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APS NEWS

APS physics

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APS Leadership Letter Condemning Racism

Dear APS Member,

We are horrified and deeply saddened by the killing of George Floyd and Ahmaud Arbery, and other recent acts of violence, particularly against Black people. We utterly condemn racism, for as Dr. Martin Luther King warned, "If we as a society fail, I fear we will learn very shortly that racism is a sickness unto death." We believe in and support social justice. While systemic racism and racial injustice persist in the US and across the world, we are especially concerned for colleagues of color and their families.

APS is firmly committed to fostering a diverse and inclusive physics community. We affirm and re-endorse the APS Board Statement on Racial Violence of 2017:

Physics flourishes best when physicists can work in an environment of safety, justice, and equity. Therefore, all of us must work vigorously against systemic racism and to overcome implicit biases. The Board of the American Physical Society believes that it is timely to reaffirm the importance of building a diverse and inclusive physics community, as expressed in the APS Joint Diversity Statement (Human Rights 08.2). The Board expresses deep concern over incidents of racially biased violence and threats of violence against people of color.

Consistent with APS's organizational values of "Diversity, Inclusion, and Respect", it is our responsibility, as leaders of this Society, to develop and support an equitable environment that is truly welcoming. Please know that this is our commitment to all of you. We are considering all measures within our powers to deepen this commitment through positive actions in support of our values.

Sincerely,

Philip H. Bucksbaum, Sylvester James Gates, Jr., Frances Hellman, David Gross, Andrea Liu, and Kate P. Kirby
2020 APS Presidential Line and Speaker of the Council, and CEO

APS Responds to COVID-19: Activities to Assist Graduate Students

Since early March, APS has focused heavily on assisting the physics community get through and beyond the pandemic. In addition to addressing general needs of the community (go.aps.org/2zyT74v), there has been particular attention to the unique needs of physics graduate students and postdocs.

"Our immediate concern was to ensure that our graduate students, post docs, and visiting researchers continue to be financially supported from their grants during the crisis due to the closure of universities and laboratories across the country," said APS President Phil Bucksbaum. "In addition," said Francis Slakey, APS Chief Government Affairs Officer, "international students faced new visa challenges related to the pandemic."

Below are the various actions taken by APS to address some of the needs and concerns of graduate students, along with the outcomes and opportunities they provide:

Graduate Students Supported by Federal Grants

The initial priority of APS was to ensure that graduate students supported by federal grants would continue to get their salaries and benefits. The APS Office of Government Affairs (OGA) partnered with the APS Forum on Graduate Student Affairs (FGSA) to send out a grassroots alert to FGSA members. These members then urged Congress to maintain the salaries and benefits of graduate students, post-docs, and visiting researchers who are supported by federal grants. FGSA members sent hundreds of letters. APS OGA heard directly from agency staff that the grassroots campaign spurred them to a swift decision of support. Within days of starting the campaign, APS received confirmation that NSF, DOE, and DOD were all extending the grant support for post-docs, graduate students and visiting researchers.

International Graduate Students Who Require Visa Processing

International students make up ~45% of all physics students studying in the United States, so a full return to pre-pandemic research capabilities requires the prompt return, or initial entry, of international graduate students to US labs and universities. There are several groups of international students impacted:

- Those who returned to their home countries to ride out coronavirus and will need their visas processed in order to return in the fall;
- Those who remained in the US but will have to extend their timeline for a Ph.D. because of lost research time, and consequently, will require an F-1 visa renewal; and
- Those who are starting in the fall and will need their visas processed.

APS maintains ongoing communication with the US State Department regarding the visa

APS RESPONDS CONTINUED ON PAGE 6

APS Responds to White House Proclamation on Visas

Dear APS Member,

On June 22, the White House issued a Proclamation that suspends entry of particular non-immigrants into the United States. We know many of our members are deeply anxious about the implications of this Proclamation for their careers and our field. Here we share the information we have and the steps APS is taking to minimize harm to physics research and education in the US.

Several weeks ago, APS was made aware that Optional Practical Training (OPT), H-1B, and J-1 visas could all be suspended by the Proclamation. Many of you participated in our APS grassroots campaign to forcefully defend OPT. We also worked with colleagues in industry and universities to support the H-1B and J-1 visa programs.

Partly due to these efforts, the final Proclamation was softened. In its final version, ***the Proclamation does not suspend OPT nor the STEM OPT extension***. In addition, ***the Proclamation does not suspend entry with J-1 visas for key STEM categories of students, professors, and research scholars.*** Many physics postdocs in the US are international students who hold these non-immigrant visa types, so this is good news for the present. Finally, ***the Proclamation does not suspend transitions to H-1B for people already in the US.***

However, there does remain an issue of great concern: ***the Proclamation suspends entry to the US of anyone who seeks to enter using an H-1B visa, but does not currently have a valid visa.*** This visa class covers many early-career scientists in industry, academia, and national labs.

Here is a summary of APS efforts to address the visa situation:

- The APS Office of Government Affairs (OGA) is working with colleagues in the tech community who are developing a legal challenge to the H-1B provision in the Proclamation, and we are hopeful that the case can significantly delay its implementation.
- The Proclamation identifies several categories of J-1 that face restrictions—including for au pairs, camp counselors, and interns. However, it is silent on three key STEM categories: "college and university student," "professor," and "research scholar." The APS

LETTER CONTINUED ON PAGE 7

From Passion to Action: Levers & Tools for Making Physics Inclusive & Equitable

On June 24, APS, along with African American Women in Physics, the American Association of Physics Teachers, the American Institute of Physics, the BSM Pandemic Seminars, and the National Society of Black Physicists, hosted a webinar to address systemic barriers in academia that have led to a gross underrepresentation of minorities, particularly Black Americans, in the field of physics.

The webinar featured a distinguished panel of people actively involved with increasing diversity in physics and improving its culture: **S. James Gates, Jr.** (Brown University & APS President-Elect), **Arlene Modeste Knowles** (American Institute of Physics, TEAM-UP Project Manager), **Philip W. Phillips** (University of Illinois, Urbana-Champaign), **Mel Sabella** (Chicago State University & American Association of Physics Teachers Past President), and **Farrah Simpson** (Brown University, National Society of Black Physicists Board Student Representative & Graduate Student). The panel discussion was moderated by **Lisa Randall** (Harvard University) and the Q&A was facilitated by **Stephon Alexander** (Brown University and NSBP President) and Randall.

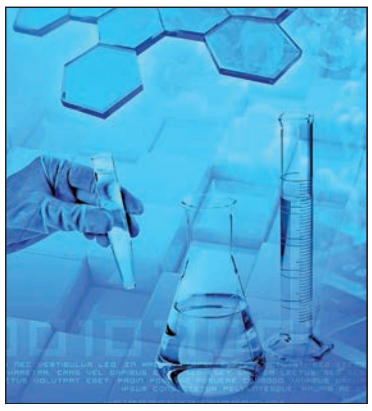
The recorded webinar can be viewed at aps.org/programs/minorities/webinar.cfm.

Revised 07/14/2020

COVID-19

Outsmarting Disease with Smart Therapeutics

BY LEAH POFFENBERGER



Creating the right medications to fight back against ever-evolving bacteria and viruses can be a long, multi-year process—but in cases of deadly pandemics, like COVID-19, therapeutic development has to happen much faster. New approaches called smart therapeutics could be a key to changing the drug-discovery landscape.

Anushree Chatterjee, a chemical engineer and professor at the University of Colorado, Boulder, is developing smart therapeutics approaches to counter rapidly evolving pathogens with new drugs on the timescale of weeks, rather than years. She was scheduled to give a talk detailing her work targeting evolving diseases, specifically drug-resistant bacteria, at the 2020 March Meeting, before its cancellation due to coronavirus.

Chatterjee's research group has been tackling three main projects: the Facile Accelerated Specific Therapeutic (FAST) platform, a technology for quick identification of potential therapeutics; the development of a quantum dot-antibiotic (QD Abx) that can target drug-resistant bacteria; and Controlled Hinderance of Adaption of Organisms—or CHAOS—a therapeutic approach to disrupt pathogens by slowing their evolution.

"When it comes to pathogens such as bacteria and viruses one of the biggest strengths they have is that they can change…smart therapy means that we can keep up with evolving pathogens," says Chatterjee. "If you think of a traditional drug discovery and development pipeline, it takes 10 years or so to create therapies, and … $1 to 2 billion worth of investment. And that model doesn't really work with evolving pathogens, which are going to evolve by the time the drug is out."

The primary goal of these smart therapeutic developments is to attack the increasing problem of antibiotic resistant bacteria, which are adapting to current drugs much faster than new drugs hit the market. However, both FAST and CHAOS have applications to combating viruses—and FAST has been employed in the search for therapies for COVID-19.

FAST's versatility comes, almost counterintuitively, from its ability to be specific: using computational models, FAST attempts to identify targets for therapeutics that can best disrupt each specific pathogen.

"FAST is a platform that generates … nucleic acid molecules that can go and bind DNA or RNA and prevent certain genes in these bugs from being expressed. The nice thing about this platform is that it is actually pretty agnostic [as] to the disease, the species, and so on," says Chatterjee. "It's an entire package where we design, we build, and we test these molecules."

Traditional drug discovery methods often rely on identifying molecules from bacteria and fungi that they use in their chemical warfare against other bacteria and fungi. As Chatterjee points out, bacteria are able to quickly gain resistance to such therapeutic methods because they've been adapting to similar attacks for billions of years of evolution. These discovery methods can also take 10 to 15 years to identify an effective therapy for a specific bug, which is too slow and too expensive. The FAST computational tool box enables speedy identification, construction, and testing of molecules that target new mechanisms in pathogens.

"[We] create a molecule for every single gene in an organism of interest and directly target that and identify whether or not it has strong therapeutic potential, [and] train our computational models in a way that we can predict what genes to go after," says Chatterjee. "We very quickly get information about what genes are good targets… after this discovery process, which we accelerate and finish within a week, [we take] the best molecule to do animal work."

DISEASE CONTINUED ON PAGE 4

THIS MONTH IN

Physics History

July 21, 1620: Birth of Jean-Félix Picard, Founder of French Modern Astronomy

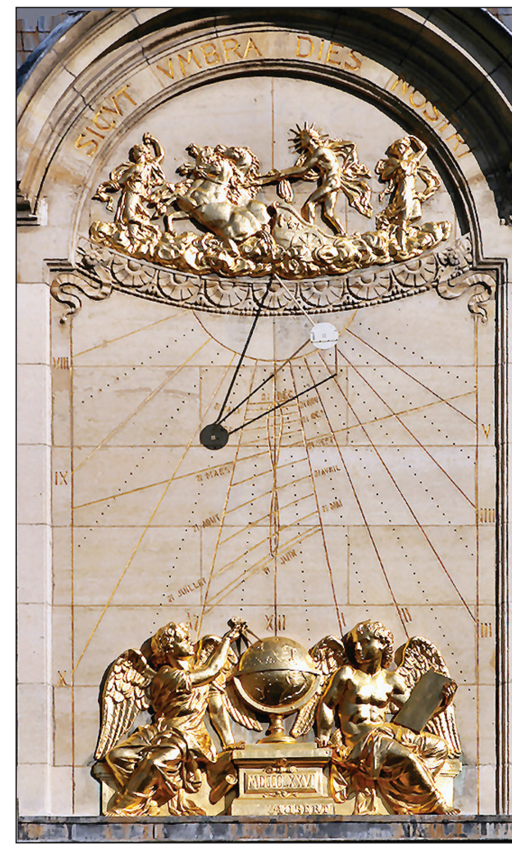
Fans of *Star Trek: The Next Generation* revere Captain Jean-Luc Picard (played by Patrick Stewart). The creator of the series, Gene Roddenberry, purportedly based the name on a Swiss scientist and deep sea explorer, Auguste Piccard. But perhaps a more fitting inspiration would have been the 17th century astronomer Jean-Félix Picard, who explored the stars and was especially known for his incredibly precise measurements.

Very little is known of Picard's early life. He was born on July 21, 1620, in a town called La Fleche in the Loire region of France. His father was a bookseller, and young Jean studied at the prestigious Jesuit college in La Fleche, most likely as a day student rather than a boarder. There was much civil unrest in the region, however, and Picard left in 1644 without receiving a degree to move to Paris. He became a disciple of noted astronomer and mathematician Pierre Gassendi of the College Royale, assisting him with observations of the solar eclipse. He appears to have been largely self-taught after leaving school.

It's unclear how Picard supported himself during this period, especially after Gassendi moved to Provence in 1648, dying seven years later. Picard took his place as professor of astronomy in Paris that same year, based solely on what was by then a stellar reputation among his fellow scientists—even though he had not yet published a single paper. He was one of the founding members of the French Academy of Sciences in 1666, exchanging correspondence with some of the most famous scientists of the time, including Christian Huygens and Isaac Newton.

When Giovanni Domenico Cassini became director of the newly established Royal Observatory in 1671, one of his first acts was to send Picard to Tycho Brahe's old observatory at Uraniborg on the island of Hven near Copenhagen. Picard's mission was to observe and record the times of the eclipses of Jupiter's moons (those known at the time) from there, while Cassini did the same back in Paris. Picard's assistant was a young Dane named Ole Romer, who would go on to measure the speed of light based on the timing of the eclipses of Jupiter's moon Io between March 2, 1672, and April 2, 1673.

Picard often carried a mercury-filled barometer with him for his observations, since the apparent positions of stars and planets would be affected by atmospheric refraction, which in turn depends on temperature and air pressure. Towards the end of 1676, Picard noticed a "barometric light" in part of the glass tube whenever it moved sufficiently to make the quicksilver in the bottom juggle. He described "flashes like sparks… a certain flickering light which fills the entire part of the tube where it is void."



Sundial at the Sorbonne in Paris depicting the work of Jean-Felix Picard. IMAGE: WIKIMEDIA COMMONS

Swiss mathematician Johann Bernoulli demonstrated the phenomenon to the French Academy in 1700, eventually inspiring Francis Hauksbee, among others, to conduct extensive experiments to study barometric light. Newton would later perform his own studies on the visible spectrum of light, ultimately leading to the development of spectrometry.

Hydraulics was another area in which Picard excelled, even figuring out how to supply the fountains of Versailles with water. According to an account by Albert van Helden, "Prodigious engineering efforts went into the solutions to this problem, and Picard's new leveling instruments with telescopic sights helped determine routes and avoided costly errors."

But it was Picard's measurement of the size

JEAN-FÉLIX PICARD CONTINUED ON PAGE 3

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Editor. . . . . David Voss
Staff Science Writer. . . . . Leah Poffenberger
Contributing Correspondents . . . . Sophia Chen and Alaina G. Levine
Design and Production. . . . . Nancy Bennett-Karasik

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MEMBERSHIP UNITS

The Division of Fluid Dynamics

BY ABIGAIL DOVE

A cornerstone of APS since 1947, the Division of Fluid Dynamics (DFD) is a home for scientists and engineers who study the flows of different fluids—from gases and liquids to multiphase mixtures and granular materials.

Prominent examples of fluid physics include the aero-and hydro-dynamics of airplanes, cars, and ships; flows of fluids inside pipes (such as oil pipelines and steam lines in power plants); and oceanographic and atmospheric science and the prediction of weather patterns—particularly important in this era of climate change.

There are also many biological applications of fluid dynamics, such as the study of how dolphins, sharks, and tuna are able to swim so quickly, or how bumblebees—once asserted in jest to be "physics-defying" given their small wing size—are able to fly. Fluid dynamics is also highly relevant to astrophysics and the study of nebulae in interstellar space. One of the early chairs of DFD was astrophysicist Subrahmanyan Chandrasekhar, who received the 1983 Nobel Prize in Physics for his work on the evolution of stars.

An especially timely example in the age of coronavirus is the fluid dynamics of respiration: How far do respiratory droplets travel when a person breathes or speaks? How does this change with vs. without a mask? How do we design better ventilators and filters?

Given this broad reach, it should come as no surprise that DFD is a highly interdisciplinary group, including not only physicists but also mathematicians, earth and atmospheric scientists, and aerospace, mechanical, and nuclear engineers. This makes DFD an important entry-point to APS for researchers beyond physics.


Minami Yoda

Approximately 3,600 members strong, DFD is the second-largest division at APS, after the Division of Condensed Matter Physics (DCMP; see *APS News* April 2019). Notably, nearly 50% of DFD members are students (graduate and undergraduate), underscoring the vibrancy of fluid dynamics.

A particular point of pride for DFD is its Annual Meeting. Typically drawing upwards of 3,500 attendees, this is the largest divisional meeting of its kind within APS. Going on 73 years, it is also the oldest. Besides a large selection of invited talks on topics of broad interest to the DFD community, the meeting also includes more focused "mini-symposia," career development workshops, student lunches hosted by senior researchers, a networking lunch for women in this male-dominated field, and a similar event for under-represented minority researchers. Oral presentations are divided into traditional 12-minute presentations and sessions of 1-minute "flash presentations" where researchers are challenged to distill their findings into a single PowerPoint slide (followed by a poster session

DFD CONTINUED ON PAGE 7

MEETINGS

International Exchanges During COVID-19

BY SOPHIA CHEN

As COVID-19 disrupts lab work and cancels conferences, many physicists have found ways to adapt. Video calls and e-mail give the impression of a well-connected world. But these are an imperfect substitute for in-person exchange—especially for people in less developed countries where infrastructure is unstable or governments are politically isolated.

"There's tremendous value in face-to-face meetings," says Joseph Niemela, an American physicist at the International Centre for Theoretical Physics (ICTP) in Trieste, Italy. For nearly six decades, one of ICTP's core missions has been to support physicists and mathematicians from developing countries. Last year, Niemela and a colleague invited two North Korean women mathematicians to give talks at ICTP's Trieste campus.

"When scientists get together from countries that may not get along, they find out individually that's not the case," says Niemela. "They find that they share a passion for science."

This year's cancelled APS March Meeting was to feature several presentations on physics programs for fostering these international exchanges.

A Charging Station for Physicists

Niemela had planned to talk about ICTP-supported opportunities for students and researchers from developing countries. These programs are designed to address the unique challenges these physicists face. For example, researchers in developing countries lack access to costly experimental facilities. ICTP offers this access to researchers through a program


Laure Gouba


Esen Ercan Alp


Christine Darve

called Training and Research in Italian Laboratories (TRIL). The Center has also expanded to partner institutes in Brazil, Rwanda, Mexico, and China over the last decade.

The isolation of working in a developing country can also adversely affect a scientist's career. Since its founding in 1964 by Pakistani Nobel Laureate Abdus Salam, the institution has served as an international oasis where physicists from developing countries can take a break from teaching and catch up with the rest of the physics community. ICTP's associates program fulfills this mission, giving researchers from developing countries the opportunity to stay in Trieste for 180 days spread over six years.

"The whole idea of Trieste was, 'come here, be around scientists from all over the world, recharge your batteries, get up to date on literature,'" says Niemela. This short-term "recharging" station is intended to prevent researchers from needing to immigrate to do cutting-edge research.

ICTP's activity in developing countries has shaped the career of Laure Gouba, who researches low-dimensional quantum field theories. The 49-year-old theorist, who has worked at ICTP in Trieste for a decade, hails from Zabré, a small city in Burkina Faso. Gouba recalls a childhood affinity for math and science, and her second-place finish in a secondary-school Olympiad. In her youth, Gouba gravitated toward mathematics before switching to mathematical physics in graduate school.

But educational resources were limited: Gouba remembers spending a lot of time at home perusing textbooks to learn the material. Her early physics education did not include lab or much hands-on activity. "For certain concepts in physics, we could only [learn from] images in books," she says. In addition, her secondary school years were marked by national instability, with a coup d'état occurring in 1983 when she was 12.

Gouba reached her current position with the help of several opportunities sponsored in part by ICTP. After graduating from university in Burkina Faso, she attended the Institut de Mathématiques et de Sciences Physiques (IMSP) in Benin,

EXCHANGES CONTINUED ON PAGE 7

JEAN-FÉLIX PICARD CONTINUED FROM PAGE 2

of the Earth, while surveying one degree of latitude along the Paris Meridien, for which he is most renowned. Eratosthenes was the first to do so in the third century BC by measuring the elevation of the sun on the summer solstice, in two cities. In 1533, Gemma Frisius used the new method of triangulation to measure a long north-south section of a meridian, and Willibrod Snel used it to determine the length of one degree of a meridian arc in 1617.

Snel's work would inspire Picard to follow suit. In 1665, the new finance minister of France, Jean-Baptist Colbert, not only established the French Academy of Science, but also requesting its members produce a modern, more accurate map of France. Picard took up the challenge, measuring the base line south of Paris between Villejuif and Juvisy with wooden measuring rods.

From there, he triangulated in the northern direction, using a theodolite with a telescope sight fitted with a cross hair—the first to use such an instrument. Picard's *Mesure de la terre* was published in 1671. Newton would later use Picard's value for the size of the Earth in his universal theory of gravitation, acknowledging the French astronomer's contribution in the *Principia*.

Picard went on to map the coastline of France with Cassini and Philippe de La Hire, although their results actually reduced the country's size so much that Louis XIV jokingly lamented that he had "lost more territory to the cartographers than he had ever lost to his enemies."

Picard died before he could complete the mapping project for France; Cassini took over, and several generations of his family kept the project alive for four generations. Picard is largely unknown outside his native France, although there is a lunar crater named after him, as well as an orbiting solar observatory (PICARD). As van Helden observed in his review of Picard's lifelong work, "It is now evident just how much modern precision measuring owes to this quiet, unassuming man who stayed out of the limelight."

Further Reading:

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EDUCATION

New Grant from NSF Helps Support Physics REU Leadership Group

BY LEAH POFFENBERGER

During a typical summer, undergraduate students all over the country are busy tackling new physics projects and gaining valuable research skills through the National Science Foundation's Research Experiences for Undergraduates (REUs). But this summer is far from typical, and REU site leaders were faced with tough decisions on how to proceed with this important program.

The NSF Physics REU Leadership Group (NPRLG), an organization of physics REU site directors that works with APS to support physics REU programs, has been hard at work adapting the program to provide students with a virtual learning experience. NSF has recently awarded APS with a grant of nearly $120,000 to support NPRLG's efforts in improving REUs—both online and on site.

"[NPRLG] is a group of REU Physics site leaders across the United States who converge to share ideas, share best practices, create a community of support to improve REU programs independently and as a whole," says Daniel Serrano, Chair of NPRLG and Faculty Specialist at the University of Maryland. "The group itself originated through an NSF grant like this one...that was used to put together an in-person meeting of these sites and when they converged in a workshop, they said, 'well, we need to give this a little bit more of a formal sense,' and created NPRLG."

The latest NSF grant will help NPRLG achieve its goals by establishing an in-person conference for REU leaders every two years; funding travel to other conferences to recruit students from underrepresented groups and REU site leaders in other disciplines; enabling more robust program evaluation. The grant will also help fund APS staff who work to support NPRGL.

In response to the coronavirus pandemic, NSF also provided a grant supplement to develop online content for students who would have been attending REUs this summer.

"This year was a very important year in showing the usefulness of the NPRLG in the way that we responded to what's happening with the pandemic," says Serrano. "We tried to coordinate what we could to help with the process of making decisions at each site...this was complex because each university was responding differently."

As each site was tackling questions of whether they should cancel their REUs for the summer, NPRLG helped open up channels of communication with NSF for guidance and began looking at ways that REUs could be conducted remotely. While a number of physics REU sites were forced to cancel their programs all together, Serrano estimates that about half of the sites were able to proceed with a modified online program.

"All the programs [had] mentors who are able to do some sort of theoretical computational work, or even in some cases, experimental work with students doing work at their home, obviously without fancy equipment or anything like that," says Serrano.

To further supplement the value of these remote REU sites, NPRLG helped collect and create professional development opportunities.

"We were trying to draw from as many resources as possible to put

REUS CONTINUED ON PAGE 5

DISEASE CONTINUED FROM PAGE 2

While FAST provides a pathway for the development of new drugs to combat ever-evolving pathogens, Chatterjee's other research projects approach antibiotic resistance in different ways: QD Abx is leveraging nanotechnologies to extend the usefulness of existing antibiotics, and CHAOS is an approach to slow down the evolution of pathogens, limiting their ability to develop resistance to therapeutics.

QD Abx uses superconducting nanoparticles that can be engineered to react with specific molecules to produce a highly reactive superoxide (ie, an ion containing O_2^-), which most bacteria only encounter from human immune systems. A strong dose of superoxide produced by the quantum dots can attack multiple targets inside a bacteria cell at one time, rendering most resistance ineffective—and even weakening bacteria to antibiotics they had been previously adapted to resist.

"This is very powerful, because it means that these technologies can be used to revitalize our current antibiotic pipeline," says Chatterjee.

CHAOS is another approach to controlling infectious diseases by throwing a wrench in their ability to select for good genetic choices.

"You just have to create enough chaos that you start accumulating fitness losses or start creating these bad decisions inside the cell," says Chatterjee. "We started accumulating these perturbations inside the cell and show that at a certain number of perturbations, automatically the cell starts making bad decisions or has fitness losses and it's not able to compete anymore. All you need to do is not necessarily kill it, but make sure it cannot compete."

Chatterjee first developed an interest in infectious disease research while in graduate school and began studying viruses during her post-doc, seeing in the field an interesting problem.

"By heart, I'm an engineer, and I'm always thinking of solutions, and infectious diseases are fascinating problems," says Chatterjee. "I really wanted to use my training to address global health challenges."

One way Chatterjee is seeking to solve global health challenges related to therapeutic development is through her efforts to create bridges between industry and academia to better leverage all the available expertise in the field. In 2018 she founded the Antimicrobial Regeneration Consortium, or ARC, to act as one such bridge.

"We have created ARC as a way of not only encouraging innovation, but also ensuring that innovation does get to the end of the discovery pipeline while also engaging the general public, the medical community, the student community, and the scientific community," says Chatterjee. "Invention is one aspect: It's a first big step towards solving something, but if that invention isn't ever helped to get to the end, it's as good as not being invented."

GOVERNMENT AFFAIRS

A Day of Congressional Visits Leads to Congressional Science Fellowship

BY TAWANDA W. JOHNSON

After David Somers participated in an APS Congressional Visit Day four years ago, he longed to learn more about science policy following positive responses he received from congressional staffers on Capitol Hill.

"The congressional staffers were receptive to our pitches to launch a study by the National Academy of Sciences to study diversity initiatives in STEM education and other projects," recalled Somers.

A year later, he took a science policy class, taught by two former members of the President's Council of Advisors on Science and Technology, including APS President-Elect S. Jim Gates Jr. who is the Ford Foundation Physics Professor and Affiliate Mathematics Professor at Brown University. Somers said the class furthered his understanding of the role of science in policymaking.

"In this class, I learned how science is distilled and delivered to policymakers, as well as how it is sometimes wholly ignored," he remembered.

Fast forward to 2020, and Somers has been selected as the 2020-21 APS Congressional Science Fellow.

"My goal is to help bridge the gap between scientific understanding and fact-based policymaking," said Somers, who earned his PhD in physics from the University of Maryland at College Park (UMD). "On many issues faced by society, we have more than enough scientific certainty to make rational decisions."

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.

Somers brings to the fellowship a diverse background of work experience, including time spent as a consultant at the Boston Consulting Group.

"I have helped deploy long-term strategies for companies to survive in an increasingly digital economy, which often involves facing hard truths and making tough decisions " said Somers "In many of these cases, the client knew what had to be done, but did not have the resources to make it happen. I believe that our policymakers face similar challenges. There is no shortage of great ideas; the hard part is buckling down and getting something done."


David Somers

With a commitment to solve problems, Somers is poised to make a positive difference on Capitol Hill.

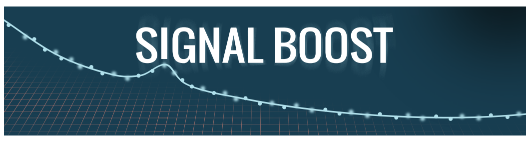
"My ability to drive meaningful impact would serve me well as a staffer to a congressperson trying to push out policies that benefit society, all under intense political and time pressures," he said.

Besides his role as a consultant, Somers has experience with the federal government, where he helped to navigate a difficult political landscape to track spending and identify savings opportunities.

Somers' research background is also impressive.

"Under the guidance of Jeremy N. Munday (former electrical and computer engineering professor at

VISITS CONTINUED ON PAGE 7



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

FYI: SCIENCE POLICY NEWS FROM AIP

Lawmakers Propose Dramatic Expansion of NSF

BY MITCH AMBROSE

The National Science Foundation would get a sweeping mandate to accelerate US technology development under a new bipartisan bill spearheaded by Senate Minority Leader Chuck Schumer (D-NY). Titled the Endless Frontier Act, it would redesignate NSF as the National Science and Technology Foundation (NSTF) to reflect the creation of a technology directorate empowered to employ funding mechanisms distinct from those used by the agency's existing science programs. The bill's other sponsors are Sen. Todd Young (R-IN) and Reps. Ro Khanna (D-CA) and Mike Gallagher (R-WI), who together with Schumer say the bill responds to the technological and economic challenge presented by China and other countries.

The directorate would support an assortment of technology centers, testbeds, and fellowships, with a total recommended budget rising to \$35 billion within four years, dwarfing the agency's current \$8.3 billion topline. The bill also proposes to create a multi-billion-dollar technology hub program within the Commerce Department focused on catalyzing R&D partnerships in areas that are not already leading centers of innovation.

A primary mission of the new technology directorate would be to more quickly translate fundamental research advances into "processes and products that can help achieve national goals," focusing on no more than 10 "key technology areas." The areas would be determined by the agency director in consultation with an advisory board and revisited every four years, though the bill establishes an initial set of 10:

- Artificial intelligence and machine learning
- High performance computing, semiconductors, and advanced computer hardware
- Quantum computing and information systems
- Robotics, automation, and advanced manufacturing
- Natural or anthropogenic disaster prevention
- Advanced communications technology
- Biotechnology, genomics, and synthetic biology
- Cybersecurity, data storage, and data management technologies
- Advanced energy
- Materials science, engineering, and exploration relevant to the other key technology focus areas

In addition to funding research at universities and nonprofit organizations, the directorate would be permitted to fund research at other federal agencies and support consortiums that include for-profit companies and entities based in "treaty allies and security partners" of the US. The bill also suggests the directorate model its operations on DARPA, which is known for giving its program managers considerable leeway to drive toward targeted R&D outcomes. By contrast, NSF traditionally uses community-based peer review of grant proposals to shape research directions.

The bill proposes the directorate receive \$100 billion over five

NSF EXPANSION CONTINUED ON PAGE 7

GRADUATE STUDENT AFFAIRS

Defending My PhD Thesis in the Time of the Coronavirus

BY DANIELLE SOFFERMAN

Ten years ago I attended the Conference for Undergraduate Women in Physics (CUWiP). Once I returned to my undergrad institution, at Adelphi University, I was ecstatic and eager to do research. This experience led me to become more involved in presenting at conferences and taking a Research Experience for Undergraduates (REU) at the University Michigan (U of M) that ultimately led me to pursue a PhD at U of M. Little did I know how the completion of my degree would unfold. In March 2020 the entire country was brought into a chaotic state where the number of COVID-19 cases were beginning to spike, businesses were forced to close and people were scrambling to stock up with as many rolls of toilet paper as possible. In the middle of this mess, I only had two more months until my PhD defense.

During my PhD studies, I worked with a home-built femtosecond Ti-Sapphire laser system that was used to create ultrafast pulses for broadband transient absorption (TA) spectroscopy of molecules in the ultraviolet-visible region. This technique involves a two-pulse sequence, where one pulse (272 nm) optically excites and another pulse (250–650 nm) probes the dynamics of the molecules after certain time delays. More specifically my studies explored the initial dynamics involved in vitamin D_3 formation in simple skin membrane models during the first 500 picoseconds after excitation. The ultimate goal was to investigate the photochemistry involved in vitamin D_3 formation as a function of lipid membrane parameters, such as lipid tail length, hydrogen bonding, and van der Waals interactions.

After restless days and nights of trying to maintain a stable laser system and collect data, I wanted to make my defense day even more memorable. But I never expected that it would turn out like this: it was held in the middle of a pandemic that will forever trigger memories of writing and defending my thesis. Within the months prior to the pandemic, I imagined my defense to be in the fanciest room on campus and I would provide my audience with a chocolate fountain and marshmallows next to an ice sculpture of a vitamin D_3 molecule. However, those ideas quickly vanished as the COVID-19 pandemic forced my defense to be held remotely.

The defense took place through the BlueJeans video conference system. Instead of being in a room filled with curious eyes and chocolate covered mouths, I was in a video meeting where I felt as if I was just talking to my PowerPoint because the meeting screen was too small to display everyone that had their camera unblocked. My camera was also off until the end where I gave the acknowledgments and answered questions. I did this to narrow the connection bandwidth and to secretly refer to notes to each of the slides. The window that showed the meeting sat in the corner of my most current slide, and it blocked some of my figures. With only a single monitor, I was forced to minimize the meeting app

Danielle Sofferman

while I spoke. My audience listened with their microphones muted to minimize the background noise and did not interrupt during the presentation. Since I wasn't able to view my audience, the actual presentation felt more like a practice run and it wasn't until the very last slide, where I gave my acknowledgments that the talk felt like the real thing. While my blocked camera didn't prevent other computer glitches and new BlueJeans users from sending me permission notifications to switch who shared the screen, it did prevent showing my worried facial expressions when my PowerPoint, for some unknown reason froze multiple times. Since this was actually a real talk and not a practice, the multiple computer glitches made me feel like I was further being initiated into the world of professional physics research.

The grand finale, when I presented the most significant parts of my research also lined up with the time when the Blue Angels, honoring all the front line workers, flew directly over me on their way to Detroit. At the end of the talk, the smiles from friends, family and visual satisfactory nods from my PhD committee were lost as most people just sent "clap" emojis and other appraisal messages through the chat window. My advisor then asked if there were any questions, the 15–30 seconds of silence felt like an eternity as I patiently waited for someone to ask anything they wanted about my research. My former labmate was the only one that asked a question. The back and forth felt similar to virtually teaching (due to the pandemic) the Math Methods discussion section that I was a Graduate Student Instructor (GSI) for during the past term: trying to answer a question as completely as possible while also trying to figure out who was asking the question. Now, while I didn't get the room setup that I imagined and lost the visual interaction with my audience, the virtual setup did allow me to invite people from outside of Michigan who otherwise would have not been able to attend.

As I start to close another successful chapter in my career, my future is just as exciting as it terrifying. The COVID-19 pandemic has slowed down my job search and left behind a trail of canceled interviews. However, in these uncertain times I am confident that my future is brighter than the strongest pump

PHD THESIS CONTINUED ON PAGE 7

CAREERS

Physicists at DAMOP Share Tips on Breaking into Careers in Industry

BY LEAH POFFENBERGER

As early career physicists face an uncertain job market, the APS Careers team is hard at work providing resources for students and job-seekers. In addition to a summer webinar series (see *APS News*, June 2020), a career advice panel at the April meeting (see *APS News*, June 2020), and other online tools, the APS Division of Atomic, Molecular, and Optical Physics (DAMOP) meeting in June also featured resources for job seekers.

A panel discussion on industry careers in AMO physics gave DAMOP attendees a chance to soak up practical advice from professionals on career advancement. The panel discussion specifically focused on industry careers rather than careers in academia in part to reflect the current job market: according to Crystal Bailey, Head of Career Programs at APS and moderator of the panel, academia has been strongly affected by COVID-19 resulting in hiring freezes, but the private sector remains full of opportunities for physicists.

Four panelists with various career paths in industry joined Bailey to offer their advice and share experiences with attendees. Dan Farkas, technical specialist in intellectual property at Lathrop GPM; Ofir Garcia, a principal physics engineer at Raytheon, Inc; Susanna Jones, lead quantum systems technology engineer for defense at the UK's Defense, Science and Technology Laboratory (DSTL); and Brian Patton, research engineer at Samsung, fielded questions from the audience on a variety of topics related to AMO careers in industry.

The first two questions put to the panelists revolved around skills, namely: what professional skills undergraduate students should cultivate and how to develop project management skills. The panel consensus was that communication skills in general are important in both industry and academic jobs, but they also offered a few industry-career-specific perspectives. Jones and Patton both pointed out that in industry there is emphasis on communicating with stakeholders and customers and those interactions often dictate the direction of research.

"One of the things I've learned along the way [is] how to be less oriented towards research for research's sake and more towards development of actual devices that need to work," added Garcia, elaborating on the difference in goals when working in academia and industry. "There's a certain spin to what the emphasis is when you're doing the work in a research lab versus when you're actually developing components that need to fly or get launched."

To develop project management skills, each panelist had a different strategy or experience, with Farkas taking classes on project management, Garcia learning through trial and error while building his lab in grad school, and Patton as a post-doc juggling new responsibilities in lab management. Jones, however, discussed the importance of skills you can gain outside of the lab.

"A lot of the skills that I've

DAMOP CONTINUED ON PAGE 6

EDUCATION

Learning Assistants at Arizona State University Help Virtual Classrooms Stay on Track

BY LEAH POFFENBERGER

As the coronavirus pandemic began forcing universities across the country to close their doors for the safety of students and staff, a big question became how to continue providing high-quality education online. Digital tools, like Zoom and Canvas, have kept classes going, and physics professors at Arizona State University (ASU) had some extra help in the form of student learning assistants.

Learning assistants at ASU are undergraduate students who are recruited to provide tutoring, mentorship, and support to other undergraduate students taking courses in the physics department. The program was launched in 2013, thanks to a grant from PhysTEC, a partnership between APS and the American Association of Physics Teachers to improve physics teacher preparation programs. The program has since grown from four learning assistants to forty, assisting in about 17 different course sections a semester.

As classes pivoted to online formats, learning assistants played an important role in helping instructors connect with students remotely. In large courses, while professors lectured, learning assistants were on hand to monitor questions entered into a chat window, and in smaller courses, they headed up small discussion groups using Zoom's "breakout rooms" feature. One student set up a server on Discord, a voice- and text-chat client popular among gamers, so he could be easily reached by other students who had questions about coursework.

"A lot of the learning assistants started taking ownership of what kinds of things they could do during this remote instruction," says Kelli Warble, Teacher in Residence in the ASU Department of Physics. "[Physics instructors] said, '[There's no] way for me to conduct these remote instruction courses without the use of learning assistants, to monitor things like chat and to have all of these supports available.'"

The learning assistants program was originally launched at ASU to provide more focused learning opportunities for students who might be struggling in their large calculus-based physics courses. As instructors recognized the value of having extra people on hand during classes and labs, the program expanded to put learning assistants in other types of classes, including upper-level math courses.

"The goal has always been to make those large lecture courses more focused on meeting student needs and making sure student discourse and discussion and physics education research principles were being used during the teaching of those courses," says Warble "The learning assistants themselves have always been sort of co-content help for the students in the [physics] program. And they have been sort of mentors guiding their fellow students through what are often very difficult courses."

At the end of each semester, Warble and professors who teach introductory level calculus-based

ASSISTANTS CONTINUED ON PAGE 6

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together a compendium of online opportunities," says Serrano. "The first thing is that APS is already running a summer webinar series, so we got in touch with them to collaborate. The second thing is that many sites already are having to adapt their own packages to their students, so we developed a survey asking sites if they were willing to record or make available whatever online activities they're doing to other students in the community."

With help from the NSF grant, NPRLG surveyed each site to determine topics they felt weren't covered in any existing activities, resulting in a list of ten topics, ranging from giving a poster presentation to research ethics.

NPRLG's in-person meeting was scheduled to take place this fall, but due to coronavirus, the conference will move online. They hope to hold an in-person conference for REU site leaders next year.

For more on NPRLG, visit go.aps.org/3dNSIsV.

APS RESPONDS CONTINUED FROM PAGE 1

challenges that international students face. As a result, APS has confirmed with staff at State that consular officers are to prioritize student applications among all non-immigrant visas, once visa processing resumes.

If you are applying for a visa, the APS Office of International Affairs (APS INTAF) provides resources to assist you (go.aps.org/2z9GysA). If you are facing a unique challenge that is not addressed on the resource page, please contact the APS INTAF at: international@aps.org.

Graduate Students Who Are Not Currently on a Federal Grant

APS OGA advocated for the inclusion of student relief funds in the federal funding responses to the pandemic. The CARES Act that was recently passed by Congress and signed into law by the President provides approximately $6 billion in funding specifically targeted as a relief fund for students. That support is available at most institutions, but it is up to each institution to determine how those funds will be dispersed.

If you are facing financial stress and have a student government at your institution, you should immediately contact your graduate student representative about how to access the relief funds provided to the institution by the CARES Act. If you do not have an accessible student government representative, you should directly contact your Dean of Students or Chancellor.

Graduate Students Completing A Degree, But A Job Offer Has Been Suspended

APS OGA and APS Office of Industrial Affairs reached out to companies to discuss opportunities for short-term employment that have been created in response to combating coronavirus. While these temporary jobs are not research or physics specific, they do provide near-term opportunities and resources while waiting for jobs to emerge. For example, Battelle is currently hiring technicians for three-week terms that can be re-upped. The positions provide travel to the location, room, board, and competitive salary (go.aps.org/2VoYNpB). And, each state is posting COVID-related short-term jobs on their own sites (see for example, Coronavirus.ohio.gov/jobsearch, MItalent.org, or onwardCA.org) As additional opportunities arise, APS will post them on its job board (go.aps.org/2YGWlN2).

ASSISTANTS CONTINUED FROM PAGE 5

physics courses identify students who might be good candidates as learning assistants and ask them to apply. As learning assistants move through their degrees, they have increased options on what kinds of courses they can assist with—some learning assistants may help with more than one class per semester, schedule permitting. Students who become learning assistants pursue a number of degree paths, from physics to engineering to computer science, the only prerequisite is that they complete a calculus-based physics course. Some of the students have an interest in becoming physics teachers, so the learning assistant program gives them valuable teaching experience.

"Usually most of our learning assistants also continue from semester to semester if they are able—I would say probably 75 to 80 percent of them continue each semester," says Warble. "We also have learning assistants who've gone through their whole career at ASU [as] learning assistants with the physics department in one way or another."

As academic institutions struggle with what future semesters will look like, especially due to financial difficulties, there is concern at ASU that the learning assistants program will be severely impacted.

"There's a lot of uncertainty right now about what's going to move forward," says Warble. "So we are worried that there won't be funding and then the instructors are telling me, 'you know, if I don't have [learning assistants], I don't know how we can even conduct this for remote instruction.' So if anything, it was almost as if the learning assistants became, more valued during the remote instruction."

Early assessments of the learning assistants program at ASU during the initial grant cycle showed that having these assistants in courses reduced the number of students getting Ds, failing, or withdrawing. While no such data exists for the current semester, a number of testimonials collected from instructors and learning assistants make the case for a continued program, especially in the case of continued online instruction.

"[Learning assistants] make the classroom environment more dynamic and interactive. In the remote format, [they] help to ensure that classes run smoothly and small group problem solving can be supported," said Anna Zaniewski, a professor at ASU in a testimonial about the program. "Furthermore, both in person and online, [the assistants] serve as mentors and role models to students, creating a community of learning across academic years." Zaniewski taught two courses in the Spring 2020 semester for first year physics majors with two learning assistants per course.

Crystal Ottoway, a senior at ASU majoring in physics, and a learning assistant who worked with two courses this past semester, also expressed strong support for the program in her testimonial.

"I cannot stress how important the program is, especially in a time such as this. There are so many different learning styles for physics students and sometimes students get left behind in conventional lecture instruction," said Ottoway. "Learning assistants can help remedy this issue and be a relatable guide for students in a way that a graduate student or professor cannot. There are also many issues that come with larger lectures for the lower-level physics courses. Those students need the most help and actually get the least."

For more on the PhysTEC Learning Assistants program visit phystec.org/keycomponents/assistants.cfm

DAMOP CONTINUED FROM PAGE 5

picked up that contribute towards project management [are] actually interpersonal skills I've taught myself or learned outside of the lab. I've taught horse-riding, I do all sorts of hobbies externally, and it's building those interpersonal skills [that] you're going to rely on when you're trying to build a successful team," she said. "Working with people is one of the hardest things. You think physics is hard? Trying to get everyone to work together towards a common goal is even harder."

Next, the panelists tackled a common conundrum in job applications: many people run into job listings with long lists of required skills that seem to be looking for someone with an engineering background rather than a physicist. Bailey described such job descriptions as "looking for a fictitious creature—they don't actually expect any one candidate to have everything they're asking for." She encouraged would-be applicants to send in their resume to such jobs as long as they meet at least a subset of the skill requirements.

Farkas, Garcia, and Jones all pointed out that, in their experience, companies like to hire people with physics backgrounds who show an aptitude or willingness to pick up new skills in order to be successful—especially in Jones' field of defense, where experience in that area can't be gained elsewhere. Patton offered some perspective of the process of hiring at a large company, where the person hiring for a role—who knows best the qualifications of the candidate they're looking for—is in a very different position from the person sorting through applications.

"There's a filtering process, and everyone tells you when you submit your resume or statement of purpose to tailor it to that specific posting—that's great advice," said Patton. "The whole point [is] just to get the interview, which can be discouraging because many times it gets bounced back, but it probably hasn't even reached the person who put down all of those qualifications... It's probably not that they're rejecting you because you don't have every single one of those qualifications, it's just a matter of the first impression."

In contrast to academia, industry often hires people at all educational levels. The next question posted to panelists asked whether post-doc positions are valuable for getting an industry job. The panelists all agreed that, while a post-doc isn't required, having the experience of at least one can help with developing new skills one might not have picked up during graduate school.

"It's really good to branch out and try something different to see if you like it or not, even if you do wind up afterwards going back to do what you did for your PhD thesis, which is a common thing to do," said Farkas. "You want to get something out of the post-doc that is meaningful in and of itself—learning some additional skills, leadership skills, management skills, soft skills, even teaching skills if you have to teach a class... take advantage of all of those experiences."

For physicists looking to make a jump from basic research to industry, the panelists addressed ways to identify problems that are relevant to industry and pivot basic-research skills towards solving them. Garcia advised paying attention to global trends and fundamental problems of society and then finding a way to apply current basic research to meet one of those needs. Patton offered further insights into how a job applicant might show how their basic research work can pivot to industry.

"I think it's hard to know... what the problem is that you'd be working on as you're moving into industry. It's a little bit of a chicken and egg problem," said Patton. "The best you can do for yourself is to explain what you've been working on, which is very narrow and very deep, how that has taught you the skills to learn other things and work on other problems...Figure out how to stress that and convey that in both your statement and interview."

The panel discussion can be viewed at go.aps.org/31z0bg7.

DFD CONTINUED FROM PAGE 3

for further discussion).

DFD chair Minami Yoda (Georgia Tech) emphasized that the DFD Annual Meeting is "abstracts-only," meaning that much of the data presented is new—sometimes only weeks-old—and reflects the very cutting edge of the field. Since the meeting effectively has a limit of one presentation per attendee, it encourages senior researchers to bring their students to give presentations of their own work.

"I was inspired by this meeting as a young graduate student, and I always come back from it with new ideas," noted Yoda. "It can be like drinking from a firehose, but here you get to see the future of fluid mechanics in a way you won't see anywhere else."

Last year's DFD Annual Meeting in Seattle, Washington was the largest-ever with a whopping 42 parallel sessions and a record-breaking 3,800 attendees. Notably, 35% of attendees hailed from abroad, underscoring DFD's status as perhaps the largest international community of fluid mechanics researchers.

The 2020 DFD Annual Meeting is slated for November 22-24 in Chicago, Illinois. Discussions are underway regarding whether the meeting will proceed live or in an altered virtual format.

Beyond conferences, DFD also runs the Gallery of Fluid Motion, an exhibition to highlight both the aesthetics and science of fluid dynamics. Every year, fluid dynamics researchers are invited to submit posters or videos to the Gallery, which are then judged for a combination of striking visual qualities and scientific interest. The winning submissions are displayed at the DFD Annual Meeting and subsequently published in the APS journal, *Physical Review Fluids*. Past winners dating back to 2014 are available at the Gallery of Fluid Motion website.

Looking to the future, the DFD Executive Committee is focused on ensuring that the DFD Annual Meeting remains "the largest and best meeting in fluid mechanics," as Yoda put it. Increasing the diversity of DFD's membership (currently over 80% male) is another key priority. On a hopeful note, much of DFD's recent growth has come from a new and more diverse generation of students and early-career scientists. To this end, half of the division's Fellows have been female over the last two years, and of the women in DFD over 60% are students.

Overall, over 73 years and counting, DFD has proven itself as a research powerhouse within APS, and a leader in engaging both young scientists and the international community. More information on this unit can be found at the DFD website at aps.org/units/dfd.

The author is a freelance writer in Stockholm, Sweden.

PHD THESIS CONTINUED FROM PAGE 5

laser that I have been working with, ~15 watts of 527 nm light, and that's VERY bright!

Danielle Sofferman graduated Magna Cum Laude from Adelphi University in 2013. Historically Adelphi's undergraduate population (~5,000 students) is mostly female (70% as of 2019), however the ratio of female to male students is dramatically switched in the physics department. During the 2013 graduation year, she was the only woman to graduate with a physics degree. She spent more than half of her undergraduate career studying the nonlinear optical properties of cadmium selenide (CdSe) quantum dots. She also collaborated with Eugene Hecht on writing Schaum's Outline of College Physics, *Eleventh edition, where she is acknowledged in the book. As a graduate student in the Applied Physics Program at The University of Michigan, Danielle continued with her passion for optics by working in an ultra-fast spectroscopy lab, researching how the human skin membrane influences the initial photochemistry involved in vitamin D_3 formation, where the initial reactions occur on the timescale of picoseconds. She has now successfully completed her PhD in the Applied Physics Program and is searching for her next adventure. (Contact: dnlesoff@umich.edu)*

VISITS CONTINUED FROM PAGE 4

the UMD), the core of my dissertation research was a solo mission to solve a single, decades-old problem. Our research group focused on interactions between light and matter, and in particular, on the Casimir effect, which is an electromagnetic force that arises between uncharged objects," he explained.

Munday, who now works as an electrical and computer engineering professor at UC Davis, said Somers is a good choice for the fellowship.

"David was an excellent student, and I believe he is very well-suited for a career in science policy. He is a critical thinker, writer and communicator – skills that are highly desirable for this position," said Munday.

Justin Rodriguez, partner at the Boston Consulting Group, offered similar sentiments about Somers.

"David's commitment to excellence and his brilliance in problem solving would be a tremendous and much needed asset to our country," he said.

Mark Elsesser, Associate Director of the APS Office of Government Affairs (APS OGA), said Somers' "impressive research and work experience, as well as his sharp focus on using his scientific ability to impact policy decisions, will enable him to make a meaningful contribution on Capitol Hill."

The role of APS Congressional Science Fellow is invaluable, said Francis Slakey, APS Chief Government Affairs Officer.

"It is a tremendous benefit to congressional offices to have the expertise of scientists working alongside them to tackle some of our nation's most pressing challenges in areas ranging from energy to health to education to national security," he said.

The author is the Senior Press Secretary at APS.

EXCHANGES CONTINUED FROM PAGE 3

where she received PhD funding from an ICTP-affiliated organization called the Organization for Women in Science for the Developing World.

A Light Source in The Middle East

Esen Ercan Alp's planned presentation centered on SESAME, an international synchrotron facility in Jordan, which began conducting experiments in 2017. Alp, a physicist at Argonne National Laboratory, who chairs SESAME's science advisory committee, has been involved with the facility since it was first approved as a project in 2000. In addition to its science, one goal of the facility was to promote peace and collaboration in the region, and its eight member countries include Iran, Israel, and Pakistan.

SESAME also helps to prevent brain drain. "In all of these countries, whether Iran, Egypt, or Turkey, there is a huge hunger for access to modern facilities," says Alp. "A lot of individuals [working in these countries] who did their thesis work elsewhere came back home, and SESAME is a light of hope for them. They can come to a modern place and meet with scientists who are really knowledgeable and work like everyone else."

This year, SESAME received 151 applications for beam time, more than a 30 percent increase from 2019. The proposals largely come from Middle Eastern member countries, but SESAME also received proposals from far-flung locations such as Finland, Mexico, and Brazil, where it can be difficult to get beam time at facilities closer to home. "They may choose to send their proposals to us without realizing that competition is also quite high at SESAME," says Alp.

Alp says that the day-to-day operation of SESAME is similar in many ways to the synchrotron facility at Argonne where he works. But he points out that in the US, for example, synchrotrons have operated for more than half a century. In the Middle East, the idea is brand new, making it difficult to communicate existential needs to politicians and often culminating in many rejected project ideas. "When you have an established culture in science, it's so much easier to work," he says. "The biggest challenge for us in the Middle East was to establish that culture. It takes sincere effort, and it is not done if you are looking for personal glory."

Accelerator Science In Africa

Building a particle accelerator, according to Christine Darve, can jump-start technological change in a country. Such a project necessitates training people in cutting-edge science and equips them to operate the accelerators used in medical treatment. With these goals in mind, Darve, who works at the European Spallation Source (ESS), has been working for over a decade to further accelerator science in African countries.

Every two years since 2010, Darve has helped put on the African School of Fundamental Physics and Applications (ASP), a three-week summer school. At each school, more than twenty physicists from around the world teach up to 85 students, around 30 percent of whom are women. Between 2010 and 2018, the school has taken place all over the continent, including Senegal, Rwanda, and Namibia. Darve, who also teaches some of the classes, describes dedicated students of limited means, including one from Madagascar named Laza, who walked an hour each way to attend school.

The school has also served as a venue to bolster the efforts to build a synchrotron in Africa called the African Light Source. Herman Winick, a professor emeritus at SLAC National Accelerator Laboratory and early advocate for such a facility, discussed the project at the 2012 school in Ghana. Leaders of the African Light Source project are currently fundraising to build the synchrotron, and they are planning a virtual meeting to detail the facility's roadmap in November.

ASP also provides an opportunity for African researchers living abroad to give back to their communities. Gouba, who attended the first ASP in South Africa as a student, worked to bring the summer school to Benin in 2022. Although Benin was not ultimately selected, she intends to contribute to the school in the future, perhaps as an instructor.

Over the last five years, Darve has also developed Massive Open Online Courses (MOOCs) on topics in accelerator physics targeted toward undergraduates, with over 4,500 learners enrolled today. Darve developed the MOOCs from three summer schools related to the construction and operation of the new synchrotron MAX IV and the future neutron source ESS, which will both be based in Lund, Sweden. The courses are available for free on the website Coursera, where the viewer can also pay to receive a certificate. The online course extends the reach of her curriculum, as young people across Africa can access the courses on their smartphones. "Youngsters are youngsters everywhere," she says. "They are captivated by screens."

An Uncertain Future

These programs provide physicists in developing countries with necessary resources for education and research. But the coronavirus pandemic has disrupted the planned programming this year. After pausing experiments in March, SESAME resumed internal operations in June and is accepting experiment proposals for three beam lines, although travel is still restricted in the Middle East. ICTP is now running virtual events. According to Darve, this year's ASP, which was slated to take place in Marrakesh in July, has been postponed until next year. In the meantime, the program has offered online courses since May. The question remains how well virtual interactions can replace in-person meetings.

NSF EXPANSION CONTINUED FROM PAGE 4

years, with an initial budget of $2 billion in fiscal year 2021, though such funding would still have to be allocated through the annual appropriations process. University technology centers would receive at least 35% of this budget, supporting activities such as "proof-of-concept development and prototyping." Among other carveouts, at least 15% of the budget would be transferred to NSTF science directorates to "pursue basic questions about natural and physical phenomena that could enable advances in the key technology focus areas."

Notably, the bill would prevent the technology directorate from receiving any funds if the budget appropriated for the rest of the agency declines year over year in inflation-adjusted terms. This provision may have been crafted to allay fears that the new technology directorate might interfere with NSF's longstanding mission to support fundamental research.

Though it is unlikely the bill will advance far in the legislative process this year, it is among a series of bills pending in Congress that propose massive increases in federal support for science and technology. It also reflects a growing willingness among legislators to pursue what is effectively a form of "industrial policy," which many lawmakers have previously been reluctant to embrace.

The author is Acting Director of FYI.

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LETTER CONTINUED FROM PAGE 1

OGA was informed, following inquiries, that those three categories are therefore not subject to the J-1 exclusion order under this Proclamation and OGA will continue to advocate strongly for the importance of immigration in these categories to the nation's wellbeing.

- More than 3,000 APS members—who together made more than 6,000 contacts to congressional offices over the last several weeks—contributed to the defense of OPT. In particular, 12 House Republicans contacted by APS members supported a letter to the White House defending OPT that helped tilt the issue in our favor.

We understand the hardship and anxiety that this Proclamation creates. The APS rejects the impression created by recent government actions that Americans do not welcome international scientists. We know that the presence of international scientists working and studying in the US enriches us all (see APS Board Statement at go.aps.org/2VPzaxl).

We also recognize that we will face ongoing federal challenges. And so we will continue to make the case, working with our APS members, for the importance of the J-1 and H-1B visa programs—and international scientists in general—to the US scientific enterprise.

Sincerely,

Philip H. Bucksbaum, Sylvester James Gates, Jr., Frances Hellman, David Gross, Andrea Liu, and Kate P. Kirby
2020 APS Presidential Line, Speaker of the Council, and CEO

THE BACK PAGE

The Increasing Peril of Nuclear Weapons: And How Physicists Can Help Reduce the Threat

BY STEWART PRAGER, STEVE FETTER, ALEX GLASER, ZIA MIAN, SÉBASTIEN PHILIPPE, AND FRANK VON HIPPEL

It is poignant to be writing about nuclear weapons in the midst of the coronavirus crisis. We were caught unprepared for the pandemic. The last pandemic of the scale of COVID-19 occurred 100 years ago. The only two nuclear explosions in conflict occurred in Japan 75 years ago. There is no preparation for nuclear war. It is urgent to increase drastically efforts to avoid a second, more destructive use of nuclear weapons. To this end, APS has initiated a project through its new Innovation Fund to engage the US physics community in advocacy for steps toward nuclear risk reduction.

The virus and nuclear weapons share some properties, but the difference in scale and risk is immense. Both start from a chain reaction. The viral chain reaction of infection can, if unchecked, kill millions worldwide in months and overwhelm health care systems. The neutron-induced fission chain reaction can fission about a kilogram of plutonium in one microsecond. When multiplied by a second fusion-fission explosive, and delivered by thousands of warheads, it can kill hundreds of millions directly, and billions indirectly. Any health care systems not destroyed would barely function, offering mostly palliative care.

The nuclear threat is clear. Controlled by a handful of men in nine nations, the current world military stockpile of more than 9,000 warheads can release about 300,000 times more explosive energy than that of the Hiroshima bomb, which claimed more than 100,000 lives. A fraction of this current nuclear arsenal could eliminate civilized life many times over.

Today, Russia and the US have about 2,000 nuclear warheads ready to launch within minutes of receiving a command. The decades of the bipolar nuclear standoff between the two nations saw numerous crises, close calls, and false warnings of attack that narrowly avoided causing a mistaken retaliatory nuclear launch. Former head of US Strategic Command, General Lee Butler concluded: "We escaped the cold war without a nuclear holocaust by some combination of skill, luck, and divine intervention, and I suspect the latter in greatest proportion."

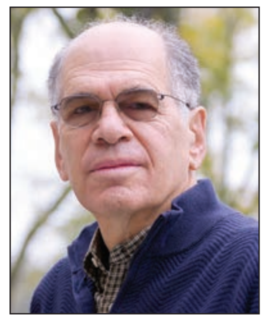
Any false comfort derived from 75 years of nonuse should be avoided. As former Secretary of Defense William Perry noted in 2015: "Today, the danger of some sort of a nuclear catastrophe is greater than it was during the Cold War and most people are blissfully unaware." The danger of nuclear use has indeed increased through at least five developments:

1. ***The collapse of arms control:*** Throughout the decades of rivalry between the US and the USSR (and later Russia), arms control helped restrain arsenals, costs and misinformation. A foundation was provided by the 1972 Anti-ballistic Missile (ABM) Treaty, which limited defenses in order to avoid provoking offensive weapon build-ups. This facilitated the removal of thousands of warheads from service. The 1987 Intermediate Nuclear Forces (INF) Treaty eliminated about 6,000 nuclear warheads that faced each other in the Soviet Union and Western Europe. Long-range, strategic weapons were reduced from a high of over 60,000 warheads in the mid-1980's to today's much reduced arsenals by a series of agreements, most recently the New START Treaty signed in 2011.

   Unfortunately, the US withdrew from the ABM treaty in 2002 and from the INF treaty in 2019, and the current Administration is inclined to let the New START Treaty lapse, without renewal, in February 2021. The potential demise of New START would leave Russia and the US with no constraint on long-range nuclear weapons for the first time in 50 years. The absence of inspections and verification provided by the treaty would feed worst-case projections of each adversary's weapon system capabilities.

   More recently, a group of Senators asked for the United States to "un-sign" the Comprehensive Test Ban Treaty so as to enable a nuclear weapon test, and in May 2020 senior US officials considered such a test, the first since 1992. The Senate Armed Services Committee has authorized $10 million to speed any possible test, which might take 6 to 10 months to arrange, opening the door for tests by other nuclear weapon states.

2. ***A new arms race:*** The escalatory response and counter-response dynamic of an arms race is underway, but this time involving three countries. The United States is beginning a 30-year, trillion-dollar replacement and upgrade of essentially all its nuclear weapons and delivery capabilities with next-generation systems. To evade future US military defenses Russia is developing hypersonic reentry vehicles that can maneuver in the upper atmosphere, underwater nuclear torpedoes, and ICBMs that can fly over the South Pole. China is building up its relatively small arsenal of strategic ballistic missiles and developing hypersonic reentry vehicles, also, at least in part, in response to the US build-up of missile defenses. The US is developing some of the same weapons and is redoubling its commitment to missile defense.

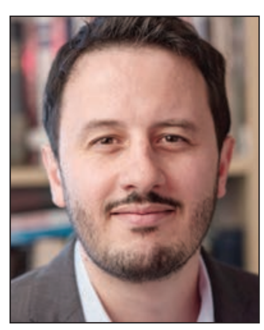


Stewart Prager

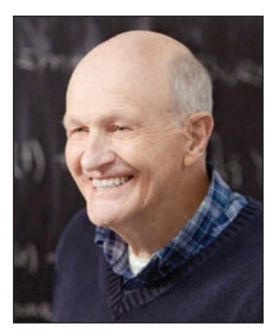
Steve Fetter

Alex Glaser

Zia Mian



Sébastien Philippe



Frank von Hippel

3. ***Proliferation and alliances:*** An increasingly complex and tangled web of cooperation and conflict links the nine states that now have nuclear weapons: the US, Russia, the UK, France, China, Israel, India, Pakistan, and North Korea. Decision makers in these countries may have competing ambitions and commitments. This yields numerous possible scenarios for intentional conflict, accident or miscalculation. In large part, because of the Non-Proliferation Treaty the number of nations with nuclear weapons has increased by only one, North Korea, since the end of the Cold War. It could have been even worse and may become so.

4. ***Cyber-technology:*** The rapidly developing capabilities of cyberwarfare can undermine strategic stability. Catastrophe could ensue if a successful cyberattack on nuclear command and control could mimic a nuclear attack by an adversary, send a counterfeit order to launch a nuclear missile, or sever communications between a nation's leader and the military during a nuclear crisis.

5. ***Non-state actors:*** The global stock of weapons-usable material (roughly 1,800 tons of highly enriched uranium and plutonium), sufficient for more than 100,000 bombs, is a potent target for theft by non-state actors or terrorists.

Nonetheless, past progress and success in nuclear arms control demonstrates that this problem can be solved. The 1970 Nuclear Non-Proliferation Treaty provides a critical foundation for the control and elimination of nuclear weapons. Five nuclear weapon states (the US, Russia, UK, France, and China) are parties and have committed to "cessation of the nuclear arms race at an early date and to nuclear disarmament." India, Pakistan, Israel, and North Korea are not members, but have all indicated in their own way that nuclear disarmament is possible in principle. The absence of meaningful progress towards nuclear disarmament, however, is threatening the durability of this critical treaty.

Meanwhile, the other 184 member states of the United Nations have forsworn nuclear weapons. Six multinational treaties have established regions of the globe, including the continents of Africa and South America, to be nuclear-weapon-free zones. The 2017 United Nations Treaty for the Prohibition of Nuclear Weapons commands the support of a large fraction of the world's non-weapon states.

Physicists have played a powerful role in arms control. Early on they issued prescient warnings of the catastrophic harm to civilians and cities from nuclear explosions, the dangers of a nuclear arms race, and the genocidal potential of thermonuclear weapons. Later physicists informed opposition to the placement of nuclear-tipped defensive missiles near US cities in the 1970s and to the unfeasible Strategic Defense Initiative in the 1980s. They worked constructively to advance new ideas for arms control, dialogue and cooperative security to help end the Cold War.

Three decades on, the issue of nuclear arms has fallen off the radars of both the physics community and the broader public. The debate has fallen into the hands of vested interests and insiders. We believe, however, that if re-engaged, the physics community could again be an influential voice in informing the public, Congress, and other key stakeholders of the necessity and possibilities of nuclear risk reduction.

For this purpose, we have joined with other concerned physicists from a handful of universities and other organizations across the country to build a Physicists Coalition for Nuclear Threat Reduction (physicistscoalition.org). The goal of this project over the next two years is to establish a network of citizen-scientists committed to understanding and advocating for nuclear threat reduction. The Coalition welcomes all physical scientists, including those working within engineering science.

The Coalition is supported by APS and the Carnegie Corporation, is partnered with the APS Office of Government Affairs, and is managed through Princeton University's Program on Science and Global Security.

We plan to inform US physicists on nuclear threats and possible threat-reduction measures, recruit interested scientists into the coalition, and help them connect to the public debate and policy process. As a first step, experts on nuclear arms issues will carry the messages directly to physicists in universities, at professional meetings and conferences, in national laboratories, and in industry. Institutions interested in arranging for a colloquium speaker on nuclear arms issues can do so at physicistscoalition.org.

For those physicists who are interested in becoming active, we will facilitate their efforts to educate members of Congress and others on nuclear policy issues. There are numerous policies the United States can implement to reduce nuclear-weapon risks and which could be possible foci of advocacy by the Coalition. These include extending the New START Treaty, adopting a sole-purpose or no-first-use posture, abandoning the launch-on-warning option and the destabilizing silo-based ballistic leg of the triad, and re-establishing limits on missile defense systems. Unlike the battle against a pandemic or climate change, the threat of nuclear weapons is not a fight with nature. All that is required is societal education and will. Physicists can be a powerful force to help build the former and instill the latter. During this critical time, we should seize the opportunity.

The authors are among the founding members of the Physicists Coalition for Nuclear Threat Reduction. Stewart Prager, Alex Glaser, Zia Mian, Sébastien Philippe, and Frank von Hippel are at Princeton University. Steve Fetter is at the University of Maryland.