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APS NEWS

A PUBLICATION OF THE AMERICAN PHYSICAL SOCIETY

MEETINGS

Exploring Collaboration and Competition at the APS International Leadership Forum

BY LEAH POFFENBERGER

The APS Leadership Convocation has in past years brought leaders from APS membership units together to connect with APS as an organization, but this year the meeting took on a new name—the Annual Leadership Meeting—and featured a brand-new event: The International Leadership Forum. The added day offered an opportunity to welcome prominent science leaders from around the world to discuss important policy issues faced by the physics community and society as a whole.

The International Leadership Forum was created to help address challenges laid out by the *APS Strategic Plan: 2019* involving the support of robust scientific research through advocacy and shaping science policy, especially policy that could impact international collaboration. The keynote speakers for this year's event were: Nobel Laureate and Former US Secretary of Energy Steven Chu, Director of the Caltech LIGO Laboratory David Reitze, and University of Maryland Professor Christopher Monroe, co-founder and Chief Scientist at IonQ. Two panels, one focused on international collaboration and the other on international competi-

Nobel laureate Steven Chu gave the keynote address at the first APS Annual Leadership Meeting. IMAGE: WILL MARTINEZ

COLLABORATION CONTINUED ON PAGE 6

JOURNALS

Introducing *PRX Quantum*

APS is gearing up to launch a new member of the *Physical Review* family of journals. *PRX Quantum* will be a highly selective, open access journal focused on quantum information science and technology with an emphasis on research with lasting and profound impact. The new journal is expected to open for submissions in the coming months, publish its first peer-reviewed content in the second half of the year, and waive article publication charges (APCs) for all submissions received in 2020.

"*PRX Quantum* will expand on the excellence and innovation of *Physical Review X* (PRX), and provide a home for and connection between the numerous research communities that make up quantum information research, from pure and applied sciences to engineering, technology, computer science, and beyond," said APS Editor in Chief Michael Thoennessen.

The field of quantum information science and the development of quantum-enabled technologies has exploded in recent years, with an increasing number of advances in quantum computing and simulation, quantum communication, and quantum sensing reported at conferences and in journal papers each week. The potential for impact on both science and society is tremendous, with promising applications in areas such as materials design, secure encryption, GPS-free navigation, and biomedical imaging.

"*PRX Quantum* represents our continuing commitment to excellence and increasing open access opportunities for researchers and readers at the top level of quality," said APS Publisher Matthew Salter.

PRX QUANTUM CONTINUED ON PAGE 2

APS Board Statement on Open Science

On February 14, the APS Board of Directors adopted a "Statement on Open Science and Recommitment to Research Principles." The Statement emphasizes the importance of open exchange of information and the need for balance with national security concerns. The full text can be found at aps.org/policy/statements/executive.cfm.

GOVERNANCE

Speaker of the APS Council Andrea Liu

Physicist Andrea Liu is the 2020 APS Speaker of the Council of Representatives, a position that was created in 2015 as part of the changes to APS governance. The Speaker chairs the Council and sets the agenda for its meetings. Liu is the Hepburn Professor of Physics at the University of Pennsylvania and an APS Fellow. APS News spoke with Liu about the role of the Council and her priorities for the year.

What is your scientific background?

I'm a soft- and living-matter physicist with an interdisciplinary career history. My degrees are in physics but I was a postdoc in chemical engineering and materials science and then was on the chemistry faculty at UCLA for ten years before coming to the physics department at Penn.

I've noticed that physicists are far more worried about preserving the purity of their discipline than chemists or engineers. In my experience in chemistry, as long as something is interesting they don't care so much whether it deserves to be called "chemistry." In physics what matters is that problems are interesting, but in engineering it is important that there be a wider impact and it's possible to choose problems that satisfy both criteria.

Explain the role of the APS Council of Representatives

The Council is really what connects members to APS as an organization. It's basically the main conduit of communication between the membership units—the divisions, topical groups, forum, and sections—and APS governance and senior management. And it's also the way different units communicate with each other.

The effectiveness of APS is limited by the ability to communicate among the various diverse parts, and so the role of council is incredibly important. It involves communication from members to the Council, and from the Council to the APS Board of Directors, in both directions. We need to get

Andrea Liu

input from members, through the units, up to the Council and then to the Board, staff and leadership.

But communication in the opposite direction is also important. Our members are not as well informed as they could be about all the great things that APS is doing and so they don't take as much advantage of the Society programs as they could. I would say that communication is not one of the strongest points of the APS and this is something the last several Council Speakers have been working really hard to improve.

What are some ways to improve communication?

I think one way is to make

LIU CONTINUED ON PAGE 5

DIVERSITY

Building Relationships at the National Mentoring Community Conference

BY LEAH POFFENBERGER

African American, Hispanic American, and Native American students are underrepresented in undergraduate physics, and APS is working to change that: the National Mentoring Community (NMC) offers these students the support and guidance they may need to succeed and earn their degrees. The NMC matches students with local mentors and helps to facilitate relationships that keep underrepresented minority students in physics.

Each year, the NMC holds a conference with resources and workshops for both mentors and mentees, with the purpose of fostering community and empowering mentors with the tools to more effectively support their students. The 2020 NMC conference, held in partnership with the National Society of Black Physicists and the National Society of Hispanic Physicists, took place from February 6 to 8 at the University of Central Florida in Orlando, with more than 120 attendees.

"This conference has been the most valuable part of the NMC experience," said Alice Olmstead, an assistant professor at Texas State University and an NMC mentor. "It's so rich and has so many resources for my students to make connections that I can't provide myself."

NMC CONTINUED ON PAGE 4

Attendees at the 2020 APS NMC Conference IMAGE: CARLOS ROMERO

Revised 03/02/20

PROGRAMS

Education and Diversity News

Physics Department Chairs Conference: Save the Date

The 2020 Physics Department Chairs Conference, sponsored jointly by the American Association of Physics Teachers and APS, will be held June 18–20, 2020 in College Park, MD. Registration information will be available in late February.

June 2020 New Faculty Workshop

Physics and Astronomy Department Chairs are invited to nominate their new faculty for the June 25–28, 2020 NSF-supported Physics and Astronomy New Faculty Workshop to be held in Los Angeles, CA. The nomination form is available at aapt.org/Conferences/newfaculty/newfaculty_nomination.cfm.

Nominations of tenure-track faculty, full-time lecturers (or equivalent), adjunct faculty and part-time faculty as deemed appropriate should be made no later than March 6.

STEP UP Ambassador Leads

STEP UP is excited to announce our seven Ambassador Leads from the first cohort who will be joining our Ambassador Program Coordinator Bree Barnett Dreyfuss, in training and supporting our 2nd cohort. These awesome folks are: Colleen Epler-Ruths, Alisa Grimes, Jolene Johnson, Brian Kays, Alma Robinson, Katherine Seguino, and Mike Wadness. See STEPUPphysics.org/news for their photos and bios, as well as the announcement of the new ambassadors joining the project!

PRX QUANTUM CONTINUED FROM PAGE 1

PRX Quantum will publish papers of flexible length and format from all topics relevant to the diverse multidisciplinary quantum information science and technology research communities spanning physics, computer science, mathematics, chemistry, materials, engineering, and technology. Research coverage in the journal will include fundamental and applied results; theoretical and experimental advances, including those in methods and instrumentation; and interdisciplinary and emerging areas.

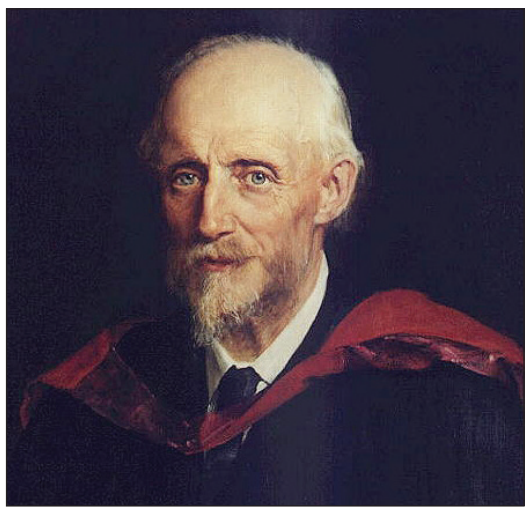
"Since launching 9 years ago, PRX has become the world's leading open access multidisciplinary physics journal, thanks to overwhelming support and appreciation from the broader physics community," said APS Associate Publisher Jeff Lewandowski. "This gives us confidence that with *PRX Quantum*, and potentially additional PRX-inspired topical titles that reflect the evolution of physics, we will better serve the global scientific community with valued and trusted open access journals of the highest quality and impact."

Learn more and sign up for updates at journals.aps.org/prxquantum. Follow PRX Quantum on Twitter at @PRX_Quantum.

THIS MONTH IN

Physics History

March 15, 1883: Osborne Reynolds Proposes the Reynolds Number



Osborne Reynolds

The intricate motion of fluids is notoriously difficult to predict, due to these substances' nonlinear nature. But physicists can predict whether the flow in a given system should be laminar or turbulent, thanks to an Irish-born physicist named Osborne Reynolds. Reynolds was a pioneer in the study of fluid dynamics, performing an elegant experiment to demonstrate that the critical transition point between the two types of flow could be predicted by one simple number. We now know it as the Reynolds number.

Born in Belfast, Reynolds inherited a love of mathematics from his clergyman father, a headmaster with a mechanical bent who had patented several improved designs for agricultural equipment. Reynolds would later recall how much he benefited from "the constant guidance of my father, also a lover of mechanics, and a man of no mean attainments in mathematics and its application to physics."

Young Osborne was an apprentice to a shipbuilder, which sparked his interest in fluid dynamics. After earning a degree in mathematics from Queens College, Cambridge, he spent a year working as a civil engineer focusing on sewage transport systems. Then, at 25, he became a professor of engineering at Owens College (now the University of Manchester), where he worked for his entire career.

Engineering was a relatively new field of study at the time. Reynolds was the first professor in the field at Owens College, thanks to a chair established by local engineers and businessmen, who wanted to increase the number of employable young men with experience in science and engineering. Reynolds emphasized math, physics, and classical mechanics in his engineering curriculum, although he apparently had no gift for lecturing. But he was an excellent mentor, according to his mathematics colleague, Horace Lamb: "To his pupils he was most generous in the opportunities for valuable work which he put in their way, and in the share of cooperation."

Initially, Reynolds' research focused on electricity and magnetism, as well as the properties of the sun and comets, but his interests soon shifted to hydraulics and hydrodynamics, where he made contributions to research on rolling friction and hydrodynamic lubrication. He did not have much in the way of laboratory equipment in those early days, so most of his experiments were relatively simple and could be done outdoors or at his home.

He also joined the Manchester Literary and Philosophical Society, then headed by James Prescott Joule, who encouraged Reynolds to present his first paper in March 1870. Reynolds nourished his more pragmatic interests via membership in the Manchester Scientific and Mechanical Society, as well as the Manchester Association of Employers, Foremen, and Draughtsmen.

Reynolds helped improve the design of boilers and condensers with his work on heat transfer and phase transitions between solids and fluids. An 1875 patent for a two-stage steam engine was a milestone in the early history of hydraulic pumps and steam turbines. He even drew on his civil engineering work when he published a short monograph in 1872 on how to keep sewer gases out of homes. The topic proved so popular the monograph went through four editions.

In early 1883, Reynolds performed his classic experiment on fluid flow, investigating different flow rates of water by squirting a jet of dyed water into water flowing through a large glass pipe. There was a control valve at one end of the pipe to allow him to control the velocity. He noted that at low velocities, the layer of dyed water kept its shape as it flowed through the pipe, while at higher velocities, the dyed layer broke apart and diffused through the rest of the water. This was the transition point between what is now known as laminar (smooth) flow and turbulent (disorderly) flow.

Based on those experiments, Reynolds discovered there was one simple predictive number taking into account the relevant physical quantities, namely a fluid's viscosity, and, in the case of Reynolds' experiments, the glass pipe's diameter. He also precisely identified the transition (critical) point: when the Reynolds number is greater than 2000, the flow becomes turbulent, described in detail in a paper submitted on March 15, 1883 to the *Proceedings of the Royal Society of London*. (A 2011 paper in the journal *Science* pegged the exact transition value as 2040.)

The Reynolds number remains the standard mathematical framework used to study turbulent systems, particularly by aeronautical engineers,

REYNOLDS CONTINUED ON PAGE 6

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HONORS

2020 APS Medal and Prize Ceremony

BY LEAH POFFENBERGER

On January 30, APS leaders and invited guests gathered at the historic Willard Intercontinental Hotel in Washington DC to witness the awarding of the 2020 APS Medal for Exceptional Achievement in Research, recognizing contributions of the highest level that advance our knowledge and understanding of the physical universe in all its facets. This year's Medal was awarded to Myriam P. Sarachik (City College of New York) for fundamental contributions to the physics of electronic transport in solids and molecular magnetism.

For the first time, two other prizes were also awarded at the APS Medal and Prize Ceremony: Norman Yao (University of California, Berkeley) received the George E. Valley Jr. Prize, created to recognize one individual in the early stages of their career for an outstanding contribution to physics. The Julius Edgar Lilienfeld Prize, recognizing a most outstanding contribution to physics, was presented to Joel R. Primack (University of California, Santa Cruz).

APS President Philip Bucksbaum presented Yao with the George E. Valley Prize "for the elucidation of non-equilibrium quantum phases of matter, in particular time crystalline order, and for enabling the realization of these phases in quantum optical systems." In a brief address, Yao described both his research and the previous work that provided the basis for his success, and thanked those influential in his physics career, including his high school physics teacher who was present for the event.

Primack was awarded the Julius Edgar Lilienfeld Prize "for seminal contributions to our understanding of the formation of structure in the universe, and for communicating to the public the extraordinary progress in our understanding of cosmology." He was honored for both his scientific achievements and his contributions to communicating about physics, recognition he extended to his wife Nancy Abrams. In his remarks, Primack emphasized the importance of science in society to effectively influence public policy issues.

(L-R): Joel Primack (Julius Edgar Lilienfeld Prize), Philip Bucksbaum (2020 APS President), Myriam Sarachik (APS Medal for Exceptional Achievement in Research), David Gross (2019 APS President), Norman Yao (George E. Valley Prize), Roger Falcone (2018 APS President) IMAGE: KYLE BERGENER

Bucksbaum then introduced Sarachik, presenting her with the APS Medal for Exceptional Achievement in Research. Sarachik is an experimental condensed matter physicist, a member of the National Academy of Sciences, a Fellow of APS, the American Academy of Arts and Sciences, the New York Academy of Sciences, and the American Association for the Advancement of Science. In her remarks, Sarachik recounted the highs and lows of her life and career as a physicist at a time when women were a rarity in the field, from her PhD at Columbia to Bell Labs to her eventual academic home of City College of New York.

Sarachik is the fifth recipient of the APS Medal, which carries a cash prize of $50,000, a certificate citing the contribution made by the recipient, and an invited talk at the APS March or April Meeting. The George E. Valley Jr. Prize and the Julius Edgar Lilienfeld Prize both consist of $10,000, certificates citing the contributions made by the recipient, and invited talks at the March or April meetings.

For more about APS Honors, visit aps.org/programs/honors/.

PROGRAMS

The CUWiP Experience at Yale

BY LEAH POFFENBERGER

On a blustery Friday afternoon in January, nearly 200 undergraduate women seeking degrees in physics arrived at the Sloane Physics Laboratory on the Yale University campus, full of excitement for the coming weekend. Over the next two days, attendees would have the chance to network with their peers, hear from accomplished women in physics, and gather resources for their future physics careers.

Yale was one of 13 regional sites hosting undergraduate students from January 17 to 19 for the Conferences for Undergraduate Women in Physics (CUWiP), an annual event that provides a professional conference experience, information about graduate school and careers, and networking opportunities.

As students trickled in on the first day of the conference, they were greeted by Yale student volunteers and went on a tour of the world-class research facilities at the Yale Quantum Institute and the Wright Laboratory. A hands-on workshop at the Wright Lab taught students the basics of particle detectors as they built their own light-sensing micro-detectors.

Undergraduate women at a poster session at the Yale CUWiP conference
IMAGE: EMILY KUHN/YALE UNIVERSITY

Yale professor Meg Urry—the first woman to have a tenured position in the department of physics at Yale—officially opened the conference with a welcome address, remarking on the status of women in physics and the need for diversity and equity in the field. Urry was followed by the first plenary speaker of the conference: Melissa Franklin, a member of the ATLAS detector collaboration at CERN, the first woman to receive tenure in the physics department at Harvard, and co-discoverer of the Higgs Boson and the top quark.

Franklin kicked off the plenary by introducing her physics role model, Nobel Laureate Maria Goeppert Mayer, a pioneer for women in physics who Franklin describes as "a smoking, drinking desperado." Franklin's talk was

CUWIP CONTINUED ON PAGE 7

MEMBERSHIP UNITS

The Topical Group on the Physics of Climate

BY ABIGAIL DOVE

The APS Topical Group on the Physics of Climate (GPC) is a home for scientists interested in the future of our planet and the physics, measurement, and modeling of climate processes. Climate physics encompasses everything from the study of Earth's hydrological and carbon cycles, to statistical analyses of climate models and measurement systems, to the physics of proxies to infer the properties of past climates. The physics of the mechanisms, magnitudes, and timescales by which both natural and anthropogenic processes affect the climate is an area of exceptional interest within this field.

Formed in 2012, GPC exists to promote the advancement of new knowledge on these topics, while remaining entirely within the domain of natural science (and outside the domains of policy, regulation, and legislation that are separately covered by the APS Office of Government Affairs). In some sense, GPC's founding was prompted by the 2007 APS Statement on Climate Change and a subsequent 2010 Climate Change Commentary (these statements, available at go.aps.org/2PkFjiQ, are archival and superseded by the 2015 APS Statement on Earth's Changing Climate, available at go.aps.org/2obnmsh). These statements

urged physicists to participate actively in climate research and help develop technological measures to mitigate climate change.

"I want physicists to know that there are lots of challenging and fascinating and important problems emerging with climate change, where their way of thinking has value," noted GPC chair-elect Mary Silber (University of Chicago). "The idea is for physicists to bring their unique skill set and mind set to the research, as well as to bring their curiosity to the discussions."

Specific areas underlying the physics of climate include fluid dynamics, modeling of nonlinear systems, the physics of complex systems, gas phase physics and chemistry, radiation/heat transfer, phase transitions, measurement

GPC CONTINUED ON PAGE 7

NMC CONTINUED FROM PAGE 1

The first day of the conference offered attendees a tour of Kennedy Space Center, as well as The Historically Black Colleges and Universities (HBCU) and Black Serving Institutions (BSI) Chairs Summit 2020. The HBCU and BSI Chairs Summit convenes physics department chairs to discuss strategies to increase the number of physics bachelor's degrees awarded to African American students, a mission that matches that of the NMC.

"The number of African American students pursing a Bachelor of Science in physics is decreasing, and this summit brought physics department chairs together to solve this problem," said Imisi Agbaniyaka, Diversity Programs Coordinator at APS. "A focus of the summit was how to recruit and retain students and provide them with opportunities like research experiences at national labs."

On the following morning, conference attendees dove into a variety of workshops. Mentors and faculty had workshops on topics such as creating a more inclusive department, advising students about career paths, and how to be a more effective mentor. Students were able to learn about creating effective resumes, hear about the best methods of finding undergraduate research experiences, and get advice on applying to graduate school.

"A highlight of the conference was Nicole Cabrera-Salazar's workshop on empowered mentoring," said Agbaniyaka. "She provided insight into the underrepresented minority student experience and tools on how to be a better mentor, like understanding that being a student is a multifaceted experience."

Between workshops, attendees gathered for the first plenary session "A Wrinkle in Space Time: Connecting Gravitational Waves and Albert Einstein with Blackfoot Culture." The speaker, Corey Gray, is a member of the Siksika nation and a lead operator at the Laser Interferometer Gravitational-Wave Observatory (LIGO), who had LIGO's results translated into Blackfoot, to connect the discovery to Blackfoot culture.

The second plenary, "The Value of Mentoring, Personal Perspectives," featured three NMC students: Elon Price, Xandira Quichocho, and Dave Austin. The speakers shared their experiences with being a part of the mentoring community and the impact their mentors had on their lives and careers.

A third plenary kicked off the third day of the conference: Tabbetha Dobbins, an associate professor at Rowan University, introduced findings from an American Institute of Physics task force investigating the reasons for persistent underrepresentation of African Americans in physics (see FYI below right). The Task Force to Elevate African American Representation in Undergraduate Physics and Astronomy (TEAM-UP) uncovered long-term and systemic issues within the physics community and suggested actionable solutions.

A networking fair followed, and students and faculty had the chance to attend another round of workshops, from bystander training to managing a healthy work-life balance.

For many of the students, the opportunity to spend time with their mentors in a casual setting and to network with their peers at other physics institutions is a crucial part of their NMC conference experience.

"One of the things that helps solidify mentor/mentee relationships are these conferences. They give us the ability to interact outside of an academic setting—it's a more natural interaction," said Alexander Vasquez, a physics student at Texas State University who is mentored by Olmstead. "This conference is the most valuable asset in the NMC in my opinion—I get to see other minority physics majors and know that I'm not alone."

To learn more about the National Mentoring Community, visitaps.org/programs/minorities/nmc/.

Corrections

In the January 2020 issue (p. 4) an article about methane regulation was accompanied by an image of the methane molecule obtained from a stock photo company. The image is incorrect and has been corrected online.

The Back Page article on the *Physical Review A, B, C,* and *D* 50th anniversary (February 2020) gave the date of the founding of *Reviews of Modern Physics* as 1919. The date has been corrected to 1929 online.

GOVERNMENT AFFAIRS

International Students are Key to a Strong Economy

BY JAMES VARY

Note: The Cedar-Rapids Gazette *first published this op-ed on February 3. Iowa State University physics professor James Vary timed the piece for publication around the Iowa caucuses to capture the attention of aspiring presidential candidates and key elected officials within the state.*

As the Iowa caucuses draw near, the presidential candidates should let voters know where they stand on ensuring our nation continues to attract the best and brightest students from around the world to keep America as a science and technology global leader.

The reason? Science and technological advancements have been the predominant drivers of gross domestic product growth during the past half-century, according to a study by the American Academy of Arts & Sciences. In Iowa, for example, we can boast of more effective and efficient ways to farm because of science.

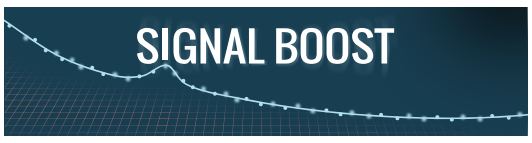
Our nation's role as a global leader in innovation, however, remains in jeopardy as the number of international students applying for physics PhDs at essential US institutions [is] experiencing a major decline. According to a survey by the American Physical Society, international applications to a representative subset of the physics departments responsible for training and educating more than 70 percent of the nation's physics PhDs dropped 22 percent during the past two years.

Fortunately, our US Sens. Joni Ernst and Chuck Grassley are in a position to help by co-sponsoring the Keep STEM Talent Act, which would enable high-skilled international graduate students to both study at US universities and [would] provide a path to a green card if they secure job offers from US employers after graduation. Both Ernst and Grassley sit on the Senate Judiciary Committee, which has jurisdiction over the legislation. The presidential candidates should also take note because Iowans care about science. In fact, in a survey jointly conducted by Research! America and Science Debate, 74 percent of respondents said it is important that presidential candidates talk about how science and scientific research will affect their policymaking decisions.

More than half of the students conducting research in my theoretical physics group at Iowa State University are from outside the country, so I know firsthand the concerns international students have about studying physics in the US. First, they are concerned about simply getting here because of visa delays. Once here, they worry about whether they will be able to stay upon graduation and work for American companies on crucial research that impacts issues most voters care about, including health care and national security. Our country needs the best and brightest students—both domestic and international—to keep our STEM workforce pipeline viable, and that includes Iowa, which has more than 12,000 open STEM jobs, according to a report by the Iowa Governor's STEM Advisory Council. To achieve that goal, the US Senate should pass the Keep STEM Talent Act. And Ernst and Grassley are integral to making that happen.

James Vary

The author is a physics professor at Iowa State University, an APS Fellow, and a descendant of Iowa immigrant farmers.



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

Task Force Urges 'Systemic Changes' to Support African American Students in Physics

BY ALLISON GASPARINI

A task force report published last month (go.aps.org/2ur0c4J) by the American Institute of Physics offers a framework for addressing the persistent underrepresentation of African Americans in physics and astronomy. It maintains that faculty, academic departments, and professional societies must embrace new ways of approaching the problem in order to bring about the "systemic changes" it argues are needed to make significant progress.

According to statistics cited by the task force, between 1997 and 2017 the proportion of physics bachelor's degrees awarded to African American students dropped from about 5% to 4% as the overall number of physics bachelor's degrees awarded in the US doubled. The report also notes that during this same period the proportion of African American students earning bachelor's degrees in other STEM fields increased.

To investigate the failure to improve diversity in physics and astronomy, AIP formed a 10 member study panel in 2017 co-chaired by Mary James, a physics professor and dean for institutional diversity at Reed College, and Edmund Bertschinger, a physics professor and former equity officer at MIT. In calling for action, the task force sets the goal of at least doubling the annual number of African Americans who earn bachelor's degrees in the fields by 2030.

Based on surveys of students and site visits to five departments, the task force concludes that financial challenges are "one of the greatest difficulties" that face African Americans seeking to study physics or astronomy. In addition, they observe that departments that have demonstrated the most success in supporting African American students also face financial challenges themselves.

Accordingly, the task force calls for physical science societies to establish a $50 million endowment dedicated to supporting minority students with financial needs in physics and astronomy. Half of the endowment would directly support African American students and the remainder would support other financially marginalized groups as well as departments' implementation of the task force's recommendations. Among its department-level recommendations are for faculty to help alleviate individual students' financial burdens by providing employment opportunities connected to their major, such as paid research internships and teaching assistantships.

In parallel with increased financial support, the task force also calls on department faculty to ensure their academic support systems recognize students' capabilities and build on their strengths. The task force states that academic support too often is "approached from the student deficit model — the idea that minoritized students have, as a consequence of their identity, learning challenges making them less capable than others."

The task force also stresses the importance of developing students' sense of "physics identity," which it defines as "how one sees oneself with respect to physics as a profession." It states physics identity is strengthened when there are same-race faculty members to serve as role models and when students are "routinely invited and financially supported to participate in established activities of the profession." However, it also states that "lone champions" are not enough to effect needed cultural

TASK FORCE CONTINUED ON PAGE 7

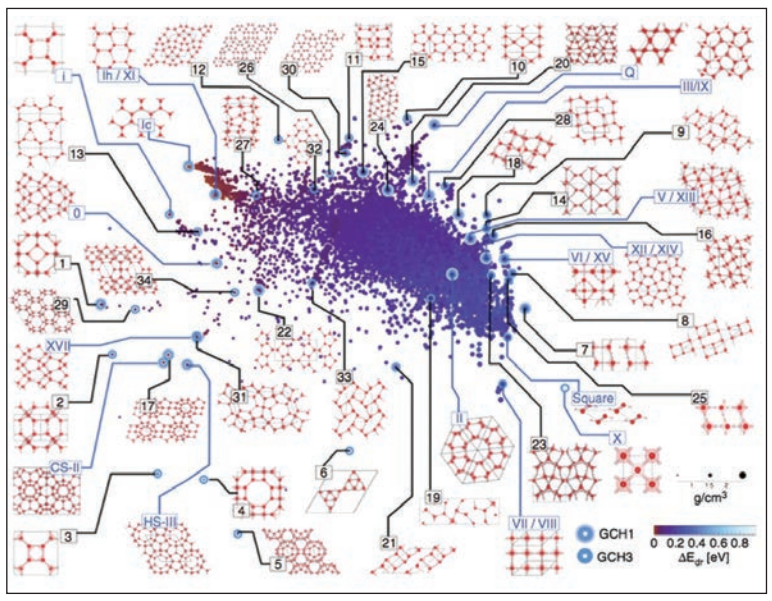
MEETINGS

Machine Learning Takes Hold in the Physical Sciences

BY DAVID VOSS

In recent years, the techniques of machine learning (ML) have become an essential part of the computational toolkit of physical scientists in fields ranging from astrophysics to fluid dynamics. In October 2018, for example, the APS Editorial Office hosted one of their ongoing series of "Physics Next"workshops on the topic of machine learning, which has now been summarized in an article in *Reviews of Modern Physics* (G. Carleo et al. DOI: 10.1103/RevModPhys.91.045002).

ML comprises an array of algorithms and methods for extracting patterns from large data sets, techniques that have been enabled by advances in image recognition and computational power. Most researchers consider ML to be part of a wider effort in the general field of artificial intelligence (AI). The article by Carleo et al. begins with an overview of ML methods, including supervised and unsupervised learning, neural networks, generative modeling, and reinforcement learning. The review then goes on to specific applications in statistical physics, particle physics, cosmology, many-body quantum systems, and quantum computing.



Machine learning can identify structurally similar materials and determine which of the many predicted structures should be most stable under certain thermodynamic constraints, such as the ice phases shown here [From G. Carelo *et al.*, Rev. Mod. Phys. **91**, 045002 (2019)].

For the field of fluid mechanics,

ML CONTINUED ON PAGE 6

JOURNALS

Mirjam Cvetič Selected as Lead Editor of *Physical Review D*

APS has appointed Mirjam Cvetič, Fay R. and Eugene L. Langberg Professor in the Department of Physics and Astronomy at the University of Pennsylvania, as the Lead Editor of *Physical Review D* (PRD). She takes over this role from Erick Weinberg of Columbia University, who has served as PRD's Lead Editor since September 1996. Cvetič will begin her new role March 1, 2020.

"I am delighted to welcome Mirjam Cvetič as the new Lead Editor of PRD. Her energy, wisdom and broad vision will be a great asset in guiding PRD towards a bright future" said Michael Thoennessen, APS Editor in Chief. "I also would like to take this opportunity to thank Erick Weinberg, who led the journal superbly for almost 24 years."

Cvetič received her PhD from the University of Maryland with a thesis titled "Origin of Mass Hierarchies in Gauge Theories." After working at the Stanford Linear Accelerator Center as a research associate, she took a second postdoc position at the University of Pennsylvania where she subsequently joined the faculty. She holds a secondary appointment in the Department of Mathematics and is also a member of the Center for Applied Mathematics and Theoretical Physics at the University of Maribor, Slovenia. She is a Fellow of APS and Elected Member of the European Academy of Sciences and Art.

Mirjam Cvetič

"It is an honor to be appointed the PRD lead editor," said Cvetič. "I am looking forward to working with its dedicated staff and editorial board to advance its key role as the premier journal of the broad high energy community."

For more on PRD, visit journals.aps.org/prd.

LIU CONTINUED FROM PAGE 1

Council meetings more engaging, so that councilors actually want to attend. They don't want to just rubber-stamp things—they want to make a difference. They can do that by communicating to the Council what the units think and communicating back to the units what transpired at the meeting on important issues and challenges that face us.

That is where the Speaker can do something because as Speaker I set the agenda for the Council meeting. I'm trying to clear room on the schedule at the Council meeting for small group discussions on important issues.

I'm asking councilors to attend two hour-long virtual meetings before the council meeting to learn what is going on before the actual meeting. There are always presentations from various officers on important issues. We get reports from the CEO, the Editor in Chief, the Publisher, the Treasurer and so forth, and we could do some of those reports remotely before the Council meeting. We will also learn important background from committees and APS staff to prepare us for the small group discussions.

What do you see as your priorities for your term as Speaker?

There are three issues I'd like the Council to discuss. One is science policy. The Council has not been very active in gathering input for the APS Office of Government Affairs about what members think is important to focus on. I'd like to use the council meetings to do that and have councilors come to the meeting having already discussed with the unit leaders what the top priorities are, so that we can pass them up.

As part of this, in the virtual meeting beforehand, we will ask Francis Slakey, the Chief Government Affairs Officer, and Dan Dahlberg, the chair of the APS Panel on Public Affairs (POPA), to talk about the process for deciding which issues to focus on and which issues APS should make official statements about, so that the councilors can understand the process to provide more input.

The second thing I want to focus on is diversity, equity, and inclusion. There were two very distressing statistics recently, one having to do with the number of undergrad women in physics surveyed at the APS Conferences for Undergraduate Women in Physics (CUWiP) who reported having experienced some form of sexual harassment—it is about 75%. And the other is the recent TEAM-UP report from the American Institute of Physics showing that the percentage of African Americans earning bachelor's degrees in physics has dropped in the 20 years from 1995 to 2015 from 5% to under 4%. These are really disturbing numbers, and we need to think about how to do more. APS has really excellent activities directed at these issues that many of us aren't aware of.

So at one of the virtual meetings we'll hear from APS Programs Director Monica Plisch about what the APS is doing—really interesting and important activities. And we'll ask if one of the TEAM-UP co-chairs, Mary James or Ed Bertschinger, could report on the results of that work. These will precede the more in-depth small group discusssions at the Council meeting.

The third thing is that I'd like the Council to discuss meetings. APS has established a task force to make recommendations on how to improve the APS March Meeting. Also, there's a pet project of mine, to discuss the idea of APS running small virtual workshops. We're going to have to learn to meet and exchange scientific ideas in a sustainable way. We can't just keep jetting around everywhere. The technology is getting there and I'd like APS to figure out how to do this in a useful way.

Small virtual workshops could draw in industrial members who can't afford the time to go to a five-day conference but could attend a half-day focused virtual workshop. It's a way to better involve our international members, especially ones that may have a hard time coming to the US due to visa or health issues. And we can involve younger members because the cost will be lower.

What else would you like members to know?

I mentioned this at the recent APS Annual Leadership Meeting, but I think many of our members feel vulnerable. Our early career members are worried about finding the right career path, and given the uncertainty of our times the stresses are higher than ever. And women and especially underrepresented minorities—why are there so many problems for us, why are there so few of us in physics after all these years, what's going on? They, along with our LGBTQ members are really worried by the backlash in society against diversity and civility, and whether it's going to affect them here in our community.

Our international members, especially those working here on temporary visas, are very nervous about their status and future prospects and whether they are welcome in this country. Industrial members are facing job insecurity and our members at government labs are facing more restrictions, continual budget pressure, and fears that their roles are not valued at all. Our members doing academic research are faced with increasingly inadequate and unreliable funding, with fluctuations that can end their research careers even when research is going well.

What I want our members to know is that APS has activities and programs designed to help with all of these issues. That's why APS is so important. I've been on the council for several years and I am still learning more about the APS all the time. The Society has a dedicated and terrific staff working to help us, so we members need to know about that, take advantage of it, and have a voice in helping APS become even more effective.

For more about APS activities, visit aps.org.

REYNOLDS CONTINUED FROM PAGE 2

as well as biologists studying the movement through fluid of organisms across size scales, from whales (high Reynolds number) to bacteria (low Reynolds number).

His more pragmatic research interests included the physics of granular materials, specifically soil mechanics: modeling water flow and sediment transport in rivers. Reynolds published a book in 1903, *The Sub-Mechanics of the Universe*, which attempted to explain the universe by proposing a liquid-state aether. But the concept of the aether soon gave way to new physics, thanks in part to the Michelson-Morley experiment in 1887, which showed no evidence for the substance.

Reynolds retired in 1905 as his health, and mind, were failing, even though he was still relatively young at 60. He died on February 21, 1912. Lamb remembered him as being strongly individualistic, with little interest in self-promotion and a dislike of academic pretensions. He was somewhat reserved, "occasionally combative and tenacious in debate," yet still "the most kindly and genial of companions."

Further Reading:

Avila, K. *et al.*, "The onset of turbulence in pipe flow," *Science* 333, 192 (2011).

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Lamb, H., "Osborne Reynolds," *Proceedings of the Royal Society* 88A, xv-xxi (1912-13).

Reynolds, O., "An experimental investigation of the circumstances which determine whether the motion of water shall be direct or sinuous, and of the law of resistance in parallel channels," *Proceedings of the Royal Society of London* 35, 84 (1883).

Purcell, E., "Life at low Reynolds number," *American Journal of Physics* 45, 1 (1977).

Rott, N. "Note on the history of the Reynolds number," *Annual Review of Fluid Mechanics* 22, 1 (1990).

COLLABORATION CONTINUED FROM PAGE 1

tion, featured prominent scientists with strong ties to international science policy.

Chu, now the William R. Kenan Jr. Professor of Physics and Professor of Molecular and Cellular Physiology at Stanford University and President of the American Association for the Advancement of Science, kicked off the International Leadership Forum with a keynote address titled "Rising Above the Gathering Storm: Open Science and Intellectual Property." The storm that Chu refers to is the growing concern about competition from other countries, notably China, and how over-reaction to that concern can harm US fundamental science.

A major aspect of this "storm" is increased worry from Congress that basic research secrets will be stolen from the US and used by China to quickly jump ahead with new products and innovations. In order to combat these issues and "rise above the storm," Chu advocates for a similar approach to that of the 1950s Sputnik era: rather than taking a strictly defensive and isolationist approach to international competition, Chu says the US should respond by directly competing to out-pace other countries in innovation. "The proper response to Chinese investment [in technology] is to make ours even better," said Chu.

In his plenary talk, Reitze provided an example of the potential of international collaboration in the success of the Laser Interferometer Gravitational-Wave Observatory (LIGO) and its ground-breaking detection of gravitational waves. His presentation, "Detecting Gravitational Waves: The Role of Large International Collaborations" detailed the process of developing LIGO, its subsequent discoveries, and the collaborative spirit that made these discoveries possible. As a collaboration made up of more than 1300 scientists representing 18 countries, LIGO serves as a model of what can be accomplished with international cooperation.

The LIGO effort originally came together in 1997 as a self-governing collaboration with no barrier to entry. That culture of openness has continued, as members of the collaboration value "cooperation over competition," according to Reitze. LIGO faced the same challenges as other large-scale international collaborations, from scientific and technical issues to sociological and cultural differences, but a system of robust conflict resolution kept LIGO together. "Overcoming these challenges requires diligence, patience, understanding, self-sacrifice, and

David Reitze

Christopher Monroe

dogged persistence," said Reitze.

After a brief coffee break, the Forum reconvened for a spirited discussion on international collaboration. The panel discussion, moderated by APS Past President David Gross, included science and policy experts from around the world: Jonathan Bagger, Director of TRIUMF in Canada; Rob Adam, Director of Square Kilometer Array in South Africa; Krishnaswamy VijayRaghavan, Principal Scientific Adviser to the Government of India; Fabio Zwirner, Steering Committee Chair, International Centre for Theoretical Physics; Arthur Bienenstock, Associate Director, Wallenberg Research Link, Stanford University; Marta Losada, Dean of Science and Professor of Physics, New York University-Abu Dhabi.

Each panelist was able to offer a unique perspective on various facets of international collaboration, extending beyond the issues that specifically impact the United States. Like Chu, VijayRaghavan sees potential for scientific collaboration to be ignited by issues like climate and energy that exist on a global scale. A major theme of the panel discussion that emerged was the importance of restoring trust in science and improving efforts to communicate about science to the general public and policy makers.

The second half of the day changed focus from international collaboration to international competition. Monroe is no stranger to competition in the developing field of quantum information science (QIS)—an area he called "competition on steroids." Large tech companies, like IBM and Google, are racing to create larger and better quantum computers, and the spirit of competition also extends internationally due to the potential applications of quantum systems in bolstering national security and facilitating economic growth.

At IonQ, Monroe says they have built four quantum systems using trapped ion qubits, and the next challenge is figuring out how these systems can be realistically applied. The two largest areas of interest are encryption and optimization problems. Encryption, which can impact national security, has drawn investment in quantum computing from various government agencies, but according to Monroe, using quantum systems for optimization—likely providing a boost to the economy—is becoming the more popular application and thus is changing the agencies that are investing in the technology.

A panel focused on international competition, moderated by Phil Bucksbaum, rounded out the event. The invited panelists were: Peter Knight, Senior Research Investigator, Department of Physics, Imperial College London; Petra Rudolf, President of the European Physical Society; Andrea Liu, Hepburn Professor of Physics at the University of Pennsylvania and Speaker of the APS Council; Siegfried Hecker, Senior Fellow, Center for International Security and Cooperation, Stanford; Craig Mundie, President of Mundie & Associates; and Steven Chu.

A central tenet of the panel discussions wasn't the competition for technology or ideas, but the international race to attract the best and brightest minds—a competition some panelists fear may be impeded in the US due to visa constraints on students from countries like China. When it comes to competition within research, Hecker, a former director of Sandia National Laboratory, advocated for a balance between keeping essential research secret, but creating an environment in which the right people can be gathered to look at crucial problems. In the case of large global issues like climate change or nuclear reactor safety Hecker adds, "maybe it's not so bad if some of our methodology is stolen."

To view these talks online, visit go.aps.org/32uBkFS.

ML CONTINUED FROM PAGE 5

an invited article in *Physical Review Fluids* (M. P. Brenner et al. DOI: 10.1103/PhysRevFluids.4.100501) mentions some specific cases where ML can be applied to two-dimensional turbulence, the physics of fish schooling, and turbulent combustion. Both Brenner et al. and Carleo et al. consider one the prime challenges of ML in physics: physicists want to learn about the mechanisms underlying observation, whereas ML tends toward black-box recognition of patterns in data.

Another indication of the rise of machine learning is the increasing number of ML sessions and workshops at the APS March and April meetings. At the 2020 March Meeting, for example, there are pre-meeting events on "Machine Learning for Polymer Physicists," "Deep Learning for Image Processing Applications," and "Machine Learning in Statistical and Nonlinear Physics." One of the keynote events, the Kavli Foundation Special Symposium, was entirely on the theme of "Frontiers of Computation: Machine Learning and Quantum Computing."

With the increased interest in ML in the physical sciences, physicists may not only benefit from algorithmic advances but help advance ML. As Carleo et al. write, "As machine learning is incorporated into the physicist's toolbox, it is reasonable to expect that physicists may shed light on some of the notoriously difficult questions machine learning is facing."

GPC CONTINUED FROM PAGE 3

science, computational physics, statistics, and biological physics.

Given this wide scope, GPC has a highly interdisciplinary membership base of more than 400 people. In terms of members' other affiliations, many GPC members hail from the Division of Fluid Dynamics (DFD) and the Division of Condensed Matter Physics (DCMP, see *APS News* April 2019). In terms of subject matter, there is also a great deal of synergy with the Topical Group on Nonlinear and Statistical Physics (GNSP).

Amidst international debate over how to address the climate crisis (and in some cases, over-framing climate change as a true crisis), nothing could be more timely than scientific work to refine our understanding of the nature of climate change. According to Adria Schwarber (University of Maryland), the student representative on GPC's executive committee, one of the topics of highest interest in climate science is narrowing the uncertainty of climate sensitivity, or the amount of warming in the atmosphere associated with increases in atmospheric carbon dioxide. Last August marked the 40th anniversary of the landmark Charney report, which famously estimated that a doubling of atmospheric carbon dioxide would translate to warming of 3 ± 1.5 °C. As Schwarber explained, "this range in climate sensitivity is remarkably close to the range we estimate today, though we currently have a more detailed understanding of climate change." Ultimately, narrowing the uncertainty in climate sensitivity is an important step in refining our projections of future warming due to anthropogenic emissions. Silber points out that another very timely topic is the development of approaches to investigating rare events and climate extremes, which have been occurring with increasing frequency in recent years.

GPC will host one invited session at the APS March Meeting in Denver, titled "Predictability of the Climate System." This session will focus on recent advances toward predicting Earth's climate from sub-seasonal to decadal time scales, and across transitions and extremes. It will bring together scientists working on a variety of approaches, from dynamical modeling to data mining to analysis grounded in fundamental physical principles.

GPC is also hosting a Thursday evening "climate cafe" at the March Meeting, an informal social event intended to spark further discussion on the physics of climate. In addition, current GPC chair Bill Collins (Lawrence Berkeley National Laboratory) and past GPC chair Chris Forest (Penn State) will be featured in Tuesday's "Student Lunch with the Experts," where they will discuss opportunities for physicists in tackling climate change.

Climate science engages not only physicists but also chemists, mathematicians, statisticians, and oceanic and atmospheric scientists, making GPC an important entry-point to APS for researchers with an academic home outside of physics. "The APS March Meeting is off the beaten track for leading researchers in climate science, so it's exciting to draw them in for a day of discussion with physicists interested in the topic," noted Silber. Likewise, "we find there is a lot of curiosity about climate research among physicists, especially the young ones worried about the future of the planet."

Beyond stimulating content at March Meeting, GPC publishes a biannual newsletter with the latest updates in climate science. In contrast to much of the popular science writing on climate science, GPC's newsletter is tailored to physicists, in a way that fosters appreciation of the results as well as the challenges that climate change poses.

GPC also offers two $500 travel grants to help one graduate student and one early career investigator cover the costs of participating in a GPC-related session at the March Meeting.

Looking forward, the GPC executive committee hopes for continued membership growth and opportunities for engagement between the physics research community and the climate research community. "I would like to see more graduate students and early-career scientists get involved with GPC," added Schwarber. "It is a small, but dedicated community where every individual can make an outsized impact, including shaping how APS and the broader community relate to climate science."

Overall, GPC stands out as an exciting interdisciplinary community and a valuable mechanism for physicists to stay connected to the latest climate-relevant research. More information on this unit can be found here: aps.org/units/gpc

The author is a freelance writer in Stockholm, Sweden

CUWIP CONTINUED FROM PAGE 3

peppered with humor, describing Goeppert Mayer's career as a theoretical physicist, how Goeppert Mayer asked questions that continue to shape particle physics today, and sharing her own perspectives on being an experimentalist.

To start the morning on day two, a panel titled "This is How I Got here" featured five women in physics with different backgrounds and career paths: Ágnes Mócsy, a Professor of Physics and Astronomy at the Pratt Institute in Brooklyn, NY, who studies the intersection of science and art; Alia Jackson, who teaches physics at Curtis High School in Staten Island, NY and is also an Adjunct Professor at the College of Staten Island; Sophia Suarez, an Associate Professor in the physics department at Brooklyn College in the City University of New York and former National Research Council fellow; Jacquelynn Garofano, a program manager for the Margaret Ingels Engineering Development Program at United Technologies; and Priyamvada Natarajan, a Yale professor with joint appointments in the Astronomy and Physics departments, and author. The panelists described their own different journeys to find fulfilling careers and provided tips to the students—things they would have told their younger selves.

After a coffee break that allowed attendees to rub elbows with the panelists and ask additional questions, students spent the rest of the morning in different workshops on a variety of physics or career related topics. Opportunities to network and learn more about aspects of physics and careers continued in an informal setting for students to eat lunch, ask questions, and get to know a topic expert. Topics ranged from quantum computing and geophysics to LGBTQ+ in physics to imposter syndrome.

On Saturday afternoon, all 13 conference sites connected virtually for the APS Keynote Address, given by Andrea Liu, a Professor in the Department of Physics and Astronomy at the University of Pennsylvania and Speaker of the APS Council. After an intriguing talk on her work in soft matter theory, Liu answered questions from all sites, giving insight into the challenges of achieving diversity in physics, naming her favorite equations (Maxwell's—which she described as "beautiful"), and offering important perspective on physics: "Being able to stand feeling stupid may actually be the key to being successful in research." She added, "when you finally make a breakthrough, it's worth it—it's an incredible high."

Following a networking fair, the second plenary of the conference featured astronomy and astrophysics researcher Lousie Edwards, an assistant professor in the Cal Poly San Luis Obispo Physics department. Edwards took conference attendees on a journey to the stars, detailing her work studying the formation of cluster galaxies and their evolution. She also shared her passion for outreach and encouraging students to go out and get involved in the physics community.

The evening was rounded out by a brief dinner talk from Yale professor Sarah Demers titled "Not a Work-Life Balance Talk." Demers, who serves as a faculty advisor to CUWiP, prefers to not think about having a career and a life as a balancing act, rather she told students "Be centered, not balanced: Know yourself, what you love, and what you care about."

The final day of the conference brought student research into the spotlight, giving attendees a chance to present their research in either a poster session or a research talk. Nearly 30 students presented posters to their peers, Yale student volunteers, and faculty members. Eighteen students gave 15-minute talks detailing their research in sessions that mimicked the environment of a larger professional conference.

Yale professor and nuclear and particle astrophysicist Reina Maruyama spoke at the third and final plenary, giving a personal talk detailing her journey in physics and her search for physics beyond the standard model as part of collaborations like IceCube and COSINE-100. She closed the session by offering what she called "unsolicited advice" to the attendees, ending with a heartfelt reminder to "be kind to others [and] be kind to yourself."

At a final lunch breakout session, attendees split into small groups led by Yale graduate student volunteers with different backgrounds for a discussion on the intersection of identity and physics. The closing ceremony featured a short talk highlighting the APS STEP UP program, which is designed to reach high school students and improve the number of women pursuing degrees in physics. Prizes were awarded for poster session presentations and trivia night wins, and Yale volunteers and the local organizing committee were recognized for their hard work to bring together an engaging and exciting CUWiP weekend.

For more information about next year's CUWiP and important application dates, visit aps.org/programs/women/workshops/cuwip.cfm

TASK FORCE CONTINUED FROM PAGE 4

changes within departments, and that departments should create incentives for all faculty to foster a supportive environment.

The task force also observes that developing a sense of "belonging" is important for mitigating phenomena such as stereotype threat, wherein a minority student's fear of confirming a negative stereotype creates anxiety that harms their performance. Among their recommendations for fostering physics identity and belonging, the task force suggests professional societies form a consortium dedicated to addressing "identity-based harassment," using the recently launched Societies Consortium on Sexual Harassment in STEMM as a model.

The author is a writer for FYI.

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Resources for Underrepresented Minorities in Physics

APS offers a number of programs to support African Americans and other underrepresented minorities in physics:

The **National Mentoring Community** supports mentoring relationships between African American, Hispanic American, and Native American undergraduate physics students and local physics mentors: aps.org/programs/minorities/nmc/.

The **APS Bridge Program** works to increase the number of physics PhDs awarded to underrepresented minority students, including African American, Hispanic American, and Native American students: apsbridgeprogram.org.

The **Inclusive Graduate Education Network** builds on the successful APS Bridge Program by working with other scientific societies to create a national network of disciplinary colleagues, expert researchers, and representatives from professional associations who will develop evidence-based knowledge of effective practices for recruitment, admissions, and retention of women and underrepresented ethnic and racial minorities: apsbridgeprogram.org/igen/

The newly formed **APS Forum on Diversity and Inclusion** works to ensure that all physicists, particularly those from historically or currently marginalized or underrepresented backgrounds or identities, will be fully included and have the opportunity to thrive within the physics community: aps.org/units/fdi/

The **APS Site Visits program** provides an outside appraisal of the environment experienced by women and minorities within a department or lab, and provides suggestions to leadership for interventions or changes that can address practices that might limit or reduce participation by underrepresented groups: aps.org/programs/women/sitevisits/.

Other APS Programs Department resources can be found at aps.org/programs/minorities/.

THE BACK PAGE

The Women of Fluid Mechanics: Personal Stories and Practical Advice

BY COURTNEY OTANI AND DAVID HU

Note: This jointly authored article contains the personal perspective of Otani combined with a summary of the DFD meeting by Hu.

Sometimes while you are in the middle of a situation or have only existed in one type of culture for years, it is easy to become numb to and unaware of all of the cultural influences in play. I have been an engineer in academia and industry for the past five and a half years now and have gotten used to the low numbers of women and the inequities they face. I am often the only woman on a project team. I have almost exclusively male figure heads (professors, managers, and mentors). I expected the same going into the 2019 APS Division of Fluid Dynamics (DFD) Meeting but was glad to see that the featured workshops focused on promoting women in fluid mechanics.

Coming into a workshop panel session at the conference, I expected to hear much of what I have already heard or experienced. What I did not expect was that the population of attendees at the Division of Fluid Dynamics Meeting is only 11% women. That statistic truly shocked me. Even though the engineering industry is still predominantly male, I thought that strides were being made to increase the female population and promote females. If everyone else has gotten so accustomed to this current state of affairs, how are we to expect anything to improve or change? The rest of the panel session continued to prompt provoking questions, bring to light shocking stories, and promote concrete actions that can improve this environment.

Peko Hosoi
IMAGE: JOHN FREIDAH

Dennice Gayme
IMAGE: WILL KIRK/JHU

Nicole Sharp
IMAGE: JOSEPH SHOER

Monica Martinez Wilhelmus
IMAGE: UC RIVERSIDE

> "I am often the only woman on a project team. I have almost exclusively male figure heads (professors, managers, and mentors). I expected the same going into the 2019 APS Division of Fluid Dynamics (DFD) Meeting but was glad to see that the featured workshops focused on promoting women in fluid mechanics." - Courtney Otani

The panel consisted of four accomplished women in fluid mechanics.

Peko Hosoi, professor of mechanical engineering and associate dean for engineering at MIT. She has been advisor to six women PhDs, and played an important role in increasing the proportion of MIT mechanical engineering undergraduate students to 50% women.

Dennice Gayme, associate professor of mechanical engineering and Carol Croft Linde Faculty Scholar at Johns Hopkins University. She convinced her department chair to create a diversity committee to give faculty credit for service related to diversity.

Nicole Sharp, founder of the FYFD website, which has provided weekly reporting in fluid mechanics for the last nine years. Her social media for the site reaches more followers than the *Journal of Fluid Mechanics* Twitter feed or the *Physical Review Fluids* Twitter feed. She was also recently selected as a AAAS If/Then Ambassador.

Monica Martinez Wilhelmus, assistant professor of mechanical engineering at UC Riverside, who when she was hired, was the second woman in her department of 17 men. She has since been part of the search committee and contributed to the recruitment of two more women professors.

In spite of their intellect, work ethic, and accomplishments, all of these women have faced and witnessed disrespect and scrutiny based on their gender. It was not as much of a surprise to me to hear that the panelists experienced injustices amongst colleagues. What I didn't expect was the disrespect and scrutiny from people with less authority. Dennice was told by undergraduate students that she needed to prove she knew the material. Nicole has been subjected to YouTube comments not related to the content of her video but on her voice or physical appearance. These kinds of reactions are unnecessary and disrespectful. It was frustrating and upsetting to know that these women have worked hard and have the knowledge and capability to teach complex scientific concepts only to be immediately questioned because they are women.

While these problems were recognized by the panelists themselves, they are difficult to address since these women were sometimes the only ones that could see the problem. This is why I am glad that I attended this workshop. The sharing of stories and awareness is a great start to addressing the problems that women engineers face. This workshop created a support group and coalition of male allies who are now aware of these injustices and will be able to make strides in calling out and fixing the situation. I believe that creating a support group outside of the women who are facing these challenges is integral to fixing the problem. Support amongst this minority is fundamental and necessary. However, bringing in those who are part of the oppressive majority may help to tip the balance and eventually create space for women to succeed.

Sometimes well intended measures to balance inequity (such as imposing quotas) are unsustainable. Women and people of color are often overloaded with work outside of their own personal research because they are expected to shoulder the extra burden. Monica shared the frustration of often being called upon to do service tasks. While she loves the work, it does take time and she often feels conflicted over refusing to participate, given the impact it has on promoting diversity. In one instance, for example, she was asked to participate in UC Riverside's Spanish-speaking student orientation—a task only two professors in the entire college could fulfill given their Hispanic backgrounds. Until the numbers of those in minority groups are raised to match the demand, allies should continue to take some of these responsibilities while advocating for the minority.

> "Sometimes well intended execution of inequity balance such as imposing quotas is unsustainable. Women and people of color are often overloaded with work outside of their own personal research because in order to make the quota, they as the only ones who meet the criteria of being a woman and/or person of color have to fill in all of those spots. ... Until the numbers of those in minority groups are raised to match the demand, allies should continue to take some of these responsibilities while advocating for the minority."

Other actions that have been more successful are making the problem tangible and promoting female figures in engineering. Both of these actions set the tone for taking steps toward tackling the problem. Peko told the story of Nancy Hopkins who in 1994 pioneered a study to measure how MIT discriminated against women. She took measurements of office size and other data to prove that women were experiencing inequality based on unconscious bias (technologyreview.com/s/608393/measuring-up/). The administration sent this information immediately to *The Boston Globe* because they knew that if the problem was public, change would have to occur. The story is hopeful in that it shows that women, in collaboration with institutions, can promote change.

MIT mechanical engineering is one of the departments that has a 50/50 ratio of women to men among their undergraduates. Peko believes that having women in prominent roles such as Associate Dean of the School of Engineering, Associate Department Head of Education, and Introductory Class professors helped set the tone for how MIT's Department of Mechanical Engineering would be run and thus encouraged more women undergraduate students to pursue mechanical engineering. Nicole is in a prominent role for middle and high school girls as one of the If/Then Ambassadors. As an ambassador, she makes herself visible to prove the If/Then motto: "If she can see it, then she can be it." I also believe that having prominent female figures can help encourage growth of female representation in engineering. Seeing people with similar backgrounds and identities as you in the roles you want to fill is inspiring because you see yourself in them. Their success feels like your success and gives you the hope that you too can achieve what they have.

> "Seeing people with similar backgrounds and identities as you in the roles you want to fill is inspiring because you see yourself in them. Their success feels like your success and gives you the hope that you too can achieve what they have.... This panel discussion left me feeling optimistic and determined to fight for a better future for women in engineering. Cultivating an environment to empower women will bring scientific discovery and industry to new heights." - Courtney Otani

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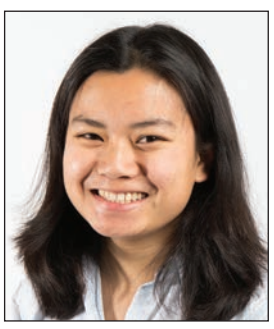

Courtney Otani (left) is a graduate student in mechanical engineering at the University of Washington.

David Hu (right) is a professor of mechanical engineering and biology at Georgia Tech.