How Do You Study Quantum Materials That Don’t Yet Exist? Ask Al.

By Sophia Chen

E ach human technological era is defined by its materials: the Stone Age, the Bronze Age, or today’s Silicon Age, if you will. Physicist Trevor David Rhone thinks we are approaching a Quantum Age. To make the materials necessary to construct quantum computers, sensors, and more, Rhone is exploring a technique beyond mining and refining. He trains artificial intelligence models to explore the properties of yet-unmade materials. In fact, he’s developing AI that, when given a desired application, will tell you how to design a new material, “much like you might ask Alexa today for a recipe to bake a cake,” said Rhone, an assistant professor at Rensselaer Polytechnic Institute.

Rhone is the 2022 recipient of the Joseph A. Johnson III Award, who tackles materials science with artificial intelligence.

You’re from Kingston, Jamaica. What was it like growing up there?

I lived in Kingston until I left for college. I came from a very middle class family, and life in Jamaica was very comfortable. I went to a Jesuit high school called Campion College, one of the better schools in the country. My parents were academics and powerful membership and service.” He credits his success in part to father, the famed Jamaican playwright Trevor Rhone, and his mother, Camella, who led Jamaica’s equivalent to the U.S. National Institute of Standards and Technology.

“She sparked my interest in science in general, and curiosity about the world,” Rhone said.

Rhone spoke to APS News about his path to and in physics. This interview has been edited for length and clarity.

Wikipedia Has a Problem That Physicists Can Help Solve

APS’s Wiki Scientist Program trains scientists to bridge the site’s gender and race gap. Physicist Alexander Moreno is going even further.

By Liz Boatman

Wikipedia is a behemoth. As one of the world’s most visited websites, the free, volunteer-written online encyclopedia has 60 million pages, 2 billion monthly users, and nearly 130,000 editors who have contributed in the last month. It also has a problem. Women and members of certain racial and ethnic groups are under-represented in Wikipedia articles, including in science — a challenge that has plagued the platform since its launch two decades ago. For example, as of January 2023, just 5% of English Wikipedia’s biographies were about women.

To help change this, the American Physical Society partnered with the nonprofit Wiki Edu in 2019 to launch the Wiki Scientists Program, which has now trained 84 people — including a Nobel Prize laureate — to the site.

Now a Nuclear Physicist at Los Alamos, APS Bridge Program Grad Says Nuclear Security is His Calling

“[My mom] was my savior,” says Jesus Perello. “She said, ‘Listen, you did not go this far just to quit.’”

By Liz Boatman

Jesus Perello Izaguirre’s favorite childhood memories are the gatherings his family held every Christmas in his hometown of El Progreso, Honduras. On Christmas Eve, eighty-some relatives would open presents together at the stroke of midnight, a tradition for many Hispanic families.

Life became harder after his father died, Perello says. For years, Perello’s grandmother, already in New York City, had insisted it was time to relocate. In 2000, his mother made the difficult decision to move the family to the United States. Perello was 9 years old.

The move would set him on a path toward a doctorate in experimental nuclear physics, earned through the APS Bridge Program — which helps underrepresented students of color pursue PhDs — and ultimately a career in the field.

By middle school, Perello knew that math and science were his strongest subjects. He always loved science; as a boy in Honduras, he scoured his family’s encyclopedia to learn about white dwarfs and black holes. And although most of his family worked in law and politics, he says, he was brimming with questions about the universe.

Seventh-grade science was “when I really would pay attention, really focus,” says Perello.

By high school, Perello’s family had settled in Miami, where his vibrant Hispanic population made the city feel more like home than New York had. He joined the football team as a starting offensive lineman. During his senior year, he took his first physics class. “I loved it,” he says. He loved it so much, in fact, that he asked his teacher to tutor him — not to catch up, but to learn college-level physics. Several days a week, prior to doming shoulder pads for football practice, Perello headed to a classroom to learn vector calculus and practice problems in classical mechanics.

After high school, Perello earned an associate degree in science at Miami Dade College. “I really enjoyed not just the observational side of physics, but the theory,” he recalls. He decided to enroll at Florida International University (FIU), where he worked toward a bachelor’s degree in physics.

“[My mom] was my savior,” says Jesus Perello. “She said, ‘Listen, you did not go this far just to quit.’”

By Liz Boatman

Jesus Perello, who earned his doctorate in physics from Florida State University in 2023, is now a nuclear physicist at Los Alamos National Lab. (Credit: Joe Pazour)

New Technique Generates Non-Flickering Flames at Normal Gravity and Atmospheric Pressure

Flickering flames are more unstable. Researchers have come up with a novel way to keep them still.

By Kendra Redmond

Dancing flames — in a fireplace, say — create a cozy ambiance, but flickering can impede a steady burn. That might be no big deal for the casual candle fan, but suppressing flickering could mean cleaner and more energy-efficient engines and furnaces, or help contain fires in spacecraft, where they can quickly grow out of control.

Now, scientists have generated nonflickering flames with a new method — varying the distance between two flames. A flame flickers when its characteristic shape is distorted by the flow of the surrounding air or other gases. When buoyant diffusion flames are close together, like in a cluster of candles or gas burners, their flows interact, or “couple,” causing coordinated flickering and less efficient burning.

There are two main ways to suppress this synchronized flickering:

 decrease the ambient pressure, or reduce the buoyancy of the flames, either with microgravity or by lowering the fuel mass burning rate.

But in research published Jan. 23 in Physical Review Applied, a team at Tohoku University of Technology in Japan, led by Yuki Nakamura, introduced a method that doesn’t use either.

The team previously studied how two flames, on side-by-side gas burners, dance flames continued on page 3
Meenakshi Narain, 1964-2023

Particle physicist who was a ‘force of nature’ dies at 58.

BY DANIEL GARISTO

Meenakshi Narain, an experimental particle physicist who helped discover the top quark and pushed her field to a new dimension, died Jan. 1, in Providence, R.I. She was 58.

She began accruing accolades early on, with one of Fermilab’s prestigious Wilson Fellowships. At the end of her life, she was the physics chair at Brown University, a member of the Particle Physics Project Prioritization Panel (PPPP) and the Department of Energy’s advisory committee, and co-founder of the Energy Physics Workshop.

Narain was elected an APS Fellow in 2007. In tribute, many described Narain as a “force of nature,” citing her tenacity and will. “She’s one of the most courageous people I know,” says Tulika Bose, an experimental particle physicist at the University of Wisconsin, Madison. “I think her biggest legacy — of course, she did fantastic physics but I think it’s the way she influenced people over the years.”

Meenakshi Narain — Meena, to friends and family — was born in Gorakhpur, India, to Prem Narain Srivastav and Kusum Srivastav. “Her desire was to do well in physics and to go to America and do good research from the very beginning,” says Boaz Klima, a particle physicist at Delhi University and close friend. After receiving degrees from Gorakhpur University and the Indian Institute of Technology Kanpur, she matriculated to Stony Brook University, in New York, in 1988.

There, she worked on upson physics in a tight-knit team under Juliet-Lee Franzini. She also met a fellow student, Ulrich Heintz, and in 1988 the two were married with their newborn son to work. According to Heintz, the Stony Brook lab helped her lead to fight for women’s rights, and despite her success, Narain was diagnosed with cancer.

Despite her success, Narain was diagnosed with cancer. Her suggestions were often ignored until a male colleague chimed in. There was no maternity leave at the lab, so Narain frequently brought her newborn son to work. According to Heintz, the Stony Brook lab helped her lead to fight for women’s rights.

Narain continued on page 5

Venus, shrouded in clouds. Credit: NASA/JPL/SSC

Meenakshi Narain examined possible top quark events at Fermilab’s DZero experiment in 1995. Credit: Wells Homan/APS

In 2020, Narain was diagnosed with cancer as she began working on the Snowmass process to plan the next decades of particle physics. “She dedicated herself to it,” Heintz says.

THIS MONTH IN PHYSICS HISTORY

March 1966: The First Human-Made Object Makes Impact With Another Planet

Venera 3, a spacecraft launched by the Soviet Union, crashes into Venus on March 1, 1966.

BY TESS JOOOSE

Two MVs were prepared for the fall 1965 launch window: Venera 2, which would fly by Venus, and Venera 3, which would land. Researchers stocked Venera 3 with scientific instruments, including ion traps, spectrometers, a cosmic ray sensor, and a magnetometer. Strapped to its side was the spherical landing probe that would descend to Venus by parachute, packed with devices to measure the temperature, pressure, density, and chemical composition of the atmosphere. Another curious object was loaded on board: a metallic emblem, made of titanium and thermostress-titanium and emblazoned with the U.S.S.R. state seal. This symbol was to be deposited on the surface of the planet; many Soviet space probes carried them during this era.

Venera 2 launched on Nov. 12. It flew within 24,000 kilometers (almost 5,000 miles) of the planet on Feb. 27, 1966, then lost contact with Earth before it could communicate any data. Venera 3 was fixed on Nov. 16. On March 1, 1966, after 105 days of traveling through the solar system, the instruments aboard crashed into the Venusian atmosphere.

Early efforts weren’t fruitful. The first Venus probe, sent in Feb. 1961, fell back down to Earth 22 days after launch, and a second, which blasted off in the same window, never reached the orbit of Venus and 24 days for flying for 10 days. Three more Soviet Venus missions, planned for launch in 1962, each lost communication with the U.S.S.R. — though on Dec. 14, 1962, the Americans pulled off a victory when their Mariner II probe flew past Venus and gathered data on its scorching temperatures, before becoming the first successful interplanetary probe.

Venera 3 was launched from the Soviet spaceport on Earth on Mar. 1, 1966, and traveled 96 million kilometers (more than 2,100,000,000 miles) to reach the area of the atmosphere. Another curious object was loaded on board: a metallic emblem, made of titanium and thermostress-titanium and emblazoned with the U.S.S.R. state seal. This symbol was to be deposited on the surface of the planet; many Soviet space probes carried them during this era.

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Despite the challenges, Venera 3 reached its goal and sent back data that showed the surface of Venus was inhospitable. The craft sent pictures of the surface, which were used to map the region and determine the composition of the atmosphere. The information gathered by Venera 3 was used to create a detailed map of the planet’s surface, which was used to plan future missions to Venus.

In the years following Venera 3’s mission, scientists continued to study the planet using data gathered by previous spacecraft. This led to the development of new missions and technology to study the planet further. The success of Venera 3 paved the way for future missions to Venus, including Mariner 10, which made multiple flybys of the planet in the late 1970s.

The mission of Venera 3 was a significant milestone in the exploration of Venus and laid the groundwork for future missions to the planet. It demonstrated the feasibility of sending spacecraft to Venus and provided valuable scientific data that helped scientists understand the planet’s atmosphere, surface, and climate.
s an undergraduate majoring in physics, Wade, Jess, wonders what do you do with your summers, especially after your sophomore and junior years, can be important if you’re planning to pursue graduate school or a career in the field. To help students, sever-
el at this year’s Conference for Undergraduate Women in Physics (CUWiP) offered workshops on ex-
ploring summer internships.
CUWiP — held annually — aims to increase the number of under-
graduate women in physics who will currently earn 4 in 1 bachelor’s de-
grees in the fields. Through work-
shops, plenty of them are close — se-
parated by less than a critical distance (a function of burner size) — to each other, in a sense, called “in-
phase.” When they’re separated by more than a critical distance but still close enough to interact, the flames flicker in tum, called “ant-
phase.”

But the most interesting be-
behavior occurs right at that critical distance, says couochu Xiaoyu Ju. There, the flicker is in sync, called “in-
phase.” When a phase flip occurs, it doesn’t happen right away. Before a flip, the flames are in a “delay” time-
temperature description, according to Ja-
queline Chen, a senior scientist at San-
dia National Laboratories who was not associated with the new re-
search. They can affect burn rate and generate acoustic noise, she says, noise that, in a combustion cham-
ber, may lead to thermoacoustic instability which may damage gas turbine combustors. In rocket en-
gines, for example, this instability can cause major problems.

And noise isn’t just an issue in combustion. The team’s technique might be useful in electrical optical, and other nonlinear systems, when it’s important to suppress flickering noise, Ju says.

Chen also notes that certain fuels increase flame-flame interactions and can become coupled. To induce the not-quite-
coupled state, the burner velocity needed to keep pace with the fluid flow’s response to the change in dis-
tance, Ju says.

Next, the researchers determined the parameters governing this kind of system. Their model, which could guide other researchers, describes “a feasible way to generate nonflickering flames in a moving dual burner system,” the authors say.

Understanding flame-flame in-
teractions, known as “coupled system,” is one of the authors’ research “relatives” he explains, so “anyone can contribute.”

The key to achieving this was find-
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tance, Ju says.

For more specialized skills, “Internships are really where you’re going to build the technical skills related to your field,” says Buetter.

Garcia adds, “If you’re applying to grad school, you definitely want to have at least one internship ex-
perience” to give your application the best shot at success.

Gowen notes another advan-
tage of internships: “If you’re a stu-
dent from a small college, you can choose an opportunity that will give you a sense for what it’s like

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Five Science Policy Stories to Watch in 2023

BY THE FYI TEAM

The last two years, lawmakers passed landmark legislation that coupled new support for research and development (R&D) with big ambitions for industrial growth, including the CHIPS and Science Act, Infrastructure Investment and Jobs Act, and Inflation Reduction Act. The Biden administration now seeks to swiftly implement the bills, which provide billions in direct funding for new initiatives.

However, most federal science programs still depend on annual appropriations and could face headwinds this year in a divided Congress. But even with partisan gridlock, 2023 is poised to be another busy year for science policy. Here are five stories to watch in the months ahead.

Test begins for Biden-era industrial policy

The Biden administration will face challenges as it begins implementing the new R&D programs and technologies it helped secure and approved by the previous Congress. These institutional programs, like REUs (research experiences for undergraduates), are typically not approved by the previous Congress. The initiatives will test the possibilities of industrial policy, in which the government actively steers technology development to promote economic transformation. Primed by the promise of federal subsidies, many companies have announced follow-on investments that the Biden administration now hopes to build on by fostering new “ecosystems” that better connect with academic and supply companies with financing, tools, materials, and workers. While some of this funding received bipartisan backing, Republicans have said they will closely watch these initiatives for signs of failure.

Divided Congress sets up rough road for science funding

With Republicans holding a narrow House majority, the party’s leaders are focusing on steep cuts in federal spending, setting up high-stakes standoff with the Democrat-controlled Senate — including over raising the statutory debt limit by this summer and passing spending bills for 2024, which starts Oct. 1. Science agencies would be hit indirectly by the economic fallout of a debt default and directly if Congress does not pass new appropriations bills, adding to current strains from inflation and supply-chain disruptions. Congress likely faces an uphill climb to meet the science budget targets in the CHIPS and Science Act, which largely includes only direct funding for new “innovators’ initiatives.” The Biden administration may also need to reallocate funding in its ambitions for the National Science Foundation (NSF) and the Commerce Department, where other CHIPS Act initiatives were planned.

Particle physicists plot new directions for the field

U.S. particle physicists will chart a course for the next decade and beyond in a report due this fall, from the Particle Physics Projects Prioritization Panel (P5). Like the last P5 study published in 2014, the report will propose a budget-constrained agenda for federal agencies, drawing on inputs from the research community at last summer’s “Snowmass” conference. A recent summary report from the conference affirms the five science priorities identified by the last P5, while recommending a new focus on precision measurements of rare processes. It also proposes the U.S. prepare to “participate in or build” an electron-positron “Higgs factory,” a subsequent high-energy muon or hadron collider, and a next-generation gravitational wave observatory.

Fusion faces opportunities and setbacks

Lawrence Livermore National Laboratory’s recent achievement of fusion ignition stoked public interest in the potential for fusion power plants, though lab leaders cautioned that the prospect remains distant. Magnetic confinement fusion could offer a shorter path to commercial fusion energy than Livermore’s laser-driven method, and private fusion companies have raised billions of dollars in recent years, hoping to bring a magnetic fusion power plant online as early as the 2030s. The Biden administration is betting on it, launching a milestone-based development program to support the industry. However, the world’s largest magnetic confinement experiment under construction, ITER, recently discovered major manufacturing flaws that may delay the project by years, on top of a separate three-year delay expected because of the pandemic and supply-chain issues.

Equity push unfolds across science agencies

The Biden administration is also ramping up efforts to promote equity and inclusion in STEM fields. The DOE Office of Science’s new RE-FAIR and PReVAIR programs will support workforce training and build research capacity at institutions that have been historically underrepresented in the represented office’s portfolio. Federal agencies are also reworking their grant review processes to promote equity. For example, the DOE Office of Science now requires grant applications to describe how they plan to promote inclusion in their research projects, and the NSF is reviewing the “broadest impacts” criteria it has long used when reviewing proposals.

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Venus 3 continued from page 2

tered a pendant with the emblem of the Soviet Union to the surface of the mysterious planet,” he writes. “We can call it a complete con- fidence, despite the fact that we lost the radio contact with the spacecraft before reaching the surface of the planet.” What’s left of Venus 3 still lies somewhere on Venus’ hostile sur- face, a reminder of humanity’s first contact with another world.

Both the Soviet Union and the U.S. made further trips to Venus in the following decades (Venus 9 and 10 reached the surface in 1975), but Earth’s sister planet is still shrouded in mystery. Several fu- tures have been proposed (one by NASA’s DAVINCI, which is scheduled for launch in 2029 and will study whether the planet’s atmo- 
sphere holds components of wa- ter. If all goes to plan, DAVINCI will drop down to Venus’ surface and gather data as it descends. It could last up to 18 minutes on the moun- tainous terrain before succumbing to the hellish pressure and heat — if it survives the landing.

This obscure is a science journalist based in Madison, Wisconsin.

APS News
less allowed me to pursue whatever I wanted. Academia in Jamaica is female dominated. A lot of the girls in school did much better than the boys, so my vision of a bright student was to do basic math and physics. My mother was the embodiment of knowledge to me; when I’d ask her a question, she always knew the answer. Your dad co-wrote The Harder They Come, the internationally acclaimed 1972 film. Were you aware your dad was growing up?

He’s extremely famous in Jamaica. I was very proud of him when I was growing up and would often see his plays. One of his books was on the exam syllabus for the Caribbean regional examinations for student teachers, SATs. I remember one time going through customs at the airport and being asked if we were related. When did you become interested in physics?

“In high school, I had a wonderful physics teacher, Mr. Henry, who made the subject really fun. I pursued it in college because it was such a good experience.”

In undergrad, I was also pre-med. My goal was to become a physician. In Jamaica, you have three career options if you’re bright — you can become a lawyer, engineer, or physician. I wanted to do law, didn’t want to do law because I thought you had to study history, and I wasn’t good at history. I chose engineering to me meant wearing a hard hat and building bridges, which I didn’t think was interesting. Medicine seemed cool until I realized I didn’t like having to memorize things. Learning physics was much more fun.

You studied 2D materials at graduate school in Columbia University. How did you become interested in this?

“As a physicist, Narain was supremely organized. ‘She had these spreadsheets… and she could almost always answer every question: ‘This is gonna take that long’ and ‘you need that many people.’”

After Fermilab, Heintz and Narain both accepted jobs at Boston University, where she began to mentor students. “I always felt protected,” says Kevin Black, a particle physicist at the University of Madison, Wisconsin and a former graduate student. “I try to emulate her as an advisor to my students, and post-docs, but I can’t do as good a job as she did. She was just so good.”

In 2006, Narain joined the Compact Muon Solenoid (CMS) at CERN in Switzerland, where she built off her experience at D-zero to search for Higgs bosons. To do these experiments, to make a mathematical model that related these simulated materials’ structures and chemical compositions to their properties. She could then interpolate that model to predict the properties of related materials that haven’t been simulated, in seconds. You could use this method on a laptop to quickly screen materials candidates for a particular application rather than making materials somewhat blindly based on chemical intuition. She, too, flew from Boston to Fermilab to pull her analysis worked.

She dedicated herself to it,” Heintz says. “We will miss her.”

When Narain was diagnosed with cancer as she began working on the Snowmass process to plan the next decades of particle physics, “She dedicated herself to it,” Heintz says. “We will miss her.”

Since Russia’s invasion of Ukraine, the American Physical Society has worked to help affected physicists and students. APS offers these physicists free APS membership and meeting registration, and it has matched APS Unit donations to the National Academy of Sciences’ Safe Passage Fund, raising nearly $100,000 to support scientific work disrupted by the invasion.

Now, with Sloan Foundation funding, APS is expanding two existing programs to support affected physicists.

APS International Research Travel Award Program (IRTP). Since 2004, IRTP has supported research collaborations between physicists in developed and developing countries. The program provides a pair of collaborators a $2,000 grant, typically funding a physicist’s travel from a developing country to a collaborator in a developed country. So far, it has funded 99 teams representing 46 countries.

With the two-year Sloan grant, APS is expanding the program to specifically support physicists affected by the invasion, enabling them to visit collaborators in other countries and receive larger grants for longer visits.

APS Distinguished Student (DS) Program. Since 2015, the DS Program has funded travel and registration for outstanding international graduate students to present their work at APS March and April Meetings. So far, the program has awarded 81 grants. With Sloan’s support, a new branch of the program will focus solely on supporting students affected by Russia’s invasion. Ukrainian students can receive expanded awards that support visits to annual APS meetings and any APS Unit meetings. Funds are also available to augment these meetings with additional visits to universities or other institutes.

To learn more about APS initiatives supporting physicists and students, visit aps.org/programs/international.

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APS International Research Travel Award Program (IRTP). Since 2004, IRTP has supported research collaborations between physicists in developed and developing countries. The program provides a pair of collaborators a $2,000 grant, typically funding a physicist’s travel from a developing country to a collaborator in a developed country. So far, it has funded 99 teams representing 46 countries.

With the two-year Sloan grant, APS is expanding the program to specifically support physicists affected by the invasion, enabling them to visit collaborators in other countries and receive larger grants for longer visits.

APS Distinguished Student (DS) Program. Since 2015, the DS Program has funded travel and registration for outstanding international graduate students to present their work at APS March and April Meetings. So far, the program has awarded 81 grants. With Sloan’s support, a new branch of the program will focus solely on supporting students affected by Russia’s invasion. Ukrainian students can receive expanded awards that support visits to annual APS meetings and any APS Unit meetings. Funds are also available to augment these meetings with additional visits to universities or other institutes.

To learn more about APS initiatives supporting physicists and students, visit aps.org/programs/international.
News

What Can U.S. Scientists Do to Help Their Ukrainian Peers?

Raymond Orbach shares his experience getting funding to physicists in Ukraine.

BY RAYMOND ORBACH

On Feb. 24, 2022 — around one year ago — Russia launched a brutal attack on Ukraine, invading cities and towns and destroying lives and livelihoods. The Ukrainian people remain fiercely strong, even as missile attacks still lay waste to homes, shops, and schools.

There is another victim of Russia’s atrocity: science. For decades, Ukraine was a bastion of research, which thrived in cities like Kyiv and Kharkiv and attracted international collaboration. In the 1980s, I myself worked with a brilliant Ukrainian physicist, Igor Gurevich Kulik, of the Verkin Institute for Low Temperature Physics and Engineering in Kharkiv (we passed away in 2019).

But from the war’s beginning, Ukraine was undisciplining in its assas, bombing universities and research institutions and killing scientists and other civilians. By mid-April, the war had displaced millions, including one-sixth of Ukraine’s scientists — some 15,000, according to Vaughan Turekian, the executive director for policy and global affairs at the U.S. National Academy of Sciences.

Remarkably, though, research in Ukraine continues — a testament to the strength of its scientists. Just as military aid from the United States and European Union has helped blunt Russia’s assault, so foreign support has helped Ukrainian scientists persist. The American Physical Society’s International Scientific Affairs program and funding to assist scientists and students in Ukraine.

We working physicists can add to these efforts, as I learned firsthand last year. On April 4, 2022, the Department of Energy’s Office of Science published a “Dear Colleague” letter notes, these supplements aim to "protect the well-being and live- hood of students and scientists impacted by the war by maintaining strong connections to the world-wide scientific community." Whether through DOE or other agencies, these grants can bolster the pro- fessional and scientific lives of our peers in Ukraine. I hope this article inspires others to use these funding opportunities.

In just over a year, Ukraine’s scientists and students have been aided by governments around the world and continue to develop new technologies to help their country recover. As I have learned firsthand from my colleague, Raymond Orbach, a physicist at Brookhaven National Laboratory and former U.S. Energy Secretary, the United States has provided funding to support scientific research in Ukraine.

In my view, it is our responsibili- ty as research scientists to find ways to help — to assist those deprived of decent working conditions by an unjust and unprovoked war. As governments around the world rally to support Ukraine’s war efforts, so we scientists should rally to aid the work of our Ukrainian peers.

Raymond Orbach is a theoretical and experimental physicist, a professor at the University of Texas-Austin in physics and mechanical engineering, and an APS Fellow. He has been involved in science policy for decades, including as the under secretary for science at the Department of Energy from 2006 to 2009.