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APS NEWS

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MEETINGS

March Meeting Plans Return as Hybrid Event

BY DAVID BARNSTONE

After two years of completely virtual meetings, physicists are preparing to convene in Chicago for the annual APS March Meeting. The 2022 March Meeting will be an in-person event with virtual components, although meeting organizers say they are keeping a close eye on the Omicron variant of COVID-19 and will adjust their plans accordingly.

The APS March Meeting brings together physicists from all over the world representing 30 APS Units and Committees. Researchers working in industry, academia, and national laboratories will present nearly 12,000 technical papers covering a broad spectrum of physics during the week-long meeting to be held this year from March 14 to 18. The in-person meeting will take place at Chicago's McCormick Place, the largest convention center in North America.

Nearly five full days of scientific sessions will explore the latest research in quantum information, superconductivity, biophysics, fluid dynamics, and much more. The online portion of the meeting will include a mix of live presentations and pre-recorded videos that will be available to registered participants on the virtual meeting platform.

Pre-meeting events to be held on March 12 and 13 include short courses on Sustainable Polymers, the Physics of Biological Movements, and Effective Science Communication as well as tutorials covering topological photonics and oxide heterostructures.

Another March Meeting highlight is the Kavli Foundation Special Symposium, which will feature a variety of exciting topics such as treating cancer with nanotechnology (Naomi Halas, Rice University) and atom-by-atom engineering of novel states of matter (Cristiane Morais Smith, Utrecht University). Attendees will also be able to browse scientific equipment, products, and services in the Exhibit Hall and meet employers at the Job Expo.

MARCH CONTINUED ON PAGE 7

JOURNALS

A Q&A with the Lead Editor of *PRX Energy*, David Scanlon

APS recently appointed David Scanlon, Professor of Computational Materials Design, University College London, United Kingdom as the inaugural Lead Editor of *PRX Energy*, a new, highly selective, open access journal covering energy science and technology.


David Scanlon

We sat down, virtually, with Professor Scanlon to learn more about his vision for this exciting new journal, which began accepting submissions late last year.

What does it mean to you to be the inaugural lead editor of *PRX Energy*?

It's a huge honor to be the inaugural lead editor of *PRX Energy*. It's incredibly exciting to be part of the birth of a new energy journal, and to guide its development and hopefully watch its growth.

At the same time I recognize the significant responsibility I have in serving the energy research community and the authors and referees who contribute to this journal. It is extremely important to me that we provide fair and high quality peer review and give authors feedback that serves to improve their papers.

What is your vision for the journal? What makes *PRX Energy* different from other journals?

My vision is to create a home for high impact energy research that bridges the Physics community with the multidisciplinary energy

PRX ENERGY CONTINUED ON PAGE 3

OBITUARY

Michael Fisher 1931-2021

BY DANIEL GARISTO

Michael Fisher, a statistical physicist who excavated the secrets underlying critical phenomena across physics, chemistry, and biophysics, died November 26, 2021 at 90.

Fisher's contributions to statistical physics earned him a share of the 1980 Wolf Prize with Leo Kadanoff and Ken Wilson, as well as a trove of other awards, including the American Chemical Society's Irving Langmuir Prize and the inaugural APS Lars Onsager Prize. He was also a Fellow of the Royal Society and APS.

"Michael was certainly one of the most influential people in statistical mechanics—due mostly to his own work, but also to his sharp analysis of others' work, and his students," said Joel Lebowitz, a mathematical physicist at Rutgers University and a longtime colleague.

Fisher applied his mathematical rigor to problems ranging from superfluid helium to molecular motors. Perhaps most notably, he worked with Ken Wilson and Ben Widom on the renormalization group—a crucial conceptual advance that clarified the universality of critical phenomena like phase transitions, and had enormous implications for other areas of research, like quantum field theory.

"I do think he should have won the Nobel Prize," said Andrea Liu, a professor at the University of Pennsylvania and a former graduate student of Fisher's. She wasn't the only one—in a 1982 *Physics Today* article, Wilson remarked that he was surprised to be getting the prize without Kadanoff and Fisher, who had introduced him to critical phenomena.

Michael Ellis Fisher was born in 1931 in Trinidad to Jeanne and Harold Fisher, who were there while Harold was working for Shell Oil. Michael was educated primarily

OBITUARY CONTINUED ON PAGE 6

LEADERSHIP

Speaker of the APS Council Robin Selinger

Robin L. B. Selinger is a Professor of Chemical Physics at Kent State University's Liquid Crystal Institute. She is an APS Fellow and previously served as Secretary-Treasurer of the Topical Group on Statistical and Nonlinear Physics. Selinger was elected to the APS Council of Representatives as a General Councilor beginning in 2019, to the Board of Directors beginning in 2020, and serves as the 2022 Speaker of the Council. *APS News* spoke with Selinger about the role of the Council and her priorities for the year as its Speaker.

What is the APS Council of Representatives? How does the Council work with the Board of Directors and Management Staff?

The Council is elected by APS members and holds oversight responsibility for the Society's scientific mission, including publications, meetings, and honors such as fellowship, prizes, and awards. The Council also holds responsibility to approve policy statements and any changes to the APS Constitution & Bylaws.

The Council includes representatives from all APS Divisions, Forums, and Sections, plus four General Councilors and four International Councilors, together with the Presidential Line and Treasurer. The Council also elects three of its members each year to serve on the Board of Directors.

The CEO and other members of the senior leadership team work closely with the Council to address key issues related to our scientific mission. In turn the Council relies on the work of APS Committees, which draft many of the proposals that come before the Council.

What do you see as the role of the Speaker? What are some priorities for your term?

The speaker, in collaboration with the Council Steering Committee, assembles the agenda for each of the Council's two annual meetings. My priorities for the coming year include:

(1) Continued focus on needs of **students and early career scientists**: I'd like to see APS undertake a new initiative to promote industrial career pathways by helping both undergrad and grad students find internships in industry. I'd also like to survey new graduates embarking on industry careers, to find out what services APS can provide to support their professional success.

(2) Continued focus on **building a diverse physics workforce:** As a mentor, I've worked with many students who face economic barriers to entry into STEM careers. Unpaid internships, for example, are a privilege of students who don't need wages to cover their basic needs. Some students are working at fast food restaurants or stacking cans at the supermarket while their more privileged classmates are getting started in the research lab. Graduate application fees—and, where applicable, the cost of standardized tests—also represent a financial barrier for undergrads who do not receive family support.


Robin Selinger

These barriers to the physics career on-ramp represent a form of **structural classism** that has grown steadily worse over time. The tragedy is, such problems could be solved for a few hundred or perhaps a few thousand dollars per student. But though the financial barrier is small relative to the total cost of an undergraduate education, these costs are not covered by financial aid, so to students the barrier often appears insurmountable.

While the APS Council cannot solve all problems in the world, we have a moral obligation to point out these barriers and lead efforts to tear them down. The solution might include APS-funded **grad school application fee waivers** for qualified physics majors who are eligible for financial aid, with support from donors.

I once made a modest financial gift to one of my former REU students to cover two of her

COUNCIL CONTINUED ON PAGE 7

APS Legacy Circle Profile: David Sward

BY DAVID BARNSTONE

David Sward

Late in his career as a computer programmer for the US Department of Veterans Affairs, David Sward came across a book entitled *The Trouble With Physics*. He was intrigued by Lee Smolin's critique of theoretical physics as well as his vision for its future.

"And the more books I read, the more I wanted to learn about a field that was attempting to explain the fundamentals of reality," says Sward. "In the process I believe I've gained an appreciation for the efforts of all those who have chosen physics as their profession."

After serving as an Aviation Electronics Technician in the Navy, Sward worked on a variety of software engineering projects at the VA.

"When I wrote code, I preferred using assembler because it put me close to the computer. Program execution was faster and the instructions were more direct as compared to other advanced languages. Perhaps that approach helped me to appreciate the efforts of physicists who were trying to get close to the fundamental laws of nature," says Sward.

That appreciation led him to join the APS Legacy Circle, which recognizes donors who support the physics community through planned giving. Sward hopes his contributions will have a positive impact on the next generation of physicists and their discoveries that will benefit humanity.

He is particularly passionate about the APS Matching Membership Program, which makes the benefits of APS membership more accessible to physicists around the world, because the connections made between APS members are essential to the progress of physics.

"Read and learn from all those who have come before you," says Sward. "Then build upon that knowledge to not only extend existing theorems but to develop new concepts. And don't be afraid to put forth novel ideas. One of them could lead to an amazing breakthrough."

Philanthropy is an important theme in Sward's life. In addition to his generous support of physics, he and his wife volunteer for animal rescue groups and have adopted many cats and dogs.

"They make incredible friends and provide solace during times of stress."

For more information about joining the Legacy Circle, please visit the Legacy Circle page or contact Kevin Kase at 301-209-3224 or email kase@aps.org.

The author is APS Head of Public Relations.

THIS MONTH IN

Physics History

Black History Month: Otis Boykin and the Cold War-Era resistor

BY SOPHIA CHEN

Otis Boykin, a Black man with a trim mustache in a jacket and tie, leans forward in profile in a monochrome photograph. He appears deep in concentration, carefully grasping an unknown object with a pair of tweezers. Whether the photograph is posed is unclear.

Labeled with the year 1958, the picture depicts the engineer in the era five years after the end of the Korean War, three years after Rosa Parks refused to give up her bus seat, and four years before the Cuban Missile Crisis. The photo is buried in the middle of a webpage belonging to a 125-year-old company called CTS Corp., still in existence today. Boykin worked there between 1954 and 1964, but his name does not appear anywhere on the webpage. In fact, the Internet yields mostly superficial descriptions of this man's life.

Boykin invented electrical components. He devised designs for resistors and capacitors meant for mass production, as the government invested heavily in electronics for defense applications, and as Americans integrated television sets into their lives. Through his work at CTS Corp., Boykin's resistors would be found in the cutting-edge technology of the time: guided missile systems, IBM computers, and the first implantable pacemakers. In honor of Black History Month, this column features Boykin's story—an incomplete tale woven together from limited details available about his life.

Otis Frank Boykin was born in 1920 in Dallas, Texas, the seventh of eight children. His father was a pastor, and his mother worked as a housekeeper. She died when Boykin was just 12 years old. He attended the segregated Booker T. Washington High School and graduated as valedictorian of his class. In 1938, he matriculated at Fisk University, a historically Black university in Nashville, Tennessee, where he studied physics and chemistry. While at Fisk, he worked as a live-in domestic worker, or "houseman," for at least two White families in the area. Boykin dropped out of Fisk in 1941, the spring of his junior year, according to the special collections of the university's John Hope and Aurelia E. Franklin Library.

Boykin then moved to Chicago and worked as a parcel post clerk for Electro Manufacturing Company, where he handled accounting for the company's president. During his stint there, Hal Fruth, a White engineer and consultant for the company, recruited Boykin as a lab assistant.

Otis Frank Boykin CTS CORPORATION

"Dr. Fruth always nodded pleasantly to me, but one day he stopped at my desk to ask, 'how much education do you have?' I detailed the extent of my training in science and he exclaimed, 'I could use a youngster like you in my laboratory,'" Boykin recalled in a 1968 interview with The *Pittsburgh Courier*, an African-American newspaper.

With Fruth, Boykin tested automatic pilot control units used in planes during World War II. In 1949, after the war, the two started a company, Boykin-Fruth Inc., where they filed at least one patent for an inexpensive method to manufacture resistors. After joining CTS Corp. in 1954, Boykin began inventing more ways of making stable, inexpensive resistors.

Engineers had developed resistor technology significantly during the war. Military needs spurred them to devise electronic components that were functional in climates ranging from the Asian tropics to arctic temperatures in Russia, as well as in high altitudes in planes. These special requirements led to the standardization and miniaturization of these components. Coming out of the war, the electronics industry boomed with consumer demand for television sets and radios.

Boykin also coincided with the golden age of innovation for cardiac medicine—artificial pacemakers in particular, which delivered a steady electrical pulse to stimulate the hearts

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Contributing Correspondents . . . . **Sophia Chen and Alaina G. Levine**
Design and Production . . . . **Leanne Poteet**

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UNITS

APS Membership Unit Profile: The Division of Astrophysics

BY ABIGAIL DOVE

With almost 3,000 members, the Division of Astrophysics (DAP) is a home for physicists striving to understand the universe and our place in it through the study of planets, stars, nebulae, galaxies, and other aspects of the cosmos.

DAP was founded in 1970 as a niche for researchers principally concerned with the physics underlying phenomena in space, rather than their observational study – the major focus of astronomy at the time. Now, over 50 years later, astrophysics has matured into an incredibly broad field, encompassing everything from galactic structure and evolution to the early history of the universe to the physical processes occurring in stars.

At the end of 2021, the most pressing research questions in astrophysics were outlined in the Decadal Assessment, a project coordinated every 10 years by the National Academy of Sciences with the aim of educating federal agencies and policymakers about the most important research topics and funding priorities in the field. These include (1) understanding stars and the planets that orbit them, specifically to identify worlds resembling Earth that may have signatures of life; (2) multi-messenger astrophysics, the use of complementary information from four different sources, or "messengers" – electromagnetic radiation, gravitational waves, neutrinos, and cosmic rays – to understand the cosmos; and (3) better understanding so-called "cosmic ecosystems," particularly the driving forces behind star formation and the growth of galaxies.

"The fun thing about astronomy is that it ties together so many physics fields," explained DAP chair Chris Fryer (Los Alamos National Laboratory). Indeed, given the major emphasis on early universe cosmology and phenomena like black holes and gravitational waves in the astrophysics community, DAP has fostered very close collaborations with several other APS divisions – most notably the Divisions of Nuclear Physics (see *APS News* January 2021), Particles and Fields (see *APS News* April 2021), and Gravitational Physics (see *APS News* October 2021). DAP also has considerable synergy with the Division of Fluid Dynamics (see *APS News* July/August 2020) when it comes to the study of nebulae in interstellar space, the Division of Plasma Physics (see *APS News* October 2020) given the abundance of plasmas in planetary cores and stars, and the Division of Atomic, Molecular, and Optical Physics (see *APS News* April 2020) as it relates to interpreting the light emitted from objects in space and the molecular basis of star and planet formation from giant molecular clouds.

With such strong interdisciplinary ties across many different areas of physics, a major highlight of DAP's activities is the APS April Meeting, where the division typically hosts or co-hosts around 50 invited and contributed sessions. DAP has a commanding presence – typically accounting for about 1/6 of the April Meeting's total content – and every year brings difficult decisions about which research areas to highlight. "There is such a broad set of topics in astrophysics that we can't hope to cover it all," Fryer noted

This year's April Meeting is right around the corner, slated for April 9-12 in a hybrid format featuring in-person sessions in New York as well as a virtual option. Fryer acknowledged that the option for remote meeting attendance has emerged as one of the unexpected silver linings of the COVID-19 pandemic, allowing meeting attendees to catch up on recorded versions of sessions they missed or could not attend due to concurrent scheduling with other talks. That said, the DAP community is eager to return to in-person experiences as soon as the public health situation allows. "The best way to build collaborations with people outside your

DAP CONTINUED ON PAGE 4

PROFILES IN VERSATILITY

This Physicist's "Business" is Family Business

BY ALAINA G. LEVINE

Some physics-educated professionals prefer to keep family and business separate. Others, like Dr. Nadine Kammerlander, run towards their coalescence by studying and launching family businesses. As a professor of family business and chair of the Institute of Family Business and Mittelstand at WHU-Otto Beisheim School of Management in Vallendar, Germany, Kammerlander endeavors to understand what makes family businesses—the enterprises founded, owned, and managed by family members—tick.

It is a fascinating area of management scholarship and community service, given the huge number of family businesses that exist. According to the Family Firm Institute and Kammerlander's research, 80-90% of firms in the United States are family-owned, which roughly matches many other regions of the world including Germany, China, Brazil and South Africa. In Germany, there are 2 million family businesses, and family firms employ more than 50% of the German workforce, she notes.

Kammerlander leads a team of researchers who aim to scrutinize the ecosystem and participants of family businesses, which range from mom-and-pop market stalls and shops to multinationals in every industry, through a marriage of robust scientific practices and innovative practical applications. While each enterprise has its own unique characteristics, there are many similarities. There is an authenticity, she shares, as families bind together in a collective pursuit of service and legacy. "Every family business is different," she says. "There are so many emotions, history, and traditions here." In fact, emotions often drive business decisions, and especially in good economic times, non-financial objectives, such as family harmony and reputation and job creation for family members, are often more important for family firm decision makers than economic goals, she notes. "Non-economic goals often appear 'irrational' to business partners – but they make perfect sense for the family!"

Nadine Kammerlander

A key attribute that has shaped her perceptive nature and dedication to this field is her background in physics. A budding experimentalist, Kammerlander became enamored with physics in high school. She kicked it up a notch as a student at the Technical University of Munich, where she graduated with a diploma in physics, with a focus on laser physics, bio/nano physics and semiconductors. While she loved learning about the universe, she was confused (as most physics majors are) about her career prospects. "My last few years of my studies I realized I didn't know what I wanted to do," she says. "I couldn't imagine being an engineer in a company- that wasn't me." But in her final year, Kammerlander got an invitation through one of her scholarships to attend a recruitment talk by representatives of McKinsey & Company, the world-renowned management consulting firm. Although she hadn't considered that organization for herself, she decided to give it a go. Sure enough, the presentation was enticing enough that she ended up applying for a role and landed it. Kammerlander's career was on its way.

Life at McKinsey was enjoyable, with opportunity to spearhead projects in product development in the automotive and high-tech sectors, and collaborate in a stimulating international setting with colleagues in Germany, the United States, and Mexico. When she learned that the company allowed its staff to pursue a PhD on paid leave, she jumped at the opportunity, and even received an offer to pursue one in physics in Munich. But Kammerlander's priorities were crystal clear. "Family was very important to me and I always wanted a family," she recalls. "I imagined taking on a PhD in biophysics and having to make the decision to stay home with a sick child or run an experiment, and that wasn't for me." So instead, she chose to get a PhD in management. But her time in consulting had uncovered a yearning to be

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PRX ENERGY CONTINUED FROM PAGE 1

community in the Physical Review family. What marks *PRX Energy* as different from other energy journals is the focus on open access, rigorous multidisciplinary energy research with a physics slant. Another differentiating factor is the rigor and transparency that is ensured through the peer review process that Physical Review journals are famous for.

I also cannot focus enough on the international nature of this journal. The applications of energy research affect everyone, and this research is truly an international effort to meet the urgent challenges our society faces. I am excited to assemble an international editorial board that represents that community and that provides greater insight into the global research community.

It is also the broader impacts of this research that indicate the need for an open access journal in this subject, so that we can move even more effectively toward the discoveries that can more efficiently harness energy and transform it, and develop innovative technologies. This motivates the editorial team to strive to deliver competitive publishing times, and ensure broader promotion and dissemination of published work to the broad, global, and diverse community.

What research are you working on right now?

My group uses *ab initio* calculations to predict the properties of new materials for a range of energy applications, including batteries, thermoelectrics, and photovoltaics. We are currently employing crystal structure prediction techniques to try to discover new lithium ion cathodes comprised of earth abundant, sustainable elements, which is a lot of fun!

Where do you see growth or emerging research in energy research? What do you think are the biggest problems for energy researchers to solve?

I think energy storage and generation will continue to grow steadily, especially as we attempt to deal with the current climate emergency. In my opinion, there is no more important problem to solve than this, and the health and wellbeing of future generations depends on how the energy community tackles these issues. I also think that due to this, climate policy research will be of the highest importance in the coming decades.

What advice would you give to someone submitting to *PRX Energy*?

As long as your paper comprises a significant advance in any area of energy research, then *PRX Energy* is the journal for you. I would advise interested authors to ensure that the importance of your findings is clearly highlighted in their submissions, to aid our editors in understanding why your work is right for *PRX Energy*. Send us a paper that you are proud of, that will be of great interest to the global interdisciplinary energy research community, and benefit from the reach and visibility that comes with open access—for which APS is covering the article publishing charges (APC) in 2022!—and our commitment to promoting the articles we publish in our inaugural year.

Learn more about and submit your manuscript to PRX Energy at journals.aps.org/prxenergy.

DAP CONTINUED FROM PAGE 3

institution is through the social aspect of in-person meetings," Fryer explained. "This is especially important for young scientists."

Looking forward, the DAP executive committee's goals for the division involve capitalizing on the unique ability of astrophysics to spark public interest in science. "We like to joke that astrophysics is the gateway drug for getting people interested in physics," said Fryer. He explained that in public outreach efforts, astronomical phenomena – neutron star mergers or supermassive black holes, for instance – can be an excellent jumping off point for discussing some of the most interesting questions in physics. For example, a non-scientist may not immediately appreciate why researchers are excited about (and why hundreds of millions of dollars have been invested in) the newly constructed Facility for Rare Isotope Beams, but their curiosity could be piqued if the discussion is framed in terms of the project's relevance to understanding the Big Bang and the forces that shaped the early history of the universe. "Getting the public interested in physics is critical – both for securing funding and for an educated society," Fryer elaborated. "If astrophysics can help spark interest in more physics fields, that's what I would like to see."

Promoting the participation of women and under-represented minorities in the astrophysics community is another key priority within the division. DAP is composed of over 20% women, placing it among the top three APS divisions for gender diversity, but still with ample room for growth. DAP also benefits from strong diversity at the leadership level: Men and women are equally represented in DAP's four chair line positions, and women account for an impressive 7 out of 11 members on the executive committee as a whole. In a hopeful trend, much of DAP's recent growth has come from a new and more diverse generation of students and early-career scientists. As it currently stands, nearly 50% of DAP members are undergraduate or graduate students.

Overall, DAP stands out as a close and collaborative community at the cutting edge of one of the most high-profile and dynamic areas in physics. As Fryer put it, "If you're doing astronomy and you're trying to build ties with plasma physicists, nuclear physicists, and gravitational physicists, DAP is the conduit. Likewise, if you're a physicist who wants to broaden your impact on astronomy, DAP is also there to help you."

More information on this unit can be found on the DAP website.

The author is a freelance writer in Stockholm, Sweden.

Note: Physical Review D has recently expanded its coverage of astrophysics and astronomy with the appointment of a new Associate Editor, Enrico Ramirez-Ruiz, Professor and the Vera Rubin Presidential Chair of Astronomy and Astrophysics at the University of California, Santa Cruz.

APS Honors Members for Outstanding Science Policy Advocacy

BY TAWANDA W. JOHNSON

APS Government Affairs (APS GA) is thrilled to announce that 10 Society members have been selected as Five Sigma Physicist awardees for their outstanding efforts to enable or participate in advocacy activities, which included taking multiple actions during the past year and maintaining communication with APS GA staff.

This year's honorees participated in various initiatives to help advance APS's science policy priorities, including: leading the effort to update APS's Statement on Earth's Changing Climate, supporting equity in research funding, meeting with key officials on research security concerns, advocating for nuclear disarmament, co-chairing the Society's recent missile defense study, and signing all of APS GA's advocacy letters throughout the year.

Taking the lead on updating APS's Statement on Earth's Changing Climate and other related activities made William Collins a standout for the Five Sigma Physicist Award. The APS Council approved a revision of the Society's climate change statement in November 2021. The updated statement clearly implicates human activities as the "dominant driver" of climate change. Collins was also instrumental in supporting the Society's role in the reversal of the rollback of regulations on methane emissions impacting oil and gas companies. Hundreds of APS members contacted Congress in support of joint House and Senate resolutions that disapproved of the rollback of the regulations, and President Joe Biden signed legislation into law on June 30, 2021, restoring the Obama-era methane regulations.

"I have enjoyed collaborating with great and dedicated colleagues from all fields of physics while chairing the APS Panel on Public Affairs and working with the talented staff of APS Government Affairs," said Collins, Director of the Climate and Ecological Science Division at Lawrence Berkeley National Laboratory. "It was important to translate our understanding of the physics of climate change into action to address this grand challenge."

For awardee Gerald C. Blazey, Vice President for Research and Innovation Partnerships at Northern Illinois University, advocating for equity in research has long been an important issue.

"As citizens, I believe we have a responsibility to participate in the political process, and as scientists, we can bring trained viewpoints to the process. For example, ensuring equity in research opportunities for all students is an important policy goal, and the issue can be illuminated and informed by a quantitative analysis of the distribution of federal research funding compared to data on student populations at the universities receiving the funding," explained Blazey. He submitted testimony on Capitol Hill and co-authored an op-ed on research equity in *The Hill* with Past APS President Sylvester James Gates, Jr. APS members' work paid off handsomely in this area, as the NSF for the Future Act includes a number of APS's policy priorities, including the broadening participation of research to bolster the domestic STEM workforce.

Gates, whose many affiliations include physics professor and Director of the Brown University Theoretical Physics Center, is also among this year's Five Sigma Physicist Awardees. He was active in multiple activities, including advocating for equity in research funding, addressing research security concerns through letters and meetings with federal officials, as well as taking active roles in policy initiatives impacting visas and immigration and global competitiveness.

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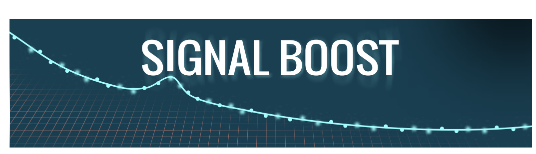

Signal Boost is a monthly email video newsletter alerting APS members to policy issues and identifying opportunities to get involved. Past issues are available at go.aps.org/2nr298D. **Join Our Mailing List: visit the sign-up page at go.aps.org/2nqGtJP.**

FYI: SCIENCE POLICY NEWS FROM AIP

White House Clarifies Disclosure Requirements for R&D Funding

BY MITCH AMBROSE

At the outset of 2022, the White House released guidance for science agencies to use as they implement National Security Presidential Memorandum 33 (NSPM-33), a directive that sets minimum requirements for research security policies across the government. NSPM-33 was issued by the Trump administration during its final week and the Biden administration so far has chosen not to modify it, opting instead to shape how the policy is applied.

The new guidance document aims to address continued confusion over what information federally funded researchers must disclose to the government pursuant to NSPM-33, and to address concerns about the administrative burdens of disclosure and the potential for unfair enforcement. Such matters have taken on high stakes, particularly as the Department of Justice has prosecuted more than a dozen academic scientists over the past three years for allegedly concealing their ties to institutions in China.

The interagency panel that produced the document was charged by White House Office of Science and Technology Policy Director Eric Lander to craft guidance that addresses risks posed by researchers' connections to certain foreign governments while also ensuring such policies do not stoke discrimination and xenophobia.

Acknowledging that tension, the document states that agency policies must be implemented in a nondiscriminatory manner and should be "risk-based," meaning they "offer tangible benefit that justifies any accompanying cost or burden."

At the same time, it stresses, "There have been efforts to induce American scientists to secretively conduct research programs on behalf of foreign governments or to inappropriately disclose non-public results from research funded by U.S. government sources." It also specifically identifies China, Russia, and Iran as examples of countries with governments that are "working vigorously ... to acquire, through both licit and illicit means, U.S. research and technology."

The guidance document does not address criminal justice matters, focusing instead on standardizing disclosure requirements and their enforcement by science agencies.

FYI SCIENCE POLICY NEWS FROM AIP

Outlining what sorts of information will be collected and on what forms, the document includes a detailed table indicating the kinds of organizational affiliations, monetary support, and "in-kind" support that must be disclosed. Lander has charged federal agencies with using this blueprint to produce "model grant application forms and instructions" within 120 days.

NSPM-33's disclosure requirements apply to principal investigators and "other senior/key personnel" on federal grants, as well as agency program officers, researchers at federal labs, peer reviewers, and federal advisory committee members. The guidance document adds that students should generally be exempt from making disclosures to science agencies.

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of patients with irregular heartbeats. First demonstrated around 1930, early pacemakers were large machines that stimulated the heart from outside of the patient's body. The device invented by US doctor Albert Hyman, credited with coining the term "artificial pacemaker," weighed more than seven kilograms. The pacemakers also needed to be plugged in, meaning they would fail the patient in case of a power outage.

But by 1957, Earl Bakken had invented the first wearable battery-operated pacemaker. In 1959, Wilson Greatbatch patented the first implantable pacemaker. During Boykin's tenure at CTS, the company collaborated with Greatbatch, where they adopted Boykin's resistor design for use in the device. The 1968 *Pittsburgh Courier* article mentions the resistor in its "control unit," presumably the part of the pacemaker that sets its frequency.

It's unclear which of Boykin's multiple resistor designs was featured in the pacemaker. One possibility is his "cermet" resistor, standing for "ceramic metal," patented in 1966. This resistor consists of finely ground glass mixed with metal powder on a thin substrate.

Another possibility is his wire-wound resistor, patented in 1961, in which a metal alloy is wrapped around a flexible insulator. In his patent, Boykin writes that his resistor could be made compactly by compressing the insulator into a ribbon shape and folding it up. This was an innovation upon the conventional wire-wound resistors at the time, which were spun around a spool and took up more space by comparison. Boykin also writes in his patent about minimizing the resistor's inductance and capacitance effects, which would affect the shape of pulses if used in a pacemaker. Boykin also claimed that his design allowed for a stable robust to temperature fluctuations and extreme accelerations. The design resembles an in-between of two different resistor types, a wire-wound resistor and film resistors, which consists of a flat substrate with a thin deposit of metal or metal oxide, according to physicist Randolph Elmquist of the National Institute for Standards and Technology.

Boykin left CTS in 1964 and became an engineering consultant, where he had clients as far as Paris, France. As described by the *Pittsburgh Courier* in 1968, Boykin was a "reserved, soft-spoken, yet eloquent, well-dressed individual who golfs on week-ends, advises youth on sports and takes frequent trips to Europe in his business interests." He also participated in an international effort to bring technological advances to the country of Guyana.

In later years, Boykin had a contentious relationship with his former employer. In 1975, Boykin sued CTS, alleging that the company unjustly acquired exclusive control over two of his patents. He also sued them for libel because the company claimed that Boykin improperly used their proprietary information. A year later, the lawsuit was dropped.

Boykin's inventions offer snapshots in the evolution of technologies still in use today. Pacemakers have grown more sophisticated: one 2021 prototype from Northwestern University consists of entirely biocompatible materials that can be absorbed into the body in a matter of weeks. While wire-wound resistors are much less popular than thin film resistors because of their expense, people still use them in specialized applications. For example, the US government still uses wire-wound resistors as resistance standards because of their stability, says Elmquist.

Boykin died in Chicago in 1982 of heart failure. He was survived by his wife, Pearlie Mae Kimble, whom he married in the 1940s. They had no children. He held at least 25 patents at the time of his death.

Sophia Chen is a freelance writer based in Columbus, Ohio.

Further reading:

R. Stites, "Boykin, Otis Frank." (*Texas State Historical Association Handbook of Texas*, May 21, 2021).

P.C. Sluby, *The Inventive Spirit of African Americans: Patented Ingenuity*, 2004.

O. Aquilina, "A Brief History of Cardiac Pacing." (*Images in Paediatric Cardiology*, April-June 2006).

K. Jeffrey and V. Parsonnet, "Cardiac Pacing: 1960-1985." (*Circulation*, May 19, 1998.)

FYI CONTINUED FROM PAGE 4

The exact requirements vary based on the nature of the role of the person in question. However, consistent with federal concern over "foreign government-sponsored talent recruitment programs," participation in such programs must be universally disclosed for all roles.

The guidance document reiterates that disclosure policy violations can warrant a range of consequences, including criminal and civil penalties as well as administrative actions, such as rejecting an application, dropping personnel from a grant, and barring personnel or entire organizations from receiving future funding. Factors agencies may consider when deciding their course of action include the "harm or potential harm" caused by the violation, the researcher's knowledge of the requirements, whether it is an isolated incident or part of a pattern, and whether the researcher was forthcoming in correcting omissions and mistakes.

Notably, the document does not describe what kinds of institutional connections should be considered unacceptable, or how exactly agencies should act on the information disclosed to them. OSTP has indicated that an interagency panel will likely develop separate guidance this year on appropriate uses of disclosed information.

The author is Director of FYI.

ADVOCACY

Meet the 2021 LeRoy Apker Award Recipients

BY DAVID BARNSTONE

The APS LeRoy Apker Award recognizes up-and-coming scientists who demonstrate great potential in physics based on outstanding achievements in undergraduate research. The award is presented annually to two students: one from an institution that grants doctoral degrees and one that does not. Each recipient receives $5,000 for themselves, $5,000 for their undergraduate institution's physics department, and an invitation to give a talk at an APS meeting.

The 2021 Apker Award recipients Caelan Brooks (Kutztown University of Pennsylvania) and Joseph R. Farah (University of Massachusetts Boston) were among seven finalists to present their work to a panel of esteemed physicists in August. *APS News* recently caught up with Brooks and Farah, who are now pursuing their PhDs at Harvard University and the University of California, Santa Barbara, respectively. This interview has been edited.

Caelan Brooks

Joseph R. Farah

Tell me about your experience presenting your research to the selection committee.

Brooks: The biggest challenge in the preparation process was to craft a cohesive presentation that conveyed a complete picture of my undergraduate research, which spans two fairly different subfields: AMO physics and biophysics. Advice and feedback from my research mentors were very valuable. When it came to presenting, I was incredibly nervous but also confident in my research and preparation. The presentation evolved into a conversation about my research with clarifying questions and new ideas which brought new perspectives. Looking back, I find myself very lucky to have discussed my small contributions with some of the best physics minds.

Farah: I enjoyed presenting my research to the Apker selection committee. I'm very passionate about my research, so to have an opportunity to discuss the nitty-gritty details with the eminent physicists of the day was an amazing opportunity I am incredibly grateful to have received. Though the following questions period was relatively short, the inquiries and ideas brought up had a serious and lasting impact on my research. Additionally, most of the committee remembered me from my finalist presentation the previous year, which was awesome. Several of the committee members even recalled the details of my research and asked questions connecting my previous project to this one, which led to some unexpected and fruitful discussion.

Why is it important for APS to recognize achievements in undergraduate research?

Brooks: Undergraduate research provides this unique opportunity to introduce students to the world of scientific research who might otherwise never consider such career pathways. This introduction to research is about discovery, and it encompasses a large degree of novelty which makes the process exciting and at times scary and very challenging. APS, by recognizing undergraduate research, places value in this discovery process and celebrates the persistence of young scientists in a world that can feel very foreign to them. Recognitions such as the Apker award give confidence and encouragement to new physicists like me.

Farah: APS awards provide important context and opportunities to develop skills that will be critical for a career in STEM. In preparing for the LeRoy Apker Award, I learned how to properly prepare and present years worth of work to a technical audience in only a few minutes. Preparing for, competing for, and receiving the award gave me the opportunity to interact with and learn from many accomplished and experienced scientists as well as giving my research substantial exposure to interested groups. Overall, APS awards help students develop as scientists by providing a goal to strive towards and motivating interaction with a diverse network of professionals.

What is the significance of this award to your undergraduate institutions?

Brooks: Kutztown University is a public school focused primarily on teaching and education, and is part of a larger conglomerate of 14 Pennsylvania state schools. As far as I know this is the first national physics prize for undergraduate research awarded to any school in this system. Within this context, I am still completely in awe to have been awarded the Apker Award. Many students at KU, like myself, come to college without any knowledge of what scientific research is. To go from that beginning to being nationally recognized for my research is a testament to my mentors who have invested so much in my growth as a physicist without ever expecting any return on their investment. It is these professors who I hope are able to see the impact they have made and the significance this brings to Kutztown University and their work.

Farah: The award will inspire future generations of students at UMass Boston to be actively involved in research as undergraduates and to compete for prestigious national awards. UMass Boston is one of the most diverse public higher education institutions in New England with 60% students of color and 61% first-generation college students. The national recognition of their efforts will inspire UMB students to work towards future careers involving research in STEM fields. Many of my classmates and closest friends within the department have also gone to success in grad school and beyond. For example, Jonathan Delgado has gone on to pursue a PhD at UC Irvine, and another student (Sarah True) from UMB Physics was awarded the Barry Goldwater Scholarship in 2021. This pattern of success is a consequence of early identification of good students and the ability to focus on their development that comes from being a small department at a university that highly values teaching.

Why did you study physics in college?

Brooks: I chose to major in physics because I really enjoyed the objectivity of math and the ability it gives us to explain the universe. Through taking more courses in college, it was the small aspects of the material that kept me hooked. The introduction to the quantum world through class and research allowed for me to develop a physical intuition for objects that I could not physically see. My research in biophysics taught me how far the applications of physics can reach. For me, the beauty of the accumulation of physics knowledge and physics research is the ability to look at something we do not understand in a different light. These new perspectives open up new questions and interpretations. That fuels the flame of curiosity.

Farah: I've always loved physics. There's something almost scary about being able to make claims about the universe the way we do in physics. For example: the Universe is expanding. That's such a cool and terrifying fact. It makes me think about the universe like it's a living thing, and then that makes me want to carefully classify every single thing inside of it and understand how it all works on micro scales and macro scales and everything in between. I also like working with equations and data and learning things from a wide array of fields, like chemistry and geology, and physics gives me that opportunity.

What research questions are you pursuing in graduate school?

Brooks: My first semester of graduate school at Harvard has awarded me the time to wrap up my undergraduate research work and present it. Completing my undergraduate degree in three years left me with my research projects unfinished. In addition, the pandemic, spanning half my college experience, prevented me from presenting my work in person. This semester has allowed me to finish writing some of the papers from my undergraduate work which are soon to be published and also attend a conference in person to present my biophysics research. These experiences, as well as adjusting to graduate school have made me excited to start graduate research work as well as be a part of this vibrant academic community, within which I will continue to explore to find the kind of research that will be the best fit for my doctorate.

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in Britain, and at King's College London, earned first his bachelor's and then in 1957, his doctorate, on analogue computing, under Donald MacKay.

At King's College, Fisher met two people who would change his life: Cyril Domb, who introduced him to critical phenomena, and Sorrel Castillejo, a math student born in Spain. Fisher and Castillejo bonded over Spanish music, and within a few years, they married. With her, Fisher had four children, two of whom also became physicists.

In 1966, Fisher moved to Cornell University where he was a professor of physics, chemistry, and mathematics. He stayed in Ithaca for two decades, among a cadre of condensed matter physicists working in both theory and experiment. Then, in 1987, Fisher moved to the University of Maryland, where he stayed until retiring in 2012.

Throughout his career, Fisher applied his talents to a variety of problems, including polymers, magnetism, and fundamental questions in statistical mechanics. But it was the entire range of critical phenomena that drew him in: condensation, surface behavior such as wetting, and phase diagrams of all kinds.

"Things are not what we might expect," Fisher said at a recent colloquium. "That's the first thing that underlies the theory of critical phenomena." He was fascinated by the sharp transitions that occurred when ferromagnets passed their Curie point, and vapors reached critical opalescence. He was especially interested in why criticality seemed to be universal across different systems, even as the size of the system changed dramatically.

Because of his theoretical insight and deep attention to experimental data, Fisher "was the person everyone went to, to figure out what was happening in critical phenomena," according to Wilson. One of the most important features in critical phenomena was known to be the dimensionality of the system. Wilson's renormalization group was a brilliant advance, but it had to be calculated numerically for a system like a three-dimensional Ising model. In 1972, Fisher worked with Wilson to develop continuous dimensionality, a mathematical tool that tamed the recursion relations so they could be calculated analytically.

Later in life, Fisher became interested in the biophysics of molecular motors. "He would go to conferences, and present posters—I find that horrible for me to do at my stage—but Michael was ever the student, he just went and

Michael Fisher AIP EMILIO SEGRÈ VISUAL ARCHIVES, PHYSICS TODAY COLLECTION

he carried his poster," said Dave Thirumalai, a professor of chemistry at The University of Texas at Austin.

In addition to an unforgiving work ethic, Fisher treated academia as sacrosanct and held himself and others to scrupulous standards. "Michael was kind of, if you wish, the terror of the statistical mechanics conference," said Lebowitz. "He would always sit in the front row, take notes and ask sharp questions."

Fisher was infamous for the red pen that he used to correct errors and make suggestions, as N. David Mermin and Neil Ashcroft wrote in the acknowledgement to *Solid State Physics*, "often making our lives very much more difficult by his unrelenting insistence that we could be more literate, accurate, intelligible, and thorough."

Though his exacting standards could make Fisher a challenging mentor, learning from him was valuable, according to Liu. "It wasn't something you could take for granted in those days, but he treated me exactly the way he would have treated a male student," she said. "Gender was never something that entered into any scientific discussion. When we talked science, it was science."

Fisher was known for frequently helping younger researchers without taking credit, and a meticulous level of organization, whether it was ordering food for a table or finding student records from decades past, Lebowitz said.

Beyond physics, Fisher taught, played, and wrote about Spanish guitar, applying the same level of intensity and rigor as he did physics.

In one of his recurring columns for *BMG Magazine*, "The Art of Flamenco," Fisher discussed performance factors, weighing the pros and cons of seemingly minute details: "The correct length of the thumb nail needs more consideration and I will take this up again in a later article," he concluded.

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

KAMMERLANDER CONTINUED FROM PAGE 3

impactful, and when it came time to focus her doctorate, Kammerlander realized that she could have the most impact by studying the category of business that impacts the most people globally: family businesses.

Her doctorate centered her sense of service and ignited a desire to discover and share more information about family enterprises, leading to her current position as a professor and scholarly leader in this space. Kammerlander's research aims to clarify common challenges that family businesses face and offer sound, evidence-based solutions, something she syphons from her physics background. Her current investigations deal with digitalization. A standard scenario might be a family company that sells something in a "real world" location. As the next generation becomes more active in the day-to-day enterprise, they introduce new mechanisms to leverage technology to improve systems, sales, and market share. "Nowadays, kids are less likely to take over these old-fashioned businesses," she says. "Instead, the kids are launching start-up ventures in the same industry as their parents but with a digital model."

Kammerlander recently examined a furniture company, where the founder's daughter sold lamps she had designed online, and later folded her business into her parent's firm, expanding the family business beyond the brick-and-mortar. In another case, a family-owned hotel chain began utilizing software to speed up room service and decrease inefficiencies, as one of the children became more engaged.

> "When we identify best practices and barriers and teach them to the family businesses, they can run their business better and avoid the negative consequences related to unemployment, bankruptcy, and other challenges."

This is critical work, and the stakes are high. Given the significance of family firms to economic health, if these businesses fail, it leads to higher unemployment rates, as well as the potential for foreign companies to swoop in and buy up these enterprises as they hit bankruptcies, resulting in high risk and volatile economies. "It's important for us as scholars and society to make sure these companies can fit in the future," she says. "When we identify best practices and barriers and teach them to the family businesses, they can run their business better and avoid the negative consequences related to unemployment, bankruptcy, and other challenges."

To further enable the success of the businesses for which she cares so much, Kammerlander engages in lots of outreach, including hosting a podcast specifically for family-run companies. She also consults for businesses. One of her wins was collaborating with a business with 200-300 employees. One of the owners had read one of her papers and contacted her, asking for assistance in how they could upgrade to digital systems. "We worked with that company and did three design thinking workshops with owners, management, and employees, and the outcome was a roadmap for digitalization that they are implementing." Now, Kammerlander and her team are expanding to present these workshops on demand.

Not surprisingly, physics has proffered a superb underpinning for her life's work. From helping her understand statistics and the meaning behind data, to using logical proofing techniques she gained from her mathematical coursework to come up with "theoretical argumentation that is waterproof," Kammerlander reaps the benefits of her degree all the time. "Even though physics and family business research are quite far away from each other, I still profit a lot from what I learned from my studies. It helps me focus on details and logic," she says. "Also, sometimes I have an intuitive feeling if numbers are correct or not. I get my colleagues who say 'I guess it's wrong'. But it turns out I was right."

In 2020, Kammlerlander became more than a scholar in this arena, as she, her parents and brother founded their own business that serves small and mid-sized companies needing support in sustainability. "I can now apply all the research here and see how this works in practice," something which brings her and her kin a new sense of pride and joy. This spark reminds Kammerlander about the dawn of her journey, as a wide-eyed physics major, with a thirst to unravel our makeup, and a need to invest in her own family makeup. And it propels her further, as she continues today as a researcher and entrepreneur. "I love physics. It is great," she says. "But I also love management research and I wouldn't change my job for any other job in the world. It gives me so much freedom. There has never been a moment of boredom. It's so pleasurable and enriching to work with family businesses."

APKER CONTINUED FROM PAGE 5

Farah: I am interested in helping establish better theoretical foundations for astrophysical processes to facilitate more precise and informative measurements. I particularly enjoy projects that use novel or recent theories to derive observational signatures, then look for those signatures in data using rigorous modeling. At UCSB, I hope to apply this pipeline to the study of supernovae and dark energy and help bring scale to our understanding of the universe. In addition to studying supernovae, I will continue my work with the Event Horizon Telescope Collaboration, helping produce images and movies of black holes, constructing methods for recovering rotational dynamics, and testing general relativity in the strong gravity regime.

The 2021 Selection Committee members were David Gross (Chair), Philip Bucksbaum (Vice-Chair), Nima Arkani-Hamed, Charles Conover, Yuliya Dovzhenko, Shelly Lesher, Geoffrey Lovelace, and Theodore Yoder. For more about the award or to find out how to apply, visit the LeRoy Apker Award page.

The author is APS Head of Public Relations.

5 SIGMA CONTINUED FROM PAGE 4

"Many times during my term as APS President, I was told this period over the last two years has been the most tumultuous for the Society since the 1960s," said Gates. "We are currently living through a time of multiple transitions. In such circumstances, good decision-making becomes even more important. All of us concerned about the welfare of our discipline need to be involved, and that is my firm belief."

Barbara Cruvinel Santiago, Matt Caplan, and Alan Kaptanoglu received Five Sigma Physicist awards for their advocacy in the area of nuclear disarmament, as well as other science policy activities. They met with congressional offices in support of the No First Use Act of 2021, putting into action the training, education, and independent research they had pursued as Next Generation Fellows, a program supported by the Physicists Coalition for Nuclear Threat Reduction. The coalition was launched in 2020 to inform, engage, and mobilize the US physics community around the danger posed by the world's nuclear weapons. The APS Innovation Fund supports the coalition while APS GA guides coalition leaders on advocacy topics and in other pertinent areas. Going beyond their role as fellows, Cruvinel Santiago and Kaptanoglu each joined additional APS advocacy campaigns on research security and R&D respectively, while Caplan supported the coalition's video development committee.

As for why she became involved in science policy advocacy, Cruvinel Santiago, a physics PhD student at Columbia University, said, "I can never stay quiet when I know there's something that needs fixing or improving that I can contribute to."

Caplan, assistant professor of physics at Illinois State University, added, "Physicists are uniquely prepared to advocate for changes to US nuclear policy. What's the point of having expertise if you won't share it through education and advocacy?"

Crucial world issues drew Kaptanoglu, a postdoctoral researcher at the University of Washington, to science policy advocacy. "I am deeply concerned about the growing threats of nuclear war and climate change, and policymakers need accurate science communication to address these challenges," he said.

Relatedly, Five Sigma Physicist awardees Fred Lamb, Laura Grego, and James Wells have been tireless in their work as co-chairs of the forthcoming APS ballistic missile defense technical assessment report, which focuses on whether current or proposed systems intended to defend the US against nuclear-armed intercontinental ballistic missiles (ICBMs) could be effective in preventing an attack by North Korea using ICBMs.

"I want to play a role in making the world a safer place by reducing the threat of nuclear weapons. I see advocating for improvements in science policy as an important way to do this," said Lamb, a physics professor at the University of Illinois at Urbana-Champaign.

Added Grego, the Stanton Nuclear Security Fellow in the Department of Nuclear Science and Engineering at MIT, "I very much believe that what you can do, you must do. Scientists' training as critical thinkers mean they are powerful and credible voices that policymakers tend to listen to."

Wells, a physics professor at the University of Michigan, echoed his colleagues' sentiments: "It is our duty as scientists to be good stewards of the funds that citizens provided to make our research possible, and good stewardship requires conscientious participation in science policy and decision making."

Jay Marx, former Executive Director of LIGO Laboratory, made a big impression on the judges for this year's award after signing all of APS GA's advocacy letters to Congress.

"I hope that I might have some small impact on encouraging government officials to understand the importance of science and to support science," he said.

"The announcement of APS's Five Sigma Physicists is a highlight for the government affairs team every year," said Mark Elsesser, APS Director of Government Affairs. "Effective advocacy is critical to achieving our science policy goals, and I continue to be impressed by APS members' commitment to helping us move the needle in the right direction."

"Effective advocacy is critical to achieving our science policy goals, and I continue to be impressed by APS members' commitment to helping us move the needle in the right direction."

The author is APS Senior Public Relations Manager.


William Collins


Gerald Blazey


S. James Gates, Jr.

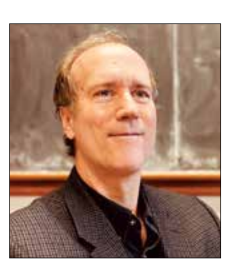

Barbara Cruvinel Santiago

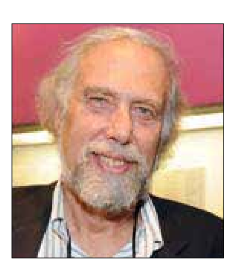

Matt Caplan


Alan Kaptanoglu


Fred Lamb


Laura Grego


James Wells


Jay Marx

MARCH CONTINUED FROM PAGE 1

Industry Days will also be featured during the meeting – a series of interesting activities that bring together graduate students, early career scientists, industry professionals, and academics who want to stay up-to-date on the latest happenings in industry and applied physics. This year's Industry Days will showcase the diverse activities of physicists who work in non-academic careers.

Those attending the meeting in-person will notice some differences around the convention center this year. For one, all attendees will be required to wear a N95, KN95, KF94, or 3-ply surgical mask at all times except when actively presenting, or eating and drinking. Additional health and safety measures to mitigate the spread if COVID-19 include a proof of vaccination requirement, submission of a negative test result, and a daily attestation that attendees are free of symptoms and have not knowingly been exposed to the virus.

Attendees will also notice an increased emphasis on sustainability. All signage will be recyclable, resource-intensive meat products will be discouraged, and water coolers will be available for refilling reusable water bottles. Additionally, APS is offering attendees the option to offset their carbon emissions resulting from their travel to Chicago by adding a nominal fee to their registration.

Registration for the 2022 March Meeting is open through the meeting. Discounted registration is available through March 7.

The author is APS Head of Public Relations. APS Senior Public Relations Manager Tawanda W. Johnson contributed to this article.

COUNCIL CONTINUED FROM PAGE 1

graduate application fees, as her parents were unable to assist. She added two "wish" schools to her list, was accepted to both, and later won an NSF graduate fellowship. Thus my small gift was multiplied many times over. There are so many deserving students who just need a little assistance to get launched.

(3) Focus on implementation of rules for **Ethical Conduct in Physics** at meetings. Session chairs have primary responsibility to set the tone and preside in our meeting sessions. I'd like to see APS offer **training materials for session chairs** to promote a welcoming and inclusive environment for both speakers and audience, whether in-person or remote. And to bring the new ethics rules to the attention of our members, I'd love to see APS start a campaign called "Don't be a d^3x/dt^3," where d^3x/dt^3= "jerk." T-shirts are already available! See https://www.amazon.com/Dont-JERK-d3x-Math-T-Shirt/dp/B07XJRNL9J .

(4) **Communications** are central to everything we do. I plan to ask our Unit representatives how APS can better support communication between Unit leadership and members, and communication among members. Is APS Engage fulfilling its promise as an ad-free social network? Or would unit leaders prefer to use Slack, Facebook, LinkedIn, or something else?

(5) **Meetings** are also on my mind. Many APS Units sponsor online seminars these days, demonstrating that we can hear excellent talks without cramming thousands of people into a conference facility. The associated cost and inconvenience of travel, the carbon footprint, and risk to public health all must be considered. Now that we've realized the benefits of online meetings, we're not going back to in-person only. Hybrid meetings will eventually become our new normal. But what is the best way to organize a hybrid event? I'm looking to our Unit leaders for ideas.

Among the Council's responsibilities are oversight of the Society's journals and approval of policy statements. What are some of the challenges facing APS and the Council in these areas?

The transition of **APS publications** from subscription-based to open access (OA) is well underway. Navigating this changing landscape means that APS cannot simply continue business as usual. Luckily the Council can depend on expertise from outside consultants, from our publications professionals, and from our own APS leadership to help us understand the issues at hand.

In my view, the trouble with conventional OA journals is that far too much administrative labor is wasted on sending and receiving small payments. One solution is for large university systems to negotiate annual contracts, but that option won't work for everyone.

As an alternative, I'd like to see APS create a new platinum OA journal that's free to both readers and authors, with financial support from generous sponsors, just like public television. APS could make the journal attractive to authors by providing a robust public outreach effort to make journal content accessible to the general public.

Policy issues that come before the Council often involve national and international affairs that go well beyond my physics training. I've needed to undertake quite a bit of reading to learn about the issues at hand. One of the most challenging issues facing the physics community this year is research security and in particular the Department of Justice's China Initiative.

Tell me about your path in physics and with APS.

My lifelong fascination with theoretical/computation physics was sparked by an NSF-funded high school research internship at Boston University. I was assigned to work with H. Eugene "Gene" Stanley, an amazing and inspiring mentor. Having learned to program with a little TRS-80 Radio Shack computer at my high school, I was so excited to run Monte Carlo simulations on an IBM mainframe. When the six-week summer internship ended, Gene invited me to stay, and I spent much of my senior year doing research at BU. I later pursued both undergrad and graduate study at Harvard and continued working with Gene, who supervised my dissertation work. After postdocs at UCLA, University of Maryland, and NIST, I joined the physics faculty at Catholic University of America in 1995, and later moved to Kent State in 2005.

Early exposure to research is a highly effective way to get students interested in STEM. It certainly worked for me. To "pay it forward," I organize research internship placements for high school students dual-enrolled at Kent State.

What are some of your current research interests?

My students and I model shape-morphing dynamics of liquid crystal elastomers, a class of stimuli-responsive programmable solids. These fascinating materials morph under stimuli such as a change of temperature or illumination, and their trajectory of motion is programmed by patterning the liquid crystal director when the material is cross-linked. I've had a lot of fun working with experimenters to understand their most puzzling results. Most recently my group is developing a machine learning approach to address the inverse problem, that is, to design a liquid crystal director field to produce a desired shape deformation. Another topic we're pursuing is the study of disclination line defects in liquid crystals. We're exploring how the Frank-Read mechanism works to drive heterogeneous defect loop nucleation in nematic liquid crystals, a close analog of the process that drives heterogeneous dislocation nucleation in ductile crystalline solids. But while such sources form stochastically in crystals, in nematics we can create them via a "materials by design" approach.

What else would you like members to know?

I hope our members will join me in extending thanks to the hard-working professional staff at APS, along with our dedicated volunteers, who have together managed to keep the organization moving forward, in spite of the challenges of the pandemic. A special thanks to APS Corporate Secretary Jeanette Russo who keeps the Council on track, along with our most recent speakers, Baha Balantekin and Andrea Liu, who both served with wisdom and good humor.

For more information about the APS Council, visit aps.org/about/governance/leadership/council/.

THE BACK PAGE

Embracing Instability—and Difference

BY STEPHON ALEXANDER

A global virus pandemic brings the world to its knees. The stock market suddenly drops, inciting fear from investors. A star collapses to form a black hole. These events all have one thing in common. They are all instabilities that correspond to a catastrophic growth in some quantity that leads to an unwanted outcome. In physics, sometimes the bad outcome of an instability threatens to obliterate the validity of the theory itself. The quantum revolution was born in part as a result of taming instabilities in atomic systems, such as the ultraviolet catastrophe and the instability of classical atomic orbits. In recent times, billion-dollar particle accelerators were built to look for supersymmetric particles that function to tame an instability that would lead to a catastrophic growth in the masses of all matter. Many physicists were confident that this pattern of fixing instabilities would lead to experimental confirmation of supersymmetry, but it didn't happen. Are all instabilities tragic, or are some useful for our universe's functioning in hidden ways that could lead to new directions in our understanding? What are instabilities, especially of the quantum type, trying to tell us about the new physics?

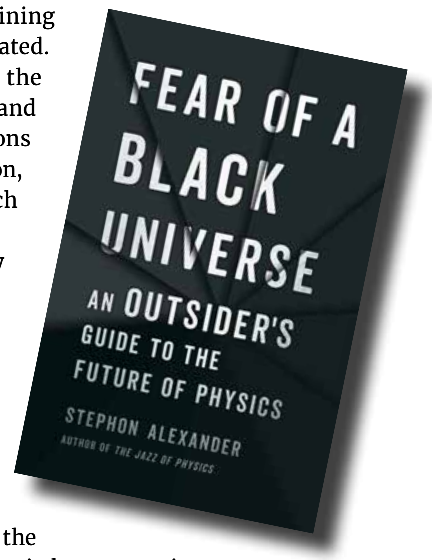
Recall that the discovery of quantum mechanics was ignited by a handful of instabilities found in classical physics. Our very existence owes to the stability of the atomic structure of hydrogen and oxygen in water molecules, but classical physics predicts that all electrons should spiral into protons, making the classical atom unstable. Every time the electron orbits around the proton it radiates away electromagnetic energy, which reduces its distance to the proton. Eventually it spirals into the proton, rendering the atomic system unstable. By quantizing the orbits of the electron by associating each orbital distance with a wave, the electron, like the lowest vibration on a guitar string, would have a lowest orbit allowed.

Another type of instability is when a system's energy continues to grow without bound. This is similar to falling down an infinite hill—your kinetic energy would continue to increase until it reaches infinity. And this contradicts relativity, which says nothing can go faster than light. Ironically, while quantum mechanics was invented to tame classical instabilities, it was later discovered that even quantum systems can have instabilities. For instance, when we consider the quantum effects of electrons, what we perceive as empty space in front of us turns out to contain a form of energy due to the activity vibrating quantum fields. This contribution to energy (often called vacuum energy or dark energy) is very large and should dominate the energy of the universe, causing this expansion to accelerate so fast that galaxies would not have a chance to form. This is known as the cosmological constant or dark energy problem, and as of today there remains no solution.

During my time at the Stanford Linear Accelerator Center, young string cosmologists like me were seeking out pathways in the jungle of ten-dimensional calculations to find solutions that have a small and positive cosmological constant. My colleagues Shamit Kachru, Renata Kallosh, Andrei Linde, and Sandip Trivedi (KKLT) found a remarkable pathway involving the de Sitter space, but many questions naturally emerged and, for the moment, a topic of active research.

The KKLT result supports a conjecture that string theory can accommodate a vast array of values of the cosmological constant, and our universe was just one of many, each with their own specific value, the cosmological constant. This landscape of universes is consistent with the anthropic principle, which argues further that we necessarily live in a universe with a cosmological constant that is capable of supporting life like us, and so we shouldn't seek any deeper explanation for it. A big debate transpired in the cosmology and string theory community as to whether the anthropic principle was scientific. I decided to take another direction, which would risk further shunning from my colleagues. This new direction would mean that I would engage in conversations with the outsiders from my club and even import their ideas into a possible resolution of the cosmological constant problem. I was guided by the motto: "Let the nature of the problem dictate the tools you should resort to," even if it meant borrowing from the outsiders or risk becoming one yourself. Active (but positive) deviance was on the horizon.

That I even wanted to work on the cosmological constant problem was already deviant behavior. Postdocs were warned to not work on it—at least until we got tenure. But I was haunted by the beauty of the cosmological constant problem and was fine with joining the ranks of those that it defeated. Plus, it was my last year on the job market for a faculty job, and I did not have high expectations of getting a permanent position, so I did not feel like I had much to lose.



I know that if there was any way forward, I would have to find a new direction that was not thought of before. One day while having coffee on top of a hill in Nob Hill, I saw a similarity between the cosmological constant problem and a problem that haunted particle physics, the strong CP problem that came up in baryogenesis and the origin of our matter-filled universe. In the strong nuclear interaction, described by a theory otherwise known as quantum chromodynamics (QCD), the gluon is the particle that mediates the interaction between quarks that bind to neutrons and protons. Classically the neutron is electrically neutral, but quantum effects induced by QCD create a very large amount of net electric charge in the neutron that would destroy the stability of atoms. This would be catastrophic, given that we're made up of neutrons and protons. Like the cosmological constant in general relativity controlling whether the universe expands, is stable, or contracts, there is a parameter in QCD, called the theta parameter, that controls the amount that the neutron deviates from electrical neutrality. Experimentally the theta parameter was measured to be on the order of one billionth. So, the strong CP problem is relegated to a question as to why the theta parameter was so close to zero, a similar predicament as the cosmological constant.

In the late seventies, Helen Quinn and Roberto Peccei found an elegant solution to this problem, a hidden symmetry that accounts for a theta parameter close to zero. I wondered if we could reimagine the cosmological constant to act like the theta parameter of gravity. Luckily, Helen Quinn was at SLAC. She walked me through the inner workings of her solution and, while she had high standards for the creative and technical implementation of my idea, she was encouraging.

To take the analogy between a problem in QCD and gravity to a place where I could attempt to do a calculation, it would help if I could place gravity on similar footing with QCD, and there was one activity of research that already did that. In the arena of quantum gravity, string theory is seen as the only game in town, but it isn't. There are other attempts to quantizing gravity, even if they do not sit well with my string theory friends.

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One particular approach is loop quantum gravity (LQG), in which the starting point is to quantize gravity using the same methods as QCD. This possibility came from Abhay Ashtekar's ingenious insight to rewrite general relativity using variables identical to QCD. The idea required me to use the Ashtekar formulation of gravity in the presence of a cosmological constant. When I spoke to the other postdocs about loop quantum gravity, many of them dismissed the theory as "loopy" and suggested that anyone that would work on that theory does not know physics. But I already felt like an outsider and pursued loop quantum gravity anyway. Besides, when I pressed some members of the group to provide a solid critique about loop quantum gravity rather than just make fun of it, most of them did not know the theory well enough to tell me why they thought it was wrong. So, I decided to invite one of the founders of loop quantum gravity, Lee Smolin, to come to Stanford and SLAC to give some lectures on the theory. I learned enough about the Ashtekar formulation to get going on the project and eventually published the results.

The paper, entitled "A Quantum Gravitational Relaxation of the Cosmological Constant," was posted on ArXiv.org, a website where physicists share drafts of their papers with the global physics community. Days of silence from the community went by. I was not offended. My office mate, string theorist Amir Kashani-Poor, returned after giving a seminar at the University of Texas at Austin. He told me with a look of awe that he had been lunching with the string theorists, and Steven Weinberg had joined the group. Weinberg shared the Nobel Prize with Abdus Salam and Sheldon Glashow for unifying the electromagnetic force with the weak interaction and is known as a straight shooter. Kashani-Poor told me that Weinberg pulled my paper from his inside sport jacket pocket and said to the group, "Have any of you seen this paper? It looks really interesting." This was especially vindicating since Weinberg wrote a seminal masterpiece on the various problems with the cosmological constant and the attempts to solve it. Weinberg's work also provided concrete criticisms and no-go theorems that ruled out many attempts to solve the cosmological constant problem. Luckily my model was able to evade Weinberg's no-go theorem. My model is still a work in progress, and my research group and I are still improving it to confront how the cosmological constant is related to the onset of dark energy today.

Both LQG and string theory have their own communities, and there are strong feelings about the veracity of each approach. Both have complementary strengths and weaknesses, ranging from technical to conceptual challenges. My take is that both theories provide tools and new concepts to address the unresolved problems facing cosmology and particle physics, and both may not be sufficient. It has always been my take to let the problems and unexplained observations dictate which theories and tools to resort to. Thus, I have had the fortune to use both LQG and string theory in my research. While we have a handful of candidates for quantum gravity, none are complete. It is my view that they are all parts of the elephant, and we can use these approaches to teach us something about what the final theory might look like.

The author is Professor of Physics at Brown University and recipient of the APS Edward A. Bouchet Award. Adapted with permission from Fear of A Black Universe: An Outsider's Guide to Physics *by Stephon Alexander. Copyright © 2021. Available from Basic Books, an imprint of Hachette Book Group, Inc.*

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