group of scientists thinking about it." Added DPP chair Ellen Zweibel (University of Wisconsin), "It is more a question of what *isn't* encompassed in plasma physics. After all, most of the universe—well over 99 percent—is plasma. Within our solar system, space plasma affects the earth's environment. And, on earth, there is



Most of the visible universe is plasma, and the physical behavior of these ionized gases is studied in both laboratories (shown) and astrophysical environments. IMAGE: SANDIA.GOV

magnetic fusion and inertial fusion, particle beams, plasma-aided manufacturing, plasma sterilization, and the list goes on."

Nuclear fusion is, of course, one of the hottest topics in plasma physics, offering the promise of limitless, clean, sustainable energy to address the problem of climate change.

"The idea that we're closing in on magnetic fusion or inertial fusion is really exciting," explained Zweibel. "The climate crisis is an enormous problem that humanity has to solve. Being part of that is very exciting, and the recent progress is amazing."

Other growing topics in the plasma field include low-temperature plasma physics (with implications for etching computer chips, industrial cleaning, or performing eye surgeries), understanding the large-scale behavior of plasmas (for instance, sheets of the aurora borealis, solar flares, or a lightning bolt), exascale com-

DPP CONTINUED ON PAGE 7

EDUCATION

PhysicsQuest 2020 Goes Live with New Online Features

BY LEAH POFFENBERGER

Since 2005, PhysicsQuest kits packed with experimental materials have been sent to classrooms around the country, giving middle school students and teachers a chance to dive into hands-on physics activities. This year, the kits will go out as usual, but since classrooms might look a little different with virtual content, PhysicsQuest is following suit with new features, available online for free.

"Thanks to funding from the Eucalyptus Foundation to improve our virtual presence, we will be able to improve how we engage with PhysicsQuest users and put out online content throughout the year," says Claudia Fracchiolla, APS Head of Public Engagement. "We're adding new videos, extension activities using Python, and opportunities for virtual engagement between students and physicists."

For each activity included in

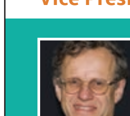
PHYSICSQUEST CONTINUED ON PAGE 7

2020 APS GENERAL ELECTION

Results Are In

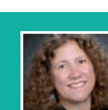
Congratulations to these newly elected members of APS leadership!

Vice President



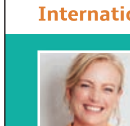
Robert Rosner
The University of Chicago

General Councilor



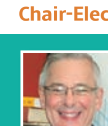
Gabriela Gonzalez
Louisiana State University

International Councilor



Karen Hallberg
Bariloche Atomic Center; and Balseiro Institute

Chair-Elect, Nominating Committee



William (Bill) Zajc
Columbia University

Thank you to all who voted, and special thanks to our candidates.

MORE INFO
go.aps.org/generalelection

revised 09/28/2020

EDUCATION AND DIVERSITY NEWS

Responding to COVID-19

APS is working with physics department chairs to create a "toolkit" to help departments facing budget cuts and systemic changes caused by the COVID-19 economic impacts or the reduction of higher education funding in general. We hope to publish a preliminary version by January 2021. For more information or to discuss strategies, please contact Anne Kornahrens, kornahrens@aps.org.

EP3 Departmental Action Leadership Institutes Starting Winter 2021—Applications Due Soon

Starting in Winter 2021, the Effective Practices for Physics Programs (EP3) project will be running the first Departmental Action Leadership Institute (DALI) to support physics departments and programs in using the EP3 Guide to address a challenge or opportunity (such as low enrollments or an upcoming program review) and/or in making a significant change (such as implementing evidence-based instruction or developing a program-level student learning assessment plan).

Due to the COVID-19 pandemic, the first DALI will be offered at no cost for participating departments, and the application deadline has been extended. Applications are now due on **October 16**. Learn more at ep3guide.org/dali.cfm.

Wiki Scientist Course

Join APS and Wiki Education (WikiEdu) to discover new ways of contributing your subject-matter expertise to high-profile Wikipedia pages that reach millions of readers. In this weekly course, you will meet via Zoom and receive training from Wikipedia experts as you create entries of varying topical subjects in physics. WikiEdu will facilitate collaborative work among participants, immersing you in the world behind Wikipedia. Application submissions will open on October 19 on the APS Wiki Scientist website (aps.org/programs/outreach/wiki-course.cfm). Financial assistance is available.

Physics Buzz Blog

The Physics Buzz Blog is looking for volunteer bloggers with a team-player attitude that have some experience or would like to gain experience writing about science concepts for general audiences. If interested, please apply at forms.gle/5RFDauwBJtdgbQbw5.

TEACHER CONTINUED FROM PAGE 1

Year National Winner receives special recognition at the PhysTEC conference, funding to attend two professional physics conferences focused on education and teacher preparedness, and a grant for classroom materials of $1,000.

Local PhysTEC Teachers of the Year will receive a certificate of recognition as well as a spotlight on the PhysTEC website and in local press. These winners are:

Jonathan Welling: Wasatch High School, Brigham Young University

Melissa Girmscheid: Centennial High School, Arizona State University

Janice Trinidad: Cedars International Next Generation High School, University of Texas, Austin

Margaret "Meg" Helmes: Williamsville Alternative Instructional Model (AIM) High School, SUNY Buffalo State College Department of Physics

To learn more about PhysTEC, its member institutions, and the Teacher of the Year award, visit phystec.org.

THIS MONTH IN

Physics History

October 14, 1947: Chuck Yeager Breaks the Sound Barrier

Today, fighter jets routinely achieve speeds faster than the speed of sound, but there was a time when scientists questioned whether the increase in aerodynamic drag as an aircraft approached that threshold would prohibit such a feat. The honor of being the first test pilot to break the sound barrier belongs to Charles Edward "Chuck" Yeager.

Chuck Yeager

Born in 1923, Yeager's parents were farmers in Myra, West Virginia. He played basketball and football in high school, graduating in 1941. Inspired by his experience at a summer Citizens Military Training camp in Indiana, he enlisted with the US Army Air Forces that fall. Technically ineligible for flight training because of his age and lack of advanced education, Yeager was admitted to the program when World War II broke out, in part because of his excellent visual acuity.

Two years later, Yeager received his pilot wings, shipping overseas to join the war effort on November 23, 1943. He proved to be an outstanding fighter pilot, racking up 11.5 official victories; he was the first pilot to down five enemy aircraft in a single day ("ace in a day") on October 12, 1944. But he later expressed regret and disgust at some of the wartime atrocities committed by personnel on both sides of the conflict, including being ordered to participate in a strafing mission that targeted civilians. After the war, Yeager became a test pilot at what is now Edwards Air Force Base.

Several claims of breaking the sound barrier emerged during World War II and its immediate aftermath, but most were attributed to instrumentation error. The Bell X-1 was especially designed for the task. Capable of absorbing 18 Gs, the X-1 had thin, upswept wings and a nose modeled after a .50 caliber bullet. It also boasted four rocket engines.

"Basically, the X-1 was a pure rocket," Yeager recalled in a 1997 interview with *NOVA*. "It burned liquid oxygen and a mixture of five parts alcohol to one part water. You know, we'd been fooling around with jets. Jet engines didn't have the thrust to push the airplane into the region of the speed of sound or beyond." He nicknamed the X-1 the *Glamorous Glennis*, after his wife.

The original plan was to choose a test pilot without a family, but Yeager argued that having a wife and little boy would make him more careful, and got the assignment. He later claimed he never worried about whether or not something would go tragically wrong. "It wasn't my job to think about that. It was my job to do the flying."

Two days before the scheduled flight, Yeager broke two ribs after falling off a horse. Determined not to be sidelined, he asked a veterinarian in a nearby town to treat his injury, telling only his wife and fellow test pilot Jack Ridley. By the day of the flight, Yeager was in so much pain that he was unable to close the X-1's hatch; fortunately, Ridley left part of a broken broom handle in the cockpit to help Yeager seal the hatch door.

On October 14, 1947, Yeager and the X-1 achieved 20 seconds of supersonic flight. "There was no buffet, no jolt, no shock," he later recalled. "Above all, no brick wall to smash into. I was alive." On the ground, however, the resulting change in pressure sounded like an explosion reverberating across the California desert.

The news of Yeager's record-breaking flight wasn't publicly announced until June 1948. He went on to have a distinguished military career, holding several squadron and wing commands and achieving the rank of brigadier general in 1969, assigned as vice-commander of the Seventeenth Air Force. He retired from the Air Force in 1975, although he still occasionally flew as a consulting test pilot for USAF and NASA.

Yeager made a cameo appearance in the 1983 movie *The Right Stuff*—based on the 1979 book by Tom Wolfe—as a bartender named Fred (Sam Shepard portrayed Yeager in the movie). But Yeager wasn't selected for the first astronaut program because he didn't have the requisite educational qualifications. He was also a technical advisor on three flight simulator video games. He was inducted into the National Aviation Hall of Fame in 1973.

Today, combat aircraft can easily break the sound barrier, thanks to the introduction of improved design features like swept wings and more powerful engines. Though many in the

YEAGER CONTINUED ON PAGE 3

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HONORS

2020 Apker Award Finalists

BY LEAH POFFENBERGER

On August 9 and 10, seven bright young physicists presented their research to the selection committee for the LeRoy Apker Award, given in recognition for outstanding achievement in physics by undergraduate students. This annual selection meeting is typically held in Washington, DC, but this year the Apker Award finalists set out to impress a panel of distinguished physicists with their talks given over Zoom.

This year's Apker Selection Meeting featured three finalists from non-PhD granting institutions, who presented on August 9, and four finalists from PhD granting institutions, who gave their talks on August 10. Over the two-day meeting, the finalists wowed the selection committee with their research topics ranging from the search for dark matter to understanding exotic materials.

The 2020 Apker Award finalists are (in order of presentation): Gerrit Farren (Haverford College), EliseAnne Koskelo (Pomona College), Ryan Beman McMillan (Amherst College), Joseph Farah (University of Massachusetts Boston), Cara Giovanetti (Princeton University), Salvatore David Pace (Boston University), and Nicholas Poniatowski (University of Maryland).

Each finalist will receive an honorarium of $2,000, $1,000 for their undergraduate institution's physics department in support of undergraduate research, and a certificate. Two winners, chosen by the Selection Committee, will each receive an award of $5,000 for themselves, $5,000 for their undergraduate physics department, a certificate, and reimbursement for travel to a future APS meeting to give an invited talk on their research. The recipients of this year's LeRoy Apker Award will be announced in October.

In thirty-minute talks, each finalist had the chance to present their undergraduate research, paying special attention to their direct contributions, and to demonstrate knowledge in their respective fields. After each talk, the Selection Committee had 15 minutes to ask the finalists questions.

To start off the meeting, Farren spoke on his research efforts to untangle the mystery of dark matter by placing constraints on axions, a popular dark matter candidate. Using information on the dynamics of the structure of the cosmic microwave background and how axions would contribute to those structures, Farren has been able to establish possible mass constraints on the axion and demonstrate its potential as a dark matter particle.

Next, Koskelo discussed a research project to transform noise from a nuisance to a tool to enhance the resolution of high-resolution imaging techniques. Her work culminated in an analytical model of stochastic resonance in thermoreflectance imaging that can help maximize resolution and lower the noise floor in future experiments.

APKER CONTINUED ON PAGE 7

YEAGER CONTINUED FROM PAGE 2

industry hoped that the introduction of supersonic commercial airlines in the 1970s—the Concorde and the Tupolev Tu-144—would lead to the next evolutionary stage of airline travel, neither were replaced when they were decommissioned. (The Concorde made its last flight in 2003.)

Records have continued to fall since Yeager's historic flight. On November 20, 1953, pilot Scott Crossfield reached twice the speed of sound in a D-558-II Skyrocket. Also in 1953, Jackie Cochrane became the first woman to break the sound barrier in a Canadair Sabre; Yeager was her wingman.] A supersonic car called the ThrustSSC, driven by Royal Air Force pilot Andy Green, surpassed Mach 1 on October 15, 1997, almost exactly 50 years after Yeager's fight.

And in 2012, Felix Baumgartner became the first person to break the sound barrier during freefall. He jumped for a world-record altitude of 24.26 miles (128,100 feet) and hit speeds as high as 833.9 mpg (Mach 1.26) during his 4 minute, 18 second freefall. On the same day, Yeager—then 89—broke the sound barrier again in an F-15 Eagle he nicknamed *Glamorous Glennis III*, although he reportedly only flew the plane during takeoff and landing. It was the last time he participated in an official Air Force flight.

Further Reading:

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EARLY CAREER PHYSICISTS

Lab Human

BY KAI TREPKA

On March 19, news broke that Harvard's dorms would close in five days as a result of COVID-19. Seniors exhibited a variety of responses, from attending class as normal to hosting last-minute daytime parties. My response was to rush to Ye Tao's lab at the Rowland Institute, hoping to somehow wrap up my last three years of research in small-scale magnetic materials. Yet when Ye heard the news, his first response was not as a taskmaster, but as a sympathetic friend. He made a reservation for that night, taking our lab community out for a last supper.

Working in the lab, I learned to design and build custom instrumentation, develop new materials and fabrication processes, and author scientific publications. But my key lesson was entirely non-technical: Science is first and foremost a human endeavor, conducted by and for human beings.

"The way of progress was neither swift nor easy." - Marie Curie

I first met Ye Tao with a feeling of intense curiosity and no knowledge whatsoever of physics. I spent the summer of 2017 attempting to build an airtight furnace for fabricating new materials, the relentless chirping of a helium leak detector telling me that my work wasn't good enough. I spent the following year running dozens of trial-and-error experiments in my furnace, the key word being error.

In my coursework, I was taught that science is a linear process culminating in groundbreaking discovery. This principle was illustrated by canned lab courses where failure was met with bad grades. Yet as I worked in Ye's lab, he always responded to my experimental mistakes with a laugh and an "oh well." There was no expectation of immediate success, no certainty in any hypothesis. By embracing Ye's openness to failure, I was able to take more experimental risks and ultimately develop a new process for making holmium oxide (Trepka et al., 2020), as well as measure the variable-temperature magnetism of rare-earth oxide nanoparticles. When negative results are acceptable, researchers feel more willing to take risks and less pressured to cherry-pick data to confirm preconstructed hypotheses, potentially mitigating the current reproducibility crisis in experimental science.

"Science cannot solve the ultimate mystery of nature. And that is because, in the last analysis, we ourselves are a part of the mystery that we are trying to solve." - Max Planck

Unlike a physics textbook, the world of discovery is not objective or rational or static. People have unconscious stereotypes that often result in the exclusion of women and people of color from physics, as well as confirmation biases that can taint even the purest data. During my extended work with Ye Tao, I learned that experimental science is conducted by a community of flawed humans using imperfect instruments to observe an ever-changing natural world.

Over a million peer-reviewed articles are published each year, an overwhelming number of papers to sift through even in specific subfields. As a consequence, communicating results to a variety of audiences across varying fora is critical. Guided by Ye, I gave presentations at conferences ranging from local (Society of Physics Students) to national (APS March Meeting) to international (NanoMRI). Every person I interacted with refined my understanding of both the technical details and the broader context of my work in nanoscale materials, information that I utilized later during the painstaking process of publishing my work in peer-reviewed journals.

My love for physics brought me to Ye's group, but it was my love for the people in the group and the scientific community that motivated

Kai Trepka

me to persist through challenges. Through my work with Ye, I realized that I loved the often-frustrating process of discovery, the process of deriving simple models to help understand complex phenomena. Yet at the same time, I craved the opportunity to more directly and immediately help people, spending my free time working in hospitals and homeless shelters. I ultimately decided to pursue both a medical degree and a professional degree, merging my two passions. As I enter the medical field, I hope to take the lessons I've learned about communication and the scientific process during my undergraduate physics research to help make discoveries that alleviate suffering.

Kai Trepka graduated Summa Cum Laude from Harvard University in 2020, with a Bachelor's degree in Chemistry and Physics and a Master's degree in Chemistry. Kai worked from 2017-2020 in the laboratory of Ye Tao in the Rowland Institute at Harvard. As an undergraduate student, Kai developed a passion for small-scale model development and discovery, researching new magnetic materials with thicknesses from 10s-100s of nanometers, nearly 10,000 times thinner than the diameter of a hair. He is now a student in the Medical Scientist Training Program at the University of California, San Francisco. (Contact: kai.trepka@ucsf.edu)

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K Trepka, R Hauert, C Cancellieri, and Y Tao, *Matter* **3**, 1 (2020) doi.org/10.1016/j.matt.2020.07.031

EDUCATION

PhysTEC Launches Two New Regional Networks

BY LEAH POFFENBERGER

The Physics Teacher Education Coalition (PhysTEC) links more than 300 institutions across the United States with the purpose of improving and promoting physics teacher education. To develop strong communities within PhysTEC, the first regional network in California was launched as a pilot program two years ago. Now, as a result of the success of that pilot network, two new PhysTEC regional networks are launching in Texas and New York.

As the United States faces a shortage of qualified physics teachers, PhysTEC, a partnership between APS and the American Association of Physics Teachers, is helping to transform physics teacher education programs. PhysTEC also facilitates ways for institutions to share effective practices. However, since the coalition is so large, and teacher requirements and policy issues vary by region, the regional networks were created to help small groups of institutions create strong avenues of communication and resource sharing.

"After many years of PhysTEC, we realized that while we have a strong community, we can't directly support every site," says David May, Education and Diversity Programs Manager for PhysTEC. "We came up with the idea of regional networks to help programs share information and support other nearby institutions."

Regional networks are formed by first identifying a PhysTEC institution to take the lead and then assume responsibility for creating and strengthening the network. Members of the networks include both member institutions of PhysTEC and unaffiliated universities with teacher training programs.

"The importance of having networks in specific regions is that the institutions exist in the same policy environment or system," says May. "Since things like teacher credential requirements can change based on the state, having a network in the same region can help institutions address common issues."

The two new regional networks will be led by Texas A&M-Commerce and SUNY-Stony Brook. Texas A&M-Commerce is already set to be joined by three other institutions—Texas State, the University of Houston, and the University of Texas-Rio Grande Valley—and they already have around 25 potential network members. Many of these potential members aren't existing PhysTEC sites but are still welcome in the network.

Stony Brook will head up a network serving southeast New York, including New York City and Long Island. While other institu-

PHYSTEC CONTINUED ON PAGE 6

GOVERNMENT AFFAIRS

APS Congressional Science Fellow Put Scientific Skills to Use During COVID-19 Crisis

BY TAWANDA W. JOHNSON

Last fall, after Laura Gladstone began her APS Congressional Science Fellowship with the US Senate Committee on Homeland Security & Government Affairs (HSGAC), she learned that one of her most important projects would be preparing for a hypothetical pandemic. Having a person with Gladstone's scientific background working on the committee was especially helpful after the World Health Organization declared the novel coronavirus disease a pandemic in March.

"Laura's interest and enthusiasm to help on a multitude of projects, from cybersecurity to COVID-19 response efforts to biosecurity was a great benefit to the committee and all our staff. Her ability to apply science to our policy agenda was definitely a huge plus," said Christopher Mulkins, Deputy Division Director of Homeland Security for HSGAC Minority.

Gladstone, who has spent most of her early career as a physicist conducting research on neutrinos added, "I was able to meet with experts and help with early communication, but COVID-19 required a response from the whole government and not just my committee's emergency planning team."

Sponsored by APS under the umbrella of the American Association for the Advancement of Science (AAAS) Science & Technology Fellowships, the aim of the Congressional Science Fellowships is to provide a public service by making available individuals with scientific knowledge and skills to members of Congress, few of whom have technical backgrounds. In turn, the program enables scientists to broaden their experience through direct involvement with the policymaking process.

Fellowships are for one year, typically running September through August. Following a two-week orientation in Washington, DC, sponsored by AAAS, incoming fellows become acquainted with their new work environment. After interviews on Capitol Hill, fellows choose a congressional office where they would like to serve.

Laura Gladstone

Prior to dealing with the coronavirus health crisis, Gladstone said the first step in her fellowship was getting acclimated to working in US Sen. Gary Peters' office. Peters, who represents Michigan, is the Ranking Member of the HSGAC.

"Each Senator's office runs differently, like each professor's research group functions differently. I started by taking notes at constituent meetings, briefings, and hearings (and learning the difference between those). I summarized other people's positions into one-page decision memos, and in doing so, learned about their work and how the office flows," she said.

Gladstone recalled there was plenty of work to do to stay on top of the health crisis.

"From January to March, we were getting reports, preparing for hearings, and working with the Federal Emergency Management Agency. I sent notes around my office from COVID-19 hearings, explaining the difference between COVID-19 and SARS-COV-2," she said.

Gladstone said that chance meetings are often the most useful. "Dr. Tom Inglesby (Director of the Center for Health Security at Johns Hopkins University's Bloomberg School of Public Health) recognized me in the milieu before a Senate-wide staff briefing as 'from HSGAC, right?' and I was able to brief him on our recent hearing," added Gladstone.

Besides COVID-19, Gladstone

FELLOW CONTINUED ON PAGE 7

GOVERNMENT AFFAIRS

New APS Special Projects Organizer

BY TAWANDA W. JOHNSON

Charlotte Selton, who holds a bachelor's degree with a double major in physics and political science, hit the ground running after recently beginning her position as Special Projects Organizer in the APS Office of Government Affairs.

Her first task: scheduling colloquia for the Physicists Coalition for Nuclear Threat Reduction—a new project supported by the APS Innovation Fund, which was launched to inform, engage, and mobilize the US physics community around the danger posed by the world's nuclear weapons.

The first step of the project is to hold colloquia at universities, labs, industry, and conferences to provide an overview of the technological and policy landscape of the nuclear arms issue. A second aspect entails building a coalition that will enable members to learn about advocacy and engage in opportunities that put their learning to the test.

"While nuclear weapons threats are less visible in the public consciousness since the decline of the Cold War, most experts agree that the present risk is at least as great," said Selton. "The US has withdrawn from many arms control agreements, and without government action, the last treaty mutually capping the Russian and US nuclear arsenals will expire in February 2021."

On any given work day, Selton is contacting various universities to set up colloquia that cover a review of the current world arsenal, recent developments in new offensive and defensive capabilities, new technologies that alter nuclear strategic stability, and the potential physical effects of the weapons. The policy portion of the colloquia will highlight the history of successful key treaties and agreements that have provided some degree of safety for the world, recent troubling changes in the framework of arms control agreements, the emerging new nuclear arms race, and policy steps that can substantially reduce the nuclear threat.

To date, Selton, who has a background in political organizing, has scheduled 10 colloquia that will take place this fall. Another one is scheduled for spring 2021. And a recent test run at Princeton Plasma Physics Laboratory went off without a hitch.

Selton said the coalition weighed a number of factors before reaching out to universities about the colloquia.

"Those factors include locations represented by Senators or House members on the respective Armed Services Committee, whether the university serves populations often underrepresented in physics, and the size of the physics department. We aimed to balance the overall list to have good geographic spread across the country," she said.

Additionally, mindful of the importance of diversity, Selton has scheduled colloquia at various Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs).

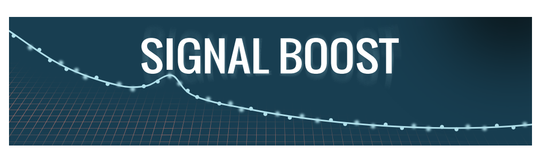
Charlotte Selton

"We've scheduled colloquia at Alabama A&M and California State University-Los Angeles, and we have invited Fisk University and Tuskegee University, as well as California State University-Dominguez Hills, University of Alaska-Fairbanks, and University of Hawaii at Manoa to host colloquia this fall," she explained.

Selton added, "We are building a coalition not just of physicists, but physical scientists broadly, including engineers. Our coalition will be stronger if we reflect the full diversity of the scientific community, so we are especially reaching out to women, underrepresented minorities, and early-career physicists, as well as postdocs and graduate students."

Selton's work has been impressive.

PROJECTS CONTINUED ON PAGE 6



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

FYI: SCIENCE POLICY NEWS FROM AIP

Biden and Harris Envision Ambitious R&D and Climate Action

BY ADRIA SCHWARBER

Democratic presidential nominee Joe Biden rolled out campaign proposals this summer that include major increases in federal R&D spending, with a focus on clean energy and emerging technologies. His infrastructure-focused $1.7 trillion energy climate plan calls for spending $400 billion over ten years on clean energy R&D, and his Made in All of America initiative to foster new manufacturing jobs proposes spending $300 billion on R&D over four years.

In a July speech on the initiative, Biden said the $300 billion would be used to "sharpen Americans' competitive edge in the new industries where global leadership is up for grabs, like battery technology, artificial intelligence, biotechnology, clean energy." The full text of the plan posted on his campaign website mentions additional priority research areas, including advanced materials, health, aerospace, automotive technology, and telecommunications. It indicates the money would go toward ramping up the budgets of agencies such as the National Science Foundation and Department of Energy as well as creating an Advanced Research Projects Agency for Health.

Aiming to ensure such investments produce equitable outcomes, the plan proposes to recapture a portion of the royalties from inventions arising from federally funded research, implement employee protections against negative consequences of new workplace technologies, and distribute funding more broadly across regions and demographic groups. One such proposal involves launching a $35 billion initiative to create research centers at Minority Serving Institutions and strengthen their graduate programs in STEM and other fields.

Biden's climate plan sets a target of the US reaching net-zero emissions by no later than 2050 through a combination of R&D, infrastructure investments, and emissions reduction regulations, among other means. One plank involves establishing a "cross-agency" entity called ARPA-C that would focus on developing "game-changing" clean energy technologies such as grid-scale energy storage, small modular nuclear reactors, and carbon capture methods. The plan also states Biden would reenter the 2015 Paris climate agreement on the first day of his administration and later convene a world summit to secure emissions reduction pledges that go beyond existing commitments.

What role vice presidential nominee Kamala Harris might take in science policy remains to be defined. Although she has not established a deep track record in the area during her nearly four years as a Democratic senator for California, she has sponsored legislation focused on social issues in STEM. For instance, she is the lead Senate sponsor of the Combating Sexual Harassment in STEM Act, which would require research insti-

BIDEN/HARRIS CONTINUED ON PAGE 6

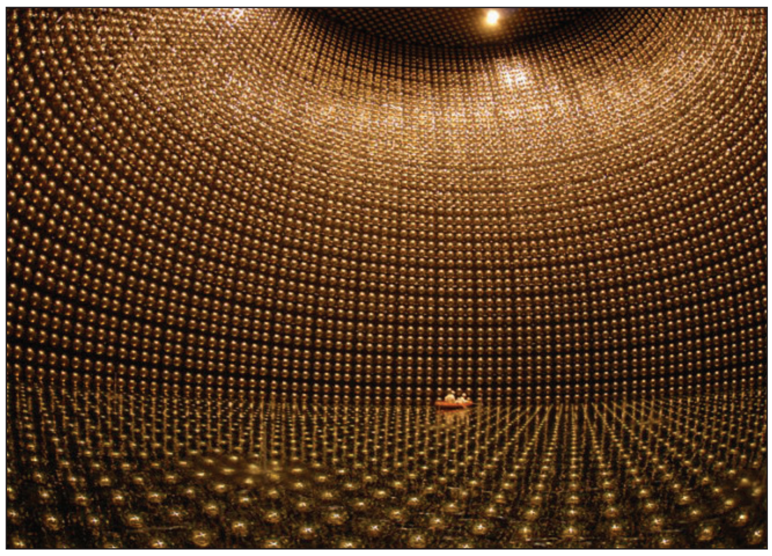
MEETINGS

Neutrinos Underground, Overhead, and Online

BY SOPHIA CHEN

Unable to meet in person this summer due to the coronavirus pandemic, neutrino physicists gathered online for the 29th International Conference on Neutrino Physics and Astrophysics for eight days between June 22 and July 2.

With registration fees dropped, more than 4,000 people signed up, compared to previous in-person conferences of about 900, according to Marvin Marshak of the University of Minnesota, a co-chair of the organizing committee. Participants dialed in from all seven continents, even Antarctica. "The reach of the conference becomes much larger and more diverse," he says. "There's not this barrier of having to spend a few thousand dollars on a hotel, flight, and conference registration fee."



Inside the neutrino detector SuperKamiokande in Japan, which may be superseded by and even larger facility, HyperKamiokande. IMAGE: T2K COLLABORATION

"Neutrino experiments are one of the few places we have evidence that contradicts what the Standard Model of particle physics tells us," says physicist Patricia Vahle of the College of William & Mary, the co-spokesperson of the NOvA experiment at Fermilab. One major puzzle is that the Standard Model predicts neutrinos to be massless, but experimental evidence indicates they do have mass. Physicists are working to measure the mass of the three "flavors" of neutrino—the tau, muon, and electron neutrino.

Other talks covered new insights into neutrinos of astrophysical origins, as well as fundamental experiments of neutrinos generated in laboratories such as particle accelerators and nuclear reactors. Astrophysical neutrinos, produced in stellar fusion or other extreme environments in space, are clues to the dynamics of the faraway processes by which they form. Meanwhile, particle physicists study human-engineered beams of neutrinos to measure their fundamental properties.

Sunny Statistics

The Borexino collaboration announced the discovery of neutrinos produced in a previously unconfirmed fusion process in the Sun. The Sun undergoes fusion via two processes to convert hydrogen into helium, one known as the proton-proton chain reaction, and another known as the carbon-nitrogen-oxygen (CNO) cycle. In results currently under peer review, Borexino reported the detection of neutrinos produced in the CNO cycle for the first time, providing the first experimental evidence that the process occurs in the Sun.

To see the solar neutrinos, Borexino's detector exploits 300 tons of liquid hydrocarbon in a thermally stabilized vat located in Italy's underground Gran Sasso Laboratory. As neutrinos fly through the liquid, a small fraction of them scatter off electrons to emit light. The team can calculate the neutrinos' energies and momenta from this light, which in turn points to the particles' origin.

Because neutrinos hardly interact, they are notoriously difficult to detect. The group used 1,072 days of data collected between July 2016 and February 2020 to announce this discovery with 5 sigma confidence. "This measurement was very difficult because [neutrinos from the CNO cycle] are very rare," says Gioacchino Ranucci of Italy's National Institute for Nuclear Physics and co-spokesperson of the collaboration. Exquisitely sensitive, Borexino detects, on average, just 7.2 CNO-produced neutrinos per 100 tons of liquid scintillator per day.

With the CNO neutrino detection, Borexino has now studied all the types of neutrinos produced in solar fusion. In 2018, the Borexino collaboration reported detection of neutrinos from every step of the proton-proton chain reaction, except one rare neutrino, for which they have set an upper limit.

Broken Symmetries?

Several groups discussed research into the potential differences between neutrinos and their antiparticles, antineutrinos. As neutrinos are the most abundant particle with mass in the universe, such differences could explain how the early universe produced more matter than antimatter. These discrepancies are known as charge-parity (CP) symmetry violations. "[Whether there are] differences between matter and antimatter is one of the big unanswered questions in science today," says physicist Patrick Dunne of Imperial College London.

Two independent experiments, the Japan-based T2K experiment and the US-based NOvA, study the rate that one flavor of neutrino and antineutrino morphs, or "oscillates," into another flavor. Both T2K and NOvA create beams of muon neutrinos and antineutrinos, which they send over hundreds of kilometers, and then measure how many of those particles oscillated into electron neutrinos and antineutrinos, respectively. Quantitatively, researchers express the difference between neutrinos and antineutrinos with multiple parameters, among them an angle called δ_{CP}.

Publishing in *Nature* in April, T2K has placed the first experimental constraints around the value of this angle. They have excluded certain values of δ_{CP}, and their values suggest it is likely that neutrinos oscillate faster than antineutrinos. "We have to do more work to confirm it, but the values we're preferring are where CP is maximally violated," says Dunne, a member of the T2K collaboration.

However, NOvA's data may suggest otherwise. The collaboration presented results at "minor tension" with T2K, according to Vahle. "NOvA does not see a strong asymmetry in the oscillation probabilities between neutrinos and antineutrinos, so we disfavor combinations of oscillation parameters that would produce a strong asymmetry," Vahle wrote in an e-mail to *APS News*.

The two groups are now collaborating on a combined analysis to try to resolve this tension. To be clear, both collaborations report their results with significant uncertainty. For more precise measurements of neutrino oscillation parameters, the community is working on two upgraded experimental facilities, the Japan-based HyperKamiokande, and the Deep Underground Neutrino Experiment, with a neutrino travel path from Illinois to South Dakota. Both are scheduled to begin taking data in the mid-to-late 2020's.

Physics in a Virtual World

BY SOPHIA CHEN

Like any attentive host, Marco Del Tutto found it impossible to relax at his own party. The Fermilab physicist flitted from room to room to monitor his chattering guests and fret over whether they were having a good time.

But this was no regular in-person party. Del Tutto was co-hosting the 29th International Conference on Neutrino Physics and Astrophysics—and all the rooms were virtual. Like many conferences in 2020, this meeting occurred over the now-ubiquitous application Zoom. But organizers introduced one innovative twist: a poster session conducted in virtual reality.

The poster sessions took place in 28 virtual 3D rooms, each room arranged with 5 posters and decorated with pixelated renderings of couches, potted plants, and other furnishings of Del Tutto's choosing. To attend, you entered the rooms as a humanoid avatar in your web browser and navigated the space like a video game. A maximum of thirty avatars were allowed in a room at a time.

Upon entering, you could overhear the conversation of others in the room, with the audio of nearer avatars louder. To make the posters readable in VR, Del Tutto blew up the proportions to about the size of a movie screen. Presenters displayed more than 500 posters in total, spread over four sessions. "We'd never done anything like this before," says Del Tutto, who designed and built the poster sessions.

Del Tutto also added personal flourishes. Because the conference originally was to take place in Chicago, he created a few rooms with reconstructions of the city's famous landmarks, such as Millennium Park, produced using his 3-D photos taken with his phone. One room included a herd of bison, an allusion to the animals that Fermilab has hosted on its premises since 1969.

It took Del Tutto two months to build the rooms for the poster session, which ran on a free and open source virtual reality chat room software called Mozilla Hubs. Not considering labor costs, conference organizers spent about $800 to host the poster session, which went to buying cloud computing time on Amazon.

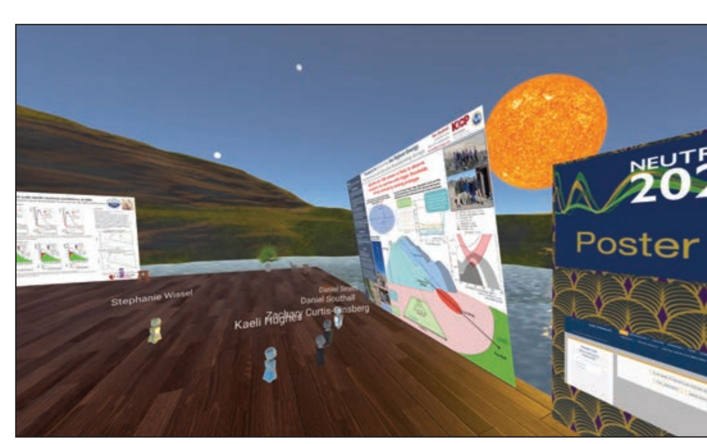
"It was really fun to attend the poster session," says María Martínez-Casales, a graduate student at Iowa State University who presented a poster. During her poster session, people asked her questions, and she was even able to point at her display with a virtual laser pointer.

In particular, Martínez-Casales found that certain social interactions were smoother online. "It was easier to ask questions," she says. "I would consider myself a shy person. In normal life, maybe I would have had more trouble approaching [someone] if I don't know anything about their poster."

Del Tutto says the poster session was "absolutely a success." But in the moment, it was a risky choice. Organizers, including Del Tutto himself, were "skeptical" that the VR format would work, he says. To improve its chances, Del Tutto ran a beta version for a couple dozen users about a week before the conference. Had it gone badly, they had a backup plan to run the poster session on Zoom.

The virtual format made discussion for some attendees much easier. Because the avatars' appearances were devoid of race or gender, some expressed that they found it easier to meet and talk to new people, says Del Tutto.

VIRTUAL CONTINUED ON PAGE 7



A poster session in cyberspace. IMAGE: MARCO DEL TUTTO

INDUSTRIAL CONTINUED FROM PAGE 1

in different countries," he said. "As a result of my global responsibilities, I found myself on an airplane most days. I accumulated more than 3 million miles in frequent flyer points!"

Pisano's career began at Yale where he worked as a postdoc. Interestingly, he has been taught by and worked with more than 10 Nobel Laureates in physics, chemistry, and medicine.

"I did a lot more than just nuclear physics, including solving a fundamentally difficult mathematical problem in nuclear reactions which utilized the full capability of the Courant Institute's supercomputer at New York University. I also dabbled in radio astronomy, astrophysics, and the atomic spectra of hydrogen-like iron, nickel, and manganese," he said.

He added, "After three years as a postdoc, I decided that sitting in front of instruments and computers was not a good use of my talents. I had more ideas than I could pursue myself; yet, in terms of my experience, academia constrained physicists to be mostly sole contributors, and it limited team players (particle accelerator teams were the exception back then.) So, I decided to move into industry where the compensation was higher, where there were technicians who might be able to help me explore new ideas, and where team players were more welcome."

Pisano landed his first industrial position with EMI Medical as a device physicist in Northbrook, Illinois.

"Little did I realize I was the first technical person the company hired for their startup to develop a practical [computed tomography] scanner for the world market," he remembered. "The president of EMI slid a yellow pad across the table along with a Bic pen and asked me to tell him everything we needed to acquire to achieve our goal! Money was no object. 'Oh, and what sort of people should we hire?' He pointed to my desk in the corner of this warehouse, and I was off and running. All this for a 30-year-old with no business experience except what I had picked up from my dad."

Pisano hired a team of about 10 physicists and engineers and they met daily over coffee and donuts at 7:30 a.m. to brainstorm how to develop the CT scanner. In about six months, they submitted a proposal to the board of directors who authorized Pisano to spend up to $65 million (in today's dollars) to get the scanner to the prototype stage. A year later, in 1977, they demonstrated their prototype at an industry trade show to great fanfare.

Next up: manufacturing the prototype scanner.

"The president of EMI encouraged me to take over manufacturing and quality, saying 'You designed it. Now build it!' In a real sense, the EMI president was my mentor. He encouraged me to visit physicians throughout the United States to learn what they really needed our new scanner to do for them to be successful in their medical practices. I was also interviewed by the *New York Times* and became a liaison to the Food and Drug Administration to explain how this new machine worked. I literally worked around the clock to keep things on track," recalled Pisano.

EMI eventually sold the company to GE Medical, a leader in the CT scanner market. Pisano went on to work for another company and also started his own consulting business before beginning his position at APS.

These days, he is often working with Crystal Bailey, Head of Career Programs at APS, on developing career webinars to prepare young physicists for future jobs in industry.

"I've enjoyed working with Dan on building this new webinar series titled 'Success in Industry Careers.' Industry employers already clearly value what physics graduates bring to their companies, but they have also pointed out that other key skills and knowledge could be stronger in new hires; we hope that this webinar series will get students thinking about how to build these skills," said Bailey.

Pisano noted that he and Bailey have tremendous support in their endeavors to improve the skill set of young physicists.

"Our driving force for assisting industrial physicists comes from all directions—the APS Industrial Advisory Board, the Forum on Applied Physics Executive Committee, and the Chairs of physics departments throughout the US," he said.

Francis Slakey, Chief Officer of External Affairs for APS, is elated to have Pisano in this new role.

"Dan brings a wealth of experience to this position, and his background in customer service and tackling problems in a holistic manner will serve APS—and its entire membership—very well," Slakey said.

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

To receive notifications about the APS Success in Industry Careers webinar series, go to aps.org/careers/guidance/webinars/. Then click "Join Mailing List" and check the "Success in Industry Careers" box.

PROJECTS CONTINUED FROM PAGE 4

"After Charlotte joined our project, there was an increase in our productivity, thanks to her communications with coalition members, her initiative in contacting universities for coalition colloquia, her writing for our website and more. The coalition is fortunate to have her on the team," said Stewart Prager, professor of astrophysical sciences at Princeton University, who is leading the coalition. Princeton's Program on Science and Global Security is coordinating the coalition.

Callie Pruett, APS Senior Strategist for Grassroots Advocacy, echoed Prager.

"Charlotte's unique background in both political science and physics makes her the absolute best fit for this role, bar none. Her passion regarding the issue of nuclear threat reduction is evident in her work thus far, and we are so excited to see her start to build this coalition."

Selton said the nuclear threat issue is a great concern of hers, especially as it relates to testing in low-income communities.

"Nuclear threat reduction is an important facet of social justice, and I'm glad to help bring renewed attention and engagement to it," she explained.

The coalition, once fully formed, will play an integral role in advocating policy that supports APS's recent board statements on New START and nuclear testing.

"Some of the initial policy areas we're focusing on include preventing new explosive nuclear weapons tests in the US and advocating for a five-year extension of New START. The coalition also supports ending launch on warning, adopting a No-First-Use policy, and transitioning the US away from vulnerable ICBMs," said Selton.

To request a colloquium, email selton@aps.org. To receive coalition updates and action alerts, sign up at aps.org/l/640833/2020-06-02/dbhyf

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

BIDEN/HARRIS CONTINUED FROM PAGE 4

tutions to report harassment-related actions taken against grantees back to their funding agencies.

She has also taken up the cause of environmental justice, which is likewise a feature of Biden's climate plan. She recently sponsored bills that seek to enhance protections for vulnerable communities against environmental harms, including by proposing to create an environmental justice office within the White House tasked with considering the impacts of regulatory proposals on low-income communities.

Harris is the first Black woman and first person of South Asian descent to be on a major party's presidential ticket, and the first to have graduated from a Historically Black College or University. In her own presidential campaign, she proposed investing $60 billion in STEM research and education at HBCUs and other Minority Serving Institutions. Harris' mother Shyamala Gopalan was a cancer researcher who moved to the US from India to pursue her graduate education, and Harris frequently cites her influence when advocating for the sciences.

Upon introducing the harassment prevention bill in 2019, she remarked in a statement, "As the daughter of a barrier-breaking woman in STEM research, I know the importance of ensuring more women enter and excel in this field."

The author is Science Policy Analyst at FYI.

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PHYSTEC CONTINUED FROM PAGE 3

tions have not yet committed to joining the network, Stony Brook is seeking partners from other universities in the SUNY system, professional teacher societies, and alternative teacher certification programs.

The initial network in California was formed thanks in part to a donation from Google. Led by Laura Henriques, a professor of science education, and Chuhee Kwon, a professor of physics, both at California State University Long Beach, the network has been a success for connecting physics teacher education programs in Southern California. The network has hosted in-person meetings, with plans for more virtual meetings to talk about issues in physics teacher education, share strategies, and take advantage of expertise at partner institutions.

The next step for the new regional networks is forming their own conferences, partially with the help of Henriques, who will join PhysTEC as an advisor.

"We've brought Henriques on board to help the leadership of these new networks think about their plans for the future," says May. "The leader institutions have to consider how to reach their target institutions, what to offer to their members, and how to best share all the expertise PhysTEC has to offer."

The regional networks will have a unique opportunity to reach like-minded physics teacher education programs that might not have yet joined PhysTEC.

"We think these regional networks are an important way to reach more institutions to improve their teaching programs," says May. "This is critical in producing more and better physics teachers."

PhysTEC is a joint project of APS and the American Association of Physics Teachers, with funding from the National Science Foundation and the APS Campaign for the 21st Century.

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

APKER CONTINUED FROM PAGE 3

McMillan rounded out the first day of talks, describing his investigations of the DNA condensation process for applications in the fabrication of biomolecular origami nanostructures. His research focused on the role of protamine proteins in formation of DNA multi-loop toroid structures.

The second day of the Apker Selection Meeting kicked off with Farah sharing his research into better characterizing the shape of black hole shadows. With inspiration drawn from a shadow he saw in a teacup, Farah helped to develop a better approximation for the black hole shadow shape which can contribute to better analysis, modeling, and imaging of black holes.

Giovanetti followed with a talk on her use of known cosmological parameters to place constraints on the mass of ultra-light, sub-GeV dark matter. Her research used existing data on the expansion rate of the universe and the CMB power spectrum to model what dark matter mass candidates would allow for the universe we see today, ruling out some mass ranges that are currently being investigated by experiments.

Next, Pace presented his research in theoretical condensed matter physics, which was an effort to further understand quantum spin ice, a class of rare-earth pyrochlore magnets. Pace helped develop models of quantum spin ice at low, previously unmodeled energies and developed calculation methods to determine the electrodynamic interactions within the material.

To finish out the selection meeting, Poniatowski spoke on his work delving into behavior of cuprates in their strange metal state—a state where electrical resistance is linked to temperature. Through theoretical analysis and then experimentation with specially grown cuprates, Poniatowski helped to further the understanding of strange metals for their use as high temperature superconductors.

For more on the APS LeRoy Apker Award, which is made possible through a donation by Jean Dickey Apker, visit the Apker Award Page (aps.org/programs/honors/prizes/apker.cfm).

FELLOW CONTINUED FROM PAGE 4

tackled other interesting matters during her fellowship.

"I worked with a group of AAAS fellows from around the federal government to produce and host a conference on the social impacts of artificial intelligence (AI). From my science and programming experience, I have internalized that computer algorithms will do exactly what you tell them, whether it's what you expected or not, so we have a responsibility to consider carefully what goes into them and how we use the output," she said, adding "we had about 500 people who watched the AI broadcast."

Added Francis Slakey, APS Chief External Affairs Officer, "Laura has done a fantastic job demonstrating how scientists can use their expertise to impact policy. Her extensive scientific background proved valuable on key issues impacting Americans."

Gladstone's next step in her career journey: working as a Research Staff Member at the Institute for Defense Analysis in Alexandria, Va.

"That means I get to stay in DC and hopefully do some cool physics with relative job stability. I also look forward to learning more about advocacy opportunities in DC, and I want to stay involved in policymaking," she said.

While Gladstone served in an unbiased, scientific capacity during her fellowship on Capitol Hill, she pointed out that scientists should not be shy about letting their voices be heard on policy matters.

"I invite all of you to contact your representatives, whether it's about your research topics or putting a logical frame around broader topics impacting the nation. This contact, just like voting, really does make a difference, even if it can feel like a small action at the time. If there's one thing I took from neutrino physics into government, it's that small actions can add up to big differences," she said.

To learn more about the APS Congressional Science Fellowship, visit aps.org/policy/fellowships/congressional.cfm. To get involved in advocacy, visit the APS Office of Government Affairs (APS OGA) Action Center (aps.org/policy) or Contact Callie Pruett, Senior Strategist for Grassroots Advocacy in APS OGA at pruett@aps.org.

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

VIRTUAL CONTINUED FROM PAGE 5

For Bernadette Cogswell of Virginia Tech, that comfort extended to the conference at large. "[This] conference is one of the first times in my physics career that I have even felt comfortable talking because it's virtual," Cogswell, a Black woman and a theorist, wrote on the conference's Slack channel.

In addition, the virtual format allowed for discussion beyond usual time constraints, Cogswell told *APS News*. Over the Slack channel, people could message presenters at their leisure. Cogswell also messaged with scientists who do not speak English as a first language. For them, usually, "it's very hard to involve yourself in conversations, because it takes so long to formulate it in your mind, by the time you're done, the conversation has moved on," says Cogswell. They found it easier to express themselves online, she says.

Still, virtual interactions have their limitations. Cogswell points out that while she found it easier to converse with strangers in the virtual world, it's difficult to forge deeper connections.

For Cogswell, though, the virtual meeting has served its purpose. After she typed up a question about a presentation in the app, a former colleague messaged her. "He said, 'I have a position I've been trying to fill for a year and a half. [...] Can I offer you a job?'" she says. She accepted, and she's now working from home.

DPP CONTINUED FROM PAGE 1

puting to model particles within a plasma at a detailed level, and even the plasma-based sterilization of water or surfaces—a topic that takes on particular relevance in light of COVID-19.

Plasma researchers themselves are as diversified as this array of topics—pursuing theoretical and experimental work, spanning academia, industry, and national labs, and with disciplinary bases ranging from engineering to computer science to astronomy as well as physics.

A particular point of pride for DPP is its longstanding Annual Meeting. Typically drawing 2,000 people and nearly as many submissions, this meeting is a major event across the spectrum of plasma research. The 62nd DPP Annual Meeting is right around the corner, slated for November 9-13 in a pandemic-friendly online format. This year's program has an emphasis on astrophysics, given that so much lab-based research has been on hold during the pandemic: Major invited talks will detail the latest insights from the Parker Solar Probe, the DKIST telescope, and the Event Horizon Telescope. The meeting also features several awards and prizes, including the Maxwell Prize for life-long achievement in plasma physics, the Rosenbluth Prize for best PhD thesis in plasma physics, the Stix Prize for early-career achievement, and the Weimer Award to recognize outstanding early-career achievement of a woman in plasma physics.

In normal times, DPP Annual Meetings also feature satellite meetings, "Plasma on Tap" events where scientists can present their research in an informal pub setting, and the hugely popular Plasma Expo where the general public can come to learn about plasma physics through presentations and hands-on experiments and demonstrations.

DPP also makes efforts to engage younger scientists at the Annual Meeting, holding a "Student Day" completely run by graduate students, an undergraduate poster session, a student appreciation reception, and town hall meetings for the concerns of early-career scientists. "Our division leans on the older side," explained Brown, "and we're doing many things to address that."

2020 marks an important year for DPP, with the culmination of two major community-wide studies that will guide the future of the field: The Decadal Assessment of Plasma Science and the Community Planning Process (CPP). The Decadal Assessment, coordinated every 10 years by the National Academy of Sciences, aims to provide a snapshot of the plasma field that will help federal agencies and policymakers appreciate the importance of plasma research and encourage funding for plasma projects in the next decade. To complement this, the CPP has the specific aim of identifying and prioritizing scientific and technological opportunities in plasma physics, particularly fusion energy science, for the Department of Energy, the major funder of plasma research.

Looking forward, the DPP executive committee's goals for the division are two-fold: Looking outward, giving plasma physics the visibility it deserves in the wider scientific community; looking inward, giving all people the visibility they deserve within plasma physics.

On the former, Zweibel explained that plasma physics can feel fragmented since researchers are spread among many disciplines. While this interdisciplinary nature is on one hand a strength that allows plasma physics to contribute to many fields, it also means that physics students are not routinely exposed to plasma physics in the way that they are to condensed matter or atomic physics. "Too often, when people think of plasma physics they think of magnetic fusion and how it isn't here yet. Plasma physics is so much more," she noted.

On the latter, both Zweibel and Brown underscored the need for greater diversity in plasma physics. "It is a problem in science in general, physics specifically, and plasma physics even more specifically," explained Brown. Indeed, DPP has the lowest percentage of women of any APS unit at just under 10 percent. Brown described several concrete actions DPP has taken to remedy this, including highlighting the work of women scientists in invited talks at the DPP Annual Meeting, and nominating a record number of women as APS Fellows in 2019 (four in total, equal to the total number of women selected over the preceding five years).

Overall, DPP stands out as a thriving group for researchers interested in the wide world of plasma. "APS members should join DPP for the exciting physics and the opportunity to contribute to some of the most challenging problems of our time," remarked Zweibel. "With such a diverse suite of problems, there is something for everyone in plasma physics."

More information on this unit can be found at the DPP website.

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

PHYSICSQUEST CONTINUED FROM PAGE 1

a PhysicsQuest kit, teachers will have access to videos explaining experimental setups to help illustrate how to best achieve results in the classroom. Videos covering the science behind each experiment will also be available for teachers and students alike, helping to connect scientific concepts with the hands-on work. Four additional extension activities will let students dive deeper into these concepts while gaining familiarity with the Python programming language.

"With the extension activities, students will get a chance to understand science content with coding," says Fracchiolla. "The activities will have pre-written code so students can input parameters to see the physics outcome, but they'll also have access to the code to edit, add to, and learn to de-bug."

Another virtual component in the works is Q&A sessions with physicists, to let students ask questions and meet the real people behind the science they've learned in the classroom. The PhysicsQuest program is currently seeking volunteers who might be interested in participating and inspiring future physicists. To sign up, visit forms.gle/VhUwroKz2G7qmRM58.

This year's experiment kit, which will be shipped out in November, explores concepts of force and motion from dropped objects to pendulums to spinning motion. As students learn about the science, they'll also have the opportunity to learn about the work of Katherine Johnson, a NASA scientist instrumental in the efforts to put humans on the moon.

"We want to advertise names of scientists students may not know who have made huge contributions to physics," says James Roche, APS Public Engagement Program Manager. "This year the experiments deal with force and motion, which have direct connections to the awesome work Johnson did with orbital motion."

Adding virtual components to the already wildly popular PhysicsQuest kits—20,000 are sent to classrooms each year reaching more than 185,000 students—comes at an ideal time as many schools face online and hybrid learning, but many of these features were already in the works.

"Adding virtual components to PhysicsQuest wasn't directly inspired by COVID-19 since we started developing them last year, but we're launching at the perfect time," says Roche. "The stars are aligning to help us increase participation and reach more students."

Signups to receive a PhysicsQuest kit are available on the PhysicsQuest website but each experiment can be done with objects found around the house. Students working at home can take advantage of the free, online content to build experiments using whatever materials they have on hand.

Connect with PhysicsQuest and keep up with virtual events, including physics Q&As on Instagram @physicscentral. For more about PhysicsQuest and other educational resources, visit physicscentral.com.

THE BACK PAGE

It's Not "Talent," It's "Privilege"

BY CARL WIEMAN

As the country confronts systemic racism and other forms of discrimination, those of us in higher education, including physics departments, need to reflect on how we may be inadvertently propping up these barriers. My research group has been studying the factors that determine the success of students in introductory college physics courses, and the data show how physics instruction and the current curriculum is supporting systemic discrimination. A primary enabling factor is the concept that students can be classified in terms of their "talent," supposedly a fundamental quantity reflecting their capability to do physics.

It is well known that various minority groups are disproportionately impacted by the COVID-19 pandemic. This is not because of some fundamental difference in their biology. It is because of the inequities in their living and working conditions, and the health care they are able to access. Similarly, the distinctions between various college students taking introductory physics primarily reflect the educational inequities in our society, rather than any innate differences between individuals. The inequities in K-12 education in this country are similar to those seen in coronavirus exposure and treatment. In both cases, these inequities across different demographic groups can be traced back to differences in socioeconomic status and the structural bias that maintains those differences.

When departments attribute differences in student performance to differences in talent, rather than differences in educational privilege, they are sustaining and enhancing these systemic inequities. Often, these inequities are further amplified by departments providing special educational opportunities and support to these more privileged students, in the form of "honors classes," research opportunities, etc. It is especially hard to recognize educational privilege when one is a beneficiary of it, as are most of the physics faculty of my generation, including myself. Of course, we all worked very hard to attain the expertise and success that we have achieved, but that does not mean there were not millions of other children who could have been just as successful if they had the same opportunities, but they did not.

Predictors of physics success

My group has investigated what factors are predictive of success in college physics [1]. Basic measures of physics preparation from high school were the only factors that we found were significant, and they were surprisingly good predictors, explaining about 30% of the variance and much of the failure rate. This was with rather crude measures of preparation. The actual effect is larger, as we see as we extend that work with more complete and detailed measures of incoming physics preparation. After controlling for these measures of preparation, gender, first generation college student, and minority status made no contribution in the predictive model.

We do see that these demographic groups are systematically receiving worse physics preparation in high school. Seymour and Hunter have carried out a broader but less detailed study [2] than ours and they also see that performance in introductory science and math courses is strongly affected by students' prior preparation. Their data show that these general differences in level of preparation across demographic groups primarily depend on the socioeconomic level of the school district the students attended. Seymour and Hunter also show how low performance in these introductory courses has a substantial impact on students switching out of a STEM major.

The legacy of inadequate preparation

Physics departments are unknowingly driving many students from under-represented groups out of physics and other STEM fields by having introductory courses in which less prepared students are likely to do badly. These students' only "mistake" is to come from poor families, or more precisely, come from school districts with less money and hence worse physics teaching. We have interviewed many aspiring STEM students who come into Stanford with relatively weak physics preparation, and they paint a stark and disturbing picture of physics teaching in the US K-12 system, shocking for those like me whose own experience with the K-12 system is from affluent college towns. Their descriptions of their high school physics courses are filled with examples like "My school did not have a physics teacher, so we just got a series of substitutes all year, none of whom knew any physics," or "The person who was supposed to teach our AP physics class told us on the first day we would need to learn on our own, and then he left for the rest of the semester." There are many other stories nearly as bad.

Innate talent or privileged preparation? Perfect pitch was something thought to be the result of having some remarkable genetic gifts, until someone seriously tried to teach it. Now it has been demonstrated that almost any child can be taught to have perfect pitch if they get the right instruction.

One striking feature of our analysis of the importance of prior preparation in physics is that other quite different institutions show very much the same pattern as Stanford. The impact of prior preparation on grades was nearly identical between Stanford and a large public university that had an acceptance ratio about 100 times greater than Stanford. The same measures of prior preparation, while much lower on average for the public university, are just as good predictors/determinants of student success and, more importantly for student career choice, failure. A third institution we examined was similar. This, in addition to the data in ref. 2, suggests that most physics departments are likely setting up their courses to cater to the well-prepared students, and in the process, they are sacrificing those less prepared. Such a choice makes sense if you mistakenly attribute the differences to talent. In that case, you want to optimize the educational benefits for the talented students, as they would be wasted on those with little talent.

Setting students up for failure?

The admissions office of a typical college or university is appropriately looking at many different student qualities, and so students are never admitted solely on the basis of their physics preparation. At any reasonably selective institution, every student has some exceptional qualities or accomplishments, most of which are less sensitive than physics teaching to the economics of their school district. As a result, many students with weak physics preparation will be accepted and enroll at a good school like Stanford, thinking that they will be able to pursue a STEM career. They do not realize until too late that their physics preparation, rather than all those accomplishments noted by the admissions office, actually will determine what majors they can and cannot pursue. Although the introductory courses are the most critical for students' career choices, at Stanford the entire curriculum for the physics major shows much the same pattern, with it being optimized for the students who come in with the very highest level of incoming preparation, while presenting huge barriers to students who are eager to pursue physics but are less prepared.

I am sure that Stanford is not unique in this regard, with many other physics programs, and other science majors, having similar features, because the concept of physics "talent" is so pervasive. I have spoken at dozens of physics and other science departments about research on teaching and learning. In virtually every case I am asked the question, "How can I deal with the wide spread of students in my class?" Curiously, this same question comes as often from instructors of graduate courses at elite universities as it does teachers of introductory physics at community colleges. In the great majority of those cases, the conversation then soon turns to "How do I best teach the most talented students, without hopelessly losing the less talented."

Fundamental change is needed

For physics departments to make progress at reducing rather than sustaining the systemic discrimination that exists in our society, they will have to make a fundamental change in how they classify students. They need to recognize that student success has little to do with "talent" and a great deal to do with "educational privilege." There is considerable research [3] supporting this claim. In studies of expertise across many different fields it has been shown that the attainment of any substantial level of expertise is determined primarily by the amount of "deliberate practice" an individual has performed, and depends little on any a priori measure of talent in the subject that anyone has been able to find. "Deliberate practice" is a particular type of intense learning activity, often present in the best graduate training and some very well taught courses. It leads to changes in neuron connections—changes that embody the enhanced expertise. This view that effortful learning ("deliberate practice") dominates over talent is very much at odds with our cultural myths, but it is strongly supported by the research. In the context of the current societal discussions, it is perhaps worth noting that the concept of the innate superiority of certain "talented" people goes back to the work of Galton in the 1800s. His goal was to generate "scientific" evidence of the innate superiority of the English nobility, to justify their hereditary privileges.

Beyond this fundamental change in thinking about student differences in terms of their educational privilege rather than their talent, what should a physics department do to avoid implicitly accepting and increasing systemic discrimination? I do not believe there are any easy solutions, and so I offer none. It will require the changing of long held beliefs, curriculum, and allocation of resources. It seems unrealistic to expect we can quickly or easily erase or compensate for the differences in the preparation of the incoming student population, whatever the source. It also is irresponsible to simply blame the K-12 education system and wash our hands of the problem. Every department should examine its student population, its educational practices, and its student outcomes, looking for where and how it is discriminating against students whose only failure is a lack of educational privilege.

Then it needs to have a painful examination of what changes it can and should make to address such educational inequities—painful because, as well as changing basic thinking about student differences, it will likely involve shifting resources from the most prepared/privileged to the least. For example, changing the coverage and pace of some intro courses so they are optimized for the third of the distribution with the least preparation, and switching from lectures to active learning teaching methods, which are especially beneficial for less prepared students. Perhaps replacing some "honors" courses with new courses targeting the less prepared, so that there is a comfortable path for students to successfully explore and pursue a physics major, regardless of their precollege preparation. It will also likely require shifts in the incentive system, so that teaching small classes with the best prepared students is no longer the prized teaching assignment, but rather faculty will be competing to show they can teach and achieve the best results with those students who have suffered the greatest educational inequities on their way to college.

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