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APS News

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Lights, camera, physics simulations

Behind many modern blockbusters’ visual effects, complex equations keep computer-generated elements moving and interacting according to the laws of physics.

By Erica K. Brockmeier

The epic space saga Dune: Part Two *won the 2024 Oscar for Best Visual Effects. The film used complex physics simulations to blend real footage and computer-generated objects and materials, including dust, sand, and explosions.* Credit: Image Courtesy of DNEG © 2024 Legendary and Warner Bros. Entertainment Inc. All Rights Reserved.

With its sweeping desert landscapes, nuclear explosions, and 1,300-foot sandworms, Dune: Part Two is replete with visuals that blend filmed footage with computer-generated imagery. The movie was recently honored with two Oscars, Best Sound and Best Visual Effects, the latter of which is given to teams that successfully address complex visual effects challenges while elevating the film’s narrative in an artistic and original way.

Behind the visual effects of many Hollywood blockbusters, including this year’s and other recent visual effects Oscar award winners and nominees, is an undercurrent of complex equations that help ensure the film’s computer-generated elements follow the laws of physics. And while they may not always be apparent to moviegoers, they bring to life some of modern cinema’s most breathtaking and iconic visuals.

Whether you call them physics engines or “sims,” these simulations use principles from classical mechanics — the physical theory that describes how forces like gravity, friction, and elasticity impact an object — to recreate motion of objects in 3D space. The objects can include rigid bodies, or any object that doesn’t deform, as well as soft materials like cloth and hair or particles like smoke, dust, and sand. Computer-generated images are created through a process called rendering, where simulations and object geometries are combined with data on how light travels through a scene and bounces off surfaces to generate an image.

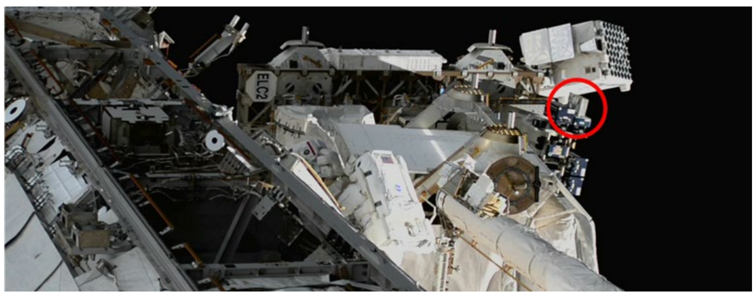
So why do films, especially ones with computer-generated visuals, need physics simulations? For Christopher Batty, an associate professor at the University of Waterloo whose group develops physics simulation tools for visual effects software, part of the goal is to “offload the physics onto the computer so the artists can really focus on their vision,” he said.

Special Effects continued on page 6

Scientists test quantum mechanics in outer space

At the APS Global Physics Summit, physicists shared results from a quantum entanglement experiment on the International Space Station.

By Briley Lewis



Astronaut Nick Hague (at center) on a spacewalk in January 2025, with the Space Entanglement and Annealing QUantum Experiment, or SEAQUE, circled in red. Credit: International Space Station/NASA

It’s hard enough to study tiny particles and the bizarre realm of quantum mechanics here on Earth — but now, scientists are bringing quantum devices to space.

It’s the International Year of Quantum Science and Technology, and at this year’s APS Global Physics Summit in Anaheim, California, a team of physicists presented the first tests from SEAQUE, an experiment on the International Space Station designed to pave the way for quantum communication systems.

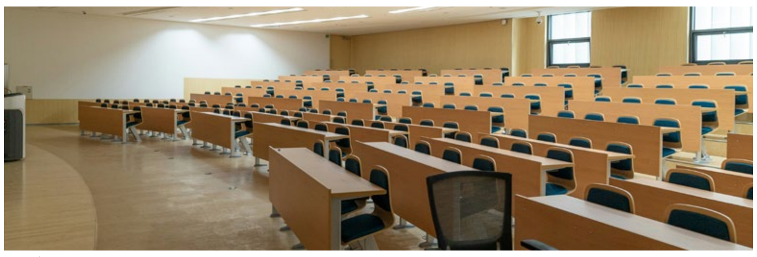
Quantum communication technology could securely connect two far-apart quantum computers, overcoming the limitations of traditional fiber optics currently used for internet access and other common devices. This could be very useful if we want to transmit information across the vast distances of space, or enable a quantum version of cloud computing.

SEAQUE continued on page 6

US physics departments expect to shrink graduate programs

Student enrollment and guaranteed financial support are expected to fall amid anticipation of federal budget cuts, a new report finds.

By Clare Zhang



Credit: Changbok Ko/Unsplash

Many U.S. graduate programs in physics and astronomy are expecting lower enrollment in the next two classes of first-year students, according to a report published yesterday by the American Institute of Physics that assesses the impacts of uncertainty about the future of federal science funding and policy under the Trump administration.

AIP contacted all 292 department chairs at schools offering graduate degrees in physics and astronomy in the U.S. and received 115 replies during the response window between April 3 and 16.

The report anticipates that first-year enrollment in physics and astronomy graduate programs could decline by about 13% this fall. This includes a 25% decline at private institutions and a 7% decline at public institutions. Those values are derived from respondents’ estimates of how many more or fewer first-year students they expect at their own institutions in 2025 compared to 2024. Many department chairs said they believe the decline in first-year students will be even larger in the fall of 2026.

Grad Programs continued on page 7

To celebrate quantum science’s centennial, scientists embrace art and play

The Global Physics Summit’s QuantumFest featured circus acts, escape rooms, and science demonstrations.

By Erica K. Brockmeier

Quantum mechanics is a “very good friend to physics and physicists,” said Paul Cadden-Zimansky, associate professor of physics at Bard College and a global coordinator for the International Year of Quantum Science and Technology. And what do you do when a good friend has a birthday? Throw a party, of course.

At the APS Global Physics Summit in Anaheim, “QuantumFest” — a full slate of live performances, escape rooms, games, and art installations — marked the 100th birthday of quantum mechanics.

Smitha Vishveshwara, the event’s director and a professor at the University of Illinois Urbana-Champaign, said QuantumFest was all about having fun. After all, some early progress in quantum mechanics was made by researchers who were playing with new ideas.

“The concepts that come out [of quantum mechanics] are really weird,” she said. “And we like weird — weird makes for fun of all sorts.”

Kicking off the celebration was the Quantum Jubilee, a full-day event that was open to meeting attendees and the public. The jubilee featured performances, live scientific demonstrations, and public lectures, including by Nobel laureates Wolfgang Ketterle and Barry Barish.

Events like QuantumFest “remind us that quantum science isn’t confined to a small group of experts,” said APS CEO Jonathan Bagger in remarks at the event. “It’s happening in the conversations we have, the partnerships we form, the ways we choose to invest, and the performances happening on this very stage.”

The Quantum Jubilee included aerial performances by Los Angeles-based cirque company Le PeTiT CiRqUe. Credit: James Gross, Spawnzone/APS

These performances included aerial feats provided by Los Angeles-based cirque company Le PeTiT CiRqUe. One show about quantum entanglement, called “Tinguely Entangled” and directed by Lukas Loss, combined live and electronic music with storytelling, poetry, and visuals. And in a play called “Quantum Voyages,” directed by Latrelle Bright, two travelers journey through the quantum realm.

Jubilee attendees also saw live demonstrations of quantum experiments taking place on the International Space Station, including the first Bose-Einstein condensate made by someone under 18 and the first crowdsourced Bell measurement in space.

Marilena Longobardi, QuantumFest director and managing director at the National Center of Competence in Research "Spin Qubits in Silicon" (NCCR SPIN) in Switzerland, explained that quantum mechanics has long been challenging to communicate because its concepts are so difficult to picture. “You can imagine stars, galaxies, or particles, but it’s not easy to visualize quantum entanglement or superposition,” she said.

But now, as principles from quantum mechanics are used in more technologies, and as ‘quantum’ crops up more frequently in society’s vernacular, there are opportunities for quantum mechanics to reach new audiences, she said. “Quantum is also related to the nature of reality — who we are,” added Longobardi.

QuantumFest continued on page 7

Five days to build three high school physics courses? No problem.

An interview with Lynn Jorgensen, 2024 PhysTEC Teacher of the Year.

By Kendra Redmond

Lynn Jorgensen and her class after the annual "egg drop," where students try to drop a raw egg on her head from the school bleachers. Credit: Lynn Jorgensen

Lynn Jorgensen was never, ever going to be a teacher. That's what she decided while watching her mom, a junior high math teacher, grade homework. "I swore I would never do that."

Now, Jorgensen is the 2024 PhysTEC Teacher of the Year, a designation that recognizes outstanding physics educators. The Physics Teacher Education Coalition (PhysTEC) — an initiative of APS and the American Association of Physics Teachers — seeks to address a shortage of qualified physics teachers in the U.S.

It's been ten years since Jorgensen began teaching physics at Gilbert High School in Gilbert, Arizona. Since then, the program has grown by leaps and bounds. Students with a wide range of math skills and postgraduation plans have found physics — and belonging — in her classroom. Colorful three-tier mobiles hang above her desk, the culmination of a unit on torque and rotational dynamics. Two dozen tiny resin ducks have appeared around her classroom, love notes from graduating seniors.

APS News spoke with Jorgensen about her story, teaching strategies, and the value of collaborations and community. This interview has been edited for brevity and clarity.

What sparked your interest in physics teaching?

I took my first physics class as a senior in high school. Math was a struggle for me all through junior high and high school. And then I got an amazing physics student teacher. The class was awesome. That was the first time that math ever made sense to me. It just clicked, and all of a sudden, I was good at something.

When I went to college, I was initially planning to go into engineering. In the first physics class I took, my professor told me I had a knack for the subject and asked if I would become a part-time peer tutor. Through that experience, I realized I was good at explaining physics to other people, and I liked it. So I got a B.S. in physics teaching from Brigham Young University. Later, I got a master's of natural sciences in physics at Arizona State University. That opened the door for me to teach dual enrollment classes.

What was your first physics teaching job?

When my youngest child started kindergarten, I started subbing in the district. The next fall, the week before school started, I noticed an opening for a physics teacher. I wasn't sure I wanted to start teaching yet, but I decided to practice interviewing. An hour after the interview, I got the offer. I picked up my keys five days before school started. I had little equipment and no curriculum, and I was about to teach regular physics, AP 1, and AP 2. I was the only physics teacher there.

Wow. So you had keys to your room but no plan. What did you do?

Partnerships with amazing collaborators and teachers got me through. Two days before school started, I met Jim Archambault, a physics teacher at a nearby school. He took me under his wing and gave me a flash drive with literally everything he did in his AP class.

Jim invited me to join a professional learning community, so I did. During those first years, we met after school on Wednesdays for two to three hours to make sure I was prepared. Eventually, I started contributing my own ideas.

I also started working with Arizona State University's modeling instruction program and collaborating with groups like the American Modeling Teachers

PhysTEC Teacher continued on page 7

THIS MONTH IN PHYSICS HISTORY

May 20, 1921: Marie Curie receives a gram of radium from US President Harding

The two-time Nobel laureate was recognized for her "transcendent service to science and humanity" with the gift of an essential ingredient for her life-saving research.

By Erica K. Brockmeier

In 1920, as the world was still recovering from World War I, two-time Nobel laureate Marie Curie was trying to get her lab up and running.

The Radium Institute in Paris had been finished shortly before the war broke out, but its research had been put on pause: The lab's male employees were sent to the front lines, while Curie made her own wartime contribution by developing mobile X-ray units for the battlefield.

But amid this new decade marked by fragile peace across Europe, Curie found herself facing a new roadblock: She didn't have enough radium for her research on radium's fundamental properties, and its usefulness for medical imaging and cancer treatments.

It was this pressing need that would lead Curie to travel halfway across the world for her first of two official visits to the United States. While her inaugural tour was replete with pomp and circumstance, it also allowed Curie to connect with scientists and see the impact of her work — and to this day, it highlights the humanitarian side of Curie's legacy.

Marie Curie's visit to the White House on May 20, 1921. From left, Marie Meloney, First Lady Florence Harding, Marie Curie, President Warren Harding, and Curie's daughter Irène Curie. Credit: The Bibliothèque nationale de France digital library/public domain

Marie Curie (third from left) arrives in the United States with Marie Meloney (far left) and her daughters, Irène and Ève. Credit: Library of Congress/public domain

In 1920, during an interview for *The Delineator* magazine, journalist and socialite Marie Mattingly Meloney asked Curie, "If you had the whole world to choose from, what would you take?" Curie replied, "I would wish for a gram of radium to facilitate my research."

This response "shocked" Meloney, said Dava Sobel, author of *The Elements of Marie Curie: How the Glow of Radium Lit a Path for Women in Science*, as Meloney realized that Curie, "who was doing such important work and was responsible for all the good that was happening because of this discovery," had so little of this essential chemical.

"Mrs. Meloney decided she was going to raise money to buy [Curie] another gram of radium and then bring her to the United States and tour her around," said Sobel. Meloney launched the Marie Curie Radium Fund and raised $100,000 — around $1.2 million today when adjusted for inflation — to pay for what was then a "vast quantity" of radium, Sobel said.

Curie arrived in New York on May 11, 1921, and, accompanied by her daughters Irène and Ève, embarked on a six-week tour of the U.S., including stops in Washington, D.C., Philadelphia, Pittsburg, Chicago, and Boston. Along the way, Curie delivered lectures and visited more than 15 universities and research institutions.

"There were all these big galas at [places like] Carnegie Hall and the Waldorf Astoria, and it was really not a lifestyle that [Curie] was accustomed to," said Sobel, adding that Curie would occasionally send one of her daughters to the receptions in her place. "It seems that only part of the trip that [Curie] really enjoyed were when she got to meet with scientists."

One of the highlights for Curie included a visit to the Standard Chemical Company's ore processing plant, now a disposal site managed by the U.S. Department of Energy, located 20 miles southwest of Pittsburg. Curie explicitly asked to see the plant, one of the world's largest radium producers in the early 1920s, where Curie "had the satisfaction of seeing that the procedures that she had pioneered were still in use," said Sobel.

Curie also mentioned her visit to the National Bureau of Standards in Washington, D.C., now known as the National Institute of Standards and Technology, where she met with scientists and dedicated a low-temperature experiment lab. In the biography of her late husband Pierre, Curie wrote of her time spent with the institute's scientists: "The hours I spent in their company are among the best of my travel."

On May 20, 1921, Curie was the guest of honor for an audience of cabinet officers, supreme court judges, and foreign diplomats at the White House. It was during this official ceremony where she received a key to the box that housed her precious radioactive cargo and a Certificate for Radioactive Material from the U.S. Bureau of Standards from President Warren Harding, who presented Curie with the gift on behalf of the "women of America" and in recognition of Curie's "transcendent service to science and humanity."

Curie was deeply moved by the ceremony, as she reflected in Pierre's biography. "A remembrance never to be forgotten was left by this reception in which the chief representative of a great nation offered me homage of infinite value, the testimonial of the recognition of his country's citizens," she wrote.

The radium itself was not actually present during the ceremony, although a replica of the box and its glass tubes was set up in the White House's East Room. Instead, the radium was measured and certified by scientists at the National Bureau of Standards, then packed into ten tubes and placed inside a chronometer box to safeguard it for the voyage back to

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The physicist building career pipelines for the next generation of quantum workers

Michael Bennett helps students apply their quantum education to a burgeoning industry.

By Nyla Husain

Since physicists first developed modern quantum mechanics, its principles have been instrumental to a range of technologies. Solar cells depend on the photoelectric effect to generate electrical currents from photons, for example, and MRI machines rely on particle "spin" to create images of the human brain.

More recently, researchers are trying to apply this knowledge to new technologies. The goal is to develop quantum systems that could far exceed current capabilities — most notably, in computing, sensing, and communications.

But realizing these technologies requires a knowledgeable workforce with diverse skillsets. This is what Michael Bennett aims to help build.

"If you look at the companies that exist, a lot of times, their CEOs and founders are Ph.D. physicists," he says. "But the people that they're hiring are no longer just Ph.D. physicists. They're hiring engineers and technicians, as well as businesspeople, marketers, and communication specialists."

As the director of education and workforce development at Q-SEnSE, or Quantum Systems through Entangled Science and Engineering — a National Science Foundation Quantum Leap Challenge Institute led by the University of Colorado Boulder — Bennett oversees programs that equip undergraduate students with the skills, experiences, and connections to carve career paths in the quantum industry. While the programs today primarily serve undergrads in physics and engineering, Bennett wants to eventually reach students across STEM. "Because quantum as a field is so multidisciplinary to begin with, it doesn't make sense to only train physicists," he says.

"Quantum is so young as a field," says Michael Bennett. "We have an opportunity to make it the field we want it to be." Credit: Michael Bennett

The center's flagship programs are Quantum Forge — a yearlong capstone experience that connects students to local quantum startups — and the Quantum Research Exchange, or QRX, an internship readiness program during the academic year. QRX provides foundational training in quantum science, along with professional development and networking, to students from local public universities and community colleges who wouldn't otherwise be exposed. "We had a student from CU Denver who didn't know what quantum was before," Bennett says, who "went on to graduate study in quantum specifically because they participated in the program."

> **If you look at the companies that exist, a lot of times, their CEOs and founders are Ph.D. physicists," Bennett says. "But the people that they're hiring are no longer just Ph.D. physicists."**

CU Boulder has a long history of pioneering research in quantum physics. Since 2001, four of its scientists have won the Nobel Prize for their discoveries. "Those are the sorts of things that people at CU Boulder specialize in," Bennett says. "A lot of quantum startups in the Colorado area are in Colorado because their founders went to CU Boulder."

Bennett began his career in a different field, pursuing his doctorate in nuclear astrophysics at Michigan State University. But his interests began to evolve. "A lot of people in grad school didn't fit the model I had built up of physics — this idea that the people who are good at it are just geniuses and don't need anybody, which is so far from the truth." Dispelling this myth, he realized, "helps people feel comfortable bringing their desire for community into the field, and fostering community helps science be more empathetic."

He sought experiences in informal physics education — anywhere physics is taught outside the classroom, like public lectures, documentaries, podcasts, or museum exhibits. He wasn't new to this type of learning. Before graduate school, he worked at the Santa Barbara Museum of Natural History, where he designed and implemented planetarium shows and stargazing events. "I really gained an appreciation for the impact that informal experiences can have, not only on a person's interest in science, but also their sense of identification with science," he says.

This work and his graduate school community solidified his desire to help students succeed in physics. After earning his doctorate in 2016, he joined the JILA Physics Frontier Center. "It was a postdoc position that was half running a public engagement program and half doing research on that program," he says.

The lessons Bennett learned at JILA have been integral to his work at Q-SEnSE. With the Quantum Research Exchange, for instance, he helps students see themselves in the industry by teaching them how to market their skills and develop confidence in their ability to understand and apply quantum physics. For example, "we have a quantum 101 lecture series," he says. "We're starting a quantum hackathon where students are going to learn how to use IBM's Qiskit platform, among others."

He often works with students in cybersecurity programs at community colleges who want to apply their skills to a new field. "A lot of different people are going to need to be involved in quantum," Bennett says, noting the industry's need for more non-specialists — workers who may have STEM backgrounds, but don't necessarily have advanced physics degrees.

Many students who participate in Quantum Forge go on to work with their industry sponsor —one of several quantum companies in the Boulder-Denver area. "Academics in professorship roles don't typically have a strong connection to industry," says Bennett, "so there aren't a lot of capstone opportunities like Research Experiences for Undergraduates, or working with a professor, for students who want to go into industry" — a gap that Quantum Forge aims to fill. "The hope is that by the time they're done with the year, they're feeling pretty equipped to just step out and go get a job."

Michael Bennett and other APS members meet with a congressional staffer for APS Congressional Visits Day in 2023. Credit: Michael Bennett

Along with his involvement in initiatives like the American Physical Society's Committee on Public Engagement and the Joint Network for Informal Physics Education and Research (JNIPER), Bennett is also helping organize a Quantum Education and Policy Summit in Washington, D.C., from Aug. 6-8 for the International Year of Quantum. "The goal of this event is to address this question, 'what do we want quantum to look like as a whole field?'" he says.

"Quantum is so young as a field," he adds. "We have an opportunity to make it the field we want it to be, and that's why I'm excited to be in it."

Nyla Husain is the science communications manager at APS.

Slime time: Goo draws crowds in Anaheim

Local families and Global Physics Summit attendees joined volunteers for an afternoon of hands-on science.

By Nyla Husain

Three volunteers stand behind a Van de Graaff generator as it creates static electricity, causing the yarn on top to stand up. Credit: APS

For the second year, Squishy Science Sunday was buzzing with energy. Amidst thrums of sound from dozens of interactive science experiments, demonstrations, and conversations, one would occasionally hear a loud pop. No big deal — just the electromagnetic can crusher, a crowd favorite.

Held on the first day of the APS Global Physics Summit in Anaheim, California, Squishy Science Sunday attracted hundreds of visitors, including children of all ages, who came out to play with fog, bubbles, and sand; make slime and oobleck; talk to scientists; and, yes, eat freshly spun cotton candy.

"The kids loved the cotton candy, but they also really loved the Weissenberg effect thing," said Hannah, an attendee, recalling a demonstration of a gooey, elastic liquid spinning up a rod like spaghetti twirling on a fork. "My daughter just loves slime, so I knew this would be right up her alley."

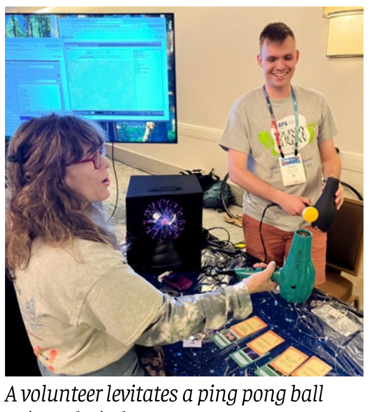
A year after its inaugural event at the APS March Meeting in 2024, Squishy Science has returned to the largest physics conference in the world to show kids and adults alike why soft materials like sands, fogs, foams, biological matter, and polymers (including slime) behave the way that they do. With more than 15,000 scientists convening in the area to present the latest physics research — much of it about everyday materials like these — why not invite local communities to join the fun?

"The intent of something like this is to spark questions. 'That's really odd — why does it behave that way?'" said Shubha Tewari, a faculty member at the University of Massachusetts Amherst who helped plan the event. "It's about getting your hands dirty and asking those questions, trying to get to the bottom of things and not being satisfied with facile explanations."

Organized by six APS units and staffed by nearly 150 volunteers, mostly APS members, the event drew more than 600 people — local families, teachers, APS members with and without their families, and other visitors. Young onlookers from a nearby dance competition, decked out in satin bomber jackets and sparkly headbands, crowded around Yale graduate student Zachary Sun as he taught them how to make slime with common household ingredients.

At another station, University of Michigan postdoc Philipp Schönhöfer showed a four-year-old how to operate a particle jamming gripper: a balloon full of tiny particles that "jam" when air is pumped out, making it a deformable, water-balloon-like ball. The gripper could grasp small objects — in this case, a chain of plastic seashells.

The child's grandfather, Joseph Benko, a physics and chemistry teacher at Servite High School in Anaheim, watched his granddaughter pedal the vacuum pump on and use the gripper to pick up the chain and toss it from the sand pit. "She has such an inquisitive mind," he said. He held up a cup of pink goo. "She made her own slime right here."



A volunteer levitates a ping pong ball using a hair dryer. Credit: APS

The slime was fun for kids, but Tewari says the activities also gave people a glimpse into the kinds of questions researchers ask — no science jargon allowed. "You have to meet the person where they are and try to explain it to them," she said.

And that's what the volunteers did. Activities like "Ask a Physicist" and lightning talks — including one about the mathematics of knotting worms that tangle together by the hundreds, drifting around in a "nightmarish blob fashion" — ran throughout the event.

Scientists at all career levels staffed more than 50 tables at the event, ready to explain their research down to the most basic concepts.

At the plasma physics booth, a new addition this year, Shannon Greco, a science educator at the Princeton Plasma Physics Laboratory, put a marshmallow in a pressure chamber and asked two children what they thought would happen when the air pressure changed. A rollercoaster of squeals and gasps followed as the marshmallow expanded and then crumpled. At a nearby table, Zachary Howe, a doctoral candidate at Auburn University, enticed spectators by levitating a ping pong ball in the air with a hair dryer — set to "cool," of course — to demonstrate air pressure differences. Then, to introduce plasmas, he asked them to guess what's hotter: lightning or the surface of the sun? What about its corona? (Answer: Lightning is hotter than the sun's surface, but not its corona.)

It's great to get kids excited, Tewari says, but she also loves seeing volunteers find joy in sharing their work. "When I look at the feedback from the volunteers and how much excitement they felt, that makes me very happy," she said. With plans to continue Squishy Science year after year, she hopes to get local universities and companies involved so they can bring their own flavor to the next event. "They keep it fresh," she added — while keeping the slime and sweets, of course.

Nyla Husain is the science communications manager at APS.

APS hosts record number of satellite sites around the world

More than 1,000 scientists joined satellite meetings in person and online.

By Tawanda W. Johnson

Audience members at the APS Global Physics Summit satellite sites hosted by the National Center for Physics in Islamabad, Pakistan (left) and the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine in Kyiv.

At the same time physicists were gathering in Anaheim, California, for the Global Physics Summit, more than 1,000 scientists and students were meeting in person and online at 17 satellite sites around the world.

The session in Ghana not only "provided a platform for knowledge exchange," said Garu Hagoss, a faculty member at the University of Ghana, but highlighted "the role of Ghanaian researchers in the global scientific landscape." Topics ranged from computational predictions of materials' properties to the Ghana Radio Astronomy Observatory's new telescope.

This is the fourth year in which APS has supported satellite sites, first launched in 2022 in response to the COVID-19 pandemic. "We wanted to give people an opportunity to be involved in the March Meeting without having to necessarily travel," says Michele Irwin, the senior international programs manager at APS.

The 2022 March Meeting had four satellite sites. By 2024, that number had more than doubled: Nine satellite sites in Asia, Africa, and South America held a March or April Meeting event for the local physics community with support from APS. These events help scientists outside of the U.S. participate, and they boost APS' partnerships abroad, says Irwin.

This year, satellite site meetings were held in Brazil, Cameroon, Chad, Democratic Republic of the Congo, Ghana, Hong Kong, Jordan, Morocco, Nepal, two places in Pakistan, the Philippines, Senegal, Serbia, South Africa, Ukraine, and Uzbekistan. Several of the sites also organized virtual sessions.

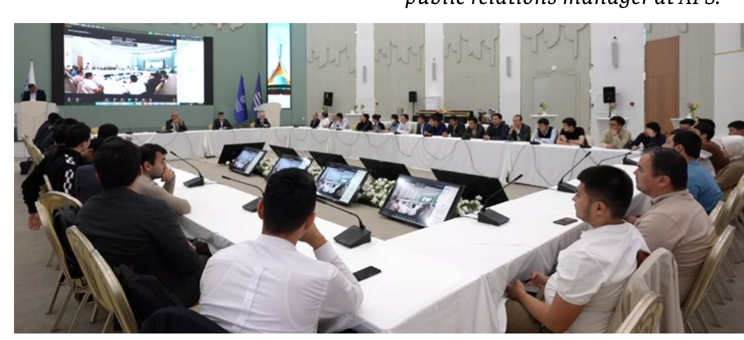
At the site in Ukraine, talks touched on quantum materials and their applications. "The post-talk discussions proved particularly valuable," said Sergiy Perepelytsya, director of the Bogolyubov Institute for Theoretical Physics of the National Academy of Sciences of Ukraine. (The timing was prescient: A week later, Perepelytsya celebrated the opening of the School on Quantum Sensing and Metrology, organized with support from APS and the Alfred P. Sloan Foundation.)

And in Pakistan, attendees listened to talks on condensed matter and high energy physics. For Hassan Shahzad, associate professor at the National Centre for Physics, the meeting was a chance to connect with "leading physicists, potential collaborators, and peers."

APS plans to build on this momentum at future physics summits. "The satellite sites have helped bridge the gaps created by distance, by place," says Irwin. "Physics is a global effort, and we're a global society, so these sites are a big part of our future."

Tawanda W. Johnson is the senior public relations manager at APS.

Centre National de Recherche pour le Développement in N'Djamena, Chad.



Physical-Technical Institute of the Academy of Sciences of Uzbekistan in Tashkent.

ICTP South American Institute for Fundamental Research in São Paulo, Brazil.

Physical Society of Hong Kong.

University of Ghana in Accra.

Nepal Physical Society in Kathmandu.

University of Kinshasa in the Democratic Republic of the Congo.

Physicists make the case for immigration reform and research funding on Capitol Hill

More than 100 scientists and students headed to Washington, D.C., for Congressional Visits Day.

By Tawanda W. Johnson

Advocates on Capitol Hill for APS' Congressional Visits Day. Credit: APS

For many international students, there's no place like the United States to pursue science research.

"We study in America primarily for the opportunities to build our dreams," says Alessandro Di Gregorio, a physics student from Italy who currently studies at Washburn University in Kansas. "We want to be helpful to science and the country [the U.S.]."

But while many foreign-born physicists study in the U.S., staying in the U.S. to work after graduation is made harder by a maze of immigration laws and regulations. Without a path to stay, these scientists are forced to take their skills to other countries.

"The issues surrounding the retention of foreign researchers who wish to naturalize are very important for the U.S. to retain a competitive workforce," says Paul DeLong, a physics and astronomy professor at the University of Kentucky.

In January, Di Gregorio, DeLong, and more than 100 other APS members took the issue to Washington, D.C., for APS' Congressional Visits Day. In 121 meetings with lawmakers and staffers on Capitol Hill, attendees advocated for legislative provisions that would allow international students pursuing advanced STEM degrees in the U.S. to legally declare their plan to stay and pursue careers here.

Members also made the case for changes to green card processes that would make it easier for high-skilled STEM workers to build lives and careers in the U.S. — for example, by exempting international students, and their spouses and children, from green card caps when they earn advanced STEM degrees from accredited U.S. institutions and receive job offers from U.S. companies.

The members' advocacy extended beyond immigration, to STEM workforce strategies and federal science funding. For example, members asked Congress to expand the National Science Foundation's Noyce teacher scholarship program, and to fund 200,000 research opportunities annually for undergraduate STEM majors at their institutions. The advocates also urged lawmakers to prioritize funding for the agencies that support the physical sciences in both the FY2025 and FY2026 budgets.

"The topline National Science Foundation funding is crucial [for] its pervasive impact on basic research everywhere," says Jaden Sicotte, an astrophysics major at George Washington University.

Science and research funding has long been backed by lawmakers on both sides of the aisle, which several advocates observed. For example, congressional offices were drawn to the "bipartisan support" of the National Quantum Initiative Act, Sicante says. The current act builds on 2018 legislation, expanding its scope to support more quantum technology, curriculum, and workforce development through new research centers. It would also strengthen the domestic quantum supply chain, establishing quantum foundries at the Department of Energy to meet the industry's device and material needs.

But despite the bipartisan support that research funding has historically received, recent executive branch actions are hurting the scientific enterprise. Today, APS is collecting stories from scientists, students, and beyond about the positive impacts that research funding has on society — and how potential cuts could harm this work.

Share your thoughts at https://go.aps.org/4bDvQMF. Submissions will never be published with identifying details without permission.

Tawanda W. Johnson is the senior public relations manager at APS.

Congress introduces bipartisan legislation to boost STEM workforce and research funding

Both bills are APS policy priorities.

By Tawanda W. Johnson

In early April, members of Congress re-introduced the Keep STEM Talent Act and the American Innovation Act — legislation that would, if enacted, help the United States attract and retain top researchers from around the world and boost federal research funding. Both are longstanding APS policy priorities. APS thanks Sens. Dick Durbin (D-IL) and Mike Rounds (R-SD), as well as Reps. Bill Foster (D-IL) and Mike Lawler (R-NY), for introducing the bills.

Keep STEM Talent Act

The bipartisan Keep STEM Talent Act — introduced this year in both the House and the Senate — would authorize international students pursuing advanced degrees to express "dual intent" and legally declare their plan to pursue STEM careers in the U.S. after graduation. The bill would also exempt students — specifically international ones who earn advanced STEM degrees from U.S. institutions and receive job offers from U.S. companies — from green card caps, which limit the number of employment-based immigrants.

"Maintaining a strong STEM workforce strengthens our economy, creates jobs, and enhances our ability to compete on the world stage," said Durbin in a joint statement. "By denying international students with advanced STEM degrees the opportunity to continue their work in America, we are losing their talents to countries overseas and won't see the positive impacts of their American education."

"Legal, highly skilled STEM immigration is crucial for our nation and has opened doors for talented immigrants like Albert Einstein to come to America," said Rounds in the statement.

American Innovation Act

The American Innovation Act would authorize annual increases to federal basic science funding by 5%, plus inflation, at the Department of Energy Office of Science, National Science Foundation, National Institute of Standards and Technology Scientific and Technical Research Services, Department of Defense Science and Technology Programs, and NASA Science Mission Directorate.

A document about the bill from Sen. Durbin's office noted, "Investments in scientific research have helped the United States lead the world in new technologies, create millions of jobs, grow the economy, and advance national security."

Tawanda W. Johnson is the senior public relations manager at APS.

APS offers membership fee waiver for scientists facing financial hardship

As cuts to federal science agencies impact or derail careers and livelihoods, APS is helping physicists affected in tangible ways. That's why we're waiving membership dues for those facing job loss or financial hardship. Besides accessing the benefits of APS membership, this no-cost, one-year membership lets you:

- Network with your community — by subfield, special interest, or geographic region — by joining APS units.
- Access more than 1,300 on-demand session recordings from the APS Global Physics Summit through June 19, 2025.

How to receive the membership hardship waiver

If you're joining APS, create or log into your APS account, select "Join Now," and enter the code MEMBWAIVER2025-JOIN at checkout. If you're renewing your membership, you can access the hardship waiver option from recent renewal emails.

While there is no requirement that you demonstrate financial hardship, if you can pay your membership dues, please do. Dues-paying members support the waiver program, as well as the APS programs that make physics accessible for all, including those under threat.

At APS, we're committed to providing a welcoming professional home to the world's physics community, including through changes and challenges. We're grateful for you — for your commitment, engagement, passion for physics, and for being a part of our community.

Learn more about the waiver program and other APS resources at go.aps.org/membershipwaiver.

Special Effects continued from page 1

"A lot of the types or scales of phenomena that we want to try and capture on film are too much for an artist to do by hand," explained Batty. "Before simulations, if a character was wearing a cape, for example, an artist would have to go in by hand and control each individual piece of geometry. Now, we can have an artist model the initial shape of the cloth, hit play on the simulation, then the cloth does whatever it should do according to the laws of physics."

The scales seen in today's blockbusters are incredibly large and complex — imagine animating all the hair follicles in an army of chimpanzees in Kingdom of the Planet of the Apes or every piece of rock and dust that make up a fictional planet's ring in Alien: Romulus. That scale also means a lot of computing power: The visual effects for second Avatar film, for example, took up 18.5 petabytes of memory, including a single shot that took 13.6 million hours to render in concurrently-running "render farms."

Along with the challenges of scale faced by visual effects teams, certain natural phenomena, like water, have historically been difficult to simulate and realistically render. While the motion of viscous fluids can be described using the Navier-Stokes equations, creating believable, computer-generated water, from mist and droplets to vortexes and tsunamis, required decades of work by specialized teams working across multiple films, explained Mike Seymour, a senior lecturer at the University of Sydney and one of the founding members of fxguide.com.

"When you really got through to solving Navier-Stokes equations was when you were at the point that you were getting visuals that could be incredibly accurate," said Seymour. "There's a lot of physics in visual effects, and to make it look realistic, we have to be able to understand it, manipulate it — and we have to model it to excruciating levels of detail to give it enough perceptual aspects that make you believe it."

"Humans are good at identifying when things are not behaving in a physical manner, with fluids being one example — if suddenly its volume changes, or it flows in a strange direction, you know it looks off," added Batty, whose group works on liquid and gas simulations. "Having good ways to simulate fluids is a matter of necessity to capture visuals that are convincing."

Water was likely the last thing on the minds of the visual effects team for Dune: Part Two, who instead faced the task of seamlessly blending real dust and sand captured during principal photography with computer-generated particles to create natural-looking landscapes. The fictional desert planet of Arrakis also had to be populated with computer-generated spaceships,

Visual effects supervisor Paul Lambert and his team had to balance artistry and audience believability in animating the sandworms of Dune: Part Two, *which defy physics.* Credit: Image Courtesy of DNEG © 2024 Legendary and Warner Bros. Entertainment Inc. All Rights Reserved.

spice harvesters, and a final battle with exploding atomic weapons.

And, of course, there's Shai-Hulud, the colossal sandworms that are longer than an aircraft carrier — whose motions don't quite follow the laws of physics but instead, Seymour explained, strike a fine balance between artistry and audience believability. "If you think about how to move the sandworm through a bunch of sand, there would be so much resistance, but you also need it to move at lightning-fast speeds. Paul Lambert [the visual effects supervisor] and his team knew when to stick with the physics versus when there's a different visual that works," he said.

"There's a lot of physics in visual effects, and to make it look realistic, we have to be able to understand it, manipulate it — and we have to model it to excruciating levels of detail to give it enough perceptual aspects that make you believe it," says Seymour.

The physics involved with rendering hair and fur for digital creatures were simulation-related challenges faced by three of this year's visual effects nominees — Better Man, Kingdom of the Planet of the Apes, and Wicked. The other nominee set in outer space, Alien: Romulus, features a space station crashing into the ring of a planet, with billions of simulated rocks and debris particles launched in the wave of the station's destruction.

Seymour said he was especially impressed with the integration of Better Man's entirely digital chimpanzee main character into complex live-action sequences. "The visual effects community understands what it is to do invisible effects, but if you're not a professional, it's hard to understand that a baby ape sitting in the bath with his grandmother washing his hair is an astonishingly hard shot — and ticks about every simulation box possible," he added.

And while this year's visual effects Oscar winners might not have thanked physics in their acceptance speeches, simulations often get their kudos during the Academy's Scientific and Technical Awards, which recognize software, tools, and innovations related to filmmaking.

One of this year's awards will go to the developers of Ziva VFX, a program for constructing and simulating the muscles, skin, and subcutaneous fat that make up a digital character's frame so they react to a character's skeleton in a realistic way. Other awards given to physics engine-related advances in recent years include the Fizt2 elastic simulation system for skin and muscle animation, the Taz Hair Simulation System for generating hair styles, and Houdini, the 3D animation software used across the industry.

And while awards season focuses on specific films, Seymour explained that it's the iterative process of building up tools, knowledge, and experience film by film that has produced today's successes in visual effects and will power the field in the future. "The Oscars recognize the crew that did a specific film, but the crew would be the first to acknowledge that they're building on a history," he added. "You don't put a major visual effects house together for one project, disband it, and expect to come up with new innovations in physics."

To that end, Batty and his group will continue studying ways to capture more of the diverse behavior of liquids to make computer-generated imagery feel even more real. "In the early days of CGI, we knew how to do a couple of simple types of simulations. Now, they've gotten more advanced, in part by trying to incorporate more accurate physics, using what an engineer or applied mathematician might consider to be the correct equations," said Batty. "The sky is really the limit as far as the level of detail and accuracy."

Erica K. Brockmeier is the science writer at APS.

SEAQUE continued from page 1

"There's a fair amount of hype about quantum computers," says Liam Ramsey, graduate student at the University of Illinois Urbana-Champaign (UIUC). "The technologies we're trialing with SEAQUE are what you'll need to start connecting these quantum computers on a global scale."

These technologies rely on quantum entanglement, or what Einstein called "spooky action at a distance." According to this principle, if you generate two particles, they'll stay connected no matter how far apart you separate them. Another uncomfortable tenet of quantum mechanics is that particles don't have defined physical properties, like spin or polarization, until you measure them, at which time their defined value comes into being.

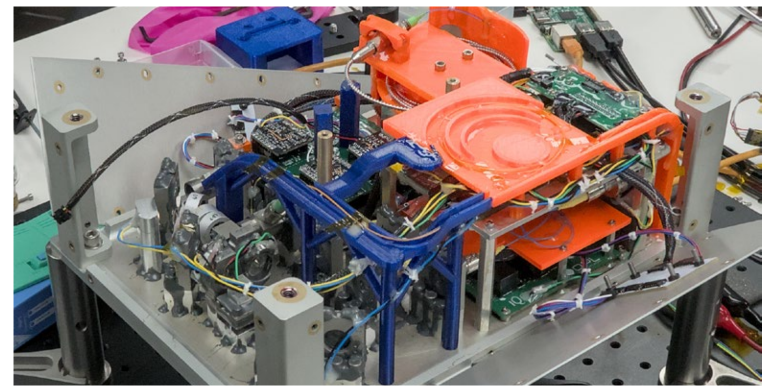
If you combine these two principles, you can get the bizarre process of entanglement swapping. Imagine you have two sets of particles. Particles 1 and 2 are entangled, and particles 3 and 4 are entangled. If you jointly measure particles 2 and 3 — that is, you see whether their polarizations are the same or different, without revealing what they are — then you also know the correlations between 1 and 4. Now 1 and 4 are entangled, no matter how far apart they are. This process can be done over and over again as a sort of relay to share quantum information across long distances.

The rocket carrying SEAQUE lifted off on Nov. 4, 2024, from NASA's Kennedy Space Center in Florida. Credit: Liam Ramsey

Before you can make the whole relay, though, you need to guarantee you can get just one pair of particles to become entangled in space, ideally in containers small enough to send into orbit. That's where SEAQUE, the Space Entanglement and Annealing QUantum Experiment, comes in. "It's a step to show we can build these quantum sources in a very small payload, about the size of a shoebox, and have it be robust enough [to survive launch and the harsh environment of space]," says Kelsey Ortiz, a graduate student at UIUC who presented the results at the APS summit.

"We're putting the main guts of a quantum router in a box and then making sure it works in space," adds Ramsey, likening the experiment to an internet router without an internet connection.

SEAQUE contains a device known as a waveguide that makes two entangled photons, as well as a series of detectors that measures the state of each photon. The whole apparatus has been mounted on the outside of the International Space Station since November 2024. This experiment's waveguide entanglement source is smaller and sturdier than any other quantum entanglement experiments that have been flown in space so far. And not only did it survive launch — its first results, presented at the APS Global Physics Summit, show that it's working extraordinarily well.



The inside of SEAQUE, taken about a year before launch. The orange and blue are 3D printed parts, primarily serving as tracks for SEAQUE's fiber optics. Credit: Liam Ramsey

The team measures this performance with an experiment known as the Bell test, designed in the 1960s by physicist John Stewart Bell. The test can determine if particles are behaving in a truly quantum way. If the particles behave classically, their measured values shouldn't be correlated with each other — but if they're strongly correlated (known as a Bell inequality violation), then quantum entanglement is afoot. So far, SEAQUE has recorded multiple Bell violations, with more confidence than the Chinese quantum communications experiment Micius, and a stronger Bell violation than SpooQy-1, Singapore's entanglement CubeSat.

SEAQUE also has a secondary goal: trying out a technology for "self-healing" its detectors after they're damaged by radiation. Space lacks the protective blanket of Earth's atmosphere, so high-energy photons are all around — and they can knock atoms out of the silicon of an expensive and sensitive detector. With a powerful laser to heat up the silicon, SEAQUE aims to fix those holes in a process called annealing.

"If you imagine having a bucket of sand, and then you take a scoop out the middle, now there's sort of a divot in the middle of your bucket," explains Ramsey. "If you then start shaking that bucket, the sand is going to settle in and fill in that hole. That's pretty much what we're just doing on the molecular level."

"We're putting the main guts of a quantum router in a box and then making sure it works in space," adds Ramsey, likening the experiment to an internet router without an internet connection.

SEAQUE's annealing tests are still in progress, but its Bell test results already look promising for the future of space-based quantum communication. The experiment also marks the United States' first major entry into the quantum communications race. "It's just not nice going to parties and [other countries] always have things up and we don't have anything," jokes Paul Kwiat, SEAQUE principal investigator and UIUC physics professor.

"It's not the glamorous dress the Chinese come walking in with," Kwiat adds, referring to the Micius satellite. "But at least we're invited to the party for a change, so it's a start. And our results are actually cleaner, higher-quality results than from the other sources that have been flown so far."

Briley Lewis is a science writer based in Southern California.

Grad Programs continued from page 1

"It is almost certain we will have to shrink the size of our graduate program in future years due to the anticipated reduction in federal funding," one respondent wrote. "Faculty will have to get more adept at pursuing non-federal sources, but that is unlikely to cover the gap. Faculty and students alike are all very concerned, and I suspect some students will start to leave the program prematurely if they perceive academia/national labs as an increasingly nonviable path for the future."

Although only three respondents said they have rescinded at least one offer of enrollment, several said their university administration did not allow them to make follow-up offers when an offer was declined. Others reported that their departments have limited their funding offers to only cover the first year of study or have removed language that commits to providing funding.

In addition, 18% of departments reported that at least one of their faculty members had federal funding terminated or reduced, and another 28% expected such news in the next six months.

Emotional toll

Several department chairs described a climate of intense stress and decreased morale among faculty and students. One respondent characterized the effects so far as "mostly psychological," as researchers anticipate cuts to grants and indirect cost rates that they believe will eliminate staff, leave scientific infrastructure to deteriorate, and set back young scientists' careers.

"One cannot work like this — all energy goes in thinking how to survive and not think in physics — it is like being in the war," another department chair wrote. "No one can be productive in climate like this — it is the end of the US scientific and technical dominance in the world — we will not recover from this in a decade," they added.

The funding uncertainty has also led to faculty and staff hiring freezes. One respondent expressed concern that their institution would be unable to replace retiring faculty in the long term.

Many department chairs also expressed concern regarding the Trump administration's border policies and their impacts on foreign researchers and international travel. One respondent said undergraduate students at their university have had their visas revoked, and another said they have witnessed a "chilling effect" on foreign postdocs and students. News outlets have reported cases of student arrests or deportations following revoked visas.

One respondent wrote that graduate students are now more interested in searching for positions abroad, while another said some scientists are leaving the country because of the unpredictable and hostile environment.

Traveling researchers often discuss what to delete from their phones and consider using burners, another respondent said, adding that British and Canadian researchers avoided their most recent meeting. A French scientist garnered attention in March after being denied U.S. entry on his way to a conference, and last week the Canadian Association of University Teachers issued travel guidance warning its members against non-essential travel to the U.S.

Clare Zhang is a science policy reporter at FYI, published by the American Institute of Physics.

QuantumFest continued from page 1

"The questions are so profound that people are intrigued."

As the curtains came down on the jubilee, those looking for more fun could test their puzzle-solving skills in the "Quantum Salvation" escape room, organized by LabEscape. To beat it, teams had less than an hour to use a quantum computer to find a cure for a highly contagious, memory-zapping virus.

During his introductory demos to would-be escapees, Paul Kwiat, physics professor at the University of Illinois Urbana-Champaign and creator of LabEscape, emphasizes the need for teams to embrace "curiosity, communication, and collaboration," rather than their scientific knowledge.

"Fun is the most important criteria for the escape room," said Kwiat. "We also want to introduce people to the quantum revolution. We want [everyone] to understand what quantum [science] is and what it can do."

During the APS summit, 52 teams — some 400 "agents" — successfully cooled and ran a quantum computer to simulate a complicated virus and its antidote in less than a minute. The classical computer, by contrast, would have needed 3 trillion years to run the same simulation.

Saipriya Satyajit, a Ph.D. candidate at the University of Maryland, completed his first-ever escape room with his lab members and other attendees. He said he enjoyed the experience, even with the team's nail-biting finish: They completed the simulation with seconds left. "The story around the quantum computer was well-made," he said. "It was all really fun."

Other in-person activities at the summit included a "Save the Cat" scavenger hunt, an origami art installation, and a Quantum Playground, where attendees could play quantum variations of games like chess and poker and meet artists involved with the events.

And even though the Global Physics Summit is now finished, the celebration will continue through the rest of IYQ.

"Science, like art, thrives on curiosity, creativity, and exploration," said Claudia Fracchiolla, the head of public engagement at APS. Events like QuantumFest help make quantum science more accessible. By blending quantum science with interactive activities and the arts, "we are able to connect with the broader public and spark a sense of wonder that brings science to life," she said.

Vishveshwara, who finds quantum mechanics "absolutely enchanting," is excited to see programs like QuantumFest take advantage of the creativity, curiosity, and rigor that artists and scientists share.

"The confluence of art and science makes something really powerful," she added. "The discoveries that you make as a scientist, or as an artist — you perceive it all in a different way."

Erica K. Brockmeier is the science writer at APS.

QuantumFest featured hands-on activities and games, including, at right, a quantum-themed escape room. *Credit: James Gross, Spawnzone/APS*

PhysTEC Teacher continued from page 2

Association and the Arizona section of the American Association of Physics Teachers. I was like a sponge, absorbing any opportunity for professional development.

What is a strategy you learned and integrated into your classroom?

Using whiteboards for inquiry-based labs and activities. By the second year, I had my students working, discussing, and whiteboarding in small groups. And I haven't stopped. My kids are at whiteboards and lab stations almost every day using visible thinking. It's easier for students to listen and make connections in smaller groups.

What is your approach to teaching?

Physics is hard. But I want my students to see physics in their everyday lives, in the world around them. We try to have as much fun as we can.

I also want my students to understand that you don't have to be good at physics for me to like you. You belong here, whether you are good at physics or not, and I am happy to help you. I will meet you wherever you're at. You're in a safe place, in the right place, and it's okay if it's hard. You can be successful.

How do you help students when they're stuck?

They get stuck all the time and never at the same point. That's why I really love whiteboarding. When I walk around from group to group, it's easier for students to let me know they need help. When they do, I go back and see if they understand the previous step. If not, we go back another step. It's important to focus on what they do know.

I tell students that everything we do in physics is exactly like everything else we do in physics, except in the ways they're different. The key is to look for similarities and go from there. Right now, we're in torque and rotational dynamics. Say we're doing the kinematic equations. I remind students, "Don't say 'theta equals omega times time' — its position equals velocity times time, just like always."

What advice do you have for physics teachers?

If you don't have a professional learning community, find one. Find groups that will build you up, help you realize you're doing great, and help you be better. Sometimes our own schools are too small, or not everyone is open to new ideas. Reach out and be creative. And there is always something new that the district wants or that somebody wants from us. But if we are creative and proactive, we can spin those things into what works for us.

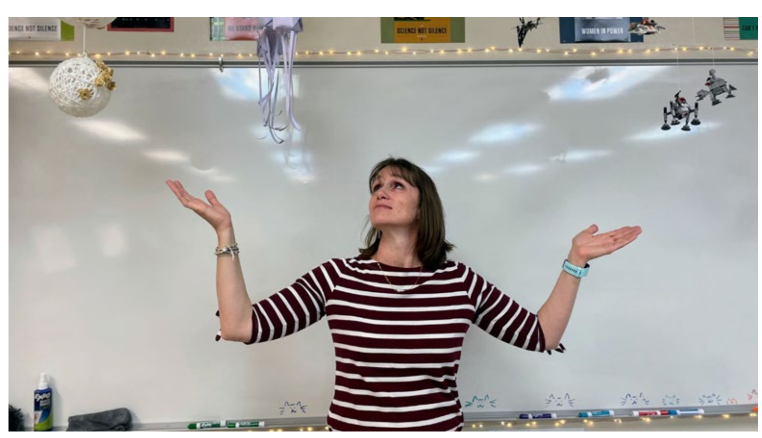
Is there a message you'd like to share with the APS community?

High school physics teaching is great! Don't downplay the job or treat students who want to go into teaching as less-than. In order to have physics majors, we need awesome physics teachers. And teachers have cool research opportunities too.

What do you like most about teaching physics?

I get to have fun and talk about stuff that I love and enjoy. I get to be weirdly obsessed with obscure ideas that nobody else in the world cares about except people in physics. I get to share the fun of physics every single day. That's the best part.

Kendra Redmond is a writer based in Minnesota.



Mobiles hang in Jorgensen's classroom, the culmination of a unit on torque and rotational dynamics. *Credit: Lynn Jorgensen*

Marie Curie continued from page 2

The cask for the ten glass tubes, each containing 100 milligrams of radium, shipped to Marie Curie in Paris. *Credit: Louis Fenn Vogt Papers and Photographs, 1921-1952, Senator John Heinz History Center. Context from Radium City, by Joel Lubenau and Edward Landa.*

Paris.

Curie returned home on June 25, 1921, where the Radium Institute would go on to become a major radioactivity research center, producing four additional Nobel prize winners — including one of her daughters, Irène Joliot-Curie.

Curie came back to the U.S. in 1929, not for radium but for money to purchase a gram of the chemical that she would use to start a new radium institute in Poland. Her visit to the Herbert Hoover White House garnered less media attention, likely overshadowed by the recent stock market crash before the Great Depression.

While Curie remains one of the world's most famous scientists, Sobel said that her first U.S. tour also highlights the humanitarian side of her work.

"We think of her as a scientist, but she was also instrumental in the discovery of the cure for cancer," said Sobel, alluding to Curie and her husband's discovery that radium killed diseased cells faster than healthy ones. Sobel likened Curie to Jonas Salk, the virologist who developed the polio vaccine, for their shared desire not to profit from science but to have their research benefit humanity — and, in a different way, to Einstein. "Similar to the way people reacted to Einstein — they didn't understand what he did, but there was something about him that was so compelling — [Curie] had that kind of stature," Sobel added.

Curie wrote of her time spent with the institute's [NIST's] scientists: "The hours I spent in their company are among the best of my travel."

Curie touched on this idea in her husband's biography. "If the discovery of radium has so much sympathy in America, it is not only because of its scientific value, and of the medical utilization; it is also because the discovery has been given to humanity without reservation or material benefits to the discoverers," she wrote.

Erica K. Brockmeier is the science writer at APS. Special thanks to Bert Coursey, NIST alumni historian, for providing background materials.

BACK PAGE

Global Physics Summit: Town hall comments on recent executive actions

Remarks from APS CEO Jonathan Bagger, President John Doyle, and Chief External Affairs Officer Francis Slakey during the summit town hall.

Francis Slakey speaks during a town hall at the APS Global Physics Summit. Credit: APS

During two town hall-style sessions at the APS Global Physics Summit in Anaheim, California, APS leaders invited attendees to share questions and concerns about ongoing executive actions impacting science, and delivered brief remarks. Below are those remarks from the second town hall, lightly edited for concision.

Remarks by Jonathan Bagger, APS CEO

Welcome to the second town hall at the Global Physics Summit. We have this opportunity to discuss the concerns we all share about the recent actions of the U.S. federal government.

APS is a nonpartisan organization, but no matter what our political or personal views, we all care about the future of physics, the future of research, and the future of our field. APS exists to advance physics, to foster discovery, innovation, and collaboration. In short, we stand for science.

Our mission at APS is to foster a vibrant, inclusive, and global community dedicated to science and society. Each word of that mission is important, and fulfilling that mission depends on a strong scientific community — one that's supported by sound policies and stable funding.

This town hall offers the opportunity to discuss how APS is responding to policies that could jeopardize scientific research and the careers of current and future colleagues, both here in the United States and abroad. Physics is a global field, and so what affects one of us, affects us all. Today, during this town hall, we'll do our best to describe what's at stake. And we'll share the steps that APS is taking, and let you know what you can do to protect the future of science.

Remarks by John Doyle, APS President

Good morning, colleagues. It's an honor and privilege to be with you here today as president of the American Physical Society. Standing here at the Global Physics Summit, I feel both a deep sense of responsibility and immense excitement for the scientific opportunities ahead.

Any incoming APS president would expect these two things, especially in the International Year of Quantum Science and Technology, and at our biggest scientific meeting, where new results and new questions abound. At the same time, I feel the weight of the challenges now facing our community from the developing actions taken by the executive branch of our government.

A major focus of APS is on supporting and navigating our community through an unprecedented targeting of the American scientific enterprise, and here at the Global Physics Summit, we are cognizant of the global impact such actions can have.

It is ironic that this year, the International Year of Quantum Science and Technology, coincides with the recent challenges we face. Quantum science and technology have undoubtedly made major contributions to national security and the economic wealth of the American people and all global citizens.

To nurture quantum science and all of physics, we must — along with the major focus of IYQ activities, educating the public — explain the best we can to elected officials not only the enriching wonder of science and discovery, but also the economic power the scientific enterprise brings, and how our collective scientific activities actually function.

An important part of that functionality is two forces working together. The first is raw curiosity of how the physical world works. Many of us are driven by fascination with a mathematical understanding of the world and the need to comprehend in detail a certain piece of physics. The second is the application of that knowledge to create tangible benefits to society, whether through new materials, transformative technologies, or systems with commercial potential.

These two forces, discovery and application, reinforce each other. This dynamic is what fuels progress. By supporting both pure, curiosity-driven research and basic physics research with an eye towards future applications, either scientific or commercial, we ensure that science continues to advance knowledge and drive the innovation needed to build a better, healthier, and more sustainable future for our global society.

We need Congress to hear this. We need the executive branch and its advisors to hear this. We need the public to hear this.

So far, the flotsam of actions concerning the physics enterprise coming out of D.C. has been unsettling, eaten up emotional and intellectual bandwidth, and greatly affected the lives of many. This situation may become much, much more challenging for physicists in the future. Make no mistake about that. Truth is under attack. APS needs to promote physics and physicists need, as always, to tell the truth — even when uncomfortable. Truth is our major currency among the public. It is our superpower. As we have, over the past two years, worked so hard at APS to focus our approach on messaging and advocacy, we will continue to carefully prepare our boat to face what is currently a squall, but which has the potential to become a hurricane.

Our APS mission and vision didn't change because Calvin Coolidge, Eisenhower, or Clinton was elected, and it didn't change when Trump was elected. We are all aware — and it didn't take a flurry of executive actions to make us so — of the pressures facing our community, from funding constraints to the erosion of public trust in science.

But as leaders, we know that every challenge is an opportunity, and the same skills that drive our research - teamwork, innovation, and problem-solving - can guide us in addressing these pressing issues.

Remarks by Francis Slakey, Chief External Affairs Officer

I'd like to start by talking directly to staff at the federal science agencies. Many of you are joining us at this meeting virtually — you couldn't join us in person because of federal budget issues and federal travel suspensions.

I've spoken with staff at the National Science Foundation, the National Institute of Standards and Technology, the Department of Energy. You have told me how challenging and dispiriting it is at your agencies right now. Some of you have said you feel abandoned by the government.

But you are not abandoned by us. This is your community, the physics community, APS — all of us here. And whether you are at NSF or DOE or NASA or NIST or NOAA, or any of the federal science agencies, I want to thank you for the work you do. You are the backbone of U.S. science.

But while that demonstration of appreciation is important, it's not enough. So APS is waiving membership fees for members who are facing financial hardships. We're allowing virtual access to meetings. We're providing career services and benefits.

And on March 11, APS filed a legal brief on behalf of employees at federal science agencies who are suing the federal government to get their jobs back. From our perspective, the government has provided no evidence that the firings address their stated goals of increasing efficiency or reducing waste, fraud, and abuse.

So when I say that we are standing with our staff at federal science agencies, these are not just words from the stage. We are in the courts directly supporting the agencies and the staff who work for them.

That's not the only issue we have to address right now. Numerous executive actions are affecting APS members and the physics community. There are proposed cuts to the federal science budget by 20% to as much as 50%. There have been caps on indirect costs, rollback or elimination of climate change policies and regulations, increasing barriers to immigration, and suspension of diversity, equity, and inclusion programs.

These executive actions touch all of us — whether you are a student worried about your future, a PI wondering about your next grant, an international scientist who wants to come here to collaborate or even just attend this meeting, or a scientist in industry wondering about the federal government's commitment to the Chips and Science Act.

I want to tell you how APS is responding to a few of these issues.

Let's start with the science budget. This week, every federal science agency had to provide the administration with a proposal to reduce their staff by as much as 50%. And soon, the president is going to propose a FY '26 budget for the government. We expect significant cuts to science — the 20-50% cuts I mentioned.

There's only one way to stop that from happening. Congress has to reject proposals to slash science. How do we get Congress to do that? Members of Congress have told us how. As Representative Chuck Edwards, a Republican from North Carolina, said recently: "I will find out what any proposed cuts are. I will find out what the impact is on my district, and if they hurt people in my district, I will vote against those cuts."

To get members of Congress to reject budget proposals that slash science, we have to meet with them and their staff in the states, speak up at town halls and talk about the impacts of cuts, and share our message with the media.

So that's what we're doing. As APS members, you've already received emails from us, including one asking you for stories. We're using these stories to build our ground game, so that when the president drops his budget proposal, we are prepared to run a 50-state, nationwide, grassroots campaign.

Meanwhile, we will pay close attention to a particular handful of states — states in which we are already building and training teams of APS members. Maybe some of you are already participating. The moment the budget drops, we'll be scheduling meetings in those states so those teams can meet with their members of Congress and staff in local state offices. We'll be providing schedules of town halls where they can speak up about the impact of the cuts. We'll be helping with op-eds and letters to the editors, so these teams can share the impacts of those cuts in local media.

In other words, we're building a member-driven, locally tuned, state-based grassroots campaign. That's how we're preparing to respond to proposed cuts to the federal science budget.

I want to talk about one more issue: the executive actions around diversity, equity, and inclusion. Maybe you've gotten a sense for this from what Jon Bagger and John Doyle said — from what I've said. But APS work is based on our values, and our values have not changed. You can go to our website and see them, right alongside our mission.

Those values and that mission are not going to change because of the executive actions of an administration — not this administration, not the last administration, not the next administration.

APS statements, which represent the application of our values to particular issues, will not change either. I encourage you to read our APS statements, particularly the APS statement on diversity in physics. That statement encourages a work environment that fosters equity and inclusion. It reads, "APS recognizes that the health of the physics discipline is best served by addressing the equally important goals of improving access to opportunities in physics to the betterment of all people, while also engaging the vast intellectual potential that resides in groups underrepresented in physics."

"Access to opportunities" — I hope that is something we can all agree to. In fact, I know the majority of you agree, because that statement was sent to every APS member for review and comment, and we received overwhelming support from our membership and from your elected Council and Board.

No executive order has changed a single word in that statement. No executive order will change a single word in our values. No executive order will change a single word of our mission.

We're also maintaining our commitment to our programs — our national mentoring program; our Bridge Program, which helps students transition from undergraduate to graduate school; our Step Up program, which helps students, young women in particular, stay in physics; and our Conference for Undergraduate Women and Gender Minorities in Physics.

We stand behind these programs. Each one of them is open to all. Each one of them provides access to opportunities. Each one of them recognizes that different communities have unique needs.

I encourage you to go to the website, to read about those programs and the stories of the hundreds of students who have benefited from them. I hope, when you come away from reading, you'll understand why we do this. Those programs enable the physics community, the full physics community, to grow and to thrive. We broaden, we grow, we thrive.

I know that there are institutions across the country that are folding up their programs. APS is not.

I know that there are organizations across the country that are scrubbing, editing, or archiving their formal statements, mission, or values. APS is not.

I want to share something I heard a couple of weeks ago. Jeremy Young, a director at PEN America, works with institutions across the country, counseling them on how to maintain their inclusion-related activities in light of executive actions. He's discovered that it helps to share an example of an organization that's standing on its values and retaining its programs. The example he gives is APS.

It's nice to be an example of an organization that stands on its values. But I'm most proud of the actions we're taking. We are working with you to fight for science in every state in this country. We are in the courts supporting our federal science agencies and the staff that work for them, and we are providing access to opportunities and maintaining our programs.

I'll close with one reminder. When there's all this political fury, it's useful to not lose sight of what APS is and what APS is not. APS is not a blue-state organization. APS is not a red-state organization. APS is a physics organization. Everything that we're doing — all the actions we're taking — are good for physics, not for a political party.

I know that many of us are stirred up by the politics of the moment. I get that. But look to other organizations to channel your partisan views. Look to APS to champion physics.

Thank you.

Learn more about APS' federal and state advocacy and how you can get involved, at go.aps.org/3WF1u66.

Opinion articles on the Back Page are member commentary; their views are not necessarily those of APS. To respond to an opinion piece or pitch your own (we welcome both), email letters@aps.org.