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APS NEWS

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JOURNALS

At the Frontiers of Subatomic Physics

BY BENJAMIN F. GIBSON AND CHRISTOPHER WESSELBORG

PHYSICAL REVIEW C

Nuclear physics was a growing and changing field in 1970 when the original *Physical Review* journal gave birth to four children: *Physical Review A–D*. Out of that split came *Physical Review C*, which has since become the pre-eminent journal of nuclear science.

One only has to look at the past nearly 50 years, in which *Physical Review C* has featured myriad nuclear physics developments: investigation of the structure of the proton; research that led to the Nobel prize for observing solar neutrino oscillations; the evolution in measurement of the neutron electric dipole moment; characterization of the quark-gluon plasma; the role of the proton-neutron interaction in shape coexistence and fragility of magic numbers; and the continuing search for new isotopes, among many others. During this time the journal has more than doubled the number of published papers per year from initially about 500 to over 1000 last year.

An important factor in the strength of the journal was its growing reputation under the 30-year leadership of the first two long-term editors Heinz H. Barschall (1972–1988) and Sam M. Austin (1988–2002). They placed primary emphasis upon a knowledgeable review process, which attracted important research papers from around the world. That approach continues to this day.

Physical Review C has always been and continues to be an international journal. While in 1982 approximately 40% of the papers published were submitted by non-U.S.-based corresponding authors, by last year this number had increased to more than 75%. Similarly, the referee base has become significantly more international.

Other changes in the journal content reflect expanding research interests and the evolution in physicists' approach to research. Owing to the trend toward larger and more complex international research collaborations the number of U.S.-submitted experimental papers has fallen slightly; in contrast, the number of non-U.S.-submitted papers has grown substantially. Moreover, the evolution in subject matter has followed the trend in research activities. Relativistic heavy-ion collision physics and nuclear astrophysics have exhibited the largest percentage growth. The classic areas of nuclear structure and nuclear reactions have remained strong but show a shift in focus to nuclei

PRC CONTINUED ON PAGE 7

APS MARCH MEETING

Kavli Symposium 2019: From Unit Cell to Biological Cell

BY LEAH POFFENBERGER

Claudia Felser

Each year, the APS March Meeting holds a special symposium sponsored by the Kavli Foundation that features outstanding physicists who have made important breakthroughs. This year's Kavli session was organized around the theme "From Unit Cell to Biological Cell."

Claudia Felser (Max Planck Institute for Chemical Physics of Solids), showed the potential of a versatile class of materials called Heusler compounds. Her presentation was followed by Philip Kim's (Harvard University) talk on emerging physics of stacked 2D materials. Mark D. Ediger (University of Wisconsin, Madison) demonstrated a method of creating strong ultra-stable glass, relying on vapor deposition. Sharon Glotzer (University of Michigan) introduced the notion of what she calls the entropic bond that allows certain types of quasi-crystals to form. Clifford Brangwynne (Princeton University) discussed self-assembly of materials within biological systems.

Heusler compounds, which Felser studies, have simple cubic lattice structures and consist of only three elements, but the composition can be manipulated to create a myriad of materials for many different purposes. The first Heusler alloy, discovered 125 years ago, combined manganese, copper

KAVLI CONTINUED ON PAGE 6

APS MARCH MEETING

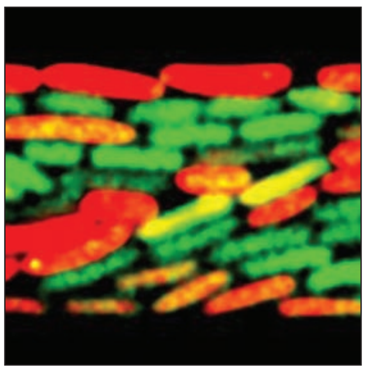
Physicists Learn to Rewire Biology

BY SOPHIA CHEN

Chris Voigt pulled up a slide of an old-fashioned calculator display: a sequence of segments programmed to light up a desired digit. Except that Voigt's jointed figure eight, pieced together with seven segments, had a twist. The segments consisted not of LEDs, but of bacteria that lit up when fed a specific chemical input.

Voigt, a researcher at the Massachusetts Institute of Technology, along with other interdisciplinary researchers in synthetic biology, presented the latest work in the field at this year's March Meeting. Broadly defined, synthetic biology involves "applying engineering principles to biology," says graduate student David Specht of Cornell University, who approaches the field from a physics background. Essentially, synthetic biologists alter the internal "software" of biological cells—their DNA—to control their functions.

In particular, synthetic biologists want to exploit cells' abilities to process raw chemicals into other molecules, says Jean-



Researchers use DNA circuits to control fluorescence in E.coli in a simple demo. IMAGE: GUILLAUME LAMBERT

Christophe Baret of the University of Bordeaux in France. One relatively mature application, now offered commercially, is to use genetically modified yeast cells to produce chemicals used in perfumes and biofuels.

But researchers want to go beyond their primitive control over yeast, since they actually can't regulate the yeast's processes well. "The yeast will make so much chemical that it just

BIOLOGY CONTINUED ON PAGE 2

APS UNIT PROFILE

The Division of Condensed Matter Physics

BY ABIGAIL DOVE

Members of the APS Division of Condensed Matter Physics (DCMP) are focused on the macro- and microscopic properties of matter in all its complexity. As outgoing DCMP chair Paul Canfield of Iowa State University put it, "if you can hold it or pour it into a vessel, we try to discover it, make it, learn about it, master it, and even use it."

Incoming DCMP chair Daniel Arovas of the University of California San Diego adds that the systems that most interest condensed matter physicists involve three basic components—electrons, ions, and photons—which can interact in unique and interesting ways to produce an incredible variety of phases of matter—metals, insulators, ferromagnets, anti-ferromagnets, superconductors, superfluids, ferroelectrics, semiconductors, glasses, topological phases, spin liquids, and more.

Between the extremes of high energy particle physics, which operates at the smallest-length scales of fundamental particles, and cosmology, which investigates the universe at the largest-length scales, condensed matter physics occupies the realm of intermediate scales, studying systems of size ranging from a few atoms up to tens of centimeters.

And the broad range of the field is reflected in the wide-ranging accomplishments of condensed matter physicists, both basic

Daniel Arovas
IMAGE: UCSD

Paul Canfield
IMAGE: IOWA STATE UNIVERSITY

and applied, through the ages. Noted Canfield, "Condensed matter physics is the field that tries to understand the birth of magnetism and superconductivity, the mechanisms of emergent phenomena, and is discovering the implications of electronic topology. It is also the field that brought the world the transistor, the read-head, the MRI unit."

With nearly 6,700 members, DCMP has the highest membership of any APS division. In fact, DCMP boasts almost twice the membership base of the next-largest divisions—the Divisions of Particles and Fields (DPF), Materials Physics (DMP), Fluid Dynamics (DFD), and Computational Physics (DCOMP)—which have between 3,200 and 3,500 members each.

In addition to being the largest APS division, DCMP is also one of the oldest. The division was first formed in 1947 as the "Division of Solid State Physics," predated only by the Division of Atomic, Molecular, and Optical Physics (DAMOP, established 1943) and the Division of Polymer Physics (DPOLY, established 1944). DCMP got its current name in 1978 in recognition that the discipline encompasses liquids, such as quantum fluids, as well as solids.

Consistent with the sheer size of DCMP, Arovas contends that condensed matter physics as a discipline is "surely the most diverse" subfield within physics. This has a lot to do with the wide variety of phases of matter that condensed matter physicists deal with as well as the broad array of experimental techniques, which focus on characterizing these many phases of matter according to their measurable responses to an almost equally wide range of

DCMP CONTINUED ON PAGE 6

BIOLOGY CONTINUED FROMPAGE 1

drowns in its own waste," says Specht. By developing methods to control hundreds—or even thousands—of genes, synthetic biologists are pursuing more control over a variety of cell types. Eventually, they want to design and produce biological cells at a scale comparable to electronic circuits.

They aim to achieve this, in part, by designing DNA segments to mimic the logic operations of electrical engineering. Cells respond to inputs according to their DNA instructions to grow, produce proteins, or divide. By introducing engineered DNA sequences like extra lines of code, researchers can control what the cell does.

To this end, Specht has designed DNA segments that function as "NOT" logic gates inside an *E. coli* cell. A NOT gate in a conventional computer switches a 1 to a 0 and vice versa. In a cell, when the NOT gate senses a specific molecular input, it halts the production of a protein. If the molecule is not present, the gate initiates protein production.

Other groups have demonstrated similar NOT gates in the past. However, when multiple NOT gates are used within a cell, they often unintentionally interfere with each other—"crosstalk," as Specht calls it. This type of interference is common in synthetic biology because cell components are often unexpectedly coupled. Specht has developed a technique to efficiently test whether two NOT gates will interfere, which he has tested on combinations of 128 different NOT gates.

Specht's labmate, graduate student Yasu Xu of Cornell University, is designing a toggle switch for *E. coli*. It's a segment of DNA that can either be "on" or "off." Depending on its setting, it can turn on or off the production of a protein depending on the presence of chemicals in the cell. Xu is tweaking the switch to respond to specific concentrations of chemicals, which means the bacterium can serve as a sensor, she says. This switch could potentially also serve as information storage inside the cell as a bit: one setting of the switch could correspond to 1, and the other 0.

About a decade ago, in the field's infancy, researchers designed these so-called genetic circuits from scratch in a long, painstaking process. To speed up the design process and build more complex circuits, Voigt's group has developed a platform known as CELLO, similar to computer-aided design programs used in electrical circuit designs. The software compiles their code into a diagram made of individual gates and creates the DNA sequence associated with the function. Researchers can send this design to an outside company, which will synthesize the DNA circuit.

In addition, researchers are also engineering the chemical reactions that power the metabolism of the cell. By controlling these reactions, they can adjust the protein production rate of a cell, for example. Such cells could be used in industrial processes but could also be useful for fundamental research as well: such systems could be used to test hypotheses about the origin of life, says Baret.

Baret's group studied a metabolic process inside tiny water droplets encased in oil—simplistic models of living cells—on a chip. They inserted glucose, along with two biological compounds known as NAD+ and NADH, into the droplets, to engineer reactions in which glucose helps convert NAD+ to NADH. They chose to study this process because in a functioning cell, the conversion of NAD+ into NADH is "like a motor, in the sense it converts the chemical energy of glucose into work that the cell can use," says Baret. With laser monitoring of concentrations, they showed that the ratio between NAD+ and NADH maintains a steady state, as occurs in living cells. In future studies, Baret wants to place the glucose outside of the droplet and engineer the cell to consume the glucose on its own to drive the chemical conversion.

However, biological circuits offer some distinctive technical challenges: Cells expend a certain amount of their energy to keep themselves alive, and it's unclear whether these processes could be turned off to produce desired chemicals more efficiently. Cells must also function in a constantly fluctuating environment. In addition, genes are often coupled in unexpected ways. Researchers have to be careful that the modifications they introduce into the cell do not play havoc with some other important function. So while researchers are achieving some promising results, their ultimate vision of versatile, mass-produced synthetic cells is still many years away.

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

THIS MONTH IN

Physics History

April 14, 1932: Cockcroft and Walton Split the Atom

"Inside the horror of Nagasaki and Hiroshima lies the beauty of Einstein's $E=mc^2$," novelist Jeanette Winterson observed in her 1997 novel, *Gut Symmetries*. That equation is indeed the underlying principle behind thermonuclear weapons and nuclear energy. It was two British physicists, John Cockcroft and Ernest Walton, who first split the atom to confirm Einstein's theory.

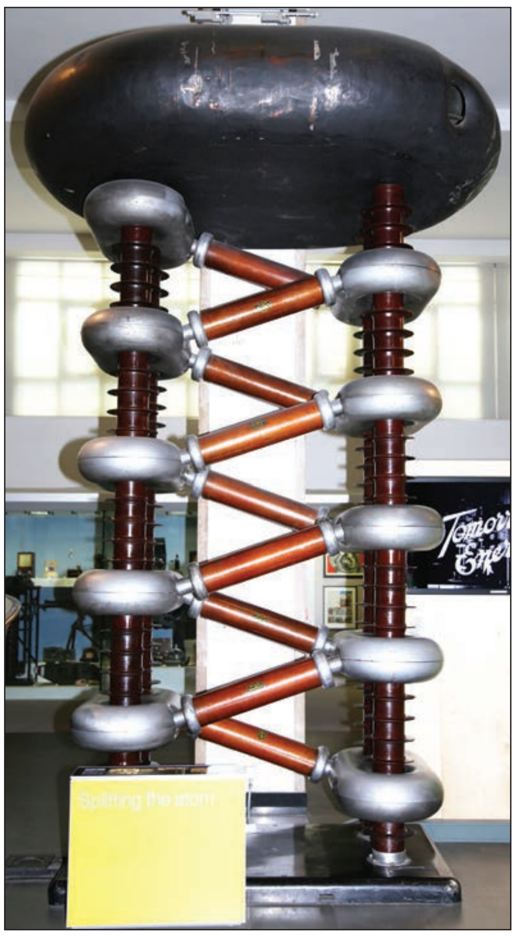
Cockcroft was born in 1897 and served on the Western front during World War I. Afterward, he studied electrical engineering before winning a scholarship to Cambridge University, eventually becoming a research student in Ernest Rutherford's Cavendish Laboratory. He earned his PhD in 1925. Walton was born in 1903 into the family of a Methodist clergyman in Ireland, and won a scholarship to Trinity College, Dublin, to study math and science. After finishing his studies, he also went to work at the Cavendish lab, completing his PhD in 1931. He stayed on as a researcher for another three years, teaming up with Cockcroft to experimentally study atomic structure.

Rutherford had successfully disintegrated nitrogen atoms with alpha particles in 1919, gleaning vital hints as to the structure of atomic nuclei. But a more powerful stream of projectiles would be needed to gather any further insight. Along with Mark Oliphant, Rutherford assigned Cockcroft and Walton to design the experimental equivalent of "a million volts in a soapbox." They built the generator out of spare parts, wood and nails, and the machine was capable of 600,000 volts when they finished it. Not quite a million volts, but Cockcroft read a seminal paper by George Gamow and realized quantum tunneling would let them achieve the same effect with a lower voltage. They began bombarding lithium and beryllium targets with high-energy protons in March 1932.

On April 14, 1932, Walton noticed the telltale signature of alpha particles after bombarding a lithium target: the lithium broke into two helium nuclei (two protons and four neutrons each). Cockcroft and Rutherford confirmed this was the case. The three men penned a letter to *Nature* that same night announcing the first artificial disintegration of an atomic nucleus—the splitting of an atom—and the first nuclear transmutation of one element (lithium) into another (helium).

As a bonus, when they measured the total kinetic energy of the new helium nuclei, it was greater than the original hydrogen and lithium nuclei, with a corresponding loss in the total mass. As a result, they had also confirmed Einstein's equation for the equivalence of mass and energy ($E=mc^2$).

The team subsequently accomplished the same feat with carbon, nitrogen, and oxygen atoms, using protons, deuterons, and alpha particles to produce radioactive isotopes. For their efforts, they received the 1951 Nobel Prize in Physics. The citation praised their work as opening up "a new and fruitful field of research" that had "profoundly influenced the whole subsequent course of nuclear physics [and] stands out as a landmark in the history of science." The release of energy was too gradual to be of much practical use. It was Hungarian physicist Leo Szilard who proposed that bombarding atomic nuclei with extra neutrons would make the atoms unstable and trigger a chain reaction to release energy much more quickly.



Cockcroft–Walton generator IMAGE: NATIONAL SCIENCE MUSEUM, LONDON

Despite their success, the accelerator Cockcroft and Walton built was not as good a design as the cyclotron developed by Ernest O. Lawrence in the US. Cockcroft convinced Rutherford to invest in a 36-inch cyclotron based on Lawrence's design for the Cavendish Lab. It was soon up and running, and a second, larger cyclotron was under construction when World War II broke out and delayed its completion.

During the war, Cockcroft did research into radar, especially for shooting down enemy aircraft, and helped get an early warning radar system operational. He was also appointed to the

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APS MEMBER BENEFITS

What Exactly is APSIT?

BY TRISH LETTIERI

Every year, APS members receive an email or letter regarding APSIT, the American Physical Society Insurance Trust, offering a range of insurance products. But what is it, and what does it offer?

APS established the Trust back in 1969 and it is offered to all member societies under the American Institute of Physics (AIP) umbrella. In fact, APS members who belong to more than one AIP member society likely receive multiple communications about APSIT. To help APS members understand more about this benefit of membership, I want to explain a bit about ASPIT and its insurance products.

APSIT was created to provide members with a convenient source for high-quality insurance coverage at an affordable cost. The trust has offered Group Term Life insurance to APSIT member society members since February of 1970. Since then, they have expanded their product range and the number of member societies participating. The insurance plans are underwritten by the New York Life Insurance Company, established in 1845, and still a market leader today. New York Life regularly earns the highest ratings for its financial strength from leading rating services and even through the recent economic crisis remained in excellent fiscal health.

The plan is now administered by a contracted company, Pearl Insurance, based in Illinois. They maintain a website about APSIT at apsitinsurance.com. The great staff at Pearl has worked to re-evaluate all the products offered and improve the customer service provided to participants in the Trust. All AIP member societies are APSIT participating organizations and any member of an AIP member society may purchase the insurance products provided by APSIT.

The APSIT offers six insurance products: term life, 10 year level term life, disability income, personal accident, hospital indemnity, and long term care. Of course, the particular products offered by APSIT may not meet your own personal needs, but their products are at least worth a look. The premiums are usually very affordable and the coverage provided is quite competitive with other providers. Additionally, because the members of AIP member societies, as a group, typically have a higher education, live conservative lifestyles and so on, the group rate provided can be far better than other group plans.

An additional benefit of APSIT is that the member societies themselves sit on the governing board and make decisions about the types of plans provided as well as other matters. In fact, I serve alongside a number of member representatives to ensure that this member benefit is the best it can be for APS. The APSIT Board has updated the tagline—"Insurance for Science Professionals"—to better explain the products and also expanded promotion to include frequent ads in *Physics Today*, so hopefully you've seen those. And if you ever receive a request to serve on the APSIT Board, I hope you will consider serving.

So, if you get a letter or informational pamphlet from the APSIT, you now know where it came from and why you received it. It remains your decision as to whether any of the insurance products provided suit your own financial needs. To learn more about other benefits of membership, please see our benefits of membership page: go.aps.org/2Uri5ew, which is updated as new benefits are added.

The author is APS Director of Membership.

APS MARCH MEETING

Fixing Wikipedia's Diversity Problem

BY JESSICA THOMAS

Karen Daniels, a physicist at North Carolina State University, woke up a few weeks ago to a new kind of fame. She had a Wikipedia page.

Daniels was one of about 30 female and minority physicists whose Wiki biographies were created in an "edit-a-thon" at the APS March Meeting in Boston. The event attracted roughly 50 attendees, who—in the latest tally—have written 26 new bios and updated 39 existing ones. APS staff, with the support of the APS Committees on the Status of Women in Physics (CSWP), on Minorities in Physics (COM), and on Informing the Public (CIP), partnered with Wiki Education to organize and run the event.

March Meeting attendees participated in a Wikipedia edit-a-thon. IMAGE: JAMES ROCHE

"Wikipedia is the first place many people look to learn about a topic, including physics. However, many prominent, deserving women scientists lack biography pages," said Katherine Wright, an editor for *Physics* who proposed the event and helped organize it. "[The event was] a step towards changing that status quo," she said.

Although Wikipedia is open to anyone, women make up just 10-15% of its editors—or "wikimedians." The source of the discrepancy is hard to pin down. It could come from women having too little free time or being turned off by Wikipedia's occasionally aggressive editor culture, said Jami Mathewson, Director of Partnerships for Wiki Education (wikiedu.org). The dearth of female editors may also explain why fewer than 20% of English-language biographies are about women.

Edit-a-thons like the one in Boston aim to address the Wikipedia monoculture. At the event, novice Wikimedians learned the dos and don'ts of editing in the company of colleagues (and refreshments.) And they had access to a list of deserving female and minority physicists on a shared dashboard. (Wikipedia ties an academic's Wiki-worthiness—or, "notability"—to such things as prestigious awards, impact on a field, or running an academic journal.) APS staff and CSWP, CIP, and COM members helped contribute roughly 100 names, many of whom were APS Fellows or had been awarded APS prizes.

Jess Wade, a physicist at Imperial College London and activist for female physicists, stirred the crowd with a talk about improved diversity in science. She expressed frustration at seeing so few Wiki pages for brilliant women when ample words had been spilled about "obscure football teams in the north of England." (Donna Strickland of the University of Waterloo, one of last year's winners of the Nobel Prize in Physics, couldn't be found on Wikipedia until the day she won.)

In a crash-course, attendees learned how to draft a biography in their Wikipedia "sandbox" and to back up their statements with verifiable sources, such as articles in trusted newspapers or a peer-reviewed journal. Representatives from Wiki Education reviewed the drafts, providing tips for improving the sourcing or punching up the writing before making the pages go live.

Daniels admitted to feeling a "little weird" about having her own Wiki page. But she loves seeing the new bios for women pop up. "School kids draw inspiration [from them]—and there [are now] a lot more there," she said.

A brochure (PDF) from Wiki Education that provides tips about editing Wikipedia pages is available at go.aps.org/2HQc0me.

The author is Editor of Physics *(physics.aps.org).*

APS MARCH MEETING

A Journey through Quantum Space and Time

BY AMANDA BABCOCK

For the past several years, Brian Schwartz, City University of New York, and Smitha Vishveshwara, University of Illinois Urbana-Champaign (UIUC) have collaborated to bring something unexpected to the APS March Meeting in Boston: physics-themed theater performances. This year's evening of culture stands out among the rest in that it gave the audience two original works back-to-back. The evening started with *Quantum Voyages*, an original play written by Vishveshwara and Latrelle Bright. Following the play was a live performance of "A History of Physics in 13 Songs" written and performed by Oakland University physics professor Alberto Rojo.

Actors and physicists take the audience on a journey through the quantum world. IMAGE: AMANDA BABCOCK

Premiered at UIUC, *Quantum Voyages* was produced and directed by Vishveshwara and Bright. The original cast—a mixture of undergraduate theater majors and graduate physics students—made the trip to Boston to perform for the March Meeting crowd. The cast members' passion for the physics in the play helped communicate the complex topics at hand and kept the audience enthralled.

The play follows Terra and Akash on a journey of curiosity led by Sapienza, the spirit of wisdom, through the wonder and perils of quantum landscapes. A "quantum ensemble" provided the backdrop, acting out a living electromagnetic spectrum, a crystal structure in which electrons moved, a superconducting surface, and many other quantum phenomena.

Throughout the performance, "quantum sages"—physics professors local to Boston or from UIUC—would appear to share their wisdom and explain some quantum phenomenon to the pair and, on one comical occasion, give an exasperated Sapienza a glass of wine.

One highlight of the performance was a charming representation of Schrödinger by Lily Newton, a former physics major

JOURNEY CONTINUED ON PAGE 7

LETTERS

Members may submit letters to letters@aps.org. APS reserves the right to select letters and edit for length and clarity.

Cosmic Rays, Pyramids, and the Void

The article "This Month in Physics History" in the February 2019 issue of APS News states that "archaeologists confirmed their discovery of a hidden burial chamber in an Egyptian pyramid in 2017..." This refers to a result published in *Nature* (nature.com/articles/nature24647), however the authors of that paper never claimed detection of a burial chamber, only a void of unknown purpose. It is possibly a relieving chamber to reduce the weight of the stone above the grand gallery similar to series of smaller relieving chambers above the king's chamber. This is the most likely explanation since it is a known fact that the builders employed relieving chambers elsewhere in the pyramid, and the new void is directly above the main gallery, of similar dimensions to the main gallery.

The Great Pyramid was a remarkable feat of ancient engineering but was the result of a century of trial and error. The Egyptians learned from past mistakes, such as when they had to change the angle of the Bent Pyramid during construction, and may have taken a lesson from the possible partial collapse of the Meidum Pyramid.

Jeffery Winkler
Hanford, California

JOURNALS

Reviews of Modern Physics 90th Anniversary Symposium

This year's APS March Meeting featured a special symposium in honor of the 90th anniversary of the founding of *Reviews of Modern Physics* (RMP).

REVIEWS OF MODERN PHYSICS
90 YEARS

Please also join the editors of RMP on Tuesday, April 16, in Denver at the APS April Meeting for a special plenary session with three distinguished speakers marking the 90th anniversary of the journal. Wim Leemans (Lawrence Berkeley Laboratory) will discuss laser-based particle accelerators, Elena Aprile (Columbia University) will give an update on the search for dark matter, and Andrea Ghez (University of California Los Angeles) will talk about physics at the center of the Milky Way. For more see go.aps.org/2I4IBDW.

Three speakers at the Symposium covered the unique aspects of Reviews of Modern Physics and the articles published over its 90 year history. L-R: Frances Hellman Frances Hellman, (University of California, Berkeley) spoke about interfaces and magnetism ; Antonio Castro Neto (National University of Singapore) talked about the science of 2D materials ; and Nigel Goldenfeld (University of Illinois at Urbana-Champaign) discussed the role of RMP in the field of statistical physics. IMAGE: ROBERT CASTAGNA

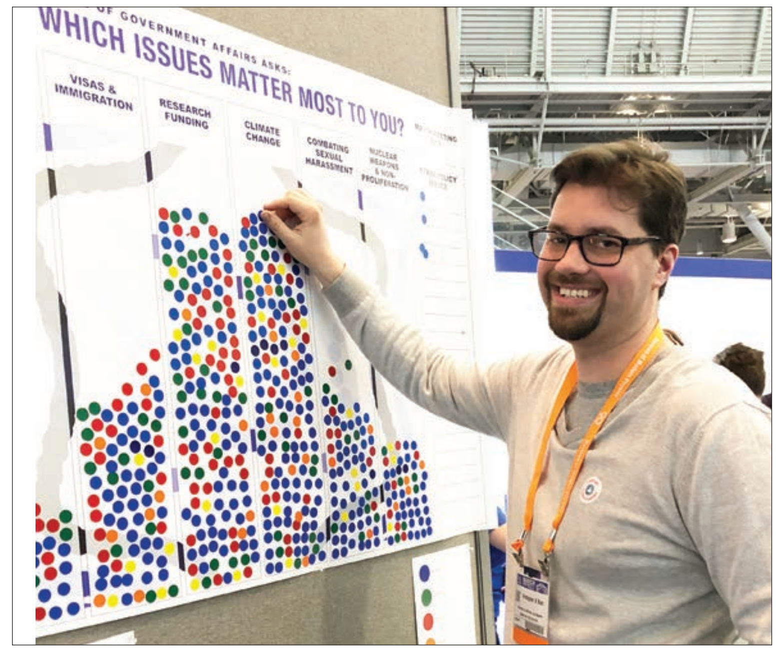
GOVERNMENT AFFAIRS

Climate Change Tops Science Policy Issues Among APS Members at March Meeting

BY TAWANDA W. JOHNSON

Climate change is a top concern among APS members who voted on the importance of six key issues highlighted by the Office of Government Affairs (OGA) during this year's March Meeting in Boston.

For the past several years, OGA has featured an "issues board" during the meeting, providing APS members an opportunity to inform the staff of their science policy concerns. This year, the main issues were: laboratory and facility upgrades, visas and immigration, research funding, climate change, combating sexual harassment, and nuclear weapons and non-proliferation. A seventh category—"other issues"—enabled members to select matters not included among the main six. APS members could identify themselves as industry, government, post-doc, faculty, or student.



APS members were asked to rank issues of most concern.

Climate change was the top overall vote-getter with 215 votes, followed by research funding (207), and visas and immigration (130). APS members also had an opportunity to send letters to Congress during the meeting about those issues. A total of 534 letters were sent to 60 Senate and 90 House offices.

APS members offered a variety of reasons about why they were concerned about the issues.

"I feel that it's our job as scientists to communicate the importance of climate change," said Kristopher Barr, a UCLA graduate student. "There's a lot of misinformation about climate change, and we must be diligent about correcting these misunderstandings."

Barr added that diversity within the STEM field is also a concern.

"We've got to frame science in such a way that it is inviting to individuals who believe that science is too hard to grasp, and to individuals who believe their socioeconomic backgrounds will keep them from pursuing science," he added.

Diana Valverde Mendez, a Princeton University graduate student, said she was concerned about the effect of plastic pollution on the environment and stressed that more research is needed to address the issue.

"Plastic is in the deepest depths of our ocean, and that's impacting wildlife and human health," she said. Valverde Mendez said that robust, sustainable research funding would go a long way in helping to create better materials, alleviating the need for plastic.

Xiangyu Song, a graduate stu-

CLIMATE CONTINUED ON PAGE 6

SIGNAL BOOST

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

Trump Again Seeks Sweeping Budget Cuts to Science

BY MITCH AMBROSE

As part of a broader push to constrain nondefense spending, President Trump's proposed budget for fiscal year 2020 would sharply pare back science programs across the federal government.

The administration's cuts resemble those it proposed in its previous two budget requests, which Congress largely rejected. Many of the steepest cuts again target programs that fund environmental research and later-stage energy R&D. Others would essentially roll back large increases that Congress provided over the past two budget cycles.

These recent increases were enabled by a budget agreement that raised statutory caps on defense and non-defense spending for fiscal years 2018 and 2019. Congress is now preparing to negotiate an agreement to raise the spending caps for the following two years.

Under the current caps for fiscal year 2020, which begins on October 1, 2019, overall spending on defense and non-defense programs would drop about 10 percent. However, since 2013, Congress has always reached an agreement to raise the caps for two years at a time.

The budget prioritizes research tied to "industries of the future," a phrase Trump used in his latest State of the Union Address. The White House has identified four corresponding priority areas: artificial intelligence, quantum information science, advanced communication networks, and advanced manufacturing. In support of the recently launched National Quantum Initiative, the budget states it includes approximately $430 million for quantum information science across the Department of Defense (DOD), Department of Energy (DOE), National Science Foundation (NSF), and National Institute of Standards and Technology (NIST).

DOD's Research, Development, Test, and Evaluation accounts would collectively rise almost 10 percent above already historically high levels to just over $100 billion under the proposal. Earlier-stage R&D programs would not benefit from this surge, with accounts for basic research, applied research, and advanced technology development instead together decreasing 12 percent to $14 billion, near their fiscal year 2017 total.

The cuts to DOE would fall heaviest on its applied energy R&D programs. For the third year in a row, the administration proposes to eliminate the Advanced Research Projects Agency–Energy and slash funding for renewable, fossil, and nuclear energy R&D. Meanwhile, the DOE Office of Science budget would be rolled back by about $1 billion, or 16 percent, bringing it just above its level in fiscal year 2017. While most of the office's divisions would see cuts ranging from about 10 to 30 percent, the advanced computing division budget would remain at a historically high level to support an exascale computing initiative.

Cuts to NSF are spread across

BUDGET CONTINUED ON PAGE 6

APS MARCH MEETING

APS News takes on LabEscape

BY LEAH POFFENBERGER

On the last day of the APS March Meeting, a rag-tag team of science writers, graduate students, scientists, and future physicists entered the lab of the famous (if fictional) Professor Schrödenberg and were issued a challenge: Solve a slew of science-based clues to unlock the Professor's computer and submit her research proposal to DARPA—in 45 minutes or less.

The challenge came courtesy of a real physics professor, Paul Kwiat, and the University of Illinois Urbana-Champaign, who brought LabEscape, a physics-based escape room, to life for the first time in 2016. LabEscape's original iteration and a sequel can be found at Lincoln Square Mall in Urbana, Illinois but Kwait and his own team of graduate students brought a special version to Boston, just for the March Meeting.

Success in LabEscape requires the same skills as science: experimentation, collaboration, and out-of-the-box ideas. During the pre-challenge briefing, Kwiat did a short demo of what kinds of things we might expect to see inside the lab and handed out explainers of physics concepts, like refraction and spectroscopy, that emphasized ideas many people learned in high school or middle school. However, Kwiat cautioned the team to not rely too much on our own knowledge of physics, but to carefully examine each clue.

Our team consisted of: graduate students Yi Wei Ho and Jun Hao Hue from the National University of Singapore; three science writers—Emily Conover of *Science News*, Amanda Babcock, freelancer extraordinaire and myself; and a family of four—Oak Ridge National Laboratory physicist Michael Manley, his wife Anne, a geochemist, 13-year-old Ryan, and 9-year-old Catherine. Ryan and Catherine would prove invaluable, often spotting clues the rest of us didn't. The time to beat for the week to escape the lab was around 33 minutes, a record set by a group of local high school students.

Upon entering the makeshift lab as "interns," our team was greeted with a video call from our new supervisor, top quantum physicist Professor Schrödenberg. She tasked us with logging in to her computer and submitting her latest research proposal to DARPA before the deadline since she was stuck on a plane. The only problem? A dropped call before she could share her password, setting off our quest to discover what it might be, guided by the many clues scattered throughout her lab.

It's a slightly lower-stakes scenario than Kwiat's first version of LabEscape, in which Professor S and four government agents have gone missing, endangering national security—a nod to an important potential application of quantum computing. Kwiat has also created a sequel for LabEscape enthusiasts, and now he's looking to expand LabEscape to new locations, like science museums.

As the clock began ticking, with the professor's research—and probably our careers as interns—hanging in the balance, the team split up, each of us running to different parts of the lab to begin our search for clues. Almost every item in the room had a purpose, from the innocuous posters of physicists lining the walls to an iPod clipped to a lab coat that gave musical cues. Along the way we encountered real scientific instrumentation, like a laser interferometer and a beam splitter that helped us uncover the code to a safe, and we used physics data to crack the code. Every person on the team contributed, with building excitement every time a new safe was opened or discovery made.

The escape room, which felt like a real-life treasure hunt complete with encrypted and hidden messages, took about three months for Kwiat and his LabEscape team to put together. Kwiat was inspired to create LabEscape after he visited a different escape room—which he says he failed. The original LabEscape mission took about six months for Kwiat to mastermind with the help of graduate students from UCIC and funding from the APS outreach mini-grants program.

In the end, we made it out of the escape room after submitting the professor's research, thanks to a small extension of the grant proposal deadline, finishing in about 52 minutes.

For more information about LabEscape, or to book your own visit to the lab, visit labescape.org.

A team of intrepid adventurers successfully escaped the laboratory of Dr. S.

APS MARCH MEETING

Q&A: Bruce Wielicki Thinks The World Needs A Climate Observatory

BY SOPHIA CHEN

"Is this uncomfortable for you?" I ask NASA scientist Bruce Wielicki in the crowded Boston Convention center hallway. The benches nearby are all occupied, so to do our interview, we have plopped down on the floor by the windows.

"I'm fine," he assures me. Over the next 75 minutes, Wielicki proceeds to patiently describe his life's work in climate science from the carpet.

He's endured more torturous circumstances. In 2017, the Trump Administration tried to kill the space-based climate mission Wielicki is leading, called the Climate Absolute Radiance and Refractivity Observatory (CLARREO) Pathfinder. Congress eventually rejected the president's request to defund the mission; Wielicki's instrument is poised to launch in 2023 for deployment to the International Space Station (ISS).

But that mission is just a tiny slice of Wielicki's bigger goal—he wants to build an international observatory dedicated to monitoring climate change over decades. To do this, he needs to get scientists and politicians globally on board, and he has come to his first APS March meeting to recruit physicists to the cause. After presenting in a session and attending a networking dinner, Wielicki says he's found a handful of physicists interested in his work. In a conversation bouncing between enthusiasm and cautious pragmatism, Wielicki tells *APS News* of the journey so far.

Make the case for us. What is this observatory you want to build, and why do we need it?

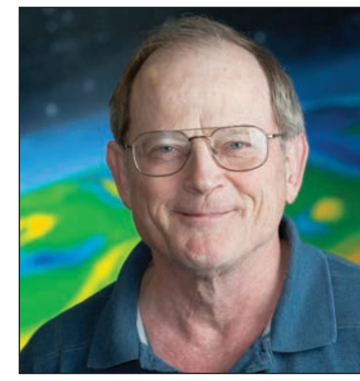
We don't have a climate observing system rigorously designed for collecting data over long time scales. Everybody's been doing their own individual missions. Maybe one satellite's spectrometer is optimized for quantifying chlorophyll in the oceans, and another is optimized for studying aerosol properties. Each satellite's instruments are designed to measure reflected solar radiation in a range of different wavelengths, and you end up with this mess where it's hard to compare data collected by different satellites.

So I'm proposing this: what if the countries of the world agreed to design, build, and maintain a dedicated climate observatory system? We did this with weather forecasting back in the 50's and 60's. For example, the UN established the World Meteorological Organization, which coordinates international infrastructure to produce and disseminate weather forecasts.

Where do things stand now?

The CLARREO Pathfinder mission that I'm leading is a small step toward standardizing climate data. It's a spectrometer that will go on the ISS for calibrating instruments on satellites. It'll cross the orbits of various satellites 1,300 times. During these orbit crossings, it'll take data that correct for calibration drifts. The most common cause of these drifts is from contaminants in the instruments that get fixed on optical components by direct solar UV exposure. The effects can be larger than 10 percent over a decade or less. CLARREO will calibrate these drifts and make for a more accurate climate record in the long term.

I've also collaborated with Roger Cooke, an economist, to publish several papers on the long-term economic benefits of building an international observatory. We calculated a metric called value of information (VOI). VOI is essentially an estimate of the economic value of accurate climate data, assuming that the government uses it to prevent climate-related disasters. We've estimated that for each dollar we invest in the observatory, it will return around 50 dollars in avoided damages. The economic models we use add around a factor of 5 of uncertainty, so the return on investment ranges from about 10 dollars per dollar to 250 dollars per dollar. Working with other climate scientists, I've put together a whitepaper making the case for this idea for the U.S. Global Change Research Program, which is the head group of all the scientific agencies. We've also published several academic papers on this.



Bruce Wielicki
IMAGE: NASA LANGLEY

So we have all sorts of documentation that we need to build this observing system. But no one has said, dang it, it's worth it, let's go ahead and do it. I've been giving talks about building it for about five years now. It doesn't appear to be going anywhere.

What's the holdup?

In the US, we have thirteen agencies doing climate research. But none of them does climate research as their number one job. It's always their third or fourth priority, whether it's NASA, NOAA, or the EPA. So what happens is a curse of the commons. No one is responsible for it. No one fails in their jobs if they don't do climate science. It would help dramatically if we had an agency whose primary budget was dedicated to climate change, but I doubt the US will do it, politically.

The scientific community has a share of the blame, too. As I've given these talks, it struck me how we seem to be crippled. I initially thought, naively, that once my work on the economic value of this observatory got published, the scientific community would get behind it—that we'd triple climate science research and start pushing to build this system.

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and aluminum—none of which are magnetic—to produce a compound that was ferromagnetic at room temperature. Felser showed the potential of using different elements from the periodic table in novel topological configurations to produce new materials with a range of properties, such as semiconductors, topological insulators, and magnets.

A vast number of Heusler compounds can be created just by selecting the right building blocks. A Heusler compound can either be what's called a half Heusler (XYZ) or a normal Heusler (X_2YZ), where X, Y, and Z are chemical elements. X can be one of 33 elements, Y one of 13 and Z one of 12, allowing for many combinations. And as Felser showed, the Heusler compounds can be further modified using a variety of tools to create an even larger family of materials.

Kim discussed another versatile method for creating materials with varied properties by stacking 2D sheets of material, a process pioneered using graphene. Like Heusler compounds, the resulting properties of 2D stacked materials depend both on which elements are used and how the material is manipulated. For example, the big story of last year's APS March Meeting, was creation of a superconductor by stacking two layers of graphene, with one layer twisted to at an optimal angle.

By stacking different atomically thin materials with structures similar to graphene, many types of materials can be created, like magnetic materials or semiconductors. According to Kim, a number of these stacked systems have predictable results, but there are plenty of new combinations of these 2D materials that remain unknown and could have interesting properties, leading to new physics. The more layers, the more complexity—and the more things the 2D system may be able to do. Using the structures created from stacked 2D materials and connecting them together has applications in electronics development.

Edeger moved away from neat stacks of materials to the disordered structures of glasses, which are highly variable. Creating highly stable glass is important for continued development in modern electronics, like OLED (organic light emitting diode) displays now found in some smartphones or optical fibers. Ediger discussed a method of creating glass that will provide higher density and low-energy amorphous packing: instead of cooling a molten liquid, the usual method of glass creation, he proposes using vapor deposition.

A typical method of glass creation involves a supercooled liquid slowly turning into a glass, where different cooling rates create different types of glasses. But to form the high-density glass states Ediger is interested in would take years using this method. With vapor deposition, collecting gas on a cold substrate to create thin but dense glass takes about an hour. The higher density occurs as the molecules fall to the substrate like blocks in the computer game Tetris and have the opportunity to switch positions to pack together as tightly as possible. Just a one percent increase in glass density achieved by vapor deposition can increase photostability of OLED

Philip Kim

Mark D. Ediger

Sharon Glotzer

Clifford Brangwynne

displays substantially, leading to increased efficiency and device lifetime.

In contrast to forming the disordered states of glass, Glotzer discussed the formation of crystals in the absence of energetic interactions. She introduced the notion of the entropic bond, the idea that particles jostling together in a space will become ordered as they find the best packing structures. The spontaneous formation of the ordered crystal state seems counterintuitive, but Glotzer explained how entropy can order matter.

Ten years ago, one of Glotzer's students found that tetrahedra self-assembled into a quasicrystal, but now she's seen over 100 other nanoparticle shapes that also form crystals. The formation is driven by the system seeking maximum entropy, which in turn means finding the maximum number of possible microstates—and for some shapes, including spheres, there are more ways to be organized than disorganized.

Brangwynne rounded out the Kavli session with applications of soft matter physics to biological systems. Molecules within living cells undergo self-assembly to fulfil certain functions. Brangwynne's research primarily deals with structures on a size scale between nanoscale—like protein folding—and the macroscale of visible cells: The rules for assembling mesoscale structures like organelles are not well understood but studying such biological structures and their rules for assembly could result in new physics.

Many people remember organelles from high school biology, but as Brangwynne points out, all of these organelles are membrane-bound. But his interest is in fluids of intercellular material that move inside the cell to control what form the cell will take. As Brangwynne has shown, liquid-liquid phase transitions inside the cell, driven by intrinsically disordered proteins, may have implications for the activation of specific genes.

All of the Kavli lectures can be viewed on the APS YouTube channel: youtube.com/user/apsphysics.

CLIMATE CONTINUED FROM PAGE 4

dent at the University of Illinois, Urbana-Champaign, picked research funding as a key issue.

"You worry about whether funding will dry up, given the uncertainty surrounding it," she said.

Another concern for Song: nuclear weapons.

"I'm from China, and we have an unstable neighbor. Nuclear weapons should be well-controlled," she opined.

America's standing as a global technology leader has declined due to a decrease in research funding, said David Tomanek, physics professor at Michigan State University.

And isolation is not the answer to the problem, he added.

"It would keep us stuck where we are instead of putting us on a cutting-edge path," Tomanek explained. Instead, being open to recruiting the best and brightest students from around the world would help solve the issue, he said.

Regarding climate change, APS is the first scientific society in the United States to broadly assess and publish its emissions. The Society has taken steps to provide members the opportunity to mitigate their carbon footprint by donating to an environmental organization of their choice—an initiative that stems directly from APS's Greenhouse Gas Inventory report (go.aps.org/2HPM5Lh). For those without a preferred organization, APS suggests directing donations to the Clean Energy Trust, a non-profit clean technology accelerator focused on bringing scientific and technological advances to the marketplace. Visit APS's donation page at go.aps.org/2Ugrx0W.

APS members can visit OGA's Advocacy Page (go.aps.org/takeaction) to learn more about science policy issues and to contact their member of Congress.

"We want our members to know that we are a key resource for them to take action on the issues that matter most to them," said Francis Slakey, APS Chief Government Affairs Officer.

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

BUDGET CONTINUED FROM PAGE 4

directorates, shaving about $1 billion or 12 percent from the agency. The budget for major facility construction would drop by a quarter, though the conclusion of two projects freed up funds for the agency to propose beginning a major upgrade to the Large Hadron Collider and launching a new program dedicated to mid-scale research infrastructure. NIST's research facility construction budget would be halved and its research programs would drop about $110 million or 16 percent.

As one of the administration's more favored agencies, NASA's budget would retain much of the increase Congress recently provided the agency. However, echoing last year's proposal, the Earth Science division would be cut by 8 percent and the Wide Field Infrared Survey Telescope would be cancelled, leaving the Astrophysics division with a 20 percent smaller budget.

The overall budget has received a chilly reception in Congress, which is apt to disregard much of its contents. Criticizing the budget's call for across-the-board cuts, House Appropriations Committee Chair Nita Lowey (D-NY) remarked, "President Trump has somehow managed to produce a budget request even more untethered from reality than his past two."

The author is Acting Director of FYI.

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DCMP CONTINUED FROM PAGE 1

probes—such as current flow or exposure to light, ultrasound, and temperature and pressure changes.

Given this broad reach, it should come as no surprise that condensed matter physics has significant overlap with many disciplines—biological physics, electrical engineering, and quantum information research to name a few. The overlap between condensed matter physics and atomic, molecular, and optical physics is an especially interesting example: Optical laser trap techniques can be used to create some of the most interesting phases of condensed matter.

Arovas pointed out that condensed matter physics even touches particle physics and cosmology: Peter Higgs' famous 1964 paper in *Physical Review Letters* (go.aps.org/2uE7QVS) describing what became known as the Higgs boson cites seminal work by the condensed matter physicist Philip Anderson that elucidates a connection between particle physics and superconductivity. And in astrophysics, neutron stars might exhibit the phenomena of superconductivity and superfluidity. According to Canfield, this breadth also allowed DCMP to act as a kind of "incubator" giving rise to other more specialized divisions and topical groups within APS, for example the Topical Group on Soft Matter (GSOFT).

Prominent avenues of research in condensed matter physics include everything from investigating how phases of matter behave on the shortest timescales to understanding emerging quantum states to the discovery of new materials in general. Particular excitement surrounds the confluence of condensed matter physics and quantum information.

Arovas explained that condensed matter physicists' work understanding the storage and flow of information at the quantum level is an important step toward scalable and fault-tolerant quantum computation. Another area of high interest is exotic phases of matter. This includes quantum spin liquids (featuring intrinsic quantum fluctuations that can lead to a breakdown of conventional order) and recently discovered two-dimensional systems like graphene, which in twisted bilayer (or "magic angle") form can exhibit superconductivity.

DCMP has historically had a prolific presence at the APS March Meeting, and 2019 was no exception. In terms of participation, DCMP's over four thousand registered March Meeting attendees comprised more than a quarter of total meeting attendance. As for content, DCMP organized 33 invited symposia and 150 contributed talk sessions—more than any other division.

The benefits of DCMP membership are many. Beyond the APS March Meeting, DCMP sponsors several smaller meetings each year on more specific topics in condensed matter physics. For instance, coming up in April in Santa Fe, New Mexico is the Center for Nonlinear Studies' annual conference on strongly correlated quantum materials, followed by an annual workshop on recent developments in electronic structure in Urbana, Illinois in May. In addition, DCMP sponsors several prizes and awards—including ten DCMP Grad Student Travel Awards and ten DCMP Honorable Mention Awards each year to support young scientists entering the condensed matter physics field.

"Nature has been extremely kind to condensed matter physicists, providing us with a seemingly inexhaustible set of fascinating materials and phenomena to investigate and to model," remarked Arovas, "Truly, it is an embarrassment of riches."

More information on this unit can be found here: aps.org/units/dcmp

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EDUCATION AND DIVERSITY NEWS

PhysTEC Teacher of the Year

The PhysTEC Teacher of the Year program recognizes outstanding physics teachers and aims to demonstrate the impact and value of physics teacher preparation programs that are members of PhysTEC. PhysTEC institutions are eligible to nominate one graduate who has at least three years of full-time teaching that has included substantial physics teaching experience. From these nominees, PhysTEC will select up to one local Teacher of the Year per institution and a single national Teacher of the Year. Learn more at phystec.org/toty/.

SPLITTING THE ATOM CONTINUED FROM PAGE 2

committee charged with dealing with issues relating to the technical feasibility of an atomic bomb.

In 1944, Cockcroft was named director of the Montreal Laboratory, a new heavy-water nuclear reactor in Canada to manufacture plutonium and enriched uranium. Two years later he became director of the Atomic Energy Research Establishment (AERE) in the UK, overseeing the construction of various reactors. The first nuclear reactor in western Europe started up in August 1947 at AERE.

In the 1950s, a similar reactor design was implemented at the Windscale facility in northwest England for producing fissile material for atomic weapons. Cockcroft made one especially controversial decision in the construction of the Windscale plutonium production reactors: He insisted the chimney stacks be fitted with high performance filters. There had been a report of uranium oxide detected near the X-10 Graphite Reactor at the Oak Ridge, Tennessee facility, and Cockcroft wanted to guard against similar leakage.

It was a costly detail, since he made the decision late in the design process, resulting in a lumpy shape to the chimneys. And it turned out the Oak Ridge uranium oxide had come from the chemical plant, not the reactor. The filters were dubbed "Cockcroft's folly," since his colleagues didn't think they were necessary. But Cockcroft's excess of caution ultimately paid off: In 1957 a fire broke out at the Windscale facility, and one of the reactors caught fire. Thanks to the filters, no radioactive material escaped into the surrounding environment.

In 1959, Cockcroft became the first Master of Churchill College, Cambridge, which formally opened in 1964. He died of a heart attack at his Cambridge home in 1967. Walton had returned to Ireland in 1934 as a fellow of his alma mater, Trinity College, working on the phosphorescent effect in glasses, radiocarbon dating, and thin-film deposition on glass, among other interests. He died in 1995 at the age of 91 in Belfast.

Further Reading:

1. Cathcart, Brian. *The Fly in the Cathedral*. New York: Penguin, 2005.
2. Hartcup, Guy, and Allibone, T.E. *Cockcroft and the Atom*. Bristol: A. Hilger, 1984.

Q&A CONTINUED FROM PAGE 5

But nope. That's not what happened. Scientists tend to be narrow specialists. Climate science is this huge complex system involving 50 essential variables. No single scientist understands all of it. When given a big picture problem like building this observatory, most scientists tend to think that it's someone else's problem. Their focus is on their next grant, next paper, next postdoc.

What are you hoping to communicate to physicists?

I'm hoping to open people's eyes to a new way of looking at things, to think about climate science in a business framework. Scientists typically start with a budget and ask what's the most important science to do within that budget. Instead, I'm saying we should think of climate science as investing in a business. The question is, how much should society invest? Right now, there's been five journal papers written on this topic. Roger Cooke and I have written four of them. We need more diversity.

So my goal here is to get more scientists to collaborate with economists. It takes some courage to take that step. Scientists don't know economics, and economists know very little science. But this is a totally unplowed area of science. I'm trying to explain to people that it didn't take Roger and me very long to learn enough economics and enough climate science to do something useful.

So what will it take to get this observatory built?

It depends on whether I'm being optimistic or pessimistic. If I'm being optimistic, I say that the message just needs more time. If I'm being pessimistic, I say that I'm starting to conclude that society is genetically not capable of dealing with long-term climate change. That may literally be the answer. [laughs]

For millions of years, we've had to protect ourselves from short-term threats—lions and tigers and storms. A long-term threat, distributed over the whole world on a fifty-year time scale, is so foreign to our genes. Our emotions are usually what force us to make decisions. But we don't react emotionally to climate change; it's a purely intellectual threat. We may be so dysfunctional in terms of long-term strategizing that we are literally marching off into oblivion.

This interview has been edited and condensed for clarity.

Sophia Chen is a freelance science writer based in Tucson, Arizona.

Additional Reading

1. Cooke, R., B. A. Wielicki, D. F. Young, and M. G. Mlynczak, "Value of Information for Climate Observing Systems," *J. Environ. Syst. Decis.*, 34, 98 (2014), DOI: 10.1007/s10669-013-9451-8.
2. Hope, C., "The $10 trillion value of better information about the transient climate response," *Phil. Trans. R. Soc. A* 373, 20140429 (2015), DOI: 10.1098/rsta.2014.0429.Cooke, R. et al., "Real Option Value of Earth Observing Systems," *Climate Policy* (2016), DOI:10.1080/14693062.2015.1110109.
3. Weatherhead, B. et al., "Designing the climate observing system of the future," *Earth's Future* (2017), DOI: 10.1002/2017EF000627.
4. Cooke, R. et al., "Monetizing the Value of Measurements of Equilibrium Climate Sensitivity Using the Social Cost of Carbon," *Environ. Mon. Assess.*, in press.

PRC CONTINUED FROM PAGE 1

far from stability and investigations with radioactive beams.

The journal also introduced new article structures and article types. In order to improve information content and increase efficiency of computer searches *Physical Review C* introduced "structured abstracts" in 2011. A year later *Physical Review C* joined the other Physical Review journals in highlighting articles that the editors find particularly interesting or important by marking these as "Editors' Suggestions." These specially marked articles are posted on the journal's home page along with a brief summary and link to the online version.

In January 2018, *Physical Review C* took an important step forward in open-access publishing by joining SCOAP³ (see *APS News*, December 2017 [1]). Under this agreement, high-energy physics articles published in *Physical Review D*, *Physical Review Letters*, and *Physical Review C* have been published fully open access (under a so-called CC-BY 4.0 license) at no additional cost to the authors or readers.

As another innovation, *Physical Review C* has embarked on an important experiment: Certain spectroscopic data are being checked, in collaboration with the National Nuclear Data Center at Brookhaven National Laboratory, for consistency in an effort to avoid having to publish corrections at a later date.

The field of nuclear physics has undergone continual change in the 49 years since *Physical Review C* was established. Yet the central goal of the journal has remained unchanged: to accept and publish those manuscripts that are scientifically sound and advance the field of nuclear physics. In that endeavor *Physical Review C*, the APS Division of Nuclear Physics, and the larger nuclear physics community owe a debt of gratitude to the outstanding scientists who have served as Associate Editors, Editorial Board members, and diligent referees of whom a few are recognized each year under the APS's Outstanding Referees program [2].

Finally, the journal appreciates the many talented scientists who have entrusted *Physical Review C* with publishing their best research. The authors are truly the heart and soul of the journal.

Benjamin F. Gibson has served as Editor of Physical Review C *since 2002. Christopher Wesselborg is the journal's Managing Editor, having joined PRC in 1993.*

1. What You Need to Know: APS and SCOAP3, *APS News*, December 2017, go.aps.org/2j0eDqK.
2. journals.aps.org/OutstandingReferees

JOURNEY CONTINUED FROM PAGE 3

at UCIC. In a monologue to the two adventurers, Newton explained the concept of quantum superposition completely in German. After a moment of initial confusion and audience laughs, Sapienza (played by Kalan Benbow) translated the monologue.

Newton fooled the audience with her convincingly fluent German thanks to careful preparation. "[Newton] studied with a native speaker," Vishveshwara confirmed. She also noted that the monologue came in part from Erwin Schrödinger's cat paradox paper.

The ensemble's creative representations of quantum phenomena included acting out a game of Clue to illustrate the confusion of being in two states at once—in this case both dead and alive at the same time. At one point in the action, the ensemble acted out discrete quantized levels in a diagonal line across the stage, each actor running in place at different "energies." The quantum voyage ended with a representation of an MRI machine, using a long, blue glow light to scan a collapsed Terra. Sapienza then returned the adventurers home. Their new-found knowledge inspired the pair to ask bigger questions, seek more answers, and appreciate that what is seen is not all there is to see.

The evening continued with the performance of "A History of Physics in 13 Songs." Rojo was joined by Michael Gould on percussion and Dave Haughey on cello with Lynnae Lehfeldt providing narration. Lehfeldt's practiced theater voice resonated over the music, reading a variety of historical material from published papers to personal letters, alternating with Rojo's vocals .

The songs covered a select list of important figures in physics history, beginning with Galileo. Letters from Maxwell to Faraday formed the basis for a song on the discovery that light is an electromagnetic wave. A song inspired by Richard Feynman, titled "Trees are made of air," relayed the idea of carbon sequestration in trees. The last song of the night focused on Vera Rubin, using jarring strains to communicate the unexpected galactic rotation curves, a discovery supporting the existence of dark matter.

The author is a freelance writer based out of Goodland, KS.

THE BACK PAGE

Impressions from the APS Division of Nuclear Physics Fall Meeting

BY SARA JANE

Note: The APS Division of Nuclear Physics (DNP) is committed to providing an inclusive space where physicists can exchange ideas and share their interests in nuclear physics, regardless of the origin, color, gender, sexual orientation, gender identity etc, of the scientist.

In this context, last year the DNP requested stories from the membership. Rather than present each story in isolation, we have chosen to collect them as though they happened to one young woman as she navigates DNP meetings. Each incident related in this compendium was submitted to us as an actual personal experience, however, only a fraction of the stories are included in this first edition (others stories will be part of future editions). All names have been changed to protect confidentiality.

Dear Diary,

Wednesday 8:30 a.m.

After our registration, my advisor told me he would introduce me to this famous physicist that was standing in the lobby. I got so excited. He just looked at my name badge, nodded in recognition and said he thought I was a man. Clearly this person needs to work on his implicit bias and expand his imagination to include women physicists…

"After our registration, my advisor told me he would introduce me to this famous physicist that was standing in the lobby. I got so excited. He just looked at my name badge, nodded in recognition and said he thought I was a man."

Wednesday 11:00 a.m.

At the coffee break I was just standing around and overheard this group talking about climate change. Someone questioned the hard evidence. Everyone ridiculed this person just for asking questions. But aren't we scientists? Aren't we supposed to be able to ask questions?

Wednesday 2:00 p.m.

I just had lunch with a couple of female students from my university. They were telling me about their visit to X National Lab. Apparently they were stopped by an armed guard. After asking protocol questions, he told them: "some days I just want to shoot all women physicists." He then explained it was just a joke but they couldn't take it as such. They felt very uneasy but didn't respond. I think they should have reported the guy. What is wrong with these people that they think joking about murdering women is ok?

Wednesday 5:00 p.m.

I've been trying to talk to my advisor but every time I spot him, he seems to get busy talking to somebody else. I've emailed him the slides but still have not heard back. I'm stressing out with my talk! Doesn't he remember my talk is tomorrow morning?

Wednesday 8:00 p.m.

I just had dinner with Eric and my advisor. Food was awful and the place was noisy. My advisor set a meeting with me for 10pm tonight in the hotel, because he needed to meet with Eric first. Eric is also a grad student in our group but he is one year ahead of me. I agreed to meet at 10:00 p.m. but seriously?? I need to give a talk tomorrow and wish I could sleep…

Wednesday 11:00 p.m.

I just met with my advisor. Instead of going over my slides, he declared he was helping me too much and his colleagues were thinking he is having an affair with me. I tried to argue that he spends more time with Eric than with me and I am less experienced as a grad student. This is my first conference! He quickly concluded the meeting saying I should just try to be more independent.

Thursday 6:00 a.m.

I woke up in the middle of the night and I could not sleep anymore. Couldn't stop thinking about what my advisor told me. Instead of milling, I decided to practice my talk again and again. Now I am more than ready!

Thursday 10:00 a.m.

Eric said my talk went fine and Matt said I looked very professional. Still, I feel terrible… I am disappointed that my advisor didn't turn up but much worse was this creepy guy in the front row. He stared at my ankles the ENTIRE TIME! I would walk from one side to the other and his eyes would follow my ankles. I am wearing a skirt below the knees and normal flat shoes, so I don't understand his focus. It was creepy and I felt so vulnerable.

GETTY IMAGES

Thursday 1:00 p.m.

I had lunch with Nancy. She is a postdoc from my university and works on precision measurements. I had never seen her so upset. Her talk was about these new measurements they are preparing to run. She spent the whole time going through the details on how they planned to calibrate their detector and get the precision they need. Someone from the audience was asking questions in a very aggressive tone and at the end he said "I won't believe any result from your experiment unless you prove to me that you will be able to calibrate your detector to x precision." She was left silent. A female senior physicist came to her after the talk, praised her talk and advised her to ignore that aggressive man from the audience. Easier said than done. Nancy is shaken.

"In the afternoon I overheard this woman physicist talking about the climate at DNP meetings to a couple of male colleagues … One man immediately responded saying that he has been a member of the DNP for almost three decades and never observed any inappropriate behavior of any kind at DNP meetings. The other confirmed that he had never witnessed any sort of racist or sexist behavior, only a high-degree of professionalism."

Thursday 4:00 p.m.

There is this senior physicist that does work relevant for my research. After his talk, I found the courage to approach him and asked him some questions. He said my questions were really good and suggested we continue the discussion in the hotel bar. It made me feel uncomfortable but I went along. The drinks came and he said: "Let's take these up to my room." I gracefully declined saying I needed to meet some of my friends soon. Honestly, I am so disappointed. I had so admired this man before he made me feel so unimportant as a scientist…

Thursday 6:00 p.m.

I came to my room early because I need to sleep. In the afternoon I overheard this woman physicist talking about the climate at DNP meetings to a couple of male colleagues. They looked pretty senior. The woman said she would like to consider ways on how to improve things. One man immediately responded saying that he has been a member of the DNP for almost three decades and never observed any inappropriate behavior of any kind at DNP meetings. The other confirmed that he had never witnessed any sort of racist or sexist behavior, only a high-degree of professionalism. Not sure what the woman answered but I was angered by these comments. These guys just don't care about what others are experiencing…

Friday 8:30 a.m.

I went for breakfast at Starbucks in the hotel. I saw the senior physicist that gave one of the plenary talks on Wed and one of his colleagues. They both looked very accomplished and talked quite loud. One was complaining about the pressure to invite more women as speakers and the other agreed and said: "Specially because good ones are really hard to find." I wondered whether they had seen my talk. Were they referring to me? Perhaps women speakers are more like tokens…

"We sat at a table with a few other students. At some point I went to the bathroom and started talking to this other woman from the conference. As we were coming back to the table, what appeared to be her colleague approached us and, before introducing himself, stared at my chest and said: "I am not looking at your boobs, I'm just trying to read your name-tag." If he is not looking at my boobs, why does he need to make this comment about my anatomy?"

Friday 2:00 p.m.

Earlier, I was having lunch with Eric and Matt. We sat at a table with a few other students. At some point I went to the bathroom and started talking to this other woman from the conference. As we were coming back to the table, what appeared to be her colleague approached us and, before introducing himself, stared at my chest and said: "I am not looking at your boobs, I'm just trying to read your name-tag." If he is not looking at my boobs, why does he need to make this comment about my anatomy?

Friday 11:00 p.m.

After the banquet I suggested to the people at our table that we go out and see a live band. I am NOT a dancer. I am quite simply pathologically bad at dancing. One of the physicists in the group insisted I dance with him and despite my many refusals, he finally said: "But you have to dance with one of us—you're the only girl!" I felt so pressured that I only wanted to get away from there.

Saturday 10:00 a.m.

There was an issue with the projector so a group of us were standing outside the conference room waiting for the session to restart. One of the postdocs made strong political statements that presume only idiots would not accept his opinion. In our group, there were people from various countries, clearly with different worldviews than his. Shouldn't he show more tolerance for the diversity of opinions in the group?

Saturday 12:00 p.m.

I don't think my advisor is talking to me. I can never get hold of him in the conference. I texted and tried to call him several times, but there is no answer. For two days I have wanted to let him know how my talk went… Thank goodness the meeting is over: I feel exhausted.

We thank the many APS members who graciously shared their stories with us. Many represent a moment of pain or confusion, and a sense of not belonging to a community they hoped would be an important part of their lives. —DNP Ad Hoc Committee on Harassment Prevention: Ron Gilman (Rutgers University), Robert Janssens (University of North Carolina at Chapel Hill), Chair: Filomena Nunes (Michigan State University), Roxanne Springer (Duke University), Warren Rogers (Indiana Wesleyan University), and Sherry Yennello (Texas A&M University).

Editor's note: *APS urges all members to become familiar with the Code of Conduct for APS Meetings and how to confidentially report any concerns or incidents. More information is available at aps.org/meetings/policies/code-conduct.cfm.*