SANDIA LABNEWS
PUBLISHED SINCE 1949

Vol. 78, No. 2, Jan. 29, 2026

HIRE Vets ranks Sandia top employer **Page 7**

Aiming to protect, with pinpoint precision

By **Michael Ellis Langley**

A sensor developed at Sandia promises a more precise way to protect cancer patients, radiologists and even American military from harmful radiation.

Sandia researchers Patrick Doty and Isaac Aviña have designed a flexible, disposable radiation patch, a wearable dosimeter that can be manufactured quickly and reacts immediately when it detects radiation.

Body of work

Film dosimeters have been used for decades as badges that change colors after radiation exposure, but they cannot show exactly when or where exposure happened. Patrick and Isaac took that idea, combined it with new light-sensing polymers and microelectronic grids, and designed a disposable, flexible patch that can show, in real time, where radiation is entering a body. The concept quickly drew interest from medical professionals trying to better target cancer treatments.

"That's where Patrick and I started, exploring oncology," Isaac said. "There was a lack of accuracy and precision when it comes to radiating tumors. There was no way to detect in real time where the radiation was going into the body and how much was being delivered to the patient."

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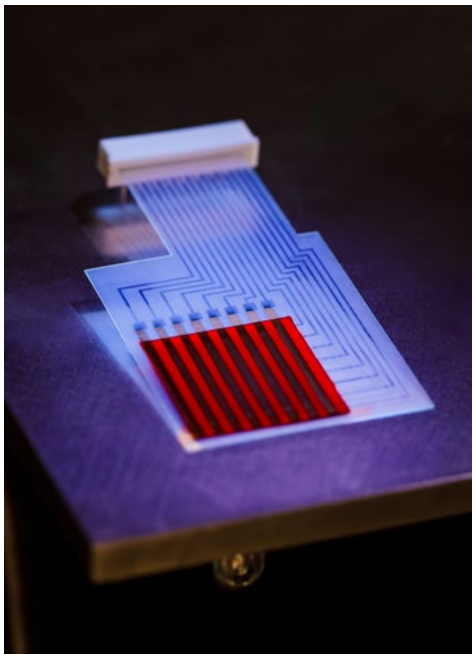

ONE PATCH FITS ALL — The dosimeter patch technology developed by Patrick Doty and Isaac Aviña is a flexible, wearable, disposable way to protect cancer patients, health providers, first responders and service members from toxic radiation exposure. **Photo by Spencer Toy**

Ready for the future

NEW GOALS — Labs Director Laura McGill presents three new goals at Steve Schiff Auditorium on Jan. 22. **Photo by Craig Fritz**

Sandia accelerates innovation, targets three new goals

By **Myles Copeland**

Imagine a doctor begins their appointments by handing the patient a prescription. Then the patient describes their symptoms.

Backward as that sounds, many attempts at problem-solving through research and development take this approach. The inventor of a cool technology sets out in search of challenges that can be met by their invention.

Sandia set a Labswide goal in 2023 to accelerate innovation. As part of its all-hands-on-deck pursuit of the goal, Sandia made a concerted effort to broaden the use of

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SANDIA LAB NEWS
PUBLISHED SINCE 1949
Managed by NTESS LLC for the National Nuclear Security Administration

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Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Published on alternate Thursdays by Communications, MS 1468

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EDITOR'S NOTE: Please send your comments and suggestions for stories or for improving the paper. If you have a column (500-800 words) or an idea to submit, contact the Lab News editor at labnews@sandia.gov.

From heart surgery to a giving heart

LOCAL LEADER — Josh Parsons speaks as the board chair during an Albuquerque Regional Economic Alliance presentation.

Photo courtesy of Josh Parsons

The journey that's helped me appreciate the power of Sandia Gives

By **Josh Parsons**

At Sandia, we share a mission that impacts the nation, and we work in an environment that fosters innovation, collaboration and a strong sense of purpose. It's easy to become focused on that mission and forget that outside our gates, many in our community face real challenges — hunger, housing insecurity and access to basic resources. These issues can feel overwhelming, but change starts with small steps.

When I first joined Sandia, I wanted to do something — anything — to make a difference. So, I started small with Sandia Gives. Over time, I've seen how even modest contributions add up to real impact. That first step was simple, but it mattered, and it taught me something important: Giving is deeply personal.

For me, giving comes from values I learned early on. I grew up in a home where community mattered. My mother was passionate

about serving others, and that shaped how I see the world. She believed that success wasn't just about what you achieve, it's about what you give back. That perspective stayed with me, and when I came to Sandia, I discovered a similar culture here: a belief that we have a responsibility to support and strengthen the communities we call home.

I also know firsthand how much it matters when help is available. When I was just over two years old, I needed open-heart surgery. At that time, options for pediatric surgery in New Mexico were limited, and pursuing surgery out of state was an expense my family wasn't positioned for. Thankfully, others supported my family to make that care possible. That experience taught me something profound: We never know when we, or someone we love, might need help. And when that moment comes, having support can change everything.

That's why I'm passionate about Sandia Gives. It's not just about giving; it's about creating opportunities for others when they need it most. One of the great things about Sandia Gives is that you can choose where your support goes. For me, that means giving to organizations that reflect my values and create lasting impact. I give to United Way of North Central New Mexico because they don't just fund programs, they strengthen the entire network of nonprofits. Their approach helps organizations collaborate, share resources and tackle root causes of issues like poverty and education gaps. I also give to the Albuquerque Regional Economic Alliance because I believe a rising tide lifts all boats. Strong economies help address challenges like education, health care and crime. And I contribute to faith-based organizations that align with my values and provide critical support to those in need.

GIVING BACK — Josh Parsons, left, serves families in the Ronald McDonald House kitchen.
Photo courtesy of Josh Parsons

FIRST-HAND EXPERIENCE — Two-year-old Josh Parsons and his mother during his recovery from open-heart surgery.
Photo courtesy of Josh Parsons

Your passions and values may lead you to different causes, and that's exactly what our community needs: a diversity of generosity. Whether it's education, housing, health or economic development, every gift matters and helps strengthen the place we all call home.

It's easy to feel like the challenges around us are too big to solve. But real change begins when we take part — when we choose to get involved, even in small ways. That's the beauty of Sandia Gives. You don't have to solve every problem, but you can make a difference in the areas that matter most to you.

Friends, it's time to go beyond our gates. Our neighbors need us. All it takes is one small step, one small act to get started, and then watch how that grows. Sandia is not just a special place because of the work we do, but because of who we are. We are Sandians. We are leaders in giving. The moment of need is here. Will you be the one who provides the help someone never expected they would need?

Get involved with Sandia Gives today at sandia.gov/give.

Dosimeter

CONTINUED FROM PAGE 1

Along with measuring dose, hitting the tumor and not nearby healthy tissue has been a long-standing challenge.

"Pinpointing it so that it hits a cancerous tumor is even harder," he said. "Right now in the medical world, we aim beams at cancerous cells, with a wide range of error, meaning that sometimes we leave large parts of cancerous cells and other times we hit healthy tissue. To fix this problem, we need better accuracy."

Motivated to innovate

The pair focused on proton radiotherapy, a form of radiation treatment often used for hard-to-treat cancers. According to the National Institutes of Health, doctors use a beam of protons to irradiate and kill cancer cells. Patients typically receive treatments several times a week for four to six weeks.

But a 2022 NIH study found that it is difficult to ensure radiation goes only where it is needed and that "children are particularly susceptible to late adverse effects of radiation."

"I found out that with this radiotherapy, there is no in vivo dosimetry," Patrick said, referring to measuring radiation inside the body during treatment. "They know exactly what the beam current is and what the energy is, so they know exactly where it's going in XY space and where it's going to stop in a tank of water. But what they don't know is where the patient is. They might breathe or move."

Both researchers have had close family members who faced cancer and its treatments' side effects. That personal experience helped drive their work, and especially for pediatric patients.

"They have to put these kids under general anesthesia because they'll move and then bring them back 30 times and do it all over again, which is horrible," Patrick said. "Kids are smaller, so everything needs to become a lot more precise and accurate. I've had oncologists tell me that if there's some really at-risk structures that they're concerned about. They will put a film dosimeter there only to find out after the fact if they didn't get the dose right."

PATCH WORK — Isaac Aviña uses a laser etching printer at Sandia California to create a disposable dosimeter patch. He and the team have used the machine to create thousands of prototypes during the development cycle. **Photo by Spencer Toy**

Even in adult patients, the tumors may be only millimeters or centimeters in size. The new dosimeter not only helps with aiming, it can also warn radiologists when they are off target.

"There's the polymer that's over a grid architecture of electrodes. Radiation comes in and interacts with the polymer. That's happening in real time," Isaac said. "So, it picks up the X and the Y in real time and also the dosage. The radiation then proceeds to go through the patient and hits the tumor."

If the patient moves even a little bit, the system can react.

"They upload the prescan shape of the tumor and that becomes the boundary for the sensor that when hit by radiation, immediately lets the computer know, which can then immediately shut off the beam," he said.

"If it's a really large movement," Patrick added, "there's a safety mechanism there that can shut off the beam before it has time to harm healthy tissue."

The right tools for the right job

Isaac and Patrick used an automated laser tool developed by Isaac and his team at Sandia California to make the patches.

"This is like a direct-write tool," Patrick said. "You start with a blank sheet, and then you etch a pattern on there, and that's what makes and defines the sensor pixels. Isaac makes the electrode structure that we then put the polymer on top of it. He can directly make custom patches for each application, or even for individuals."

"We're really agile and flexible here at Sandia," Isaac added. "We can quickly iterate on an idea Patrick and I have one morning. We design it using my computer-aided design, and in the afternoon, take it to my laser, do my fabrication and we have something to work with. Maybe it's going to work, maybe it doesn't. But that laser technique is super useful to fabricate quickly."

Copy, cut, repeat

Because the patches are relatively easy to produce, the team has made thousands of prototypes in the last few years. That level of disposable accessibility is exactly what Patrick and Isaac are refining now.

"Imagine if you took a CT scan, the doctor defined the target area, the tumor, and then you immediately upload the tumor boundary to the patch. That would be pretty cool," Patrick said.

This Sandia innovation began drawing wider attention after they entered the DOE Energy I-Corps program.

Through Energy I-Corps they connected with FedTech, a company founded in 2015 to match intellectual property created at

national labs with entrepreneurial investors. Businessman John Sanwo saw the potential.

"Patrick, John and I began collaborating, and John then launched the company WearableDose Inc.," Isaac said. "Now we just go off to the races. We start making patches, start developing the materials, start getting it to the point that we can start to see how soon this can become a commercial product."

That collaboration is leading in new directions.

"The next step of phase two is starting to interact with the beam itself, such that if the patient moves, the beam can also follow with the patient," Isaac said. "So, there's some real-life tracking to influence the direction of the beam. That requires a lot more FDA approval because at that point you're interfering with a sensor interacting with the treatment plan in real time."

EARLY WARNING — From left, Annabelle Benin, Isaac Aviña and Patrick Doty developed and began producing the "printable" polymer-based dosimeter patches using the laser etching machine behind them. **Photo by Spencer Toy**

Protecting the protectors

What started as a project with light-sensing polymers may lead to lifesaving technologies for cancer patients. But it may not end there.

"The other opportunity, besides just oncology, is protecting clinicians and technicians, even parents that are in the room, because they get a lot of exposure to radiation besides just the treatment itself," Isaac said. "So, if your technician comes into the room and is dosing people all day long, no one keeps a count of how much radiation they are exposed to. Could you stick a patch directly on a certain portion of the body that we're really concerned about and then start to monitor that?"

This Sandia technology is so sought after that after evaluating over 2,000 global innovations, Wearable Dose was honored with Top Global Innovation of the Year at the MedTech World Awards in November. Sandia is accepting licensing proposals for the technology from other interested companies.

The technology also holds considerable potential for the military and first responders. The research team has garnered new funding from the DOD Defense Threat Reduction Agency to investigate how the patches can help service members — providing improved situational awareness and new ways to monitor exposure in hazardous environments. This translates to improved military readiness, national security, and health outcomes for today's military and crisis responder.

Bottom line, top of mind

"We're making a disposable patch that ensures real-time accuracy and precision for cancer treatments for patients. That's what is really novel about what we're doing. It doesn't involve a vacuum to manufacture or high-temperature processing. You can make solutions and create them," Isaac said. "My child has a medical condition with his heart and had to spend a lot of time in the hospital over at Stanford. I was able to see firsthand how these pediatric cancers really impact the child as well as the families in ways that are difficult for everyone involved. It's particularly traumatic for children. We wanted to see how we can help mitigate some of that where they're not having to stay at the hospital for months and months on end. Being able to have something that's impactful and provides a solution is a big motivation for me."

"We know these people. They're our families and friends," Patrick said. "Everybody should want to do something about this. What we're doing just happened to fall in that direction, and of course we want to run with it."

Goals

CONTINUED FROM PAGE 1

design thinking. Not specific to engineering, design thinking is a broad problem-solving method that focuses on deeply understanding the needs of those affected by the problem to develop innovative solutions.

"Instead of me coming to the stakeholder with an idea, I came to them with curiosity, and we conversed about their problem," said Sharlotte Kramer, a mechanical engineer who applied design-thinking methodology to work with stakeholders on proposed improvements to the process used to qualify components for the nuclear deterrent. "Without that, I don't think I would have come up with the solution I did … I would have come to them with a preconceived notion of what their problems were."

Sharlotte's story is an episode in the epic tale of how Sandia accelerated innovation. In a Jan. 21 event at Steve Schiff Auditorium, the Labs' top leaders declared success in this goal, described its evolutionary next step and pointed Sandia staff toward three new Labswide goals: future-ready engineering, future-ready operations and a future-ready workforce. Sandia staff can watch the recording.

"Sandia is different now than it was in September 2023, when (then-Labs Director) James Peery introduced the goal to accelerate innovation," Labs Director Laura McGill said. "We have made significant progress since that time as a result of efforts across the Labs, and also driven by the urgency of the moment, where we need to deter two nuclear peer adversaries and a host of other threats."

Workforce sentiment around innovation has changed for the better. A Labswide innovation survey in July 2024 and Sandia's employee engagement survey in March 2025 both included the statement, "I feel encouraged to come up with better ways of doing things." Over those eight months, agreement with the statement jumped from 73% to 84%, from lagging behind industry benchmark to exceeding it.

Sandia's achievement in accelerating innovation consisted of many discrete steps that added up to this cultural shift. Sharlotte and about 30 other colleagues from across the Labs were trained as design-thinking facilitators during spring 2024. In less than two years, that modest cohort, dubbed Sandia Catalysts, led more than 2,300 participants through design-thinking sessions.

SEE THE FUTURE — Steve Girrens, left, envisions the future of Sandia engineering while speaking with Laura McGill as she announces new goals on Jan. 22. **Photo by Craig Fritz**

The Labs instituted an innovation competition, created events and infrastructure for celebrating innovative methodologies and sharing lessons learned, established a way of crowd sourcing solutions to important questions from Sandia's 16,000 staff, encouraged staff to take intelligent risks and removed more than 400 requirements from its policies.

"The broader nuclear security enterprise and Sandia had become more risk averse," said Deputy Labs Director David Gibson, reflecting on the problem that the goal to accelerate innovation aimed to solve. "We had built policy and procedure and, really, a culture, that was less conducive to innovation."

The increased emphasis on innovation coincided with technical accomplishments including achievement of the B61-13 first production unit in a schedule-slashing 13 months and development of SkyFox, a first-of-its-kind 3D-printed hypersonic glide body.

The progress made Sandia executives comfortable closing the goal to accelerate innovation and directing the Labs' attention toward new goals. Readying its engineering, operations and workforce for a complex and fast-moving future will demand that Sandia keep innovating.

"Innovation is evolving from a Labswide goal to a pillar of our Sandia culture," said David, referencing a six-characteristic culture the Labs has described for itself that includes "we innovate," "we deliver," "we team," and more. "Innovation isn't the end. Really, it never was. It's how we need to show up to accomplish our goals. I think we have succeeded in remaking ourselves so that we can honestly say, 'we innovate,' which is the language of our Sandia culture. Now it's on each of us to make sure that remains true."

Sandia's goals

Future-ready engineering
Transform Sandia's engineering tools and workflows by embracing digital, AI and innovative practices to make products better, faster, cheaper.

Future-ready operations
Operate with competitive efficiency and effectiveness by streamlining processes and leveraging innovation.

Future-ready workforce
Transform the way Sandia leads and manages a healthy workforce to swiftly align with national security demands.

HIRE Vets ranks Sandia at top for employing military veterans

Labs in step with Department of Labor for fifth consecutive platinum award

By **Luke Frank**

For the fifth consecutive year, Sandia has earned the HIRE Vets Platinum Medallion Award — the U.S. Department of Labor's highest designation — for its commitment to attracting, hiring and retaining veterans.

The HIRE Vets Medallion Program cited Sandia's veteran hiring and retention rates and its support programs, including veteran-specific resources, leadership programming, dedicated human resources efforts, compensation and tuition assistance.

"Sandia's business imperative is to attract top talent and maintain our competitive advantage," said Brian Maloney, a veteran talent acquisition specialist at Sandia and a retired U.S. Air Force senior master sergeant. "Speaking from experience, our service members and veterans exemplify exceptional service in the national interest. They're a natural fit in a highly motivated, disciplined culture dedicated to our national security mission and goals."

In 2024, nearly 20% of Sandia's new hires were military veterans, and more than 85% of those hires were retained for at least 12 months. Sandia attributes its success in attracting and retaining veterans in part to the efforts of its Military Support Committee, which provides employment and veteran integration support.

Suitable recruiter

Maj. Nick Nava, a U.S. Air Force reservist who works in cybersecurity research and development at Sandia, is an active participant in the committee. "I hired on at Sandia in 2022 but was unaware of the committee and the host of programs to attract veterans," he said. "I've learned there's so much more than recruiting efforts at Sandia. There's an underlying support culture that makes veterans feel welcomed and valued.

NATIONAL SERVICE — Sandia cybersecurity specialist Maj. Nick Nava, a U.S. Air Force reservist, works with the Labs' Military Support Committee. **Photo by Craig Fritz**

"I work with the committee's veterans recruiting team and have been on a few recruiting trips," Nick said. "It's always interesting talking with prospects, drawing out their skills from their service and education and matching them with Sandia's needs. Nine times out of 10 I recognize a skill set that Sandia can use. Many are surprised that they might be a fit, but the Labs has such a broad mission and variety of jobs."

A common refrain Nick hears from reservists or National Guard members considering a career at Sandia is that they're unsure if they can juggle both commitments.

"My response is always the same," he said. "Sandia's been very supportive of me being in the reserves. It's clear the Labs appreciates and supports veterans through its programs and management principles. I'm so fortunate that I don't have to stress about leaving my day job to perform my military requirements."

Sandia also offers a newly developed leadership ecosystem that provides an extensive catalog of services, resources, platforms and opportunities for leadership development that resonates with veterans' personal and professional goals and aspirations.

In addition to recruiting and hiring initiatives, Sandia provides onboarding and mentoring programs, veteran network groups and support to bridge cultural gaps between veteran and nonveteran employees.

"I recommend Sandia to any veteran looking to transition to private industry," Nick said. "The culture at the Labs aligns very similarly to military service. And you're still serving your country."

Top-down culture

During a Veterans Day celebration last November at Sandia's Livermore campus, Labs Director Laura McGill told veterans that their work at the Labs makes every Sandia team better. "Your exceptional competency, your skills, your critical thinking and your leadership that you gained in your military careers continue to benefit our nation through the important work that you do here at Sandia," she said. "We are grateful for the service that you have rendered to our nation. We can't thank you enough for the sacrifices that you and your families have made to keep us all safe."

Not the largest supercomputer, but maybe the most interesting

Sandia, NextSilicon abandon design norms to pursue technological frontier

By **Troy Rummler**

A new kind of supercomputer has arrived at Sandia, and while it's not the largest in the world, it may be one of the most unconventional.

Designed through a collaboration between the Labs and tech company NextSilicon, the new prototype system called Spectra is designed to process data in a fundamentally different way than most computers. If successful, Spectra could reshape how the nation performs high-stakes simulations critical to its nuclear deterrence mission.

Spectra features 128 of NextSilicon's Maverick-2 dual-die accelerators, specialized chips that analyze code to prioritize tasks in real time. This is a major design departure from CPUs or GPUs, which typically treat all data equally. The potential payoff is increased performance and reduced power consumption. It is the first supercomputer to incorporate this new chip architecture.

"We have deployed a first-of-its-kind computing capability," said Sandia senior scientist and project lead James Laros. "And it's the result of this tremendous partnership between the national labs and industry."

Sandia researchers will now push the limits of this new advanced architecture prototype. They're leading a consortium with Lawrence Livermore and Los Alamos national laboratories under NNSA's Advanced Simulation and Computing program. Ultimately, the team wants to know how the system handles national security-related tasks such as advanced fluid dynamics simulations, which help assess the safety and reliability of the nation's nuclear deterrent without underground testing.

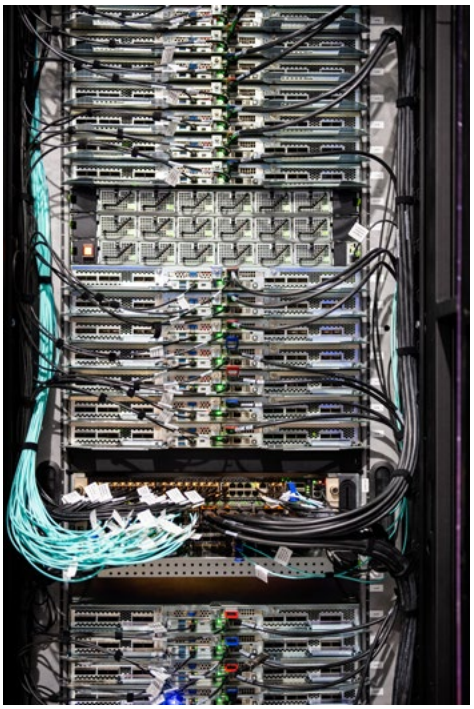
If successful, the research could mark a path forward for more sophisticated simulations.

AVANT-GARDE — Spectra is Sandia's newest supercomputer and the second in the Vanguard program, which explores advanced computer architectures for national security applications. **Photo by Craig Fritz**

Vanguard program pushes frontiers of computing technology

Spectra is the second platform deployed as part of Sandia's Vanguard program, which explores the viability of emerging technologies for ASC mission applications.

"By deploying prototype systems, we investigate whether new technologies can be integrated into our large production



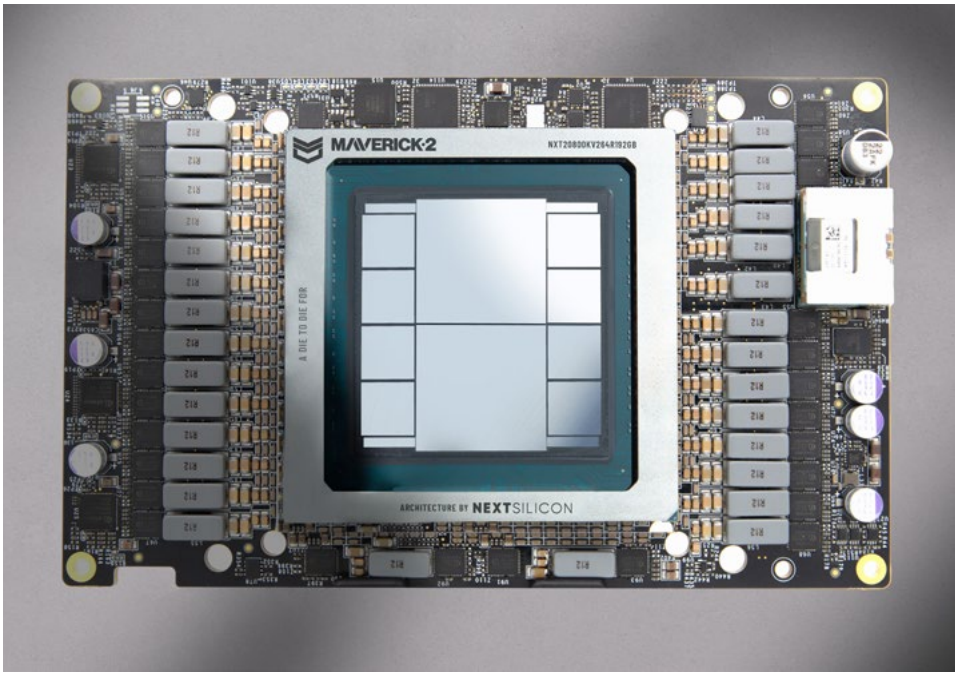
ADVANCED ARCHITECTURE — Penguin Solutions integrated the thermal management and power distribution systems for Spectra, and led the installation at Sandia. **Photo by Craig Fritz**

platforms in the coming years," said Simon Hammond, director of the NNSA Office of Advanced Simulation and Computing and Institutional Research and Development Programs.

The first Vanguard system, Astra, was the world's fastest Arm-based supercomputer in 2018. It was a pivotal experiment showing that Arm processors, traditionally used in embedded applications like cellphones and car electronics, could be successfully adapted for heavyweight jobs such as modeling and simulation.

"While it seems obvious today that Arm-based processors can handle demanding workloads, at the time of Astra's deployment the software stacks, compilers and libraries were untested and lacked necessary optimizations for production environments," Hammond said.

Astra's success paved the way for other labs to follow. Los Alamos National Laboratory deployed Venado, a full-size, partially Arm-based supercomputer, in 2024. Now Sandia and NextSilicon aim to achieve a new technology milestone with Spectra, focusing on efficiency and adaptive computing.



ADAPTIVE DESIGN — Sandia's Spectra features 64 compute nodes, each equipped with two second-generation Maverick Open Accelerator Module devices like the one pictured here. Each device hosts two Maverick-2 accelerators in a dual-die configuration. **Photo courtesy of NextSilicon**

Enhancing efficiency and performance

"Breakthrough scientific discoveries require breakthrough computing architectures," NextSilicon CEO Elad Raz said. "We built Maverick-2 because when researchers wait hours for simulations that could unlock major breakthroughs, the bottleneck isn't human imagination — it's computing efficiency."

An advantage of the Maverick-2's experimental design is that it simplifies porting applications to the new system. Raz said, "We deliver up to 10x performance improvements at half the power without requiring users to rewrite their applications."

This could save months to years of work researchers normally spend optimizing their software to the latest hardware, making NNSA programs more agile and saving taxpayer dollars.

While Sandia will evaluate the extent of this backward compatibility, James confirmed that on day one the system could support the supercomputing benchmark test HPCG, the molecular dynamics simulation LAMMPS and the Monte Carlo code SPARTA, which Sandia researchers regularly use to simulate low-density gases.

Plenty of room to grow

Spectra was integrated and installed by Penguin Solutions with scalability in mind. The company designed an innovative server that can support up to four high-performance NextSilicon Open Accelerator Modules running at full power, although the current setup uses two.

"We engineered a system with aggressive capabilities so that Sandia could fully explore the entire envelope of power and performance of the chips over time," said Phil Pokorny, chief technology officer at Penguin Solutions. "Sandia will have plenty of room to grow this cluster to higher levels of performance."

SPECTRA INSTALLATION
WATCH THE VIDEO
Video by Ruth Frank and Arianna Andreatta

An advanced Chilldyne negative pressure liquid cooling system and Penguin's Tundra infrastructure, which optimizes thermal management, power distribution and scaling, enable the flexibility. Penguin successfully adapted these solutions to the power infrastructure of Sandia's data center.

"Revolutionary new designs are among the most fascinating to learn about and work on," Pokorny said. "Being part of delivering such a new design is a rare opportunity. It's very exciting."

For Sandia and NNSA, Spectra represents more than another supercomputer. It's a testbed for a future where computing breakthroughs come not from bigger machines, but from smarter, more adaptive designs.

Physicists employ AI labmates to supercharge LED light control

Fourfold improvement bridges basic science with next-generation technology

By **Troy Rummler**

In 2023, a team of physicists from Sandia announced a major discovery: a way to steer LED light. If refined, it could mean someday replacing lasers with cheaper, smaller, more energy-efficient LEDs in countless technologies, from UPC scanners and holographic projectors to self-driving cars. The team assumed it would take years of meticulous experimentation to refine their technique.

Now the same researchers have reported that a trio of artificial intelligence labmates has improved their best results fourfold. It took about five hours.

The resulting paper, published in Nature Communications, shows how AI is advancing beyond a mere automation tool toward becoming a powerful engine for clear, comprehensible scientific discovery.

"We are one of the leading examples of how a self-driving lab could be set up to aid and augment human knowledge," said Sandia's Prasad Iyer, an author on the new paper and the 2023 announcement.

Research was funded by DOE's Office of Basic Energy Sciences and Sandia's Laboratory Directed Research and Development program. It was performed in part at the Center for Integrated Nanotechnologies, a DOE Office of Science user facility jointly operated by Sandia and Los Alamos national laboratories.

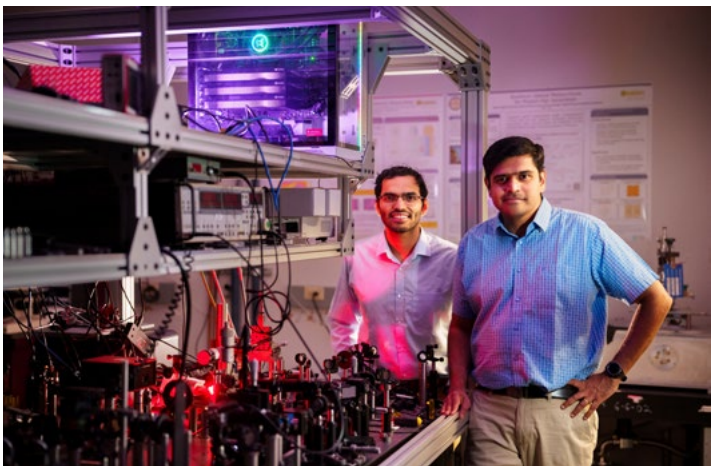
Researchers team across disciplines to modernize lab

A lucky coincidence spurred the research: Prasad got a new officemate.

Saaketh Desai came to Sandia as a postdoctoral researcher. Prasad is an expert in optics, but Saaketh knew machine learning — a category of AI — and had been testing out ways to use it for scientific research. Together, they modernized Prasad's optics lab.

First, they used a generative AI model to learn and simplify their complex data. Then they provided this simpler dataset to a second AI, called an active learning agent, and connected it to optical equipment. They instructed it to design an experiment based on the learned data, run it on the equipment, analyze the results and then repeat the process by coming up with a new experiment based on its findings.

After the 300th experiment, which took about five hours, it had significantly improved on what the researchers had spent years developing.



SELF-DRIVING LAB — Sandia scientists Saaketh Desai, left, and Prasad Iyer, modernized an optics lab with a team of artificial intelligences that learn data, design and run experiments, and interpret results. **Photo by Craig Fritz**

Addressing AI's black box problem

Even though it was his idea to bring Saaketh onto the project, Prasad said he had some worries about handing over lab equipment to an AI agent.

"We could potentially do infinite nonsensical experiments without having any meaningful results," Prasad said.

This is because AI has a black box problem. A query goes in, an answer comes out, but it's often hard for users to figure out how the AI came up with its answer.

But science requires explanations. When a scientist makes a discovery, they share why they think their discovery works or makes sense. It's the only way science moves forward — because other scientists can then test that idea to either build on it or disprove it.

PRASAD IYER — "We are one of the leading examples of how a self-driving lab could be set up to aid and augment human knowledge," Sandia scientist Prasad Iyer said. **Photo by Craig Fritz**

Saaketh also recognized the importance of making sure any AI-based conclusions would be understandable.

"We are constraining ourselves to finding good experiments that will advance our understanding of the domain," he said.

"Therefore, there is a high emphasis on interpreting why something worked or didn't work."

Team prioritizes verifiable, AI-augmented research

Prasad and Saaketh agreed that an AI automaton would not be enough to advance their field. To address the black box problem, they brought in a kind of fact-checker. Maybe unsurprisingly, it was another AI. This one, however, was trained differently. Its job was to figure out equations to explain complex data trends.

The researchers connected this third AI with the second AI in a loop. The active learning agent generated data and worked out its next experiments, while the equation learner attempted to devise a formula to fit the data.

Within moments of finishing the experiments, researchers had new equations in hand to verify that their self-driving lab had found a methodical way to steer spontaneous emission, the kind of light produced by an LED, on average 2.2 times more effectively than they had previously accomplished across a 74-degree angle. Their best results at specific angles showed fourfold improvement.

Surprisingly, the AI had achieved this in a way the Sandia team had never considered. It was based on a fundamentally new way of thinking about how light and materials interact at the nanoscale.

The AI platform's success is promising for science, said Saaketh, but it also relies on a lot of computing power, which might not be accessible to every lab. Learning from data was powered by a Lambda Labs workstation with three high-end NVIDIA RTX A6000 GPUs.

Still, Saaketh said, he wants to see how far he can take this process.

"For next steps, we are generally interested in interpretable optimization schemes and arriving at explainable decisions using AI. We are interested in applying this to the steering problem, as well as other material science problems in general."

SAAKETH DESAI — "We are constraining ourselves to finding good experiments that will advance our understanding of the domain," Sandia scientist Saaketh Desai said. **Photo by Craig Fritz**

Making the nation safer with Sandia's help

NM businesses get support from NMSBA for 25 years

By **Kim Vallez Quintana**

When a SWAT team trains multiple times a week, running repeated live-fire drills, the noise can be intense. Even with premium hearing protection, the sound and pressure can damage hearing over time, contributing to traumatic brain injuries for officers and disorienting civilians nearby. If only there were a way to curb that danger.

Those kinds of problems are exactly what the New Mexico Small Business Assistance program has helped tackle for 25 years with support from Sandia and, since 2007, Los Alamos National Laboratory.

The program, created in the year 2000, helps small businesses solve critical challenges by providing technical assistance and expertise that they don't have access to anywhere else, at no cost to them.

This year, two of the businesses Sandia helped aim to make the nation safer with their products were Ridgeline Engineering and Manufacturing, which is working to reduce hearing damage from firearms, and Aperi Computational Mechanics Consulting, which is making critical engineering simulations faster and more affordable.

SURROUND SOUND — Sandia engineers placed multiple microphones around a Ridgeline Manufacturing suppressor during testing to record the sound at different points, then analyzed the data to determine impact on the human ear. **Photo by Bret Latter**

Ridgeline Engineering and Manufacturing

When Matias Roybal and his wife started Ridgeline Engineering and Manufacturing in Cedar Crest, New Mexico, in 2018, the goal was to use his mechanical engineering background to build a product they could, in all ways, call their own.

"After college, I went right to work as a performance development engineer and have worked in the automotive, defense and aerospace industries," Roybal said. "I wanted to

develop my own product and own the whole process, from design to finish."

With his expertise in mechanical and structural design and additive manufacturing, or 3D printing, Roybal started building a quieter firearm suppressor.

Protecting first responders

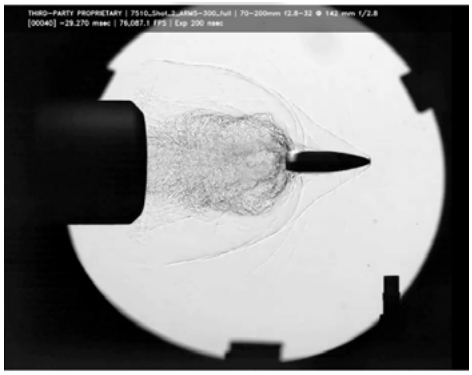
"A big motivator is to protect the hearing of first responders like police officers and the military, as well as innocent bystanders," Roybal said.

Roybal, who grew up in Mora, New Mexico, knew the basics of firearms and the dangers of hearing loss because of his hunting and shooting experience, but when he delved deep into the industry and partnered with a local SWAT team member, he learned just how significant the impact is.

"When you have 25 guys on a team and you are training multiple days a week, running five-shot drills per person, you all of a sudden have a lot of sound, a lot of pressure and are heavily exposed," Roybal said. "While they are wearing premium hearing protection, you still get concussive impulse that causes hearing damage or even traumatic brain injuries. What we are trying to do with this product is take a problem in the industry and eliminate the occupational hazards."

Roybal also wanted to consider bystanders who may find themselves exposed to gunshots unexpectedly.

"When a SWAT team goes into a building and they must discharge a firearm, there are sometimes civilians. People's ears are ringing. It's difficult for everyone involved and puts officers and civilians in danger," Roybal said. "We're trying to reduce that sound, get rid of that concussive force and pressure. It helps the officer as they try to communicate with people to get them out safe."



HIGH-SPEED VISUAL — High-speed cameras capture the gas velocities and flow patterns as a bullet is fired through a Ridgeline suppressor, helping to determine gas flow rates inside the suppressor. **Photo courtesy of Ridgeline Manufacturing**

Ridgeline Engineering and Manufacturing worked to build a suppressor they believe can better attenuate frequencies that cause hearing damage. But having a product in hand was just a first step.

PRECISION SOUND — Matias Roybal and a fellow member of the Ridgeline team conduct high-fidelity acoustic tests on their suppressors with the help of Sandia acoustics and vibration engineers. **Photo by Bret Latter**

Partnering with Sandia

That's when Roybal and his team turned to Sandia and NMSBA for help. They needed to test that suppressor.

"They needed high-fidelity acoustic recordings that required specialized, high-precision and calibrated equipment," said Michael Denison, Sandia acoustics and vibration engineer.

That is not something a small company like Ridgeline usually has access to. With the NMSBA program, they did.

It also gave them access to Denison's expertise and that of lab technologist Stephen Aulbach, who has extensive outside firearms experience.

Ridgeline and Sandia worked together for two years conducting sound tests. The tests were designed to not only record the sound the suppressor made, but the potential impact to everyone within hearing distance.

They placed microphones to the right and left of the muzzle, near the shooter and downrange, recorded the sound at each point and then analyzed the data.

"The cool thing about this project is that most suppressor manufacturers only care about sound pressure level," Denison said. "We looked further into how the sound wave affects the human ear. We used modeling techniques that the Army Research Lab developed to figure out how certain suppressors will be more hearing safe. That is harder to quantify than simply measuring sound pressure levels."

The team, which also included Sandia engineer Chad Heitman, used the Labs' access to high-speed video and image equipment and diagnostics to show exactly what was going on inside the suppressor during firing.

"We built a suppressor with a clear case that showed the airflow so that we could see exactly what was going on inside the suppressor when a shot was taken. We were able to analyze each movement and action taking place," Roybal said.

That enabled the Ridgeline team to make necessary changes and create a better product, all the while consulting those with firsthand experience, including law enforcement officers, a retired Special Forces colonel and soldiers at Fort Carson and Fort Bragg.

The end picture

Ridgeline's suppressor is now on the market, but the team said they will keep working to make it even better.

"Building a safer environment for those impacted by firearms is important to this team," Roybal said. "The reason that we are using this high-fidelity data is because we care about the end user. We're not chasing money. We have a good product, but a good engineer knows as soon as a product goes out the door you can make it better."

Denison said he looks forward to working with Ridgeline again. "This project was a little outside the box for me," he said. "It was a good way to exercise some of my other expertise that I don't use daily during my regular job."

It's also a good way for staff like Denison to share their expertise with small businesses.

"We have advanced and unique capability at Sandia, and it's nice to be able to find ways to benefit the community and perform the work I love to do for people who benefit the most from it."

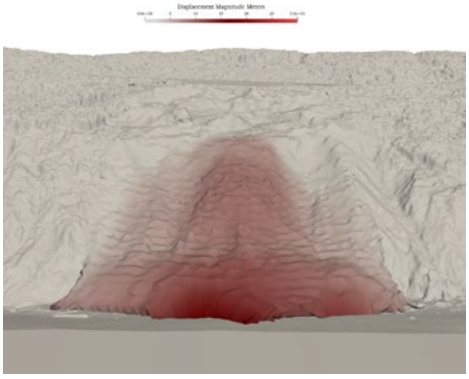
Aperi Computational Mechanics Consulting

NMSBA's impact is not limited to physical products. In 2024, the NMSBA program and Sandia also helped a young software engineering company make a big impact. Aperi Computational Mechanics Consulting was founded in 2023 by Megan Ford to make engineering simulation cheaper.

Some of its applications include modeling the movement of underground soil such as nuclear waste storage tunnels or landslides and predicting their long-term stability. "There is a need to understand collapse in tunnels that occurs over many years, but it's hard to get test data of that," Aperi Chief Strategy Officer Kurtis Ford said.

Aperi aims to make those simulations quicker and less expensive. That is where Sandia and the NMSBA came in.

"At Sandia, we have a bunch of resources that have been developed over many years for the mission-related work," said Alan Williams, the Sandia computer science engineer who collaborated on the project. "We have similar applications and code libraries that provide the data structures and algorithms that allow them to do their calculations at a much faster pace."



SEEING UNDERGROUND — Simulation of a landslide, conducted using Aperi software, features geometry derived from a high-resolution LiDAR scan of an unstable mountain in Oregon. **Photo courtesy of Aperi**

Making calculations faster

Williams said it has to do with the ability to process simulations on a graphics processing unit, or GPU, instead of a central processing unit, or CPU.

"It's like the graphics processor on a computer; nearly every computer has one or more CPUs that do set value calculations like arithmetic," he said. "But displaying pixels and rendering colors on your screen is best handled by a GPU, which is very fast and highly parallel. It can render millions of pixels and update them many times per second. What we can do with our simulation libraries is use the GPU's power to do our engineering calculations super fast. That is what Aperi was looking for."

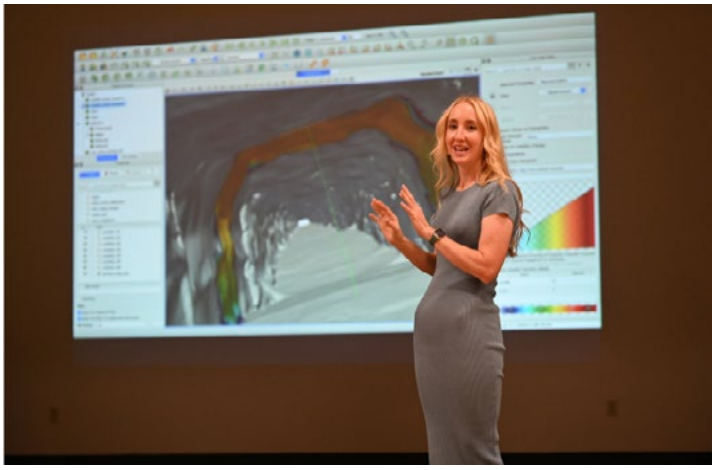
Aperi has been able to do its simulations 150 times faster.

"That resource and expertise is not readily available to businesses like ours," Ford said. "Without help from Sandia, it would have cost us $2 million to $3 million and would have taken a couple of years because we would have had to learn all the codes and libraries on our own. With Sandia, we knew what we needed, reached out to the place that has the expertise and got it done quickly."

Mutual benefit

The NMSBA partnership has also brought something to Sandia.

Williams said the code libraries that Aperi used were still being built. "What we did with the NMSBA grant is build some enhancements and developments that are specific for Aperi applications that also helped improve capabilities for internal Sandia applications," he said. "It was a pooling of resources that turned out to be mutually beneficial."



HIGH-RESOLUTION DATA — Megan Ford of Aperi Computational Mechanics Consulting presents a new capability in Aperi software that uses high-resolution 3D scan data to predict the long-term stability of nuclear waste storage tunnels. **Photo by Bret Latter**

Williams said these improvements have also helped Sandia make better use of El Capitan, the world's fastest computer, currently at Lawrence Livermore National Laboratory.

Aperi, meanwhile, continues to grow. Ford said the NMSBA program work proved to be the company's first big win, helping it earn three Small Business Innovation Research grants and the NMSBA Honorable Speaker Ben Lujan Award for Small Business Excellence.

The company is now working on detailed models of collapsing materials such as foam used in helmets and cars. They also hope to carry on the relationship with Sandia.

"It's been a really positive experience," Williams said. "It has been a more tangible benefit to see how you've helped a small business. You can feel their excitement when their code speeds up or does something new, and so it's been exciting and rewarding."

The NMSBA program started at Sandia in 2000 in response to the State of New Mexico Partnership with Small Business Tax Credit Act. The act is designed as a rural economic development program that allows up to $40,000 in annual assistance to companies outside of Bernalillo and Santa Fe counties. Companies within Bernalillo and Santa Fe counties are still eligible but at a lower rate of $20,000 since they are in an urban area.

Since its inception, the NMSBA program has provided more than $89.7 million in assistance to 3,410 companies in all 33 counties.

She got it from her mom

Giving back to the community runs in the family for this longtime Sandian

By **Magdalena Krajewski**

Raised by a single mother who worked two full-time jobs, Roberta Rivera grew up in a modest household.

"We didn't have much, but I had everything I needed, and whatever extra we had, my mom would put right back into her community," said Roberta, a community relations specialist.

Compassion in the classroom

Although Roberta was an only child, her mother, Esther Montoya, nurtured hundreds of young men and women over the years while working at West Mesa High School.

"My mom's day job was at West Mesa, where she worked as a teaching assistant with at-risk students," she explained. "Many of these students lived in group homes and came from difficult backgrounds. Some struggled with self-control and could be disruptive in class, but my mom loved these kids. She did everything in her power to make their lives a little easier and keep them out of trouble."

If a student needed a haircut but couldn't afford one, Montoya would take them. If they needed food, bus fare or clothes, Roberta's mom would make it happen.

"She was determined to make sure these kids had their basic needs met," Roberta said.

If Montoya heard there was going to be a fight at a park or elsewhere, Roberta said her mom would show up and break it up.

"She was tiny, just 4'11", but she'd show up and say, 'Nope, this isn't happening,'" Roberta recalled. "Later, when I was a student at West Mesa, I came across my mom in the hallway breaking up a fight between two much larger students."

"Her students loved her. I can just picture these big, tough guys coming into her classroom and just melting when they saw her," she said. "She was so patient and made them feel heard. They'd talk to her about problems at home or when they didn't know how to handle something. She was gracious and kind to these kids."

Growing up, Roberta was in awe of her mom and, as often happens with children, picked up lessons along the way.

"She was always demonstrating acts of kindness," Roberta said. "We didn't have a lot of extra money, but my mom never hesitated to share what we had with others. She believed that you get what you put out into the world; you leave people better than you find them."

Carrying on the tradition

This belief has carried into Roberta's own life and work at Sandia, helping to foster a culture of generosity and support that enhances the Labs' impact in the community and inspires the next generation of innovators who contribute to Sandia's critical mission.

"I love helping people, and luckily, every role I've had in my 33 years here has allowed me to do just that," Roberta said. "I started as a clerical intern in the student program office, and in 1997, I was hired as an office administrative assistant. A few years later, I got a new job back in student programs, where I worked for nearly 12 years."

In that role, Roberta guided students through the process of getting hired as interns and was eventually promoted to lead the graduate programs, including Sandia's annual student intern symposium.

GIVING BACK — Roberta participates in Sandia Serves at the Seed2Need apple picking event in Corrales in the fall of 2025. **Photo by Craig Fritz**

"I connected students to fellowship programs that helped them pay for their master's and Ph.D. degrees," Roberta said. "I had accumulated debt from student loans when I was in school, so being able to help students secure these fellowships was really rewarding."

Roberta would help hundreds of former interns obtain full-time positions at Sandia.

In 2002, Roberta signed up to assist with Sandia's social mentor program, which helped new student interns acclimate to Albuquerque.

THE VERY BEST — Roberta and her mom, Evelyn, smiling for a photo in 2001. Roberta says her mom was the very best.

Photo courtesy of the Rivera family

"We had interns coming in from all over the country, and our social mentors served as personal guides, picking them up from the airport, taking them to their apartments and helping them figure out where to buy groceries or get their hair done. Whatever they needed to make their lives easier," Roberta explained. "I guess, following in my mom's footsteps, I felt compelled to go the extra mile if it meant it would help someone."

'As long as I have my health'

Roberta describes her mom's work ethic as exceptional; she never called in sick and only took time off when her managers insisted.

"She always said, 'As long as I have my health, I'm going to work,'" Roberta recalled. "And then she got sick."

In 2013, Montoya was diagnosed with cancer.

"She had retired from West Mesa but was working at Presbyterian as a diet aide and was on her feet a lot. She started experiencing a lot of pain in her legs and hips, and then one day, she just couldn't walk," Roberta said. "This led to some time in the ER and tests, which revealed she had multiple myeloma. Had she not gotten sick, I think she would have worked forever because she really loved what she did, but at 65, she had to retire."

FAMILY PHOTOS — Roberta says her mom was a lover of family photos. Roberta is 4 years old in this one taken in 1978.
Photo courtesy of the Rivera family

AWARD WINNER — Roberta was selected by Great Minds in STEM for the 2025 Santiago Rodriguez Impact Award.
Photo courtesy of Great Minds in STEM

Montoya moved in with Roberta and her family after receiving a bone marrow transplant in 2014. And for a while her health was on the upswing, but in 2016 the cancer came back and metastasized all over her body.

"She died on my birthday, Aug. 18, 2016," Roberta said. "I was an only child so I guess it's fitting, like full circle, that she would leave this earth on the anniversary of the day she brought me into it."

"My mom was the best. She followed the golden rule completely and had this all-in mentality, if you're going to help, you're going to help all the way, not just 100%, but 150%."

Roberta says it is this and many other lessons learned from her mom that continue to drive her own work.

Leaving people better than you found them

The same year her mom passed away; Roberta began working with Sandia's Community Involvement team in a formal community outreach position.

She has been a key player in Lab's many efforts to give back to the local community, including Sandia Gives, the Holiday Gift Drive, the Read to Me! ABQ Network annual Book Drive and several other fundraising and volunteer initiatives.

"Sandians are such a historically generous group. I think we all feel fortunate to work here, to have well-paying and secure positions that allow us to give back to our community," she said. "And I love that I get to help facilitate these efforts, helping our employees give back through with their time or money. Making these connections is such an honor."

Roberta's enthusiasm for giving back and helping others is contagious. Whether it was nature or nurture, she inherited it from her mom.

"I love knowing that I made a difference. Like my mom said, you always leave people better than you found them, and I can only hope that one day, when I'm gone, people will remember what I've done for them the same way I know people remember my mom."

Changemaker

Roberta has received numerous awards and recognitions throughout her career at Sandia National Laboratories, reflecting her exceptional contributions to community involvement and support for future generations. Most recently she was selected by Great Minds in STEM for the 2025 Santiago Rodriguez Impact Award.

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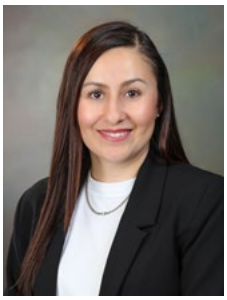
Marlene Lucero 25

Tim Walsh 25

Brenton Elisberg 20

Angie Kelic 20

Mark Atkins 15



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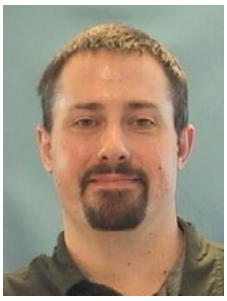
Alex Dessanti 15

Nathan Elliott 15

Sherri Engler 15

Christine Ford 15

Nicola Kinzie 15



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Mark Maes 15

Leo Small 15

Andrew Stuart 15