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Cool science at STEM in the Sun **Page 9**

Bigger and better quantum computers possible with new ion trap, dubbed the Enchilada

THE WHOLE ENCHILADA — The Enchilada Trap, manufactured in the Microsystems Engineering, Science and Applications fabrication facility. **Photo by Craig Fritz**

Sandia delivers its first devices capable of supporting 200 trapped ion qubits

By **Troy Rummler**

Sandia has produced its first lot of a new world-class ion trap, a central component for certain quantum computers. The new device, dubbed the Enchilada Trap, enables scientists to build more powerful machines to advance the experimental but potentially revolutionary field of quantum computing.

In addition to traps operated at Sandia,

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'Stunning' discovery: Metals can heal themselves

Microscopic cracks vanish in experiments, revealing possibility of self-healing machines

By **Troy Rummler**

Scientists for the first time have witnessed pieces of metal crack, then fuse back together without any human intervention, overturning fundamental scientific theories in the process. If the newly discovered phenomenon can be harnessed, it could usher in an engineering revolution — one in which self-healing engines, bridges and airplanes could reverse damage caused by wear and tear, making them safer and longer-lasting.

The research team from Sandia and Texas A&M University described their findings July 19 in the journal Nature.

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WATCHMAN — Sandia researcher Ryan Schoell uses a specialized transmission microscope technique to study fatigue cracks at the nanoscale. **Photo by Craig Fritz**

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Sandia National Laboratories

Albuquerque, New Mexico 87185-1468
Livermore, California 94550-0969
Tonopah, Nevada | Kauai, Hawaii
Amarillo, Texas | Carlsbad, New Mexico | Washington, D.C.

Katherine Beherec, Editor kgbeher@sandia.gov
Ray Johnson, Production rbjohns@sandia.gov
Craig Fritz, Photographer cvfritz@sandia.gov
Michael Langley, California Contact mlangle@sandia.gov

CONTRIBUTORS

Michelle Fleming (milepost photos, 505-844-4902), **Neal Singer** (505-846-7078), **Kristen Meub** (505-845-7215), **Troy Rummler** (505-284-1056), **Valerie Alba** (505-284-7879), **Meagan Brace** (505-844-0499), **Mollie Rappe** (505-288-6123), **Skyler Swezy** (505-850-2063), **Kim Quintana** (505-264-1886), **Kenneth Vigil** (505-537-1528), **Luke Frank** (505-844-2020), **Michael Baker** (505-284-1085)

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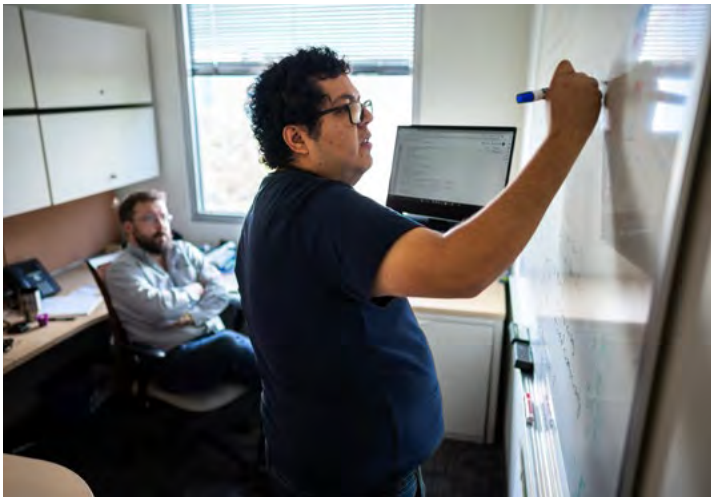
Labs mentor program engages minority students, aims to attract STEM hires



MACHINE-LEARNING MENTORSHIP — Doctoral candidate Arturo Rodriguez, center, works with mentor Nat Trask on machine learning using satellite imagery to predict ice sheet movement. They are part of the Rio Grande Consortium for Advanced Research on Exascale Simulation mentorship program. **Photo by Craig Fritz**

By **Neal Singer**

A government-funded consortium offering science and technology learning opportunities to student minorities aims to, over time, equalize workforce demographics at national laboratories, said leaders of the effort at Sandia.

The partnership, titled the Rio Grande Consortium for Advanced Research on Exascale Simulation, known as Grande CARES, is funded by the NNSA's Minority Serving Institute Partnership Program, which sponsors similar efforts around the U.S.

The local result is a five-year partnership between Sandia and five regional universities, all with high minority populations: the University of New Mexico, the University of Texas at El Paso, New Mexico State University, New Mexico Institute of Mining and Technology and Prairie View A&M University.

The consortium has both a research and an educational goal, said Irina Tezaur, lead Sandia scientist on the project. "The research goal is to integrate cutting-edge computational algorithms and tools for complex engineering problems," she said. "Equally important,

Grande CARES will develop scientists and engineers from underrepresented communities. This should create a sustainable pipeline of researchers who are well-equipped to tackle the complex problems arising in Sandia's mission spaces.

"The hope is to give students, who may come from underprivileged backgrounds, the opportunity to experience research in STEM firsthand and discover a path within this field with help from Sandia role models they can relate to," Irina said.

The consortium was the brainchild of the late director of Sandia's Center for Computing Research, Scott Collis, who was actively involved for several years in getting the center funded. Scott did not live long enough to see the consortium come to fruition but passed the torch to Irina to continue and possibly enlarge the five-year program, she said.

Irina's interest in helping minorities and the disadvantaged arose from personal experience: in 1992, as a child speaking no English, she immigrated to the U.S. with her family from Russia. Despite facing various challenges along the way, in 2019, she received the Presidential Early Career Award for Scientists and Engineers for her work in computational modeling.

"As a woman and an immigrant myself, I very much understand the value of role models in helping students achieve goals," she said. "If you are considering a career in which there are virtually no role models that look like you or have a similar background, it is hard to imagine yourself being successful in that field."

The consortium operates by funding collaborations between students, faculty from the affiliated academic institutions and staff scientists at Sandia. Students are matched with prospective Sandia mentors based on their research interests and background.

"The vision is to have the Sandia mentors work closely with the students and their advisors to design research projects that are mutually beneficial and foster a long-term collaboration," Irina said.

Once projects are selected, students execute the work with help from their Sandia mentors during agreed-upon timeframes, which can range from two to three months for undergraduate students to four to five years for doctoral candidates. To facilitate collaboration, mentor-mentee engagement and to help widen their knowledge base, students are encouraged to visit Sandia for extended periods. During these visits, students are given access to advanced software, hardware and, importantly, experts.

PROGRAM VISIONARY — Irina Tezaur, lead Sandia scientist on the Rio Grande Consortium for Advanced Research on Exascale Simulation, or Grande CARES, project. **Photo by Craig Fritz**

The first batch of students — Arturo Rodriguez, a doctoral candidate, and undergraduate students Rene Reza, Kate Reza and Vicente Corral, all from University of Texas at El Paso — is in the process of completing their initial three-month summer visit to Sandia's primary site in New Mexico. The students are mentored by Sandians Nat Trask, Jay Lofstead, Scott Roberts and Ember Sikorski, respectively, and their projects include developing machine-learned interatomic potentials, using unsupervised learning to identify features in satellite imagery, creating reproducibility standards in machine learning models and performing 3D image segmentation. New developments will be presented at fiscal year 2024 conferences and incorporated into journal publications. An additional 10-12 graduate and undergraduate students are expected to join the consortium in fiscal years 2024 and 2025.

Grande CARES voices

"The program offers experience working with some of the leading experts in fields like applied mathematics and machine learning, to mention a few."

—Participant Arturo Rodriguez, doctoral candidate specializing in aerospace and mechanical engineering

"Getting the chance to see what the research environment is really like by working on a real project allows students to see firsthand what research at a national lab looks like. It is about the best recruiting tool we have available."

—Sandia mentor Jay Lofstead

"I dream of the demographics of the national labs one day reflecting the demographics of the nation and want to do my part in working towards that goal. I think providing internships for students from a wide variety of schools is one of the best ways to improve our pipeline."

—Sandia mentor Ember Sikorski

"Grande CARES is unique by directly and explicitly attempting to build out a recruiting pipeline with a minority-serving institution and makes it very easy to do so."

—Sandia mentor Nat Trask

Enchilada Trap

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several traps were delivered to Duke University in July for analysis and testing. Duke and Sandia are research partners through the Quantum Systems Accelerator, one of five U.S. National Quantum Information Science Research Centers funded by the DOE Office of Science.

An ion trap is a type of microchip that holds electrically charged atoms, or ions. With more trapped ions, or qubits, a quantum com-puter can run more complex algorithms.

With sufficient control hardware, the Enchilada Trap could store and transport up to 200 qubits using a network of five trapping zones inspired by its predecessor, the Roadrunner Trap. Both versions are produced at Sandia's Microsystems Engineering, Science and Applications fabrication facility.

According to Daniel Stick, a Sandia scientist and leading researcher with the Quantum Systems Accelerator, a quantum computer with up to 200 qubits and current error rates will not outperform a conventional computer for solving useful problems. However, it will enable researchers to test an architecture with many qubits that in the future will support more sophisticated quantum algorithms for physics, chemistry, data science, materials science and other areas.

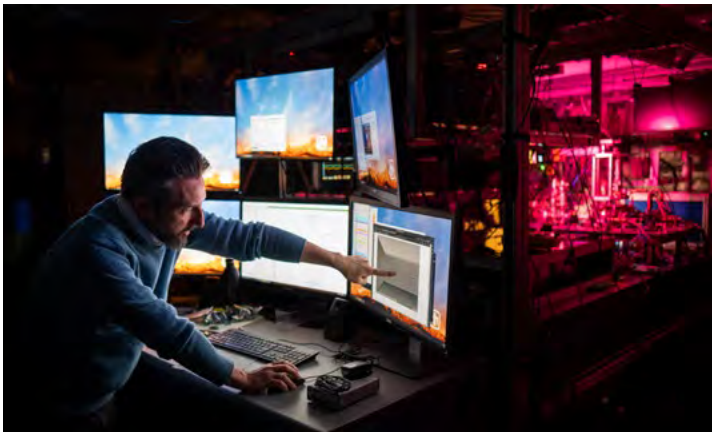
"We are providing the field of quantum computing room to grow and explore larger machines and more complicated programming," Daniel said.

A forward-looking design

Sandia has researched, built and tested ion traps for 20 years. To overcome a series of design challenges, the team combined institutional knowledge with new innovations.

For one, they needed space to hold more ions and a way to rearrange them for complex calculations. The solution was a network of electrodes that branches out similar to a family tree or tournament bracket. Each narrow branch serves as a place to store and shuttle ions.

Sandia had experimented with similar junctions in previous traps. The Enchilada Trap uses the same design in a tiled way so it can explore scaling properties of a smaller trap. Daniel believes the branching architecture is currently the best solution for rearranging trapped ion qubits and anticipates that future, even larger versions of the trap will feature a similar design.



JUNCTION FUNCTION — Quantum physicist and optical engineer Jonathan Sterk points to the section of an ion trap where trapped ion qubits travel. The close-up view is of a trap inside a vacuum chamber at Sandia. **Photo by Craig Fritz**

SETTING THE TRAP — Electrical engineer Ray Haltli optimizes parameters before placing gold wire bonds on an ion trap. When ready, the machine runs automatically, placing up to seven wires per second. **Photo by Craig Fritz**

Another concern was the dissipation of electrical power on the Enchilada Trap, which could generate significant heat, leading to increased outgassing from surfaces, a higher risk of electrical breakdown and elevated levels of electrical field noise. To address this issue, production specialists designed new microscopic features to reduce the capacitance of certain electrodes.

"Our team is always looking ahead," said Sandia's Zach Meinelt, the lead integrator on the project. "We collaborate with scientists and engineers to learn about the kind of technology, features and performance improvements they will need in the coming years. We then design and fabricate traps to meet those requirements and constantly seek ways to further improve."

Healing metals

CONTINUED FROM PAGE 1

"This was absolutely stunning to watch firsthand," said Sandia materials scientist Brad Boyce.

"What we have confirmed is that metals have their own intrinsic, natural ability to heal themselves, at least in the case of fatigue damage at the nanoscale," Brad said.

Fatigue damage is one way machines wear out and eventually break. Repeated stress or motion causes microscopic cracks to form. Over time, these cracks grow and spread until — snap! The whole device breaks, or in the scientific lingo, it fails.

The fissure Brad and his team saw disappear was one of these tiny but consequential fractures — measured in nanometers.

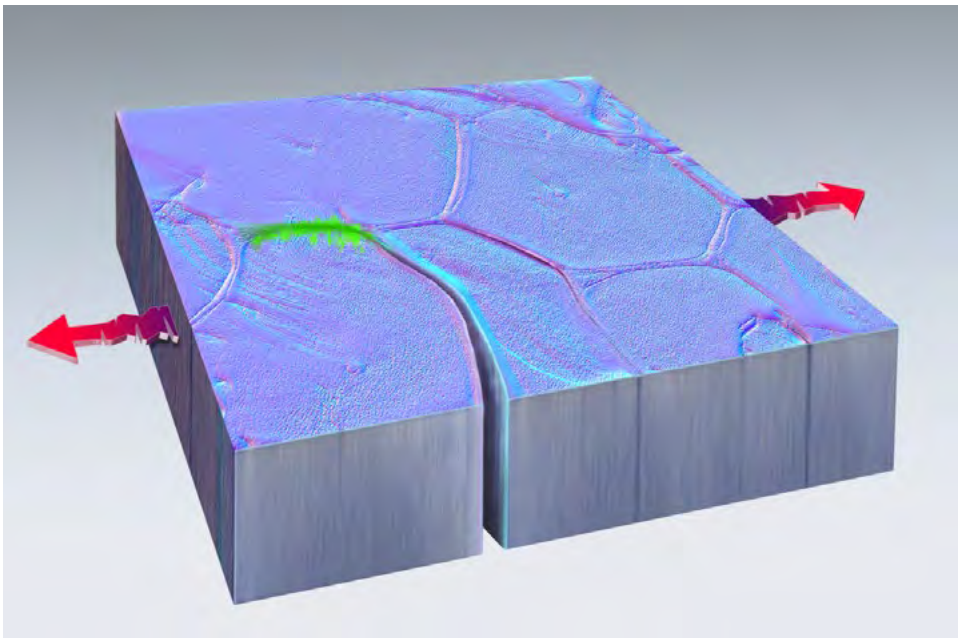
"From solder joints in our electronic devices to our vehicle's engines to the bridges that we drive over, these structures often fail unpredictably due to cyclic loading that leads to crack initiation and eventual fracture," Brad said. "When they do fail, we have to contend with replacement costs, lost time and, in some cases, even injuries or loss of life. The economic impact of these failures is measured in hundreds of billions of dollars every year for the U.S."

Although scientists have created some self-healing materials, mostly plastics, the notion of a self-healing metal has largely been the domain of science fiction.

"Cracks in metals were only ever expected to get bigger, not smaller. Even some of the basic equations we use to describe crack growth preclude the possibility of such healing processes," Brad said.

Unexpected discovery confirmed by theory's originator

In 2013, Michael Demkowicz — then an assistant professor at the Massachusetts Institute of Technology's department of materials science and engineering, now a full professor at Texas A&M — began chipping away at conventional materials theory. He published a new theory, based on findings in computer simulations, that under certain conditions metal should be able to weld shut cracks formed by wear and tear.



REVERSING COURSE — Green marks the spot where a fissure formed, then fused back together in this artistic rendering of nanoscale self-healing in metal, discovered at Sandia. Red arrows indicate the direction of the pulling force that unexpectedly triggered the phenomenon.

Image by Dan Thompson

The discovery that his theory was true came inadvertently at the Center for Integrated Nanotechnologies, a DOE user facility jointly operated by Sandia and Los Alamos national laboratories.

"We certainly weren't looking for it," Brad said.

Khalid Hattar, an associate professor at the University of Tennessee, Knoxville, and Chris Barr, who works for the DOE Office of Nuclear Energy, were running the experiment at Sandia when the discovery was made. They only meant to evaluate how cracks formed and spread through a nanoscale piece of platinum using a specialized electron microscope technique they had developed to repeatedly pull on the ends of the metal 200 times per second.

Surprisingly, about 40 minutes into the experiment, the damage reversed course. One end of the crack fused back together as if it was retracing its steps, leaving no trace of the former injury. Over time, the crack regrew along a different direction.

Hattar called it an "unprecedented insight."

Brad, who was aware of the theory, shared his findings with Demkowicz.

"I was very glad to hear it, of course," Demkowicz said. The professor then recreated the experiment on a computer model, substantiating that the phenomenon witnessed at Sandia was the same one he had theorized years earlier.

Their work was supported by the DOE Office of Science, Basic Energy Sciences; NNSA and the National Science Foundation.

A lot remains unknown about the self-healing process, including whether it will become a practical tool in a manufacturing setting.

"The extent to which these findings are generalizable will likely become a subject of extensive research," Brad said. "We show this happening in nanocrystalline metals in vacuum. But we don't know if this can also be induced in conventional metals in air."

Yet for all the unknowns, the discovery remains a leap forward at the frontier of materials science.

"My hope is that this finding will encourage materials researchers to consider that, under the right circumstances, materials can do things we never expected," Demkowicz said.

Materials scientist named fellow of American Chemical Society

Hongyou Fan's resume displays 20 years of annual awards

By **Neal Singer**

Sandia researcher and manager Hongyou Fan has been named a fellow of the American Chemical Society.

He joins only two active Sandia researchers listed as American Chemical Society Fellows: Tina Nenoff, a Sandia Fellow, and Tim Zwier, who was elected a fellow when he was a Purdue University professor.

"Hongyou has been a prolific and first-rate scientific contributor who has been highly effective at converting scientific insights into technological breakthroughs," said Sandia Climate Change Security Director Rob Leland.

Erik Webb, senior manager for geoscience research and applications, said, "I am thrilled that Hongyou has received this recognition for his outstanding contributions to basic science at the nanoscale. The selection also celebrates his ability to see applications of that basic work across a suite of societally important topics, including electronics, energy and material separations. He continues this research individually and as the leader of our geochemistry department, where he strongly encourages the development of several additional generations of scientists."

The society recognized Hongyou "for outstanding contributions to the novel design, synthesis, functionalization and integration of nanomaterials leading to innovative applications in nanoelectronics, clean energy, sensor development and photocatalysis."

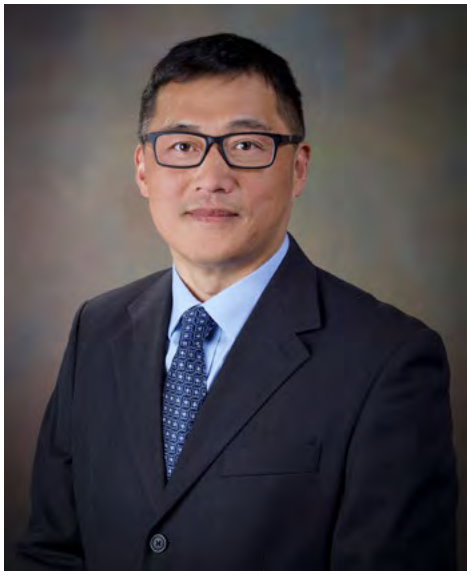
It also recognized him "for impactful service in organizing ACS symposia, promoting the Division of Colloid and Surface Chemistry, STEM outreach events, ACS journal publications and the ACS Petroleum Research Fund program."

"This recognition is a personal honor and undoubtedly a significant milestone in my career," Hongyou said. "However, this achievement wouldn't have been possible without the unwavering support of Sandia and the collaboration of an exceptional interdisciplinary team."

Hongyou has received more than an award a year since 2000 when he was presented with the University of New Mexico Outstanding Graduate Student Award and, confirming University of New Mexico's selection, the Materials Research Society's Outstanding Graduate Student Award the same year. In 2005, he was presented with University of New Mexico's Outstanding Faculty Mentor Award.

Focusing more on research, at Sandia he won six R&D 100 awards between 2007 and 2022. He was selected as the Asian American Engineer of the Year in 2012, a fellow of both the Materials Research Society and American Physical Society in 2016, and the Society of Asian Scientists and Engineers Career Achievement Award winner in 2022. He serves as an editorial board member for Nature-Scientific Reports, American Chemical Society Applied Nano Materials, and Journal of Physics: Materials.

Hongyou has published more than 140 papers and reports, delivered more than 70 invited talks, holds 21 patents and co-founded Lunano LLC, a company that develops disinfectants to kill viruses, bacteria and fungi, including COVID-19 and various other harmful microbes.



EXCEPTIONAL FELLOW — Sandia materials scientist and researcher Hongyou Fan has been named a fellow of the American Chemical Society. His work has applications in electronics, energy, materials separation and more.

Photo by Lonnie Anderson

About the American Chemical Society

Founded in 1876 and chartered by the U.S. Congress, the American Chemical Society has more than 173,000 members in 140 countries and supports scientific inquiry in the field of chemistry.

The 2023 class of fellows will be honored at a ceremony during their fall meeting, a hybrid in-person and virtual event, in San Francisco, California, on Monday, Aug. 14.

Hybrid and remote work here to stay

Once a pandemic-era necessity, working off-site is now permanent option for many Sandians in response to evolving mission needs

By **Stephanie Hobby**

As the world grapples with the aftermath of the pandemic, organizations everywhere are striving to creatively adapt to a new work environment, and Sandia is no different. To meet changing work expectations, Sandia now offers permanent telecommuting and remote work options for some employees.

Numerous reasons for the shift

Building a hybrid work environment is a priority to Labs leadership, as defined as the fourth goal in the 2023 Strategic Plan. According to Sandia Hybrid Work Team program communications specialist Lyndsy Ortiz, three main goals have been driving Sandia's efforts: to ensure Sandia's ability to attract and retain a strong workforce by offering flexible work schedules; to meet NNSA expectations for adopting hybrid work; and to ensure modern, efficient, timely and compelling infrastructure that meets the national security mission by renovating and replacing aging, unused office spaces.

Prior to COVID-19, only a few hundred Sandians were employed off-site or had telecommuting agreements. Now, the goal is for 30% of the workforce to be remote, meaning they rarely come on-site and in many cases, live outside the state, or telecommuting, defined as having a home office but being on-site part-time. Sandia is rapidly advancing toward that milestone: earlier this year, the Labs had 1,700 full-time telecommuters, 1,100 part-time, also known as hybrid, telecommuters, and 1,200 fully remote workers across the country.

"This is not a question of whether we're going to pursue a hybrid and remote environment; it's a question of how we are going to do it," said Director Krista Smith, whose organization has been responsible for shepherding the Labs' transition to hybrid work.

The move is strategically mission-focused, with a goal of attracting and retaining qualified employees, and remaining competitive in today's work environment. Advocates say it offers a better work-life balance with greater flexibility, in part due to reduced commute times. Employees have reported greater satisfaction, with fewer interruptions and greater productivity, and have more opportunities for wellness, whether preparing healthier lunches or spending more time outside.

Massive undertaking

Facilities project manager Clint Moore said there have been three milestones for hybrid work environment success: evolving information technology infrastructure and services to accommodate hybrid work; creating remote hubs capable of executing classified work; and fostering Sandia's cultural transition to a long-term hybrid work model.

To work more cohesively, owners of each Labswide Goal 4 Hybrid Work milestone have been collaborating through an advisory board and an action council, with a broad range of stakeholders, including information technology, human resources, supply chain, emergency management, environmental safety and health, culture, training, communications and cybersecurity.

"We meet up at least monthly with each senior manager member of our action council," Clint said. "We are also in regular communication with leaders from across divisions who have answered the call to be champions for hybrid work."

New possibilities for classified work

Sandia is navigating the challenge of finding new options for classified work. Jen Gaudioso, leader of the remote hub strategy and member of the Sandia Hybrid Task Force, has been working to set up secure hubs around the country.

Using a series of criteria for secure mission work, Sandia identified three potential sites, including Sandia's Minnesota site, which is currently designated for specific programmatic work but could be expanded for broader use.

ADVANCING THE FUTURE OF WORK — Director Krista Smith and her organization are leading the Labs' transition to hybrid work, which includes evolving information technology to accommodate off-site work, opening remote hubs across the U.S. where staff can conduct classified work and shaping cultural perspectives around the transition to a long-term hybrid work model. **Photo by Craig Fritz**

Additionally, after previous collaborations proved successful, Pacific Northwest National Laboratory was chosen as a potential site, partly because it is also a DOE lab. The task force is working on reciprocal arrangements where Sandia employees could access their Seattle and Richland, Washington sites while allowing Pacific Northwest employees access to Sandia sites in Livermore, California, and New Mexico. The third exemplar, Texas A&M University, is attractive due to its existing classified workspace, and having Sandia employees on campus could help with recruiting efforts.

The first three sites are expected to be ready for Sandia employees by the end of 2023. Additional sites are possible in the future, but progress is purposefully slow.

"We are going slowly and intentionally to ensure that these sites will be enduring and not have to be pulled back two years from now," Jen said. "Our crawl, walk, run strategy has been understandably frustrating for many people, but it's important that we get it right."

Making room

Space constraints are another important factor. Even before the pandemic, Sandia sites were reaching a critical mass; it was difficult to find parking spots, and nearly every office space was occupied. The pandemic accelerated talks about how to offer remote and telecommuting options, and created an opportunity to update existing facilities. Currently, nine buildings are being renovated.

According to Krista, one of the greatest challenges has been addressing the cultural changes associated with giving up individual office space.

"All of us conflate our physical space with the extent to which the organization values us, but we need to decouple that to have a more skillful conversation," she said, adding that even if Sandia had unlimited resources to provide every telecommuter with their own office, it wouldn't be the right thing for the taxpayer. "We have to be good stewards of the resources, and that isn't having a bunch of vacant offices that are individually assigned."

Sandia now offers reservable touchdown spaces where telecommuting employees can connect, as well as collaboration areas and conference rooms, and information technology support is readily available.

Matthew-Ryan Morrell, manager of strategic site planning, was a lean process engineer when he was called to help direct the Labs' efforts to support people in their home offices, but it was clear early on that work arrangements would never be the same. As space opens, Sandia's focus has shifted to help members of the workforce work together more intentionally.

"We are finding our balance in a good way," Matthew-Ryan said. "This is no longer about trying to get out of a pandemic. Our focus today is finding our new rhythm and connecting. We can't go back in the same manner. Now, we have over 1,000 people across the country who aren't able to physically come in at a moment's notice, so it's a lot harder to get everyone together, and we need to be intentional about how to do that."

Intentional collisions

Like countless other companies around the world, Sandia is experimenting with creative ways to maintain teamwork while not physically being in the same space for long stretches of time.

"We have to make collisions more intentional when people are on-site," Krista said. "We are sharing best practices across management and learning from each other, because the whole world is facing this change."

One such connection that could be uncomfortable, but Krista emphasized that Sandians must get used to, is being able to answer direct questions about time management.

"We need to be able to have more difficult conversations about what is and isn't working around employees' schedules," she said. "We need to be able to get better and more specific about setting expectations about productivity and what a solid workweek looks like. And to have people not get insulted when a manager brings up that question. We've got to grow the courage to have those conversations."

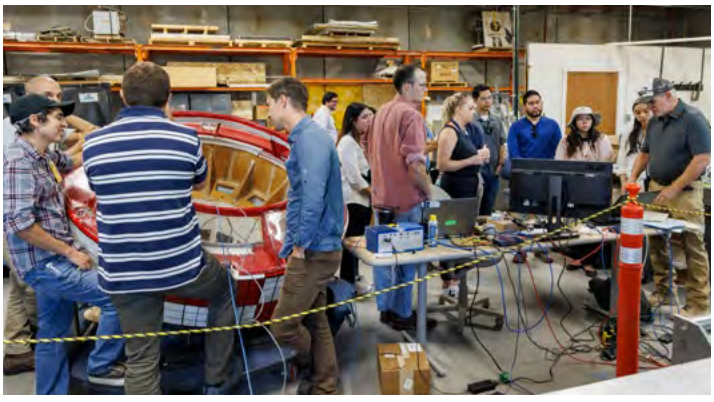
Recognizing that everyone is on this learning curve, Clint said he and his team are working on a menu of options to help managers find more ways to connect. He said managers should try to meet weekly with the whole team, encourage people to have their cameras on and make it a priority to incorporate fun activities that foster personal relationships.

All these changes come with understandable growing pains, but already benefits are being realized, and qualified applicants who would not consider a move to New Mexico or California are now considering working for Sandia.

"As an experiment, we have posted identical job postings, with the exception of being on-site or remote possible, and continued to keep those up. We regularly saw 200 percent more qualified applicants to the remote positions, so it's not just applicants, but qualified applicants, who made it through the initial HR screening," Jen said. "So clearly, we are reaching more people. We are very optimistic about the future."

Pioneers of wave energy conversion

MAKING WAVES — Sandia engineer Giorgio Bacelli, right, hosts a tour of the Wavebot Laboratory for DOE Water Power Technologies Office staff, from left, Sabastian Grimm, Raquel Torre and Amanda Vieillard on July 19. The DOE Water Power Technologies Office is partnering with Sandia on the Pioneer Wave Energy Convertor project with the aim of powering a buoy that gathers oceanographic data. **Photo by Bret Latter**



WAVE POWER — Sandia water power technologies team members, visitors from the DOE Water Power Technologies Office and interns from the Consortium of Hybrid Resilient Energy Systems program toured the Wavebot Laboratory on July 19. Sandia is collaborating with the DOE on the Pioneer Wave Energy Convertor project. Two interns from CHRES, Andrea Galvan and Gabriel Fuentes, are working with the DOE on a Spanish-language video that explains the project. **Photo by Bret Latter**

STEM in the Sun keeps learning cool amid record temperatures

By **Kim Vallez Quintana**

Volunteers from Sandia helped wrap up summer break with fun, hands-on science, technology, engineering and math activities at the fourth annual STEM in the Sun program. With outdoor temperatures hovering near 100 degrees, this year's event was moved indoors to a cooler environment for sun-based STEM learning.

Elementary and middle school-age students watched the effects of ultraviolet light using UV beads and made lava lamps, catapults and towering structures using marshmallows and dried pasta. They learned about surface tension and programmed Ozobots, tiny robots designed to introduce young students to coding.

"My favorite was building with the noodles and marshmallows because my mom's an engineer," said second-grader Maevyn Haynes who attends Griegos Elementary School. "It's fun to learn about science."

The award for the biggest marshmallow and dried pasta structure went to Matthias White, a fourth grader in Farmington.

"I've never made something this tall. I made something like this before, but they didn't have a lot of stuff, so I couldn't make it this tall," White said. "I want to be a scientist, so yeah, I like learning about science."

This summer, STEM in the Sun consisted of seven sessions throughout June and July in partnership with the city of Albuquerque's summer recreation program. More than 40 volunteers from various Sandia organizations participated.

"At the end of the day, kids don't realize they're learning STEM because they're having so much fun," said Roberta Rivera, a member of Sandia's Community Involvement team.

The latest event at Griegos Elementary School on July 26 was the final event for the summer and was led by members of Sandia's Hispanic Outreach for Leadership & Awareness group.

"I have two little boys, and I've always been interested in outreach, and this was a good opportunity," said volunteer Carlos Perez, who works in materials science at Sandia. "Curiosity is always fun to see, especially when started from an early stage; maybe it will get them on the right track. We certainly need the next generation to get interested in that subject."

STEM in the Sun was started in summer 2020 by Sandia's Community Involvement team to engage kids in fun, hands-on STEM activities at various Albuquerque community centers during COVID-19. The program been a continued success, even when it has to be held inside when the sun is just a little too hot.

COOL CREATIONS — Quinn Fetman, 8, left, and Edward Ortega, 7, make miniature lava lamps during STEM in the Sun at Griegos Elementary School on July 26. **Photo by Craig Fritz**

A MOUNTAIN OF MARSHMALLOWS AND PASTA — Matthias White, 9, accomplishes his goal of building a marshmallow and spaghetti tower taller than himself during STEM in the Sun. **Photo by Craig Fritz**

Mileposts


Dave Sandison 30


Douglas Ghormley 25


James Arnold 20


Nazir Khalil 20


Krissy McGltotten 20


Leslie Phinney 20


Ellen Pope 20


Carol Scharmer 20


Jens Schwarz 20


Clark Snow 20


Henry Coakly 15

Recent Retirees


Mario Martinez 42

Linda Skrien 10

Collaboration, innovation drive SIAM Fellow to succeed

Ali Pinar selected for his leadership in network science

By **Michael Ellis Langley**

For a man whose job is to imagine outcomes, Ali Pinar says he was completely surprised when the Society for Industrial and Applied Mathematics named him one of their 2023 fellows.

"When I was doing my Ph.D., if somebody told me I would be a SIAM Fellow — no way," Ali said. "You just put these things together one brick at a time. You're building something in your career and getting that recognition. That is just surprising."

Ali earned his bachelor's and master's degrees from Bilkent University in his native country Turkey, then came to the U.S. and obtained his doctorate in computer science at the University of Illinois.

"I interned at Sandia as a Ph.D. student," he said. "I loved the culture at Sandia, and there were multiple people that I said, 'When I grow up, I want to be like them.'"

Studying every system imaginable

He has spent the last 15 years at the Labs studying network science, getting his U.S. citizenship along the way.

"Networks can be like physical networks, as in a power grid, cyber network or water networks. These networks have high consequences if they fail," Ali said. "There are also biological networks within bodies. We look for abnormal behaviors. How can I make it more resilient? For example, if it is going to be a disaster if two powerlines go down at the same time, how do I fix that problem by

building, adding other lines or using my current resources in a way so that I don't put all my eggs in the same basket?"

Ali said he and his fellow network scientists look for patterns, potentially planning for worst-case scenarios. For example, he can identify bad actors in cyberspace by identifying behavior on accounts that are managed by the same people, or accounts that are bots, by observing a product review on a shopping site that is then followed by 10,000 more on the same product, around the same time. It's all a matter of looking for abnormal behavior outside of the expected.

"But to define abnormal you need to understand what is normal," Ali said. "If you look at a functional unit, like protein interaction networks, you know how proteins function in a body. If you see a bunch of proteins that just appear at the same time, you know these should be doing something. It cannot be just coincidence. Then you just start looking at: What do they do at the same time? What is the function of this protein? What is the pathway? How do they interact?"

Recognized for leadership

Network science is a field of study that has fired Ali's imagination and intellect for years. But his scientific work was far from the only thing that garnered the attention of the Society for Industrial and Applied Mathematics, which named him a fellow "for theoretical, algorithmic and application impacts, and community leadership in combinatorial scientific computing and network science."

"I started a workshop within SIAM on network science," he said of the annual meeting that draws more than 100 network professionals each year. "People who are doing statistics or more applied sciences like cybersecurity, I thought, 'Why don't we come together, build a platform for like-minded people and discuss things in that way.'"

Ali launched the workshop in 2003 and currently serves as the chair of the steering committee. "I like the interactions, and I see new people, especially younger Ph.D. students, making the connections and getting advice from everybody. They are going through the same things you've been through, and you can help them. I like that feeling of community and how people share their ideas," he said.

Working with the best

Ali prizes that feeling of community at Sandia.

"I love interdisciplinary work," he said. "It's not just doing it for the sake of my publishing but working with the domain scientists and making a real impact."

Ali appreciates the Labs for two vital reasons.

"First there are a lot of opportunities, and second there is the culture of Sandia people. If I just approach someone, they welcome you with open arms. 'Yeah, let's do work together!' We could do something better and it's more goal-oriented, so we are not trying to prove who is smarter. We're just teaming up for a national security problem and just helping each other to solve that problem. That is the ultimate goal," he said.

Ali appreciates his mentors at Sandia and around the world and is committed to use his fellowship to pass his expertise and experience on to others.

"I really felt gratitude for them. You don't do it by yourself," he said. "This fellowship and my level at Sandia now means I have the responsibility to speak up, to reach out. If you see something is wrong, even here, it's your responsibility to say something. It's your job to speak up."

NETWORKER — Ali Pinar was selected by the Society of Industrial and Applied Mathematics as a 2023 fellow because of his passion for and leadership in computing network research. **Photo by Spencer Toy**

Powering classrooms with technology

Sandia donates hundreds of computers to New Mexico schools

By **Kim Vallez Quintana**

Thanks to Sandia's annual K-12 Computer Donation Program, 1,654 desktops, laptops and iPads are on their way to classrooms, computer labs and offices of New Mexico schools.

Each year, Sandia upgrades aging technology to ensure it can meet performance standards, then donates the retired computers to schools. While the computers are wiped and the hard drives removed to ensure no sensitive information is released, schools are able to refurbish the equipment at a very low cost.

This year, five Albuquerque Public Schools and five Silver City schools will benefit from the program. Along with desktops, laptops and iPads, the schools also receive printers, monitors and keyboards for their use.

Since the program began in 2012, Sandia has donated nearly 22,000 computers with a total value of more than $26 million to New Mexico classrooms. Most of the computers donated are four to six years old with plenty of usable life in them.

LOADING THEM UP — Sandia's Property Management and Reapplication team packs computers into a moving truck destined for Silver City schools as part of the Computer Donation Program on Aug. 1.
Photo by Craig Fritz

TREASURE HUNT — Silver Consolidated Schools staff member Richard Walter looks through a pile of monitors donated by Sandia to take home to classrooms in Silver City.
Photo by Craig Fritz

THE GIFT OF TECH — Silver Consolidated Schools employees load printers donated by Sandia into a van headed for Silver City to use during the upcoming school year.
Photo by Craig Fritz