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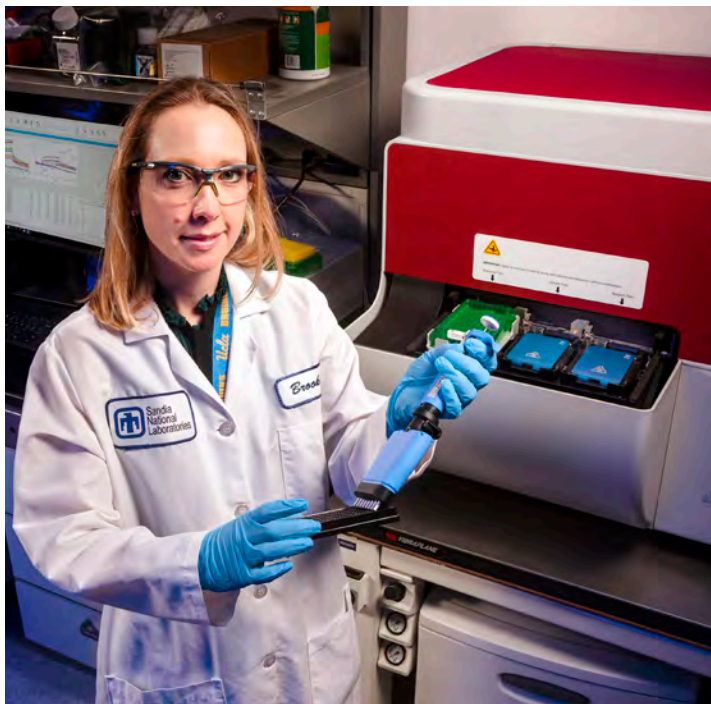
## LABNEWS

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Vol. 73, No. 23, Dec. 10, 2021

R&D 100  
Awards  
Page 3

Bay Area SLAM	7
Electric cars	11
Mileposts	15
Giving back	17



**NEUTRALIZING NANOBODIES** — Brooke Harmon, a virologist at Sandia, leads research to discover, design and engineer novel antibody countermeasures for emerging viruses.

Photo by Randy Wong

## Neutralizing antibodies for emerging viruses

*Sandia research defends against COVID-19, prepares for future pandemics*

Story by Paul Rhien

**R**esearchers at Sandia have created a platform for discovering, designing and engineering novel antibody countermeasures for emerging viruses. This new process of screening for nanobodies that “neutralize” or disable the virus represents a faster, more effective approach to developing nanobody therapies that prevent or treat viral infection.

Traditionally used to treat a variety of conditions, including cancer and autoimmune and inflammatory diseases, nanobodies are smaller components of conventional antibodies — a vital element of the body’s immune system that defends against disease-causing viruses or bacteria.

— CONTINUED ON PAGE 10

## New testing method yields pathway to better, longer-lasting batteries

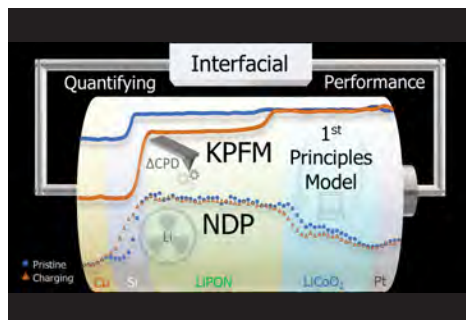
By Michael Ellis Langley

**U**sing a microscopic method for measuring electrical potential, Sandia scientists may have discovered how to make a longer-lasting, more efficient battery.

The team of Elliot Fuller, Josh Sugar and Alec Talin detailed their findings in an article published Oct. 19 in [American Chemical Society Energy Letters](#).

“One of the challenges with solid-state batteries is that at the boundaries between different parts of the battery — a cathode

— CONTINUED ON PAGE 8



**ELECTRON TRACKERS** — This illustration shows how a team used Kelvin probe force microscopy to locate places where electron flows get stuck, potentially leading to engineering longer-lasting, more efficient batteries.

Illustration courtesy of National Institute of Standards and Technology



## WHERE SCIENCE MEETS ART

— PAGE 12

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### Sandia National Laboratories

Albuquerque, New Mexico 87185-1468

Livermore, California 94550-0969

Tonopah, Nevada | Nevada National Security Site

Amarillo, Texas | Carlsbad, New Mexico | Washington, D.C.

**Katherine Beherec, Editor** kgbeher@sandia.gov

**Taylor Henry, Production** takenr@sandia.gov

**Randy Montoya, Photographer** 505-808-9622

**Paul Rhien, California Site Contact** prhien@sandia.gov

#### CONTRIBUTORS

Michelle Fleming (milepost photos, 505-844-4902),  
 Neal Singer (505-846-7078), Stephanie Holinka (505-284-9227),  
 Kristen Meub (505-845-7215), Michael Baker (505-284-1085),  
 Troy Rummier (505-284-1056), Manette Fisher (505-844-1742),  
 Valerie Alba (505-284-7879), Luke Frank (505-844-2020),  
 Michael Langley (925-294-1482), Meagan Brace (505-844-0499),  
 Mollie Rappe (505-228-6123), Darrick Hurst (505-844-8009),  
 Jim Danneskiold (jddanne@sandia.gov),  
 Heather Clark, manager (505-844-3511)

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## TABLE of CONTENTS

- 1** | Neutralizing antibodies for emerging viruses *continued on Page 10*
- 1** | Better, longer-lasting batteries *continued on Page 8*
- 2** | Sandia and AWE sign strategic intent document *continued on Page 6*
- 3** | Sandia wins seven R&D 100 Awards and two honors
- 6** | Transgender Day of Remembrance
- 7** | Sandia shines in inaugural Bay Area SLAM research
- 9** | Maximizing healthcare benefits in the new year
- 11** | Virtual Electric Car Challenge sparks creativity
- 12** | Coming together, making magic
- 15** | Mileposts and recent retirees
- 16** | Society of Asian Scientists and Engineers honors physicist
- 17** | Turkey time
- 18** | Directors give back during the Fall Leadership Forum

## LABNEWS Notes

Lab News may contain photos shot prior to current COVID-19 policies. People in photos followed all social distancing and masking guidelines that were in place when photos were taken.

**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 Lab News editor Katherine Beherec at kgbeher@sandia.gov. This is the last edition of 2021.



**STRATEGIC INTENT** — AWE Chief Technical Officer Graeme Nicholson, left, and Sandia Associate Labs Director for Nuclear Deterrence Rita Gonzales sign an update to the Sandia-AWE strategic intent document.

Photos courtesy of the Atomic Weapons Establishment

# Sandia and AWE sign strategic intent document

By Jennifer Awe

The United States and the United Kingdom have a rich history of cooperation dating back to the Manhattan Project. Since 1958, the two countries have shared ideas, information, materials and equipment within the provisions of the [Mutual Defense Agreement](#). Sandia and the United Kingdom's Atomic Weapons Establishment have a partnership that is codified in a strategic intent agreement between the two institutions.

In September, as part of an annual health check of the partnership, Sandia senior leadership, led by Deputy Labs Director Laura McGill, visited AWE to review the strategic intent partnership and outline future plans. The review confirmed and reinforced the strong relationship between the two organizations.

— CONTINUED ON PAGE 6



# Sandia wins seven R&D 100 Awards and two specialty honors

## Annual breadth of invention is wide

Story by **Neal Singer**

Competing in an international pool of universities, corporations and government labs, inventions from Sandia captured seven **R&D 100 Awards** (one in conjunction with the National Renewable Energy Laboratory) this year, as well as two special awards

for green technology and corporate responsibility.

Independent panels of judges, chosen by R&D World magazine, selected projects to represent the year's 100 most outstanding advances in applied technologies. The awards, in their 59th year, focus on practical impact rather than pure research, and recognize entrants for their products' designs, development, testing and production.

The criterion for winning has been "demonstrable technological significance compared with competing products and technologies," and emphasizes properties, such as smaller size, faster speed, greater efficiency and higher environmental consciousness.

Since 1976, Sandia has earned 139 R&D 100 awards, including this year's winners.

## Sandia's R&D 100 selected projects for 2021

### Secure-Firmware Over-the-Air

The embedded software known as firmware requires frequent updates in most modern cars. But when these updates occur remotely over the airwaves, the process is vulnerable to cyberattacks that can compromise critical functions like air bag response, steering, acceleration and braking. S-FOTA protection can be installed as a firmware plug-in in each car at its manufacturing plant and is remotely managed by the manufacturer, without inconveniencing the vehicle owner. S-FOTA provides the convenience of a single application interface as well as authenticity assurance, with enhanced security from mathematically quantifiable integrity checks.

*Submitted by S. Peter Choi*



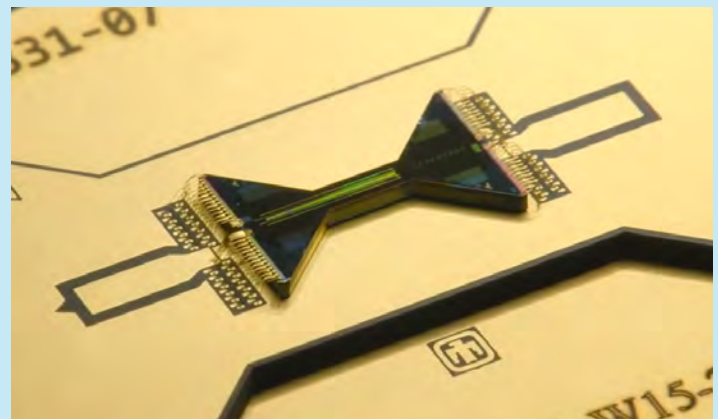
**REMOTE CONTROL** — Secure-Firmware Over-the-Air can allow car manufacturers to remotely manage firmware updates and provides enhanced security.

**Graphic courtesy of Sandia**

### Quantum Scientific Computing Open User Testbed

QSCOUT provides scientists free and complete access to the only open quantum computing testbed in the world based on trapped ions. It gives the scientific community a new level of programming control and execution for improving quantum computer science. These types of controls give researchers the ability to study and answer the major open questions in quantum computing, including understanding and mitigating sources of noise, learning how to characterize and validate quantum operations, and developing and optimizing quantum algorithms for scientific applications. In short, QSCOUT is a quantum computer for scientists, made by scientists, to advance quantum computing science.

*Submitted by Susan Clark*



**QUANTUM ANSWERS** — QSCOUT provides scientists free and complete access to the only open quantum computing testbed in the world based on trapped ions.

**Photo courtesy of Sandia**

## RAPTR N95

A reusable, rapidly producible N95 respirator for medical applications developed at Sandia can be completely disassembled for sterilization, decontamination and component replacement. A swappable passive resonator transmits voice or can be used for fit certification. Air is filtered during inhalation and exhalation. A wide range of filter media, held in a protective structure, can be used to help alleviate supply chain issues. The researchers have filed a patent for the design of the RAPTR and are open to licensing the design.

*Submitted by Eric Shaner and Todd Barrick*



**FAST FILTER** — Sandia developed a reusable and rapidly producible N95 respirator for medical applications in the RAPTR N95 project.

## WEC-Sim

**Wave Energy Converter Simulator** software is widely used by academia and industry to better understand how devices convert the motion of waves into usable energy and fare in the open sea. This advance can help replace physical testing with computer modeling and is the first open-source software tool allowing developers to numerically model wave-energy converter dynamics and performance. The multiyear collaborative effort included a team of researchers from Sandia and the National Renewable Energy Laboratory.

*Submitted by NREL; Sandia contact Kelley Ruehl*

## Slycat

Computational modeling frequently generates collections of runs known as ensembles. Ensemble sizes can exceed 10,000 runs, each with hundreds of changing variables, plus multimedia outputs. Slycat makes sense of ensemble data by integrating data management, scalable analysis, abstract visual representations and remote interaction through a web-based interface that is designed for access-controlled collaboration between authenticated project members.

*Submitted by Patricia Crossno*



**CREATIVE ENSEMBLE** — Members of the Sandia research team working on Slycat.

## AeroMINE

Stationary wind harvesters provide electricity generation with no external moving parts. Co-developed by Sandia researchers with Westergaard Solutions Inc. and Texas Tech University, they can complement rooftop solar setups and provide affordable, reliable power to warehouses, box stores, commercial buildings, military bases and remote locations, reducing greenhouse gas emissions from conventional sources. Distributed, or point-of-use, wind energy has the potential to significantly increase worldwide green energy production and allow microgrids to supplement the electricity grids in many regions.

*Submitted by Brent Houchens*



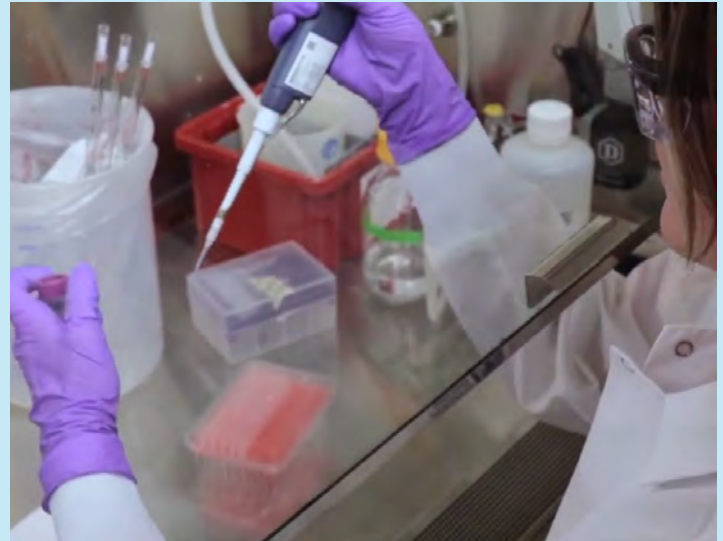
**WINDLESS** — Sandia co-developed a stationary wind harvester with no external moving parts. **Photos courtesy of Sandia**



## Potent and Effective Synthetic SARS-CoV-2 Neutralizing Nanobodies

Using a library of variable antibody fragments called nanobodies, Sandia researchers have assembled extremely potent next-generation anti-COVID-19 neutralizing antibodies. Nanobodies offer easier manufacturability, increased versatility, smaller size and the ability to bind to more than one target site to increase potency and resistance to viral mutants. Researchers have shown they can produce a nanobody-based countermeasure within 90 days once a virus' genetic code has been identified. The method has not yet been tested on humans. The researchers have filed for a patent on aspects of their work and are actively seeking commercial partners to help identify and engineer next-generation antibodies.

*Submitted by Brooke Harmon*



**POWERFUL NANOBODIES** — Researchers have assembled extremely potent next-generation anti-COVID-19 neutralizing antibodies.

## In addition, Sandia researchers were awarded:

A GOLD Special Recognition in Green Technology award for Environmentally Benign Extraction of Critical Metals Using Supercritical CO<sub>2</sub>-Based Solvent. A method that uses environmentally harmless citric acid in tandem with carbon dioxide to detoxify coal tailings by extracting critically needed rare elements and more harmful components at the same time. The extraction improves the environment instead of destroying it as conventional mining may do.

*Submitted by Guangping Xu*

A SILVER Corporate Social Responsibility award for RAPTR N95.



# JOIN THE CONVERSATION

Sandia Labs has official social media accounts on several online communities to engage in conversations about our work, update followers about the latest Labs news, share opportunities, and support the open government principles of transparency, participation and collaboration.

Visit us on your favorite networks and join the conversation.

**Facebook**  
[facebook.com/SandiaLabs](https://facebook.com/SandiaLabs)

**Twitter**  
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# Transgender Day of Remembrance

## *Inclusion for all*

By **Stephanie Holinka**

**A**ssociate Labs Director Susan Seestrom, the executive champion of the Sandia Pride Alliance Network, recently sent out the first Labwide [message](#) intended to raise awareness for Transgender Day of Remembrance, an annual event that this year [memorialized the at least 45 people](#), largely Black or Latinx, killed for being transgender.

“It’s important that all employees see themselves reflected at work, and cisgendered people enjoy that privilege without even noticing it. That makes gender identity and expression an important workplace issue, so all staff can bring their whole selves to work,” Susan said.

Sandia’s diverse members of the workforce include many transgender and gender nonconforming employees and contractors. Many more employees are parents and

family members of transgender or gender nonconforming loved ones.

“Sandia values all parts of the workforce. Being more inclusive of staff who present at work as having a different gender identity or expression does not take something away from the rest of the workforce,” Susan said. “When we connect with others in open, supportive ways, we create powerful ties and build secure spaces of belonging for everyone.”

The Sandia Parents Group also now includes the Parents of Nonbinary and Trans Kids Peer Support Group among its peer support groups.

In her message, Susan explains she is proud of her transgender grandchild and his parents, and understands how families of trans people worry about the future of their loved ones: “Will they be safe? Will they have career opportunities? And, most importantly, will they be happy?”

Sandia protects its LGBTQ+ employees from discrimination based on gender identity and expression, and sexual orientation. Interested parents can contact the group



**EXECUTIVE ALLY** — Associate Labs Director Susan Seestrom is an LGBTQ+ ally and executive champion for the Sandia Pride Alliance Network. She recently sent a message to the Labs to raise awareness of the Transgender Day of Remembrance.

coordinator Chris LaFleur for more information or to join.

In Albuquerque, this year’s event was sponsored by the [Transgender Resource Center](#). Its website includes local resources for assistance.

The SPAN website includes resources for allies and those who want to learn more. [f](#)



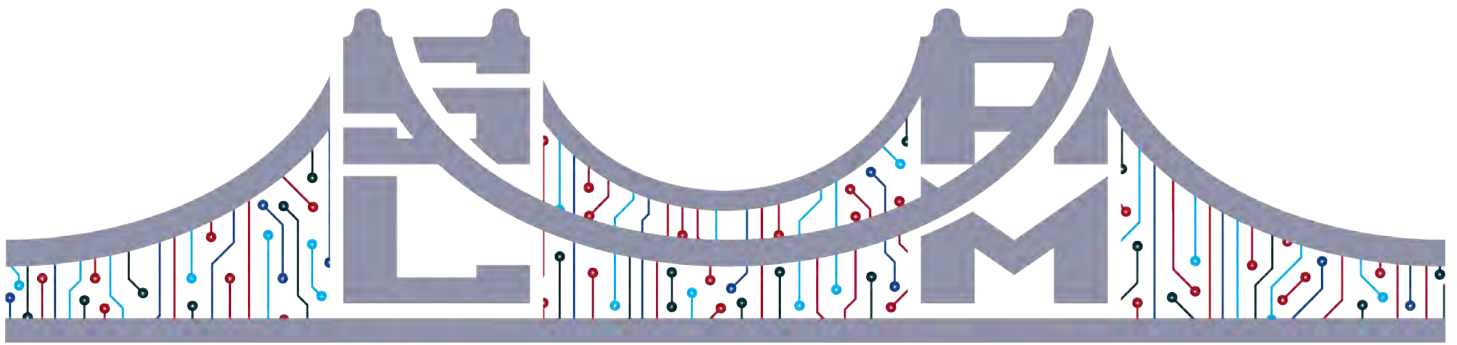
**STRONG PARTNERSHIP** — Sandia executives, Associate Labs Director Rita Gonzales, front and second from left, and Deputy Labs Director Laura McGill, front and second from right, met with AWE leadership during a September visit to the United Kingdom. Participating in a successful international meeting, while following all U.K. government and AWE COVID-19 guidelines, marked an important step in restoring essential business activities.

## AWE

CONTINUED FROM  
PAGE 2

At the conclusion of the review, Rita Gonzales, Sandia’s associate Labs director for nuclear deterrence modernization and future systems, and Graeme Nicholson, AWE’s chief technical officer, signed an update to the document that renews and endorses mutually beneficial opportunities for strategically aligned collaborations between Sandia and AWE. [f](#)





## BAY AREA RESEARCH SLAM

Graphic by Stephanie Blackwell

# Sandia shines in inaugural Bay Area postdoctoral research SLAM

*Research SLAM is a technical elevator speech on steroids*

By Amy Treece

**T**welve postdoctoral researchers from national labs took the virtual stage on Oct. 28 to compete in the inaugural **Bay Area Research SLAM**. Former Secretary of Homeland Security Janet Napolitano served as master of ceremonies for the competition, which was judged by executives from Sandia, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory and SLAC National Accelerator Laboratory.

No props, the use of only one static background slide and a strict time limit made the spoken-word competition really challenging, said Sandia's three participants.

"Three minutes and a static background are tremendous constraints that really forced me to think critically about the story being told," said Nicole Jackson, who works in energy water systems integration.

Josh Rackers from the computational multiscale department added, "Day to day, we get wrapped up in details, but this allowed me to distill down what's most important in my research."

Jennifer Loe in scalable algorithms concurred. "Squeezing the main ideas into three minutes proved far more difficult than I expected. It also pushed me to explain my research with analogies for a nontechnical audience."

### A Don Quixote-style quest to simulate biological molecules with physics

Josh is on a mission. "Since my first physics class, I've had a Don Quixote-style quest to use quantum mechanics simulations to help understand disease," he said.

Companies are applying artificial intelligence to simulate biomolecules now, but no one has discovered how to piece together fragmented training data into whole simulations. Josh and his team trained a neural network to make accurate



**SLAM STARS** — Sandia postdoctoral researchers, from left, Nicole Jackson, Jennifer Loe and Josh Rackers competed in the Bay Area Research SLAM on Oct. 28.

Photos courtesy of Nicole, Jennifer and Josh

predictions on larger sets of water molecules using a much smaller fragment through an approach fusing physics and artificial intelligence.

"Electron density is key," he said. "If we can learn the electron density for water, we might be able to do it for whatever molecule causes the next pandemic."

### Evaluating 54,000 days of 'medical records' for solar energy sites

**Extreme weather impacts** are key to Nicole's work on a multilab effort between Sandia, the National Renewable Energy

Lab and Berkeley Lab. The team utilized machine learning to correlate data gathered from the 800 sites in Sandia's Photovoltaic Operations and Maintenance Database.

"This presents a new way of fusing together a lot of disparate datasets — production, operations and weather — to form a more complete picture of what's happening to performance at solar energy sites," Nicole said. "This could provide us with the ability to improve resiliency to extreme weather and gain energy output."

### Think high-precision simulations provide the best analysis? Think again.

Even supercomputers get weighed down running high-precision simulations, so Jennifer's team ran theirs in low, 32-bit precision while utilizing [multiprecision strategies on their GMRES linear solver](#) to take smaller, more frequent steps to refine the solution. Both the mixed-precision solver

and the standard double-precision solver reached the necessary high accuracy in a similar number of steps, but the low-precision solver's steps were much cheaper and reached the solution in less time.

"We're adding our mixed-precision refinement solver to Sandia's widely used Trilinos library for use by scientists everywhere," Jennifer said.

"Events like these allow scientists to practice conveying the 'so what' aspect of their work in a concise, relatable manner," said Tracie Durbin, who leads Sandia's [Postdoc Program](#) for the Chief Research Office and helped organize the Bay Area Research SLAM. "This type of critical exercise helps teach how to cast a vision of where Sandia's research could take the nation."

Lydia Rachbauer from Berkeley Lab won both the first place and the People's Choice awards for her presentation "From Waste to Wanted — The Seaweed Story." [f](#)

## Bay Area Research SLAM was a slam dunk

The inaugural Bay Area Research SLAM was livestreamed for 283 audience members, and the individual Sandia presentations from Josh Rackers, Nicole Jackson and Jennifer Loe are available on YouTube. Chief Research Officer Susan Seestrom, one of the competition judges, later invited the three Sandia participants to give their presentations at one of her monthly "Coffee Chats."



### JOSH RACKERS'

PRESENTATION "UNCHARTED TERRITORY: MAPPING THE QUANTUM WORLD WITH MACHINE LEARNING."



### NICOLE JACKSON'S

PRESENTATION "ESTIMATING WEATHER IMPACTS ON UTILITY-SCALE PHOTOVOLTAIC PLANT PERFORMANCE."



### JENNIFER LOE'S

PRESENTATION "USING MULTIPLE PRECISIONS IN THE GMRES LINEAR SOLVER."

## Batteries

CONTINUED FROM PAGE 1

and a layer of ion-conducting electrolyte, let's say — something interferes with the flow of electrons," Alec said.

Solid-state batteries employ solid electrolytes instead of electrochemical gels and liquids and generally power small electronics. Most researchers suspected that there was a loss of voltage or electrical potential at interfaces within the battery, but did not know which interface was responsible for most of the impedance in the battery. The team started work five years ago to get some clarity.

"There were two main motivations for this. The first was fundamental: We want to have good models for batteries that we can use to develop better materials," Alec explained. "The second thing was to figure out how we can engineer the interfaces to make them less impeding. In our case, it really has to do a lot with how fast lithium ions can move in the Si anode used in the study."

They turned to Kelvin probe force microscopy, which measures electrical potential on a surface, and while using instruments in new ways is certainly not something Sandia is unaccustomed to, what the team did next no one had ever done, Alec said.

"The voltage between battery electrodes is relatively straightforward for researchers to calculate and measure," Elliot said. "However, where that voltage drops within the battery layers has remained a mystery. It's critical to understand where the voltage drops, as it is intimately tied to the performance-limiting resistances. Kelvin probe force microscopy is a technique that finally enabled us to measure where these drops are occurring."

"This technique has been used for many years to measure local voltage, with people using it on parts of a battery. It was difficult to interpret because it was not a full functioning battery," Alec continued. "We cut the battery in half longitudinally, with the elements stacked like a layer cake. You can still charge it and discharge it, so we did this measurement over the entire battery."

The team found that a large part of the electrical potential of the battery was getting lost at the boundary between the electrolyte and the anode, or negative, terminal.

"Most people thought the biggest change was going to happen at the interface between the cathode (positive) and electrolyte," he added. "Understanding the measurements took a lot of time. We wanted to validate the data by measuring where the lithium ions were at different states during charging."

To accomplish this, the team worked with researchers at the National Institute of Standards and Technology Center for Neutron Research using a technique called neutron depth profiling that can measure where lithium ions are at a particular moment. Now that neutron depth profiling has confirmed the Kelvin probe force microscopy data, the team is looking to apply this methodology to a host of technologies that will benefit the nation.

"We're going to use this technique to look at other batteries as well as other solid-state electrical systems, like the electrochemical random-access memory invented at Sandia," Alec said. "This will allow us to develop devices that operate like we would like them to operate."

The work was done in collaboration with [NIST](#), [Naval Research Lab](#), [University of Maryland College Park](#) and [Brown University](#). It was sponsored through Sandia's [Laboratory Directed Research and Development](#) Lithium Battery Grand Challenge and the Nanostructures for Electrical Energy Storage Energy Frontiers Research Center as well as the Platforms core program, both led by the University of Maryland and sponsored by the [DOE Office of Basic Energy Sciences](#). [f](#)



# Maximizing healthcare benefits in the new year

By **Shelley Kleinschmidt**

**T**he Benefits team in Human Resources has offered several suggestions on how Sandians and retirees can make the most of the health care plans they have chosen for 2022.

The new Health Savings Plan with the health savings account (HSA) or the Total Health PPO Plan with the health reimbursement account (HRA) both provide comprehensive medical coverage for 2022 and share several similarities, like no-cost preventive care when visiting an in-network provider or Sandia's on-site clinics, and lower costs if using a Tier 1 provider, when applicable.

Both plans also offer access to a HSA or HRA to help cover current or future out-of-pocket healthcare expenses with tax-free funds, as well as options to boost the HSA or HRA balance in 2023 by completing healthy activities through Virgin Pulse throughout 2022.

## Watch for health savings or HRA funding

For Health Savings Plan enrollees, Sandia will open a HSA with Optum Bank on their behalf. Sandia will deposit an initial contribution, called seed money, plus any incentives the enrollee earned in 2021, into the account in mid-January. The contribution amount elected during Open Enrollment, plus Sandia's match, will deposit in the account with each pay period.

Total Health PPO Plan enrollees have a HRA. Sandia will deposit incentives earned during 2021 into accounts in mid-January. This is a change from previous years when incentives were available in December. If new to the Total Health PPO plan, Sandia will set up a HRA on behalf of the employee with their chosen carrier. New participants will not have any funds deposited into the new HRA for

2022. The incentives earned from healthy activities during 2022 will be deposited into these accounts in 2023.


## ID cards

The medical carriers will mail new medical plan ID cards to those who changed their insurer in late December. Enrollees who did not select a new insurer should continue to use their current ID cards. Sandians and retirees may request electronic copies of their physical health plan ID cards anytime on their provider's website: [Blue Cross Blue Shield of New Mexico](#), [UnitedHealthcare](#) or [Kaiser Permanente](#).

## On-site Employee Health Services clinics

Employee Health Services clinics will continue to provide Sandians with quality care regardless of the medical plan or provider they chose. Preventive care is provided at no cost to all Sandians under both medical plans. However, Health Savings Plan enrollees will pay the fair-market value for [personal healthcare services](#) until they meet the deductible, then they will have no additional cost when using the clinics for the rest of the year.

To ensure a seamless experience, Sandians will not be charged for their personal healthcare visit at the time they receive treatment at a clinic. They will be asked to

provide a copy of their health plan ID card. Insurers will first process a claim for the visit, then the clinic's billing vendor will send a bill for the services received to the employee. See a list of [example costs](#) for personal healthcare services at [hrs.sandia.gov](https://hrs.sandia.gov). 

## Make the most of 2022 health plans.

### Health Savings Plan tips

### Total Health PPO Plan tips

Questions? Contact [HR Solutions](#) or call 505-284-4700.

### Sandia Employee Health Services Clinic (New Mexico)

505-284-4700, Option 1  
(phone lines open at 7 a.m. MT)

### Sandia Employee Health Services Clinic (California)

505-284-4700, Option 3  
(phone lines open at 6:30 a.m. PT)



# Nanobodies

CONTINUED FROM PAGE 1

After screening a large, diverse library of synthetic nanobodies, Sandia researchers identified and evaluated several potent nanobodies that can protect against COVID-19. The scientists now aim to replicate this method to defend against current and future biological threats.

“The coronavirus pandemic has made evident the need for a broad range of preventive and therapeutic strategies to control diseases associated with novel viruses,” said Craig Tewell, director of Sandia’s Chemical, Biological, Radiological and Nuclear Defense and Energy Technologies Center.

With a rich history of biodefense research, Sandia helps protect the nation and the world from threats presented by bioterrorism and naturally occurring diseases, Craig said.

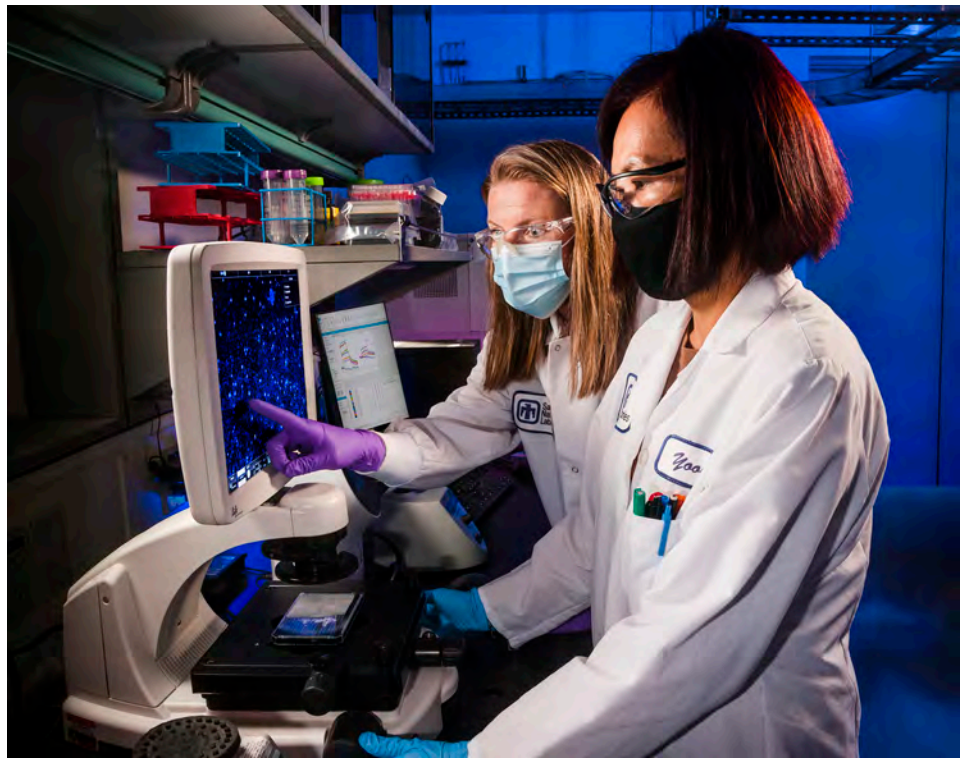
“With a deep understanding of how infectious disease develops and spreads, as well as how the immune system defends from infection,” Craig said, “our researchers are in a unique position to advance the creation of a wide array of disease-fighting tools, including nanobodies.”

Virologist Brooke Harmon leads Sandia’s nanobody research, a new and growing area of bioscience.

“Vaccines are very good at preventing infection, but they can take a long time to be developed and move through the regulatory process,” Brooke said. “We saw a critical need to create effective therapies that can be rapidly developed and deployed.”

Once the protein sequence, or genetic coding, of a virus has been identified, Sandia researchers have shown they can produce a nanobody-based countermeasure within 90 days. The method has not yet been tested on humans. Speeding up the discovery of neutralizing antibodies could reduce the impact of future viral outbreaks.

“Under current practice, virologists rely upon patients’ blood samples to build an antibody library that we can then screen for potential treatments. This means we have to wait, either for people to become infected or for those



**PANDEMIC COUNTERMEASURES** — Sandia researchers Jennifer Schwedler, left, and Yooli Kim Light advance the creation of a wide array of disease-fighting tools, including scientific discoveries to support new nanobody therapies.

Photos by Randy Wong



**BIODEFENSE AND COUNTERING DISEASE** — Christine Thatcher, left, and Peter McIlroy are members of the nanobody research team. With a rich history of biodefense research, Sandia helps protect the nation and the world from threats presented by bioterrorism and naturally occurring diseases.

who are vaccinated to build an immune response,” Brooke said. “Sandia’s new method is more forward-thinking. Because we have already built a highly

diverse, proprietary library, we can begin to screen for extremely potent neutralizing nanobodies as soon as the genetic coding of a virus has been identified.”



## Nanobodies diverse attributes

Neutralizing nanobodies represent an attractive strategy, Brooke said, due to their ability to work effectively against an entire family of viruses or variants.

“We can take advantage of the fact that virus families tend to interact with immune response in the same way,” Brooke said. “This makes our treatments rapidly adaptable to all variants of a virus.”

Nanobodies are modular, meaning they can be combined with other nanobodies to increase their ability to bind to the virus or target specific tissues. Nanobodies can also be produced as smaller versions of conventional antibodies with the ability to engage the immune response.

Additionally, due to the small size of the nanobodies, they can be released into the blood and penetrate tissues more thoroughly than conventional antibodies. Nanobody therapies can also target an infection site directly, decreasing the dose needed and increasing efficacy.

Nanobodies can also be administered via aerosol, so they can be given to a patient orally or in an inhalable form. Conventional antibody treatments are less versatile and must be received through injection only.

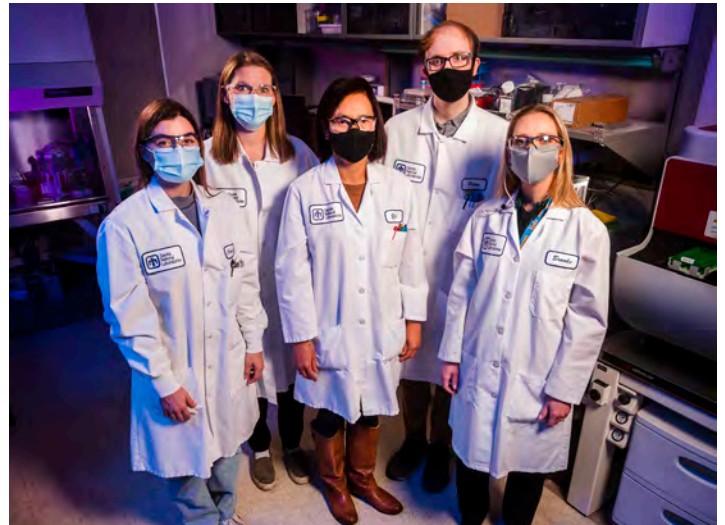
“All of these qualities and features of nanobodies make nanobody therapies

more effective than current solutions. These treatments are also easier and cheaper to manufacture,” Brooke said, “making Sandia’s method for developing and characterizing novel neutralizing antibodies an invaluable addition to the toolset for combatting the COVID-19 pandemic and future health crises.”

## National recognition

Sandia’s research on nanobodies for emerging viruses received national recognition in October as a recipient of a **2021 R&D 100 Award**, which honors the 100 most technologically significant products and advancements in the past year.

This research also received acclamation at the **2021 National Lab Accelerator Pitch Event**, where scientists present seasoned investors with business model ideas based on innovations at the DOE laboratories. A video of Sandia’s presentation at the event can be viewed [here](#).



**PREPARING FOR EMERGING VIRUSES** — Sandia researchers, from left, Christine Thatcher, Jennifer Schwedler, Yooli Kim Light, Peter McIlroy and Brooke Harmon have developed a new process of screening for nanobodies that “neutralize” or disable the virus. This process represents a faster, more effective approach to developing nanobody therapies that prevent or treat viral infection.

One role of the national laboratories is to develop innovative technologies and commercialize the underlying intellectual property through licensing agreements with companies. The labs also engage the expertise of industry and academia to further develop technology using cooperative research and development agreements. Sandia is **currently exploring multiple opportunities** for licensing this research and partnering with others in the bio and chemical defense, diagnostics and medical research fields. [i](#)

## Virtual Electric Car Challenge sparks creativity

**TEAM TESLA TRUCK** — Sixth graders from Roosevelt Middle School in Tijeras won first place at this year’s New Mexico Virtual Electric Car Challenge with their Tesla Truck. The team, from left, Katelynn LaJeunesse, Adwen Nelson and Olivia Gonzales, also took first place with their research project on renewable energy and in the design challenge. Berrendo Middle School teams from Roswell took second and third overall and had the fastest race times.

The challenge, hosted by Sandia, the University of New Mexico STEM-H Center and Los Alamos National Laboratory, featured 14 teams from eight New Mexico schools. Students built and raced battery-powered cars and presented a research challenge to judges.

Photo courtesy of Roosevelt Middle School





# Coming together, making magic

## Vibrant new mural celebrates women, science



**'LIMITLESS'** — A new Sandia Science & Technology Park mural by artist Amanda Phingbodhipakkiya tells a story about what happens when women work together to produce something bigger than they could on their own.

Photo by Rebecca Gustaf

By **Manette Newbold Fisher**

With every brush stroke of pink, yellow, purple and orange paint, **Amanda Phingbodhipakkiya** transformed a plain, white wall in the **Sandia Science & Technology Park** into a lively design depicting women reaching toward each other within a landscape of bursting bubbles.

The mural, titled **"Limitless,"** represents what happens when electrons' orbitals overlap, connect and activate.

Wearing a pink paint-splattered jacket and overalls, Phingbodhipakkiya said, "We can draw parallels between the dynamism of women in our society and basic

physics research tenets. For example, when women are isolated, and when atoms are isolated, they are inert. But when atoms come into close proximity and their orbitals are allowed to overlap, there is a flurry of activity in the way that when women commune and break free of their isolation or boundaries to come together, they can move, create and make magic."

The Sandia Science & Technology Park was able to secure the location of Phingbodhipakkiya's **mural** on Research Road through partnerships between the tech park program office staffed by Sandia employees, the city of Albuquerque, Meow Wolf Santa Fe, the artist and Cooperative Educational Services, a company in the tech park that offered its wall.

"We're proud that partnerships with the Sandia Science & Technology Park helped bring this science-themed mural to Albuquerque," said Mary Monson, Sandia senior manager for Technology Partnerships and Business Development. "Art inspires gathering, the exchange of ideas and invites people to pause, chat or think about themes they might not otherwise consider during a walk or drive through town."

The tech park mural is the seventh piece out of 10 in Phingbodhipakkiya's **"Findings"** series funded by the Heising-Simons Foundation. For each mural in the series, Phingbodhipakkiya teamed with a woman working on cutting-edge science.





**INSPIRED BY SCIENCE** — Students from the Technology Leadership High School learn about the meaning of the mural with artist Amanda Phingbodhipakkiya and Nadya Mason through video chat. The Sandia Science & Technology Park mural is inspired by the work of Mason, a physics professor at the University of Illinois at Urbana-Champaign.

She also has a science background of her own. Prior to becoming a full-time multidisciplinary artist based in Brooklyn, New York, Phingbodhipakkiya studied neuroscience and worked at an Alzheimer's research lab.

The Albuquerque mural is inspired by the work of Nadya Mason, a physics professor at the University of Illinois at Urbana-Champaign. She researches condensed matter physics and what happens when electrical currents flow through new materials.

"For example, in some materials, when they are at low enough temperatures, electrons pair up. And when they pair up, they can move almost miraculously through the material without bumping into anything, without losing any energy," Mason said. "When electrons are separate, they just have normal behavior, but when they pair up, they can do something totally different."

### Artist's background inspires colorful work

The mural is the first large-scale piece of art within the tech park community that is filled with startup companies and large, established corporations, public schools and walking paths.

"I had the advantage of showing up for work every day and seeing it transform a blank, stucco wall into this beautiful painting," said Robin Strauser, deputy executive director of Cooperative Educational Services. "I think the wonderful blue sky is a huge contrast to it. It just looks amazing and it's interesting. It looks a little bit different every time you look at it."

According to Phingbodhipakkiya, the colors in the painting are inspired by the desert landscape that she experienced while visiting the Southwest in 2019. In all her artwork, she chooses bright colors inspired by her family's Thai and Indonesian backgrounds. Phingbodhipakkiya said her father was a cook, and she grew up with vibrancy all around her, in the form of flavors used in her dad's restaurant, and colors that represent her



**WOMEN IN STEM** — Artist and former neuroscientist Amanda Phingbodhipakkiya, left, and Whitney Ingram, engineer and co-chair of the Sandia Women's Action Network, talk outside the Cooperative Educational Services building where the mural is located. Whitney praised the mural for representing women in STEM.



**COMMUNITY DAY** — Artist Amanda Phingbodhipakkiya works on the mural with students from Technology Leadership High School located in the Sandia Science & Technology Park.

Photos by Bret Latter



parent's native countries. That vibrancy in Phingbodhipakkiya's art feeds into the way she portrays women.

"I'm always depicting women as vital, as luminous and harnessing their power to fight for a more just world," she said.

Sherri Brueggemann, Albuquerque Public Art Urban Enhancement Division manager, said many murals have been painted throughout the city's history, but significantly more of them were completed by men than women.

"Having a female muralist, a woman that's got a really bold, strong identity and such an incredible story to tell about women of color and science is an incredible addition to our whole collection here in Albuquerque," Brueggemann said.

### Tech park students assist in mural project

Phingbodhipakkiya arrived in Albuquerque in October and three days after she began work on the piece, she conversed with students from Technology Leadership High School, located in the

tech park. As part of the "Findings" series, each mural is co-created in partnership with youth living in the area. When the tech park program office reached out to Technology Leadership High School, teachers and students were immediately on board.

While talking with the students, Phingbodhipakkiya answered questions about science, how she became an artist, and invited them to come back in a week and help paint.


"When we all come together as a society, we can make magic and make big things happen," she told the teens. "That's what this mural is about. Coming together and making magic."

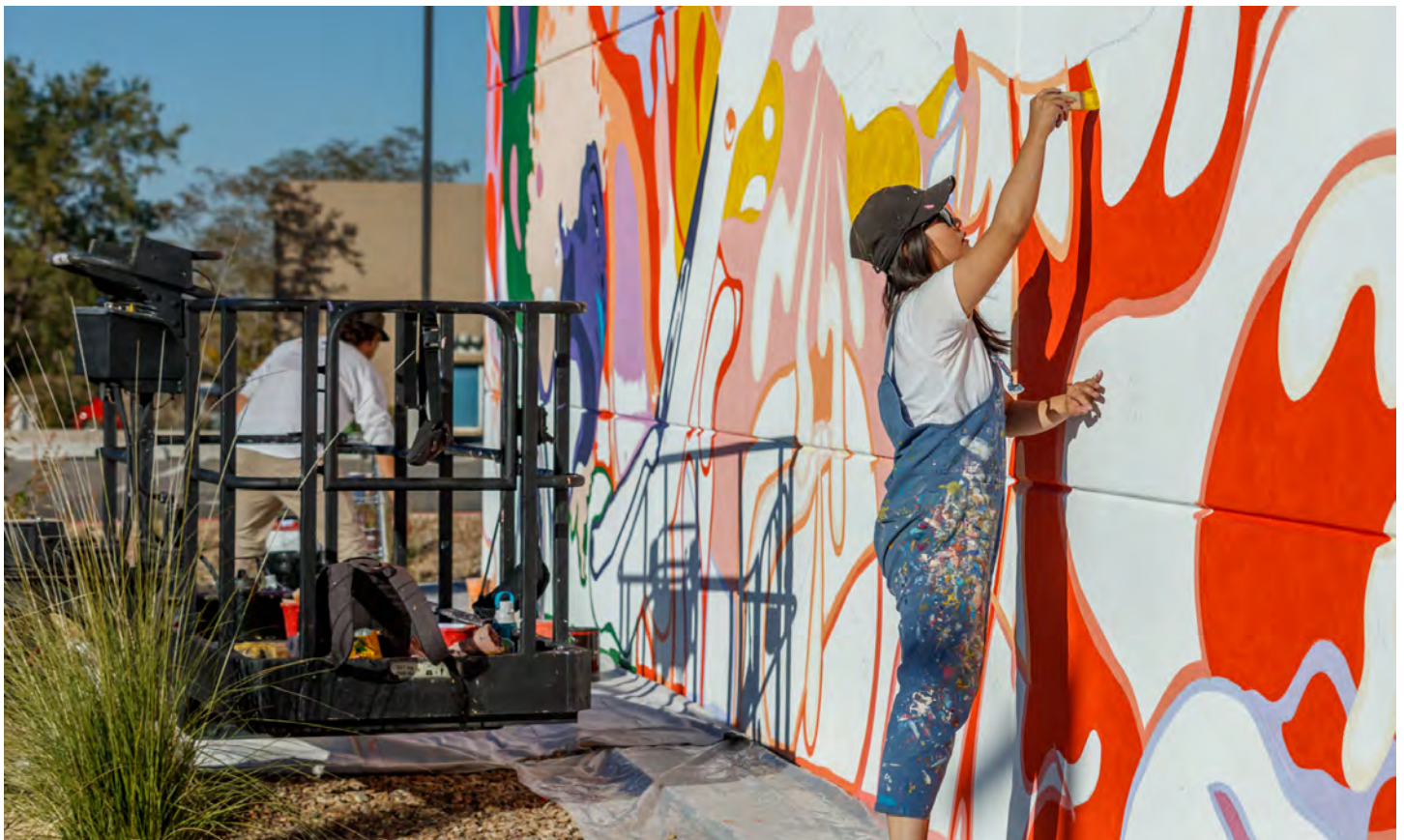
The students were also able to meet Mason through video chat and learned about the science behind the art.

"It was a great opportunity to be part of a community project, which is huge, and to learn by doing," said Executive Director Kara Cortazzo of the Technology Leadership High School. "I'm very

humbled and proud that the Sandia Science & Technology Park asked seniors to be part of this project because they are high schoolers, they aren't professional painters, they don't have background in it, and they took a chance on us."

Reactions to the mural have been positive. Albuquerque City Councilors Don Harris and Lan Sena hosted a dedication ceremony for "Limitless" and expressed their excitement and gratitude that the mural found a home in the city. In addition, Whitney Ingram, engineer and co-chair of the [Sandia Women's Action Network](#), said after reading about the mural and seeing it in person, the meaning became personal.

"I live pretty close to where the mural is. I take a personal sense of pride in driving past and seeing it represent the impact women can have on a community working together — bringing women of different backgrounds and creating this kinetic energy, this movement and inspiration. It inspires me," Whitney said. 



**MURAL MAKING** — Artist Amanda Phingbodhipakkiya works on the mural on the Cooperative Educational Services building. Vibrant colors are incorporated in all her pieces. **Photo by Bret Latter**



## Mileposts



Jessica Shaffer-Gant 35

## Recent Retirees



Larry Carrillo 43



Leo Convisser 41



Curtis Gibson 37



Scott Nicolaysen 37



Dennis Roach 37



James Jones 34



Curt Nilsen 34



Norma Lauben 30



Carla Busick 28



Ruth Harris 28



James Gruetzner 27



Kenneth Struve 23

# KEEP UP WITH THE LABS

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# Society of Asian Scientists and Engineers honors atomic physicist

By **Stephanie Holinka**

**A**tomic physicist Yuan-Yu Jau has been honored by the Society of Asian Scientists and Engineers with a 2020 Professional Achievement Award.

“Yuan-Yu is a daily advocate of science, and specifically atomic physics, in service to his community and to the United States,” said Labs Director James Peery, who nominated Yuan-Yu for the award.

His publishing record includes more than 40 high-impact, peer-reviewed papers primarily in [American Physical Society](#) journals, including [American Institute of Physics](#), [Optical Society of America](#) and [Nature portfolio](#). He co-authored the foundational book “[Optically Pumped Atoms](#),” and his published work has been cited more than 2,000 times.

He received a bachelor’s degree in physics from National Taiwan University in Taiwan and a doctorate in physics from Princeton University. He credits his Princeton advisors with the broad background and experience he’s able to contribute to his work.

“Usually, researchers are either an experimentalist or a theorist. But you need both in order to get into the real-world state that brings in engineering. My advisors at Princeton trained me to do both. And, at Sandia, I can conduct both sophisticated experiments and complex modeling work for physics systems associated with atoms and photons,” Yuan-Yu said.

His recent work on electric field mapping with a record-breaking measurement represents the first demonstration of using neutrons to image and sense an electric field inside a metal box, an idea of great relevance for the nuclear deterrence community. Currently, he is working on advancing this novel neutron imaging technology for field-deployable applications. He is also leading two new projects: one to enhance the neutral-atom quantum entangling method he invented and first demonstrated in 2014, and another project

to further improve highly sensitive, quasi-direct current, atomic electric-field sensing technology based on vapor cells that he achieved in 2019 for the first time in the world.

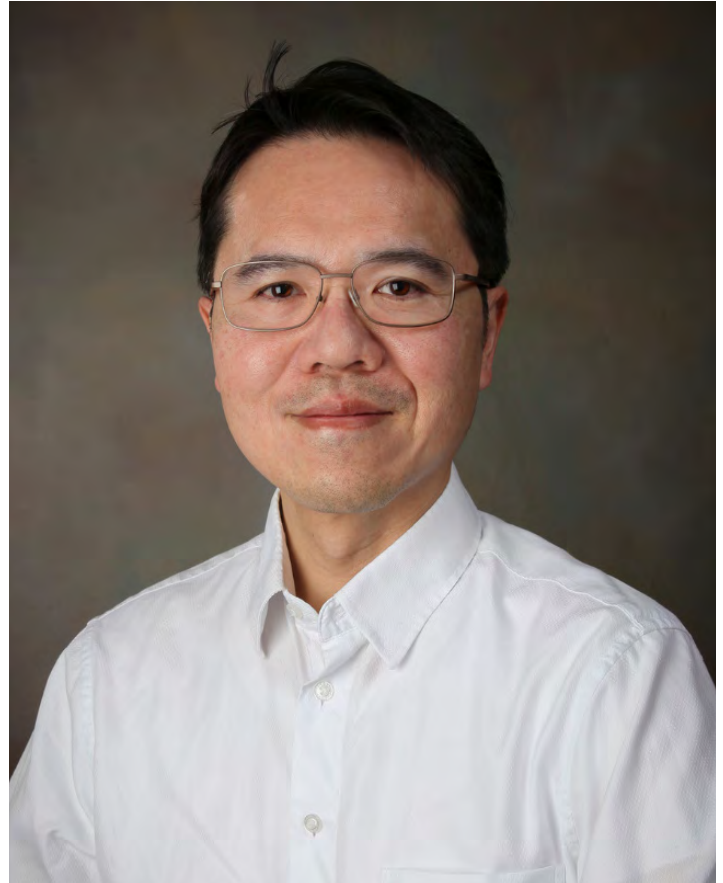
Yuan-Yu has been at Sandia since 2009 and was originally one of only a handful of foreign national interim technical staff. As a foreign national, he sometimes had to prepare research materials for other staff to present on his research, rather than being able to directly present. He became a naturalized U.S. citizen in 2019.

“Becoming a citizen allowed me to be the spokesperson for my own research and opened up more research opportunities for me,” Yuan-Yu said.

Coming to Sandia’s New Mexico site from the east coast was also a bit of a climate surprise.

“The climate and the air are so different here. I originally had to drink what felt like gallons of water every day. I went to the supermarket for those big things of water every week,” Yuan-Yu said.

In addition to his contributions to the world of academics, Yuan-Yu strives to preserve his cultural heritage by supporting activities through the New Mexico Taiwanese/Chinese Association and passing down appreciation of the Chinese language to his children so that they can be




**PROLIFIC PHYSICIST** — Yuan-Yu Jau received a 2020 Professional Achievement for his work, which includes more than 40 influential, peer-reviewed papers and his book “Optically Pumped Atoms.”

Photo courtesy of the Society of Asian Scientists and Engineers

bilingual. He also continues to mentor doctoral students, postdoctoral researchers and technologists at the Labs.

“Yuan-Yu is the most innovative scientist I have ever known — Sandia is lucky to have him working here. He is a wonderful educator,” said Yuan-Yu’s manager Shanalyn Kemme.

The Society of Asian Scientists and Engineers award supports the advancement of Asian heritage scientists and engineers in education and employment so that they can achieve their full career potential. In addition to professional development, the society also encourages members to contribute to the enhancement of the communities in which they live. 



# Turkey time

## Donations benefit New Mexico families

By **Manette Newbold Fisher**

**S**andia hosted the annual Take a Frozen Turkey to Work Day on Nov. 16 in partnership with Sandia Laboratory Federal Credit Union, Roadrunner Food Bank, local churches and pantries. Turkeys and monetary donations were collected for New Mexicans needing assistance this holiday season.

Employees from the Labs and the credit union, along with credit union members, donated a total of 181 turkeys. In addition, \$6,100 was raised for Roadrunner Food Bank through the nonprofit's corporate donation website.

Roadrunner Food Bank received 118 of the turkeys that were donated at Sandia Labs and the Juan Tabo Boulevard and Paseo Del Norte credit union branches.

Sixty-three of the turkeys were donated at credit union branches located on Jefferson Street and Ellison Road in Albuquerque, and in Los Lunas, Edgewood and Rio Rancho. Turkeys collected at those branches were given to Calvary Chapel Rio Grande Valley, Bethel Storehouse, St. Felix Pantry and Rio Grande Food Project. [f](#)



**SHARING IS CARING** — Materials scientist Tina Nenoff drops off turkeys at Sandia for Roadrunner Food Bank. **Photo by Katrina Wagner**



**GIVING SEASON** — From left, Labs Director James Peery, Associate Labs Director Rita Gonzales and Associate Labs Director Doug Bruder help unload frozen turkeys donated to Roadrunner Food Bank. **Photo by Lonnie Anderson**



# Directors give back during the Fall Leadership Forum

The Fall Leadership Forum is an annual opportunity to connect Sandia's leadership through engaging discussion and networking. This year's forum in November featured four individual service projects where leaders gave back to the community and learned about the work of multiple nonprofits in Albuquerque. [📷](#)



**WORKING TOGETHER TO FEED THE COMMUNITY** — Labs Director James Peery works on an assembly line filling boxes with food at Roadrunner Food Bank. As the largest food bank in New Mexico, Roadrunner plays a major role in distributing food to people facing food insecurity. **Photo by Lonnie Anderson**



**COMFORTING CHILDREN** — From left, Associate Labs Director Nancy Davis, Director Samantha Flores and Director Amy Halloran created no-sew blankets that will be given to children in foster care in Bernalillo County through New Mexico Kids Matter. The agency advocates for children who have been abused or neglected by empowering community volunteers to speak up for them in the foster care system. Materials for the blankets were provided by TenderLove Community Center, an agency that helps women escape from the cycle of poverty and achieve stable, self-supporting lives.

**Photo by Roberta Rivera**



**FILLING BOXES FOR NEW MEXICO FAMILIES** — Lab Fellow Bill Miller, left, and Associate Labs Director Rita Gonzales prepare boxes of food that were distributed by Roadrunner Food Bank. The nonprofit impacts the lives of 70,000 hungry people every week of the year.

**Photo by Lonnie Anderson**





**FALL CLEAN UP** — Director Kevin Dixon cleaned up the campus at Mandy's Farm as part of the leadership forum service projects in November. Mandy's Farm provides engaging opportunities for individuals with intellectual and developmental disabilities and includes horseback riding, a barn and a community garden. Volunteers raked leaves and removed debris. **Photo by Amy Tapia**



**WINTER VEGGIES** — Director Jen Gaudioso plants winter kale in the urban garden at the Rio Grande Food Project. The agency provides a food pantry, an urban garden and serves as a community hub that works to ensure that kids, adults and seniors have enough nutritious food to live their most healthy, active lives. **Photo by Debra Menke**



**PREPARING FOR SPRING PLANTING** — Directors Rafael Gonzalez, left, and Lorenzo Gutierrez winterized the urban garden at the Rio Grande Food Project, preparing it for spring planting in 2022. **Photo by Debra Menke**