



S A N D I A

LABNEWS

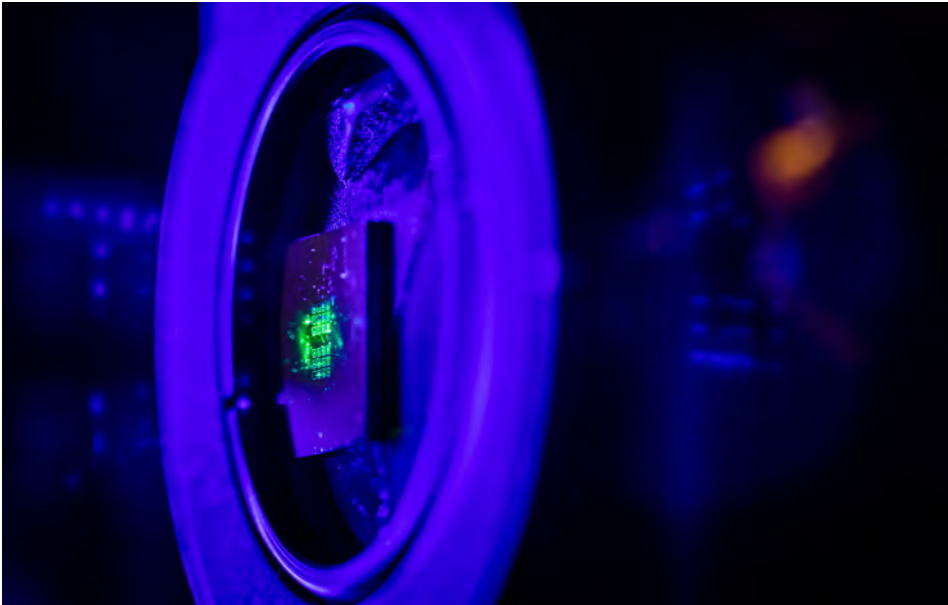
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answer
the call
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Through the quantum looking glass



A thin device triggers one of quantum mechanics' strangest and most useful phenomena

By **Troy Rummler**

An ultrathin invention could make future computing, sensing and encryption technologies remarkably smaller and more powerful by helping scientists control a strange but useful phenomenon of quantum mechanics, according to new research recently published in the journal [Science](#).

Scientists at Sandia and the [Max Planck Institute for the Science of Light](#) have

QUANTUM LOOKING GLASS — Green laser light illuminates a metasurface that is a hundred times thinner than paper, which was fabricated at the Center for Integrated Nanotechnologies. CINT is jointly operated by Sandia and Los Alamos national laboratories for the DOE Office of Science.

Photo by Craig Fritz

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Sandia wins five R&D 100 Awards and a silver specialty award

By **Neal Singer**

Competing in an international pool of universities, corporations and government labs, Sandia researchers captured four [R&D 100 Awards](#) this year and supported a fifth. One entry also won the R&D 100's Special Recognition market disrupter Silver Award.

R&D World Magazine — formerly R&D Magazine — presents the awards each year to researchers whom its editors and judges determine have developed the year's 100 most outstanding advances in applied technologies.

The awards, with their focus on practical impact rather than pure research, reward entrants on their products' design, development, testing and production.

The criterion for winning has been “demonstrable technological significance compared with competing products and

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LABNEWS Notes

Lab News may contain photos shot prior to current COVID-19 policies. Individuals 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.

Weapon Intern Program 27th class graduation



NNSA Administrator Hruby congratulates this year's class

By Stephanie Holinka

Sandia's Weapon Intern Program graduated its 27th class in 24 years, at a time when the nation relies heavily on the work of weaponeers in the Nuclear Security Enterprise to maintain nuclear deterrence in an uncertain world.

The program was created in 1998 to accelerate the learning process and transfer decades of knowledge and experience in all phases of the nuclear weapon life cycle, from experienced weaponeers to the new generation of stockpile stewards. The WIP curriculum evolves over time to better

WIP GRADUATION — NNSA Administrator and DOE Under Secretary for Nuclear Security Jill Hruby congratulated the 27th graduating class of Sandia's Weapon Intern Program during a ceremony on Aug. 25.

Photo by Lonnie Anderson

address the challenges of maintaining the nation's nuclear deterrent.

WIP students are Sandians and national security professionals from other organizations, including the U.S. Air Force and its Nuclear Weapons Center, U.S. Navy, Kansas City National Security Campus, Pantex, Y-12, Savannah River and Los Alamos national laboratories, Defense Threat Reduction Agency and students from intelligence community organizations, such as the FBI.

This year's class managed challenges due to the COVID-19 pandemic and the resulting need for staff to intermittently isolate or work from home. Important experiences at Washington, D.C., Naval Base Kitsap and McChord Air Force Base were postponed and rescheduled, and another event had to be canceled.

Deputy Labs Director Laura McGill welcomed NNSA Administrator and former Labs Director Jill Hruby back to Sandia on Aug. 25. Hruby congratulated WIP graduates on their important work that is sorely needed during this challenging time. She also acknowledged the contributions of current WIP program lead Matt Wingle and program founders John

Hogan and Andy Rogulich, who continue to support the program, along with many other experienced weaponeers, both current and retired.

"Over the past 24 years, this prestigious internship opportunity has graduated over 500 participants from across the nuclear security enterprise. Each of you, and each of your home organizations, is helping us execute our most ambitious nuclear modernization agenda in decades," Hruby said.

In her remarks, Hruby noted this year also marks the 30th anniversary of the stockpile stewardship program, highlighting that "the scientific research that is the hallmark of our stockpile stewardship program is a critical part of our ability to maintain leadership on nuclear issues in the international community and helps preserve our deterrent."

Hruby directly acknowledged this challenging time in history both because of the effects of the pandemic on the nation and the national security challenges facing the nation and the world, saying, "Not since the Cuban missile crisis has the American public heard so much about nuclear issues. Russia's unprovoked invasion of Ukraine

has been the most shocking event in recent memory. And Russian and Chinese weapons modernization programs, North Korean, Indian and Pakistani missile tests and the uncertain future of the Iran Deal have cast an intense spotlight on how the United States is meeting this moment."

The event concluded with Hruby and Laura handing out certificates to the WIP graduates. Marie McLetchie of NNSA was recognized as the Outstanding Leadership Award recipient.

The class of 2023 begins Sept. 19, and WIP will soon begin accepting applications for the 2024 class. Candidates with a Q clearance and one to 10 years of nuclear weapons experience should discuss it with their immediate manager and then contact their division point of contact, listed on the WIP Become an Intern webpage.

In addition to the WIP, weapon engineer professional development also offers a manager's course, Nuclear Weapons Management Orientation Course, to provide a broader overview of the nuclear security enterprise.

Employees can visit the WIP website to learn more. [🔗](#)

From student to senior

Seizing opportunities to serve the nation

By **Jennifer Awe**

Doug Deming's relationship with Sandia began 29 years ago when he arrived as a student intern while attending the University of Texas, El Paso. From intern to senior engineer, Sandia has witnessed Doug the college athlete, the post-grad, the newlywed, new father, multisport athlete and senior leader.

"I'm so fortunate to have found a place early on that allows me to explore so many facets of my personal and professional life," he said. "I appreciate Sandia for all it's given me, and I feel valued here."



LIFELONG LEARNER — Senior engineer Doug Deming credits his successful 29 years at Sandia to on-the-job learning opportunities that have allowed him to expand his experience beyond his academic degrees.

Photo by Craig Fritz

His early career was spent in use control, where he received the UTEP Student Co-op of the Year award as a summer intern for design contributions to the fault management logic within the cryptographic processor, an integral element of the code management system used in nuclear deterrence every day to protect the U.S. nuclear stockpile. The cryptographic processor eventually received multiple Sandia and NNSA awards including the Sandia Award for Excellence and the Turquoise Presidential Quality Award.

“I recall taking classes where I understood what we were studying as much as the professor due to the rich experiences and learning I received on the job at Sandia,” Doug said. “There is nothing like hands-on experience to solidify your understanding of an engineering discipline. I feel extremely grateful to the mentors I had early in my career for giving me opportunities to learn and contribute in a meaningful way to the nuclear deterrence mission.”

Rise to career success

This early award foreshadowed Doug’s prestigious professional journey. His resume boasts more than 30 awards from Sandia and the NNSA, a promotion to distinguished member of the technical staff in 2015, and then to senior engineer in 2021. A special appointment to senior scientist or engineer is a distinction reserved for just 2% of Sandians.

“Doug has earned the full respect of our nuclear deterrence community as he blends elite engineering aptitude with leadership that inspires teams,” Sandia’s Advanced Systems and Transformation Director Ernie Wilson said. “He’s committed his entire career to serving Sandia and the nation. Plus, he exudes humility and kindness towards his colleagues.”

More than any award, Doug says he’s grateful to Sandia for the wealth of opportunity he’s been given to further his education and grow as an engineer. He received his Master of Science in computer engineering from Purdue University through Sandia’s then One-Year-on-Campus program. Two

years later, he received his master’s degree in engineering mechanics with an emphasis in explosives engineering from the New Mexico Institute of Mining and Technology as part of Sandia’s Weapon Intern Program.

“WIP was the single coolest opportunity I’ve ever experienced at Sandia,” Doug said. “The senior mentors were legendary and amazing to work with. The experiences were invaluable to understanding our critical role within the Nuclear Security Enterprise.”

On-the-job learning and innovation

Fast forward nearly three decades serving the nuclear deterrence mission, through work in special processors and computers, surety electronics and software, and advanced and exploratory systems, where he’s been since 2010.

“I’ve worked on electronic hardware, custom digital ASICs (application specific integrated circuits), custom processor design, embedded software design, software simulation engines and systems engineering,” he said. “Despite studying electrical engineering in college, the on-the-job learning has

allowed me to expand well beyond that single degree discipline. This sort of scope and experience is unique to Sandia. It allows employees to keep things fresh and fun.”

Doug currently serves as chief engineer for the [W973/Mk7 program](#), the newest in the nation’s nuclear weapons modernization efforts. The W93/Mk7 program will provide a modern warhead to the U.S. submarine launched ballistic missile fleet.

“Doug is a spectacular person and an innovative engineer,” said Jennifer Franklin, senior manager for the W93. “In his role as chief engineer, he demonstrates dedication and passion and cares deeply about the team, integrating ideas to blaze new trails necessary for the program’s success.”

Balance beyond work

Along with exciting work and broad career opportunities, Doug also credits his lifelong love of sports for finding fulfillment at Sandia.

“Running collegiate track while taking a heavy course load taught me valuable time management skills you’re not taught in a classroom,” he said. “Being part of



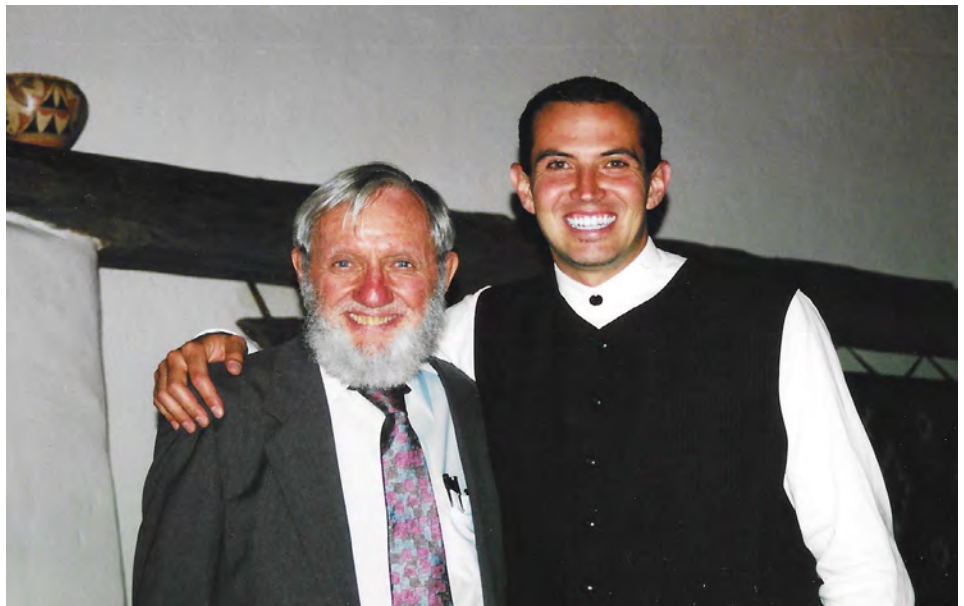
STAR RUNNER — Doug Deming, center, stands on the medal stand at the 1996 Corporate Cup at which Sandia competed on the Lockheed Martin team.

Photo courtesy of Doug Deming

a team and organizing my life outside of work has served me well.”

At UTEP, he co-captained the track and field team and earned six all-conference titles and two team conference championships. He later competed as middle hitter on Purdue’s intramural men’s volleyball team. He now spends his free time running, training for various multisport events and coaching his daughter’s club volleyball team.

“I appreciate that I can work hard for my country and still have the personal time I need to feel happy,” he said. “I know many people who have left the Labs to earn a higher salary elsewhere yet have realized that they’re expected to work significantly more hours at all hours of the day and night. The work-life balance at Sandia is hard to beat.” 🏠



WIP WINS — Sandia senior engineer Doug Deming, right, with former Sandian and nuclear deterrence pioneer **Leon Smith**, who served as a senior mentor for Doug’s Weapon Intern Program class.

Photo courtesy of Doug Deming

Retiree Deaths

February 12–August 6, 2022

Adam Waquie (age 78)	Feb. 12
Virginia Goen (94)	Feb. 17
William Dodson (88)	Feb. 20
Mary Warner (80)	Feb. 23
Jesse Allen (89)	Feb. 23
David Bray (88)	Feb. 24
Jan Collins (85)	Feb. 28
Lewis Clauson (90)	March 3
Paul Tsutsumi (74)	March 3
Francisco Alton (75)	March 3
Ronald Zottnick (90)	March 5
John Williams (90)	March 8
W. Vonriesemann (92)	March 9
Bill Emrick (83)	March 13
Eleanor Shirley (81)	March 13
Rita Harold (73)	March 15
Robert Aragon (72)	March 23
Katharine Sozanski (85)	March 23
Raymond Ostensen (82)	March 25
Alexander Hachigian (91)	March 27
Mary Ann Ferguson (92)	March 29
Roy Hertweck (69)	March 30
Robert Martin (80)	April 1
James Hayes (99)	April 7
Henry Baisdon (95)	April 9

Jimmie Bauman (89)	April 10
Suzanne Follett (80)	April 10
Donald Benthussen (84)	April 16
Emilia Perea (92)	April 16
Juanita Benson (91)	April 16
Glenn Case (88)	April 18
John Soares Souza (96)	April 23
Shirley Pike (87)	April 26
Leonard Beavis (92)	April 28
Michael Quintana (70)	April 29
John Laster (89)	April 30
Lydia Ann Boye (67)	May 1
Leo Torres (76)	May 3
Linda McLaughlin (80)	May 4
Lyle Whelchel (93)	May 5
Calla Pepmuller (90)	May 7
Margaret Chavez (94)	May 8
Abbie Williams (89)	May 8
Timothy Evans (74)	May 8
James Clemons (89)	May 11
Leonel Miranda (83)	May 12
Federico Martinez (98)	May 12
Miguel Griego (91)	May 15
Edward Gallegos (90)	May 17
Rudolph Schindewolf (91)	May 20
Grover Edwards (69)	May 20
Gersedon Martinez (93)	May 22
Larry Tichenor (85)	May 27
John Keilman (78)	May 28
Sylvester Grisby (91)	May 28
Henry Passmore (88)	May 29
Muriel Iverson (97)	June 1
Joseph Deveney (89)	June 2

John Foster (94)	June 3
Sally Douglas (76)	June 5
Dale Grant Pipher (98)	June 5
Warren Bronson (94)	June 6
James Cole (90)	June 7
Paul Gammill (90)	June 7
Lawrence O’Connell (87)	June 8
Betty Shaum (90)	June 8
Francis Sieradzki (78)	June 10
Patricia Kyle (78)	June 12
Frances Morris (88)	June 15
Robert Walkney (71)	June 18
Sandra Harris (83)	June 18
Bobby Toledo (68)	June 24
Kevin Lynch (77)	June 24
Charles Spencer (92)	June 24
Linda Caudell (81)	June 24
Jose Luna (96)	June 27
Virginia Hill (98)	July 1
Dolores Carlson (92)	July 2
Leroy Brace (88)	July 6
Allen Wilshusen (73)	July 8
Robert Velasquez (89)	July 9
Jeffrey West (77)	July 13
William Burnett (87)	July 14
Nancy Sanchez (92)	July 20
W. Keith McCoy (90)	July 22
C. Wayne Cook (85)	July 24
Ernest Niper (89)	July 24
Ernestine Riggs (93)	July 27
Mark Bishop (66)	July 31
Thomas Felter (74)	Aug. 2
Judith Morice (82)	Aug. 6

Quantum looking glass

CONTINUED FROM PAGE 1

reported on a device that could replace a roomful of equipment to link photons in a bizarre quantum effect called entanglement. This device — a kind of nano-engineered material called a metasurface — paves the way for entangling photons in complex ways that have not been possible with compact technologies.

When scientists say photons are entangled, they mean they are linked in such a way that actions on one affect the other, no matter where or how far apart the photons are in the universe. It is an effect of quantum mechanics, the laws of physics that govern particles and other very tiny things.

Although the phenomenon might seem odd, scientists have harnessed it to process information in new ways. For example, entanglement helps protect delicate quantum information and correct errors in quantum computing, a field that could someday have sweeping impacts in areas such as national security, science and finance. Entanglement is also enabling new, advanced encryption methods for secure communication.

Research for the groundbreaking device, which is a hundred times thinner than a sheet of paper, was performed, in part, at the [Center for Integrated Nanotechnologies](#), a DOE Office of Science user facility operated by Sandia and Los Alamos national laboratories. Sandia's team received funding from the Office of Science, Basic Energy Sciences program.



GOOD OPTICS — Sandia senior scientist Igal Brener, an expert in nonlinear optics, led a team that helped demonstrate a device that is paving the way for powerful, compact quantum information processing technologies.

Photo by Craig Fritz

Light goes in, entangled photons come out

The new metasurface acts as a doorway to this unusual quantum phenomenon. In some ways, it's like the mirror in Lewis Carroll's "Through the Looking-Glass," through which the young protagonist Alice experiences a strange, new world.

Instead of walking through their new device, scientists shine a laser through it. The beam of light passes through an ultrathin sample of glass covered in nanoscale structures made of a common semiconductor material called gallium arsenide.

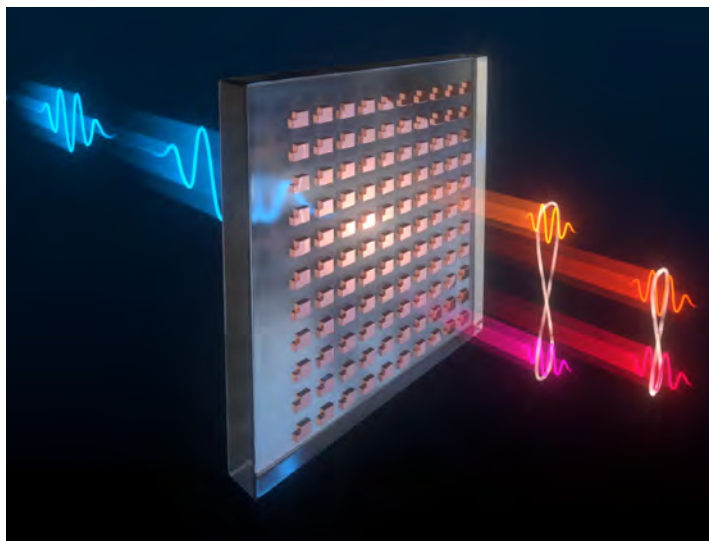
"It scrambles all the optical fields," said Sandia senior scientist Igal Brener, an expert in a field called nonlinear optics who led the Sandia team. Occasionally, he said, a pair of entangled photons at different wavelengths emerge from the sample in the same direction as the incoming laser beam.

Igal said he is excited about this device because it is designed to produce complex webs of entangled photons — not just one pair at a time, but several pairs all entangled together, and some that can be indistinguishable from each other. Some technologies need these complex varieties of so-called multi-entanglement for sophisticated information processing schemes.

Other miniature technologies based on silicon photonics can also entangle photons but without the much-needed level of complex multi-entanglement. Until now, the only way to produce such results was with multiple tables full of lasers, specialized crystals and other optical equipment.

"It is quite complicated and kind of intractable when this multi-entanglement needs more than two or three pairs," Igal said. "These nonlinear metasurfaces essentially achieve this task in one sample when before it would have required incredibly complex optical setups."

The Science paper outlines how the team successfully tuned their metasurface to produce entangled photons with varying wavelengths, a critical precursor to generating several pairs of intricately entangled



IT TAKES TWO TO ENTANGLE — In this artist rendering of a metasurface, light passes through tiny, rectangular structures — the building blocks of the metasurface — and creates pairs of entangled photons at different wavelengths. The device was designed, fabricated and tested through a partnership between Sandia and the Max Planck Institute for the Science of Light.

Image courtesy of Sandia

photons simultaneously.

However, the researchers note in their paper that the efficiency of their device — the rate at which they can generate groups of entangled photons — is lower than that of other techniques and needs to be improved.

What is a metasurface?

A metasurface is a synthetic material that interacts with light and other electromagnetic waves in ways conventional materials can't. Commercial industries, said Igal, are busy developing metasurfaces because they take up less space and can do more with light than, for instance, a traditional lens.

"You now can replace lenses and thick optical elements with metasurfaces," Igal said. "Those types of metasurfaces will revolutionize consumer products."

Sandia is one of the leading institutions

in the world performing research in metasurfaces and metamaterials. Between its **Microsystems Engineering, Science and Applications** complex, which manufactures compound semiconductors, and the nearby Center for Integrated Nanotechnologies, researchers have access to all the specialized tools they need to design, fabricate and analyze these ambitious new materials.

"The work was challenging as it required precise nanofabrication technology to obtain the sharp, narrowband optical resonances that seeds the quantum process of the work," said Sylvain Gennaro, a former postdoctoral researcher at Sandia who worked on several aspects of the project.

The device was designed, fabricated and tested through a partnership between Sandia and a research group led by physicist Maria Chekhova, an expert in the quantum

entanglement of photons at the Max Planck Institute for the Science of Light.

"Metasurfaces are leading to a paradigm shift in quantum optics, combining ultrasmall sources of quantum light with far-reaching possibilities for quantum state engineering," said Tomás Santiago-Cruz, a member of the Max Planck team and first author on the paper.

Igal, who has studied metamaterials for more than a decade, said this newest research could possibly spark a second revolution — one that sees these materials developed not just as a new kind of lens, but as a technology for quantum information processing and other new applications.

"There was one wave with metasurfaces that is already well established and on its way. Maybe there is a second wave of innovative applications coming," he said.

Mileposts



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Sandia's R&D 100 selected projects for 2022

R&D 100

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technologies,” and emphasizes properties such as smaller size, faster speed, greater efficiency and higher environmental consciousness. Long ago, now-retired Chicago Tribune science writer Jon Van dubbed them “the Oscars of invention.”

The R&D 100 Awards began in 1963. Since 1976, Sandia has earned 144 awards, including this year's winners. 

Automated Threat Estimator for Networks and Applications

With net contents always in flux, cyber analysts must not only quell repetitive cyberattacks but must keep up with threats from electronic entities that might not have existed an hour earlier. Sandia researcher Vince Urias says cyber watchdogs can use Sandia's **Automated Threat Estimator for Networks and Applications** to model all possible adversarial paths through network architecture and device configurations. ATHENA fuses data collected from multiple sources to enable users to model and build virtualizations of their networks. Current threat information is then overlaid on the network “digital twin” to prioritize mitigations against cyber threats to their assets. ATHENA, after validating possible attack routes, provides a decision interface to select the most likely adversarial routes to disable. This situational-awareness tool provides a dynamic network view that can aid in path prediction and threat prioritization. Because the program is not a snapshot but updates continually, decision making is always based on fresh information. Sandia's **Laboratory Directed Research and Development** office supported this research.

Submitted by Vince Urias



Vince Urias

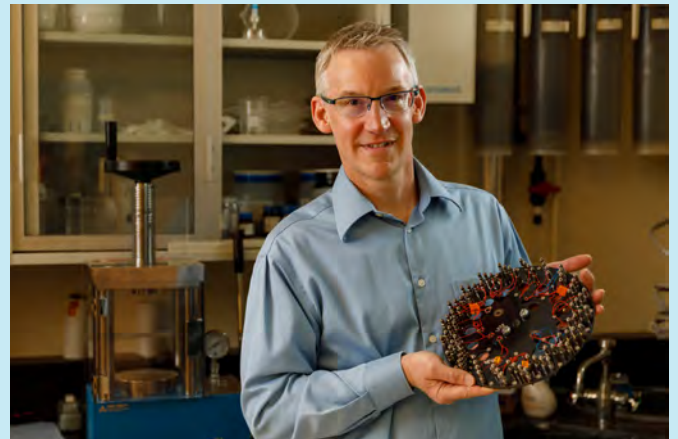
Photo by Randy Montoya

Iron Nitride Soft Magnetics

Because of **iron nitride's** high magnetization and resistance, the soft magnetic alloy — capable of operating at high temperatures — is expected to increase the efficiency of smart grid electronics, transformers and electric machines, while reducing their size and weight by an order of magnitude. Modern devices and electric-based solutions for vehicles, aircraft and ships require ultra-high-voltage power semiconductor devices to minimize energy loss with high-frequency ratings to reduce system size, weight and volume. They therefore rely on high performance soft magnetic materials. A reduction of even 1% of existing transmission and distribution losses in grid-scale power conversion systems through use of iron nitride would produce \$500 million to \$1 billion per year in savings. The highly desirable material is now available for licensing, said Sandia team lead Todd Monson, who worked with co-developers at the University of California, Irvine.

The work, mainly supported by the DOE's Office of Electricity, received seed funding from Sandia's Laboratory Directed Research and Development office.

Submitted by Todd Monson



Todd Monson

Photo by Bret Latter





Guangping Xu, right, with team of researchers, from left, Hongyou Fan, Haley Davis, Chad McCoy, Jens Schwarz and Melissa Mills.
Photo courtesy of Guangping Xu

Ultra-Stable Thermally Excellent Advancements in Material Strength

Taking note of the strength demonstrated by the alternating layers of materials that form seashells, a team of Sandia researchers led by Guangping Xu alternated microscopically thin layers of common table sugar with silica, married them through heat and created a coating stronger, lighter and more cost-effective than those currently protecting U.S. satellites in space. Because the **new material** is also relatively unaffected by high heat, it is being considered as a protective layer in fusion labs for instruments exposed to temperatures of hundreds of degrees. Sandia's Laboratory Directed Research and Development office supported this research.

Submitted by Guangping Xu

MOSAICS

More situational awareness for industrial control systems, known as MOSAICS, is a comprehensive, integrated and automated cyberdefense capability for industrial control systems, co-developed by researchers at Sandia, Idaho and Pacific Northwest national laboratories, and Johns Hopkins University Applied Physics Laboratory. It allows system operators to more quickly, easily and effectively detect and characterize cyberattacks against critical infrastructure systems in real time and

will eventually provide support for automated response actions. The objective for MOSAICS was the initial operational cyberdefense capacity to defend mission critical infrastructure, said William Waugaman, Sandia acting manager and laboratory technical manager overseeing development and demonstration for the entire project. A MOSAICS prototype was validated through a military utility assessment in August 2021 on a live electrical distribution system.

Submitted by Johns Hopkins University Applied Physics Laboratory



William Waugaman
Photo courtesy of William Waugaman

Proactive Intrusion Detection and Mitigation System

Energy generation through distributed solar resources is making an increasingly positive impact on the environment and the interconnected electric grid. But monitoring the security and protecting the operation of these grid-edge units raises its own problems. To Sandia researcher Shamina Hossain-McKenzie, her team's newly developed **Proactive Intrusion Detection and Mitigation System** is the best solution. Developed to secure photovoltaic "smart" inverters and other equipment in distributed energy resources systems, PIDMS, deployed either as software or bump-in-the-wire hardware, provides real-time cyber-physical data analysis to detect malicious and abnormal events and deploy suitable mitigations to eliminate or reduce system impact. PIDMS can monitor for small photovoltaic system behavior and provide a scalable problem-detection solution for large photovoltaic systems. PIDMS also can be extended to upstream levels such as aggregator and utility systems for multi-level situational awareness coupled with automated detection and mitigation capabilities. PIDMS was also awarded a SILVER Market Disrupter award.

Submitted by Shamina Hossain-McKenzie



Shamina Hossain-McKenzie
Photo by Taylor McKenzie

Recent Patents

April-June 2022

Note: Patents listed here include the names of active Sandians only; former Sandians and non-Sandia inventors are not included.

Following the listing for each patent is a patent number, searchable at the U.S. Patent and Trademark Office website ([uspto.gov](https://www.uspto.gov)).

- **Paul Davids, Robert L. Jarecki, Jr., David W. Peters and Andrew Lea Starbuck:** Tunneling full-wave infrared rectenna. Patent #11296240
- **Thomas Dewers:** Injection withdrawal tracer tests to assess proppant placement. Patent #11294349
- **Rick A. Kellogg, Marshall Klee, Michael E. McReaken and Bradley Salzbrenner:** Hermetic edge-connect headers and corresponding connectors. Patent #11296454
- **Timothy Briggs:** Mode I fracture testing fixture. Patent #11298754
- **David W. Raymond:** Fluid-powered linear motor with rotary pistons and motion rectifier and synthetic diamond bearing assemblies. Patent #11306749
- **David Louie, Rekha R. Rao and Yifeng Wang:** Injectable sacrificial material systems and methods to contain molten corium in nuclear accidents. Patent #11309096
- **Ryan Wesley Davis and Mary Bao Tran-Gyamfi:** Biochemical upgrading of high-protein biomass and grain products. Patent #11312978
- **Igal Brener, Salvatore Campione, John F. Klem and Raktim Sarma:** Efficient ultrathin all-dielectric nonlinear optical device. Patent #11314145
- **Gregory Philip Anders and David S. Lee:** FPGA-based computing system for processing data in size, weight, and power constrained environments. Patent #11314508
- **David G. Wilson:** Energy storage systems for electrical microgrids with pulsed power loads. Patent #11316363
- **Charles R. Bryan, Thomas Dewers, Jason E. Heath and Chowdary Ramesh Koripella:** System and method of thermopile energy harvesting for subsurface wellbore sensors. Patent #11319779
- **Ryan Wesley Davis:** Enrichment of amino acids from biomass residuum. Patent #11326193
- **Clifford K. Ho:** Falling particle solar receivers. Patent #11326810
- **Stephen Buerger:** Systems, methods and computer program products for collaborative agent control. Patent #11334069
- **Clifford K. Ho:** Solar receivers and methods for capturing solar energy. Patent #11336224
- **Caleb Loverro and Vincent Urias:** Threat emulation framework. Patent #11336690
- **Andrea Ambrosini, Sean Michael Babiniec and Eric Nicholas Coker:** Redox-active oxide materials for thermal energy storage. Patent #11339766
- **Timothy Walsh:** Total-internal reflection elastic metasurfaces: design and application. Patent #11339845
- **Celestino A. Corral:** Enhancing obfuscation of digital content through use of linear error correction codes. Patent #11341217
- **Scott E. Bisson and Daniel Beom Soo Soh:** Systems and methods for quantum optical device authentication. Patent #11343088
- **Barney Lee Doyle, Clark Sheldon Snow and William R. Wampler:** Thin-film target for deuterium production. Patent #11343900
- **Brett Bagwell, Jayson Briscoe, Erika C. Vreeland and Jeremy Benjamin Wright:** Micro-lensed fiber optic plate. Patent #11346993
- **Eric Christopher Forrest, Robert Knepper, Michael P. Marquez and Alexander S. Tappan:** Explosive device comprising an explosive material having controlled explosive properties. Patent #11358910
- **Bryan Carson and Robert Meagher:** Real time autonomous surveillance of pathogens. Patent #11366116
- **Karla Rosa Reyes:** Thermal measurement apparatus and methods for anisotropic thermal materials. Patent #11371949
- **Jess Matthew Sustarich:** Method and device for manipulation of droplets. Patent #11369962

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Answering the call

Sandians support national security mission

In support of the Nuclear Deterrence Modernization Efforts Rally Cry, Lab News continues to highlight employees and the variety of ways that they contribute to Sandia's core mission. Lab News will run these short stories in future editions and online. Read more profiles from [previous editions](#).

Photos by **Craig Fritz**

Katrina Frohn

*Project manager
4 years at Sandia*

Katrina has supported the W80-4 program in various roles since joining Sandia in October 2017. She recently reflected on what drew her to the Labs.

"It was the opportunity to support mission-driven work — the feeling of contributing my knowledge and experience to support our nation," she said.

"The W80-4 program is critical to our nation's nuclear deterrence posture. In my current role, I take pride in leading teams to proactively address problems and resolve issues, as well as distilling programmatic information to develop proposals for decision-makers."

It's those issues along with collaboration and other benefits that Katrina appreciates about Sandia.

"It's the mission, people and work-life balance," she said. "I enjoy collaborating with administrative, business and technical team members and various levels of management to support programmatic success."

— David Hill



Photo by Randy Wong

Sam Poli

*Environmental technical professional
3 years at Sandia*

Sam's work as a specialist in National Environmental Policy Act guidance for nuclear deterrence contributes to national security by streamlining communication and document preparation between Sandia's line partners and environmental experts to achieve compliance with federal, state and municipal environmental statutes and regulations.

His expertise with NEPA empowers Sandia's nuclear deterrence partners to avoid compliance complications before they materialize.

"I get to look at a proposed test area, facility or any mission work and think about how the work can best coexist with Sandia's environmental stewardship mission and minimize or mitigate environmental impacts," he said. "I get to collaborate with Sandia's best and brightest to help keep our national security mission moving forward in the right way."

His work supports vital collaboration between ES&H coordinators, facilities partners, technicians and management, so they can work together to understand the planning process and how their work impacts the environment, with a goal of supporting future mission work.

— Dan Ware

Chris O'Gorman

*Director of weapons stockpile management
28 years at Sandia*

As director of weapons stockpile management, Chris is integrally involved with and responsible for a wide breadth of programs supporting our nation's nuclear deterrence. Chris leads a team of senior managers, managers, team leads and approximately 400 technologists, scientists and engineers. Chris' team is responsible for competencies, budgets,



personnel safety, tools, equipment, capabilities, labs, facilities and a test range.

Chris is inspired and motivated by the people he works with and the mission. He is proud of the hard work and accomplishments, the resiliency and dedication, and the agility and commitment of this team. Chris recognizes that much work in the recent months has included navigating during a global pandemic.

“Throughout the pandemic, our team did an outstanding job to meet all customer commitments and demonstrated Sandia’s excellent service in the national interest,” he said. “The need for Sandia to continue to meet our nation’s national security mission is essential.”

Chris has fond memories of working side-by-side with a talented workforce on key nuclear deterrence programs.

“I’ve seen our teams step up to meet challenging mission deliverables, and I’m confident we will do it again,” he said. “Sandia is an outstanding place to work.”

— Laura Sowko

Whitney Lacy

Program communications specialist

18 years at Sandia

Whitney started her Sandia career in 2004 as a technical writer in the Military Liaison group, drafting and refining maintenance manuals for weapons programs.

Currently, Whitney supports the ND executives — Laura McGill, Rita Gonzales and Steve Girrens. The role, Whitney said, gives her a higher-level view



of Sandia’s programs and a relationship with leadership as a trusted communications adviser. Whitney supports the ND call to action by preparing talking points, presentations, near- and long-term communication plans, and responding to employees’ questions.

When she first took the job at Sandia supporting the ND program, Whitney reassured her parents her work was noble.

“What we’re doing in nuclear weapons is a good thing because nuclear weapons already exist,” she said. “You can’t ignore them, and my job, by writing these manuals, is to make sure the weapons stay safe and secure.”

Whitney now ensures Sandia’s ND leaders have clear messages, she said. “I’m helping the executives get their messages across and answer some tough questions. Their workload is very intense, and my role is to make it easier for them to do their jobs.”

— Valerie Alba

Jason Joe Phillips

Research and development, science and engineering

11 years at Sandia

Jason has a passion for explosives, so handling them every day makes him glad to come to work in the morning. But he also loves to teach and support others. He was hired to do two jobs: start up a sensitivity testing lab and instruct a class on improvised explosives.

“I taught at New Mexico Tech, so I already knew I

liked it. But teaching a classroom of 20 Marines about explosives, that kind of solidified it for me. A big part of my job now is training, mentoring and qualifying people to work with explosives safely and efficiently,” he said. “We’re kind of just cogs in the entire system, so it can be hard to see the impact we’re having. I’m in a support-based role. I feel like I’m enabling a lot of really important work.

“I wasn’t able to serve in the military, so I support the mission this way.”

— Antonia Cardella



Creating diamonds to shed light on the quantum world

By **Michael Ellis Langley**

Diamonds are a scientist's best friend. That much is at least true for physicist Andy Mounce, whose work with diamond quantum sensors has earned him a DOE Early Career Research Award.

The scientist in Sandia's Center for Integrated Nanotechnologies specializes in making microscopic sensors to try to understand the nature of quantum materials and their electrons' behavior. Andy is an expert in creating nitrogen-vacancy defects in the artificial diamonds, which are extremely sensitive to the electric and magnetic fields at a nanoscale.

"With these quantum sensors we can study basic properties of low dimensional quantum materials, such as superconducting phases, magnetic phases," he said. "A quantum material can be anything from a nanostructure to a large material that just has electrons that interact with each other very strongly. The distinguishing property of a quantum material is that their behavior is defined by quantum mechanics, so not your typical copper conductor."

Understanding changes at a quantum level

Using the five-year Early Career Research Award, Andy hopes to understand the topological phase transitions of quantum materials.

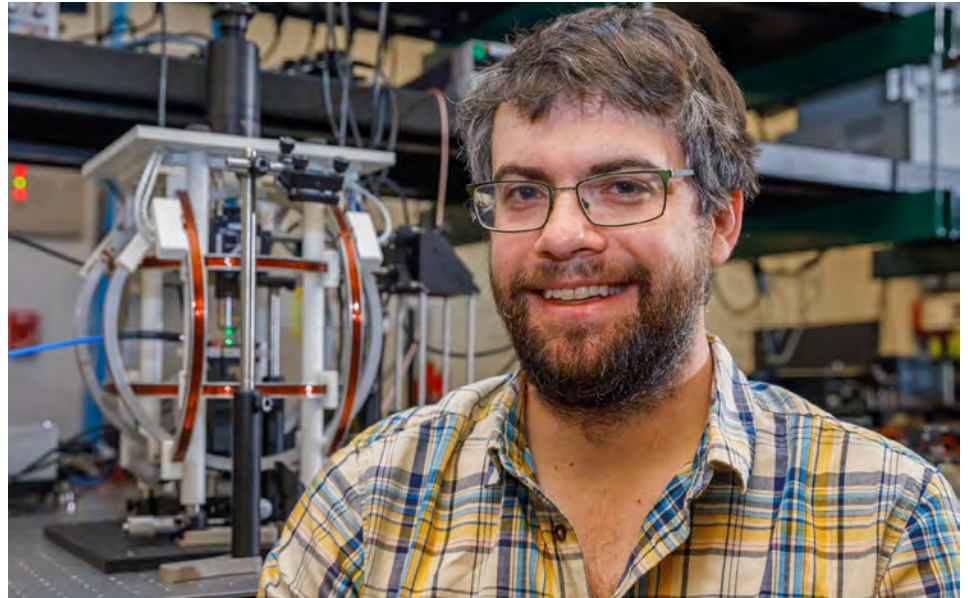
"A topological phase breaks the classic paradigm of how materials traditionally go through phase transitions; they don't behave like simple liquid-to-solid transitions. Furthermore, topological phases are really hard to detect, particularly at the limit of single atomic layer materials," he said. "If we can harness topological phases in quantum materials, we can use them for a new generation of quantum computers or energy efficient devices."

Andy believes his diamond quantum sensors can bring unique insight into the signatures of topological phases in 2D materials, providing new insights into their emergence and basic properties.

Between a rock and a hard place

But there is another aspect to the work Andy and his team will carry out: enabling diamond quantum sensing in extreme conditions of low temperatures, high magnetic fields and very high pressures.

"We can create a diamond anvil cell and actually use two diamonds and push a quantum material together really hard," Andy said. "We'll get the material to very high pressure to reveal new



WORK SMALLER — Andy Mounce makes microscopic sensors to try to understand quantum materials at Sandia's Center for Integrated Nanotechnologies. He is one of four Sandians to earn DOE's Early Career Research Award.

Photo by Bret Latter

phases in quantum materials with our nitrogen-vacancy quantum sensor right at the action, at the surface of the diamond. These are challenging experiments for which the Center for Integrated Nanotechnologies, a DOE Office of Science user facility operated by Sandia and Los Alamos national laboratories, will be one of the few places that will have the capabilities and expertise to perform with qualified users."

Building a career at Sandia

Andy did not start out trying to understand the fundamental building blocks of the world around us.

"When I was younger, I liked both chemistry and physics. In my undergraduate work I was doing both of those, but I really liked the mathematical framework that physics obeys. It really drew me in," he recalled. "I like to build things, which is exactly what experimental physics provides. You really have to be interested in instrumentation and methodology of how to take measurements in these extreme conditions."

Andy earned his doctorate in condensed matter physics from Northwestern University, studying quantum materials through more traditional methods. He was hired at Sandia in 2015 to work on quantum computation but then got the opportunity to combine these experiences and join CINT in 2018.

"Here at the Center for Integrated Nanotechnologies, you always have to be looking ahead of the game and provide unique and new capabilities. You really need to be pushing the envelope of scientific

techniques,” he said.


Andy thanked the first members of his team, Jake Henshaw and Pauli Kehayias, who helped him develop a successful quantum sensing program. He also credits his friend and mentor Mike Lilly with encouraging his efforts to think beyond the traditional. He believes that Mike helped him achieve this Early Career Research Award through his support and mentorship. Andy also recognizes the foundational support from his wife, Sandia software systems engineer Heidi Uphoff. “I’m really lucky that our paths crossed.”

“It’s a very big honor and there’s a lot of qualified people out there, so I feel very lucky and honored to be considered in the same category as them,” Andy said of other Early Career Research Award honorees.

“I’m excited for the opportunity to even further build our quantum sensing program at CINT.”

The bigger picture of quantum study

Andy hopes to have CINT’s quantum sensing continually expand to users who would not normally have access to the equipment and expertise needed to perform these experiments on quantum materials.

“After the project is over, we’re going to have new techniques to make quantum sensors and new capabilities to use quantum sensors,” he said. “We’re also going to have new discoveries of how quantum materials work as seen by those quantum sensors. With these new capabilities and discoveries, the sky is the limit.” 


DOE Early Career Research Awards

The DOE Office of Science has selected four Sandia researchers to receive Early Career Research Awards this year. **Krupa Ramasesha, Pete Bosler, Timothy Proctor** and Andy Mounce will receive up to \$500,000 per year for five years to advance their research.

The program, now in its 13th year, is designed to provide support to researchers during their early career years, when many scientists do their formative work. This year, the DOE awarded 83 scientists nationwide, including 27 from national laboratories.

Making a home more accessible

By **Katrina Wagner**

Rebuilding Together Sandoval County makes essential home repairs to help low-income neighbors stay in their homes. More than 15,000 homeowners live in inadequate housing in Sandoval County, and many homeowners cannot afford to make needed home repairs. Sandia supported their work with a \$5,000 grant and Sandia volunteers helped a disabled resident by building a complex system of ramps and platforms to make her Bernalillo home more accessible. 



WORKING TOGETHER — Electrical engineer Andy Dilts works with other volunteers to construct ramps that were installed to make a home more easily accessible for the homeowner.

Photo courtesy of Rebuilding Together Sandoval County



A HELPING DRILL — Facilities Management and Engineering Director Rafael Gonzales and other Sandia volunteers working with Rebuilding Together Sandoval County helped build ramps and platforms for a home in Bernalillo.

Photo courtesy of Rebuilding Together Sandoval County

The Packaging Advisory Board turns 50

Title is low on pizzazz but high in impact

By **Neal Singer**

Many are the titles more likely to attract attention than an article simply headed, “The Packaging Advisory Board.”

But quiet titles can indicate a deeper focus. The PAB provides insights into packages containing the hardware of nuclear components and devices. The board evaluates packages on their ability to contain high voltages, maintain appropriate interconnects and demonstrate microcircuit reliability.

The goal is to improve a package’s functionality, reliability and security.

To meet those ends, the PAB provides independent peer review and information on technical services available. It aids designers by providing access to experts who recommend options and identify issues early, including environmental and human factors, that impact a design. The board provides pertinent references, best practices, lessons learned in specific areas of packaging and supports many materials options and interfaces.

The board became an entity in 1972 with five members. In 1986, after various closures, restarts and locational additions — including Sandia/California, Kansas City Nuclear Security Complex and various experts — it had established its tone. “ATTENTION, WEAPON DESIGNERS,” ran a Lab News ad of that year. “Trouble-shooting group will, on request, review component packaging designs, identify potential problem areas, seek to resolve. Also on call for packaging problems just before or during production. Contact PAB ...”

The group received good marks in a mid-90s evaluation from one of the W88 programs: “The Packaging Advisory Board provided outstanding support to all organizations in review of designs and suggestions for improvement in performance



and manufacturability.” The PAB also received an Employee Recognition Award in 2015 for “generously serving Sandia’s product realization communities.”

The PAB completed 35 packaging reviews for the B61 and 17 for the W88 between 2014 and 2016, and 32 virtual reviews between 2019 and 2021, working remotely during COVID-19 restrictions. Board membership has increased to 12, in partnership between Sandia and the Kansas City Nuclear Security Complex.

“We’re in demand, that’s a fact, with all the work to which Sandia committed for the nation’s weapons modernization programs,” said PAB current coordinator Jim McElhanon.

Get-togethers were held Aug. 30 on both Sandia campuses to celebrate 50 years of PAB service to the Labs. [f](#)



50-YEAR SUCCESS — Sandia Packaging Advisory Board members gathered in August to celebrate 50 years of service to the Labs. **Photo by Craig Fritz**

USSTRATCOM deputy commander visits Labs

By Katherine Beherec

Lt. Gen. Thomas Bussiere, deputy commander of U.S. Strategic Command, addressed a packed all-hands meeting of Sandia staff during his visit to the New Mexico site Aug. 24.

His presentation entitled “STRATCOM’s Perspective on Deterrence: Integrated Deterrence and Multi-Actor Deterrence”

covered the nuclear landscape globally and offered encouragement to the workforce. Bussiere

described the geopolitical situation as a “bipolar world of nuclear instability” and expanded on changes abroad, including **Russia’s threats of nuclear war and China multiplying its arsenal.** He emphasized the importance of Sandia’s work in response to these changes.

“Every capability in the DOD is underpinned by the fact that strategic deterrence will hold. Everything unravels itself if those things are not true,” he said.

Bussiere reminded staff of the value that the Labs provides to the nation. “We can’t do our business without you. The national lab construct is crucial to the ability to do our job. The byproduct of what you do is our ability to defend this nation,” he said.

At the end of his presentation, Bussiere invited questions from the audience, including a question about what Sandia can do in response to nuclear acceleration in Russia and China.

“We have the coolest science, coolest airplanes and coolest facilities, but the strength of the DOD and this nation doesn’t come with a serial number or a tail number. It comes with a social security number,” he said. “So how do you build a workforce that has the talent and creativity that we need? That’s job number one.”

He said that the second priority is

to ensure the stockpile is up to date.


“Understanding the credibility of the stockpile affects everything we do,” he said.

To conclude his presentation, Bussiere responded to a question about global economics and cybersecurity, and their impact on defense. “Who do you think created the economic juggernaut of China? The economic stronghold that

China has internationally is alarming,” he said.

During his visit, the lieutenant general received briefings from experts about

Sandia’s work in hypersonics, ballistic efficiency and integrated deterrence.

“The level of expertise and talent at this organization is a national treasure,” he said. 

“The level of expertise and talent at this organization is a national treasure.”

— U.S. Strategic Command Deputy Commander Thomas Bussiere



STRATCOM VISIT — Sandia hosted Lt. Gen. Thomas Bussiere, deputy commander of U.S. Strategic Command, for an all-hands presentation Aug. 24.

Photo courtesy of the U.S. Air Force



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Robotics camp provides real virtual reality experience

By **Mollie Rappe**

Photos by **Craig Fritz**


The fifth annual Robotics Training Institute, a weeklong event for teens, included demonstrations and talks by Sandia experts, tours and a hefty amount of hands-on experience in computer-aided design and virtual reality. The camp was sponsored by **R4 Creating**, a local nonprofit organization that provides robotics and STEM opportunities for kids.

The workshop, which took place Aug. 1-5, introduced 16 teenagers to computer-aided design software and virtual reality. Sandia experts, including computer scientist Tam Le, electromechanical technologist Divina Calderon and engineering program lead Michal Kuca, volunteered and gave presentations on their work at Sandia in fields such as **virtual and augmented reality training, testing exoskeletons** and slowing down bad guys trying to get into places they shouldn't.

Throughout the week, Sandia interns Julian Lee and Nick Ross, Sandia computer scientist John Krukar and Shelly Gruenig of R4 Creating were on hand to

assist the students with their personal projects and provide informal mentoring.

On Friday, the students who ranged from incoming eighth graders to incoming college freshmen, presented their work, an exhibit illustrating how they took a concept

from idea to a computer-aided design to reality, virtual reality. Prior Robotics Training Institutes focused on topics such as using **3D printers to make robots** and the particular challenges of **programming robots in a hybrid world**. 



TEAMWORK — Ithen Valentino, left, and Triston Stephens celebrate as they got a part to fit in their computer-aided design to virtual reality project.



HELPING OUT — Sandia intern Nick Ross, left, and summer camp student Samantha Hoffman smile while troubleshooting her team's computer-aided design to virtual reality project during a workshop at Robotics Training Institute in Rio Rancho on Aug. 4. Sandia robotics interns helped to lead the workshop, sponsored by nonprofit R4 Creating.



VIRTUALLY, REALLY — Zach Fernandez, left, and Samantha Hoffman run a computer-aided design to virtual reality simulation while working on their project during the Robotics Training Institute summer camp.

Computer extravaganza

Sandia donates thousands of computers to New Mexico schools


By **Luke Frank**

Photos by **Craig Fritz**

More than 4,200 computers were lined up in precise rows of skids across two acres for distribution to schools in Albuquerque, Socorro and Silver City as part of Sandia's Annual K-12 Computer Donation event held Aug. 10.

Each year, Sandia donates central processing units, laptops, iPads, monitors, keyboards, printers and other IT accoutrements to kindergarten through 12th grade classrooms in New Mexico.

Because computer technology evolves so quickly, Sandia's workforce is encouraged to regularly acquire new computers to meet performance standard retired computers are then sent to Sandia's Property Management and Reapplication Department for distribution to New Mexico classrooms.

Since the program's inception, Sandia has donated more than 20,000 desktop, iPad and laptop computers to New Mexico classrooms. 



FILL 'ER UP — Sandia Reapplication team members Benjamin Madrid, James Vigil, Greg Ulibarri and Gilbert Alvarado, left to right, load computers for the Early Childhood Academy in Albuquerque during Sandia's Annual K-12 Computer Donation event.



STRIKING A "CORD" — Representatives from schools pick through a box of cords during Sandia's Annual K-12 Computer Donation event.

2022 by the numbers

CPU's – 2,168
Laptops – 2,185
iPads – 872
Monitors – about 150
Printers – about 400
Keyboards – about 75



BY THE TRUCKLOAD — Martin Gonzales, left and Ron Baca begin to load a truck with computers for the Silver Consolidated School District during Sandia's Annual K-12 Computer Donation event.