

# **Sandia launches a bus into space** HOT SHOT sounding rocket program picks up flight pace



SECOND TIME'S A CHARM — A sounding rocket designed and launched by Sandia lifts off from the Kauai Test Facility in Hawaii on April 24. Photo by Mike Bejarano and Mark Olona

#### By Troy Rummler

Andia recently launched a bus into space. Not the kind with wheels that go round and round, but the kind of device that links electronic devices, such as commonly used USB cables, short for "universal serial bus."

The bus was among 16 total experiments aboard two sounding rockets that were launched as part of the NNSA's HOT SHOT program, which conducts scientific experiments and tests developing technologies on nonweaponized rockets. The flights took place April 23-24 at the Labs' Kauai Test Facility in Hawaii.

The pair of flights marked an increase in the program's tempo.

"Sandia's team was able to develop, fabricate, and launch two distinct payloads in less than 11 months," said Nick Leathe, who oversaw the payload development. The last HOT SHOT flight — a single rocket launched in May 2018 — took 16 months to develop.

Sandia, Lawrence Livermore National Laboratory, Kansas City National Security Campus and the Atomic Weapons Establishment in the U.K. provided experiments for this series of HOT SHOTs.

- CONTINUED ON PAGE 2

# New look at old data leads to cleaner engines

Work unlocks new avenue for research at Sandia's Combustion Research Facility

#### By Michael Padilla

New insights about how to understand and ultimately control the chemistry of ignition behavior and pollutant formation have been discovered in research led by Sandia. The discovery eventually will lead to cleaner, more efficient internal combustion engines.

"Our findings will allow the design of new fuels and improved combustion strategies," said Nils Hansen, Sandia researcher and lead author of the research. "Making combustion cleaner and more efficient will have a huge impact, reducing energy use around the globe."

The work, which focuses on the chemical science of low-pressure flame measurements, is featured in the Proceedings of the Combustion Institute and was selected as a distinguished paper in Reaction Kinetics for the 37th International Symposium on Combustion. Authors include Nils, Xiaoyu He, former Sandia intern Rachel Griggs and former Sandia postdoctoral fellow Kai Moshammer, who is now at the Physikalisch-Technische Bundesanstalt



in Germany. The research was funded by the DOE's Office of Science.

#### Creating a massive dataset of flames and fuels

The team combined the output from carefully controlled measurements on a wide range of fuels into a single categorized and annotated data set. Correlations among the 55 individual flames involving 30 different fuels were then used to reduce the effects of common uncertainty sources, identify inconsistent data and disentangle the effects of the fuel structure on chemical combustions pathways that lead to harmful pollutants. An initial analysis considered relationships among peak concentrations of chemical intermediates that play a role in molecular weight growth and eventual soot formation.

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**PRECISION EQUIPMENT** — Nils Hansen, shown here assembling equipment in the Combustion Research Facility, says new insights on how to control the chemistry of ignition behavior and pollutant formation will lead to the design of new fuels and improved combustion strategies. Photo by Dino Vournas



# **USAF Thunderbirds Show**

The U.S. Air Force Air Demonstration Squadron, better known as the Thunderbirds, performed at Kirtland Air Force Base recently to an enormous crowd. See photos on Page 7.

## **D** LAB**NEWS** Notes

**Creating the Future** 

# Strategic priority No. 2 prepares for future nuclear deterrent

By **Steve Girrens** Associate Labs Director for Nuclear Deterrence

Today, more than ever, there is urgency for Sandia's Nuclear Deterrence portfolio to implement strategic initiatives that explore, research and refine "big ideas" and innovative approaches for nuclear deterrence on the 15- to 20-year time horizon, and in many cases much sooner. Such initiatives are the focus of our Labs-level strategic priority No. 2 — Maintain an Agile and Effective Nuclear Deterrent.

In developing the Labs' strategy, senior leadership and the strategic planning team reviewed many national security strategies, including the NNSA Strategic Vision, DOE Strategic Plan, Nuclear Weapons Council Strategic Plan and the Stockpile Stewardship Management Plan, among others.

One fundamental change outlined within the 2018 Nuclear Posture Review is that we must again be cognizant of a return to great powers competition, as well as emerging adversaries in an uncertain, changing global landscape. Labs Director Steve Younger has stated that Sandia's long-range view can help the nation avoid technology surprise.

As stated in Sandia's strategic direction document, Creating the Future, we must "become more agile in our development process" in order to meet emerging threats. "We must match and surpass our adversaries' development speed and find ways to leapfrog technology insertion into our weapons. Our development must be tailored to meet an increasingly dynamic adversarial threat."

The strategic direction document outlines what we should be doing, and our work on



**DETERRENCE STRATEGY** — Steve Girrens said that implementing strategic priority No. 2, Maintain an Agile and Effective Nuclear Deterrent, will take the involvement of everyone at the Labs. **Photo by Randy Montoya** 

priority No. 2 begins to address how we do this. As Sandia's core mission, our Nuclear Deterrence imperative is both present and future-focused: deliver a safe, secure and effective U.S. nuclear deterrent today and into the future. Priority no. 2 drives our mission forward, and it must also strengthen all the other priorities.

It's a symbiotic relationship. Our Labs-level priority has specific goals and objectives, such as dramatically reducing development cycle times and working National Security Enterprise-wide on maximizing production capacity, including figuring out new architectures, materials and capabilities needed for our nation's future deterrent.

These initiatives also help us fully engage the weapons workforce in exciting, innovative work. The strategic direction document states, "We must be careful not to lose the capability to design new nuclear weapons. If left to atrophy, such a capability would be difficult to reacquire in the absence of nuclear testing. While executing (our core) life-extension programs and alterations, we must find ways to retain and exercise the design capability."

Forward-leaning programs, such as our HOT SHOT sounding rocket program under NNSA's direction (see story, Page 1), help us exercise these creative muscles and invigorate staff within the Labs and across the National Security Enterprise. Sandia designed HOT SHOT as a low-risk program to encourage exploration, which further augments NNSA's ability to flexibly adapt weapon systems to meet urgent needs. This work could help cut research and development time for new weapon systems from as many as 15 years to less than five.

#### **Teaming for results**

A multidisciplinary team from across the Labs is working to ensure this strategic priority receives high-level attention and makes ongoing progress toward its long-term goals and 2019 deliverables. They meet monthly to track progress and provide quarterly reports to myself and director Scott Holswade, the Nuclear Deterrence priority team lead who also oversees the HOT SHOT program.

Sandia's priority No. 2 is effectively a Labswide initiative because it will take the involvement of every mission and mission-enabling division to move forward and get it done. Success will require all of us. If you're interested in learning more about this corporate priority, you can reach out to team facilitator Donna Robertson.

Programs to extend the life of the current stockpile are Sandia's top priority but should not be our only focus. Strategic, long-term preparation that starts today is exciting and allows us to manage these programs with the continued sustainment of the engineering and science-based capabilities required to carry out our Nuclear Deterrence mission now and into the future. This balance of immediate mission-critical work and preparation for the future more than motivates me to come to work each day.



Managed by NTESS LLC for the National Nuclear Security Administration

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## HOT SHOT sounding rocket

**CONTINUED FROM PAGE 1** 

The rockets also featured several improvements over the one launched last year, including new sensors to measure pressure, temperature and acceleration. The additions provided researchers more details about the conditions their experiments endured while traveling through the atmosphere. The experimental bus, for example, was tested to find out whether components would be robust enough to operate during a rocket launch. The new technology was designed expressly for power distribution in national security applications and could make other electronics easier to upgrade. It includes Sandia-developed semiconductors and was made to withstand intense radiation. observe in different ways the dramatic temperature and pressure swings that are normal in rocketry but difficult to reproduce on the ground. The researchers are aiming to improve software that models these conditions for national security applications, and they are now analyzing the flight data for discrepancies between what they observed and what their software predicted. Differences could lead to scientific insights that would help refine the program.

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

Published on alternate Fridays by Internal, Digital and Executive Communications Dept. 3651, MS 1468

LAB NEWS ONLINE: sandia.gov/LabNews

Sandia is planning another pair of launches this summer.

The name HOT SHOT comes from the term "high operational tempo," which refers to the relatively high frequency of flights. A brisk flight schedule allows scientists and engineers to perform multiple tests in a highly specialized test environment in quick succession.

For the recent flight tests, one Sandia team prepared two experiments, one for each flight, to Some experiments also studied potential further improvements for HOT SHOT itself, including additively manufactured parts that could be incorporated into future flights and instruments measuring rocket vibration.

The sounding rockets are designed to achieve an altitude of about 1.2 million feet and to fly about 220 nautical miles down range into the Pacific Ocean. Sandia uses refurbished, surplus rocket engines, making the test flights more economical than conventional flight tests common at the end of a technology's development.

The HOT SHOT program enables accelerated cycles of learning for engineers and experimentalists.

"Our goal is to take a 10-year process and truncate it to three years without losing quality in the resulting technologies. HOT SHOT is the first step in that direction," said Todd Hughes, NNSA's HOT SHOT federal program manager.



EARTHY CONVERSATION — Steve Curwood, host of National Public Radio's science program "Living on Earth," talked with Sandia staff and viewed Earth Day exhibits in the lobby of the Steve Schiff Auditorium following his talk on the economics of renewable and non-renewable energy. Photo by Lonnie Anderson

# EARTH DAY 2019: 'The most endangered species on Earth is us'

#### By Shelley Kleinschmidt

Stark contrasts between the costs of climate disruption brought on by the fossil fuel economy and the value of investments in technology that could lead to a more sustainable future were the focus of Sandia's keynote Earth Day talk by well-known journalist Steve Curwood.

Curwood, executive producer and host of public radio's "Living on Earth," spoke about "Investing in the New Energy Economy" to an audience of more than 200 in the Steve Schiff auditorium. His presentation examined the complexities of a transition from an energy portfolio dominated by fossil fuels, potential technological developments and future changes to the energy grid.

Faculty associate of the Harvard University Center for the Environment and professor of practice at the University of Massachusetts, Boston, Curwood shared thought-provoking insights and historical perspectives on the global, national and social aspects of renewable and non-renewable energy sources.

While it's relatively easy to harvest energy from renewable resources such as solar, wind and nuclear power, the storage and distribution of that renewable energy is a much greater and more expensive challenge, he said.

Curwood illustrated the economic value of renewable energy storage and overhauling the electric grid by noting the unprecedented recent costs of climate-fueled storms, rising water levels on the coasts and devastating fires across the country.

#### Trees vs. CO2

Reminding the audience that trees are the most efficient way to reduce atmospheric carbon dioxide, he pointed to some difficult tradeoffs. To halt globally destructive deforestation or to dramatically reduce the need for coal-fired power, societies must find ways to replace the livelihoods of those dependent on such industries.

Such dilemmas come from "not having the connections with each other necessary to implement the changes we need," he said. "It's both our challenge and our opportunity. Ecology is systems thinking, and we need the people part and the connections among us."

Curwood advocated for scientific literacy and education. Understanding nature and habitat is desperately needed as an anchor to support enduring solutions to climate disruption, he said.

"The most endangered species on Earth is us," he said. "What do you do with endangered species? You protect their habitat." To succeed in doing so, Curwood said citizens must use their social capital to build connections with one another.

#### New energy economy

Curwood told the audience that contributing to the new energy economy could be as simple as sharing information about the soon-to-decrease solar tax credit or as substantive as adding solar photovoltaics to a home.

After the talk, Curwood shared more advice.

"Look most closely at companies' environmental, social and governance standards. How responsible are they being as a company?" he asked. "Do you want to invest in a bank that is investing in a bunch of coal-fired power plants?"

In the auditorium lobby after the talk, attendees browsed through 17 booths that provided resources and interactive opportunities for Sandia staff to learn more about reducing their environmental footprint at work and at home. There they learned how to join the Zero Waste Challenge, and more than 115 signed up.

## Labs' green allstars honored on Earth Day

#### By Shelley Kleinschmidt

A highlight of Sandia Earth Day activities was presentation of five Environmental Excellence Awards, which showcase the work of Sandia staff who have led innovations that reduce the Labs' environmental impact.

Winners included Nathan Golden for the Resource Conservation Award: Sandia NM Corporate Moves Service Goes "Green;" and Schylar Malone for the Greenie Award: Recycling Hero Transforms the Customer Funded Record Center.

Other award winners were:

#### Grassroots Award -Reapplication Welcome Baskets

Ann Ryder, Jordan Olivas-Kelcourse, Kelsey Noga, Lori Wilson

#### Above and Beyond Award - Tritium Lab Hood and Associated Equipment Removal

Dale Zschiesche, Justin Griffin, Steven Bonadore, Jason Mays, Michael Garcia, Caitlin Taylor, Luke Paulus, Matthew Burris, Tyson Nemudrov, Douglas Evans, David Martinez, Daniel Valerio, Patrick Apodaca, Wayne Miller, John Thomas III, Sean Kehoe, Alex Lovato, Jeffery Mccracken, Michael Esquibel

#### Sequoia Award -Implementation of Universal Waste

Jesse Farr, Lyndsy Ortiz, Karli Massey, Nicholas Massey, Kelly Hennessey, Paul Sabia, Alexander Voges, Jorge Martinez, Linda Gonzales, Christopher Dean, Anita Reiser, Dwayne Hartranft, Craig Wood, Watasha Budlong



#### FROM CONGRESS TO

MESA — U.S. Rep. Xochitl Torres Small, who represents southern New Mexico, toured Sandia last week. At the Microsystems Engineering, Science, and Applications complex, (left to right) Sandia Field Office Manager Jeff Harrell, Rep. Torres Small, and Labs Director Steve Younger listen as Kalia Raby, senior manager for advanced complimentary metal-oxide semiconductors, talks about the work at MESA. The congresswoman also received briefings on nuclear deterrence and hypersonics during her tour of the Labs. Photo by Randy Montoya

# **NEW ROBOTS, NEW TRICKS**



**ROVING ROBOTS** — In this Robot Rodeo challenge, bomb squad teams maneuvered robots through multiple timed obstacle courses set up in a hangar by the U.S. Department of Commerce's National Institute of Standards and Technology.

# Rodeo challenges robots, bomb squads with innovative scenarios

By **Manette Newbold Fisher** Photos By **Randy Montoya** 

omb squad teams from coast to coast challenged their emergency preparedness skills during Sandia's five-day Robot Rodeo and Capability Exercise last month.

Twelve scenarios involving vehicles, simulated terrorist events and timed obstacles were set up from May 13-17 around Sandia and Kirtland Air Force Base for the military and civilian teams. The event, which tests bomb squad teams to their limits, takes a year of planning and collaboration with multiple agencies and volunteers, said Sandia robotics manager Jake Deuel.

One of the volunteers, retired Marine Judy Ellis, helped the 21st U.S. Army Explosives Ordnance Disposal team with the mock explosives challenges this year. She has been participating in the Robot Rodeo for four years in various capacities, helping at scenario sites and even volunteering joined the Robot Rodeo this year and set up two scenarios in a Sandia warehouse. In one of the challenges, teams used a virtual training system to detect simulated radiation sources.

Original challenges involving mannequins representing terrorists and a tunnel with simulated traps took place at Sandia's National Solar Thermal Test Facility, with help from Kirtland Air Force Base.

Jake said other organizations that pitched in include the Army, which donated a two-armed robot. The U.S. Department of Commerce's National Institute of Standards and Technology made a return to the event and set up obstacles in a hangar where robots maneuvered up and down stairs, around tight corners and through dark spaces.

The multi-organization effort pays off every year, Jake said. He called this year, "Lucky 13."

"The Robot Rodeo gives agencies and bomb squads a chance to work together in no-harm, no-foul scenarios," Jake said. "There's great synergy here."

on teams that were shorthanded.

Ellis, who lives in Belen, was one of the first female bomb techs in the Marine Corps, graduating from EOD training in 1981. She said the tools she used as a bomb tech consisted of a tool bag or belt, not a bomb protection suit and robots.

"I really enjoy keeping up with the latest technology, learning the robots and getting proficient," Ellis said. "My training was years ago, but being a bomb technician, a lot of the basic concepts don't change. Now I like watching the new technicians learn and grow and sometimes I interject a little oldschool wisdom. Overall, I enjoy how hard these guys work and seeing how talented our young bomb squads are."

#### 'Lucky 13' provided many firsts

The 13th annual event offered many first-time scenarios with the help of external agencies. Jake said this was the first year Sandia hosted teams from both sides of country: the Riverside County Sheriff's Office from California and two Navy teams from Virginia.

The Albuquerque International Sunport and the Transportation Security Administration in Albuquerque teamed with Sandia for the first time to support a cargo airplane scenario, and an inaugural Albuquerque Transit Department scenario incorporated a city bus.

Representatives from the Waste Isolation Pilot Plant in Carlsbad also



LUCKY 13 - Inside a Sandia training facility, robots maneuvered to find simulated explosives. The Labs hosted the 13th annual Robot Rodeo in May.



**TOWER OF TERROR** — Two Robot Rodeo scenarios took place at Sandia's National Solar Thermal Test Facility with the help of Kirtland Air Force Base. One challenge involved mannequins that represented terrorists rappelling with mock explosives.



**FRIENDLY COMPETITION** — Staff Sgt. Michael Marquez of the March Air Reserve Base in California works through one of the bomb squad scenarios during the Robot Rodeo. The weeklong event is a competition for civilian and military teams.



**INSPECTOR GADGET** — A robot searches for a mock suspicious device inside an airplane during Sandia's Robot Rodeo and Capability Exercise. Twelve scenarios were set up for military and civilian bomb squad teams to work through during the five-day event.



**SYNERGY** — Manager Jake Deuel is pictured with Robot Rodeo volunteer Judy Ellis, one of the first female bomb techs in the Marine Corps. (Photo courtesy of Jake Deuel)

# Robot Rodeo and Capability Exercise

Kirtland Air Force Base Explosive Ordnance Disposal Team

21st U.S. Army EOD group, Kirtland Air Force Base

Albuquerque Police Dept. Doña Ana County Sheriff's Office New Mexico State Police Two Navy EOD Teams, Virginia Holloman Air Force Base EOD Dallas/Fort Worth Airport Police Fort Worth Police Dept. and Fire Dept. Plano Police Dept., Texas Riverside County Sheriff's Office, California



March Air Reserve Base, California

**CARGO SEARCH** — Two Robot Rodeo scenarios incorporated a decommissioned 727 jet plane. Teams used robots to find mock suspicious devices inside the belly and cabin of the plane.



**STAIR STEPPER** — Bomb squad teams used robots to maneuver up and down stairs, open and close doors and inspect locations where mock explosives were located.

## Pilot program prepares future leaders

#### By Melissae Fellet

Thirty Sandia employees, working in departments ranging from engineering to security, recently finished a deep dive into leadership skills through the Future Leaders Pathway program. The seven-month pilot program provided an opportunity for partnership building across the Labs, identifying professional strengths through classroom activities, group projects and self-reflection about career goals and personal motivations.

"I thought about the term leader in a broader context after this program," said Rachael Gutierrez, in partnership and planning in facilities at Sandia/ California. "I learned about how my skills could benefit other groups across the Labs."

Starting in July 2018, 25 employees from Sandia/New Mexico and five from Sandia/ California met in Albuquerque every other month for courses about leadership, teamwork, networking, strengthening personal resiliency and bringing visions to fruition. The classes were taught by Sandia leaders, an Olympic pentathlete, and business professors from Case Western Reserve University, the University of Texas, Austin, and the University of California, Los Angeles.

Some meetings also involved small-group sessions with senior leaders and managers. "Those



SANDIA'S FUTURE — Graduates of the first class of the Sandia Future Leaders Pathway program enjoy lunch with their networking session. The students are (left to right) Steve Hau, John Mersch, Justin Martinez, Miguel Palaviccini, Kavit Kumar, Meaghan Chelucci and Rachael Gutierrez.

Photo courtesy of Rachael Gutierrez

sessions were valuable because they allowed us to ask questions that we wouldn't have the opportunity to otherwise," Rachael said.

Janice Duis, a leadership and organizational development specialist at the Labs, and a team of volunteers from across the Labs helped craft the content based on feedback from focus groups and the needs assessment of early-career employees. "The goal of the program was to build leaders who could competently and confidently step into leadership roles, whether formally or informally," Janice said.

The group divided into four teams, each sponsored by an associate Labs director, to explore issues such as attraction and retention, onboarding, recognition and program improvement. Each team selected a topic and created a presentation to senior leadership. Then team members made recommendations based on their perspective from working less than five years at the Labs.

Several participants agreed that one of the most valuable parts of the program was working with colleagues from diverse professional and academic backgrounds. Those connections helped them expand their networks to departments and divisions where they did not have previous connections. Following the lesson to maintain their networks, Rachael said her team plans to stay in touch and reconnect every few months.

The program also provided time for self-reflection that would have been hard to find in a standard work day. Before the program, Steve Hau, a business development specialist at Sandia/ California, wondered if his easygoing management style would be compatible with effective leadership. "This program allowed me to see that leadership could be a path for me with that personality trait," he said.

Since the program ended in February, Justin Martinez and several other participants have been promoted, and he said the program helped him prepare for his new role. "I've immediately applied the many lessons I learned." Of the several leadership courses he has taken at Sandia, Justin said, "This one, by far, is the best."

Janice recommends that individuals with an interest in leadership development start by talking with their managers. 🛅





New Mexico photos by Michelle Fleming California photos by Randy Wong





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- 5TH WHEEL HITCH, Reese 16K. \$150. Woods. 822-9561.
- LOVESEAT, 2017, Crate & Barrel, paid \$849, asking \$500; have matching chair, but can sell ea. separately. Hussong, 280-4307.
- ANTIOUE/VINTAGE CLOCKS wall/mantle/ floor, mechanically driven, working, serviced, excellent condition Ross. 332-0659.
- ADJUSTABLE BED PLAT-FORM, queen, Tempur-Pedic Tempur-Ergo, 2 yrs. old, mechanics barely used, \$700 OBO. Daniels, 228-261-1042.
- GOLF CLUBS, King Cobra, oversize irons, 4-GW, PW, Lamkin grips, used 7 rounds, excellent condition, \$200 OBO, Holmes, 873-5255.

- '11 FORD F150 XLT, 4x4, Triton, supercrew, 5.0L V8, 6-spd. AT, new tires, 98K miles, good condition, \$17,000. Cover. 505-228-5337
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- VOLUNTEERS, Fabulous Felines charity, work with cats. Stubblefield. 263-3468, fabulousfelines@ comcast.net.
- GOOD HOME, good natured female cat, stray, & 2 kittens. Baca, 505-850-2621, ask for Diana.
- BREVILLE TEA MAKER. Romero, 505-288-0080.
- **RECOMMENDATIONS**, for trustworthy & amazing mechanic, carpenter/ handyman & landscaper, new to area. Crawford, 865-765-2065.

# **USAF Thunderbird Show**





THUNDER(BIRD)STRUCK – An estimated 35,000 people attended the Kirtland Air Force Base Air and Space Fiesta last month, capped by a dazzling aerial show by the U.S. Air Force Thunderbirds. The aerobatics, along with static aircraft displays and a STEM and space exhibition, brought in the crowds for the base open house. Based at Photos by Randy Montoya Nellis Air Force Base in Nevada, the Thunderbirds are in their 66th year.

# **Workshop strengthens Caribbean resilience**

By Dan Ware

In 2017, the disastrous hurricanes Irma and Maria killed thousands, destroyed homes and businesses and left thousands homeless in Puerto Rico, the U.S. Virgin Islands, Dominica, Barbuda and other island nations in the Caribbean.

The hurricanes also exposed a massive problem: the lack of resiliency in the electrical grids that the small, isolated islands rely upon to keep the power running.

Many parts of the Caribbean were without sustained power for months following the hurricanes, despite government aid and help from the energy providers who sent experts and equipment to bring power back online.

#### Enhancing energy resilience

Sandia and DOE recently hosted the Advancing Caribbean Energy Resilience workshop at the Universidad Ana G. Mendez's Gurabo campus in Puerto Rico, where researchers, engineers, policy



GARDEN PARTY - Participants in the Sandia-led Advancing Caribbean Energy Resilience workshop visited the El Coqui community center near Salinas, Puerto Rico, to see how local photovoltaic generation and battery storage systems power water pumps for the

### New look at old data leads to cleaner engines

**CONTINUED FROM PAGE 1** 

Nils said that, to his knowledge, this is the first time that researchers have looked at these possibilities. By identifying inconsistencies, the new methods ultimately should lead to better models for understanding combustion. Typically, well-controlled experiments help validate computer models to understand the combustion process and to develop new combustion strategies.

Data from low-pressure premixed flames are typically used to validate chemical kinetic mechanisms in combustion. These detailed mechanisms then provide the basis for understanding the formation of pollutants and predicting behavior for combustion applications.

Historically, research papers reported data from a single flame or a few flames, along with one new mechanism for a specific fuel. However, the approach pioneered by Nils' team paves the way for measuring a large number of flames and publishing numerous mechanisms that are not usually cross-validated with other data and mechanisms.

Nils compares the discovery to the unearthing of an old artifact. Very few conclusions can be drawn from a single artifact. However, piecing together thousands of similar artifacts creates a more complete historical picture.

"Our work reveals information typically hidden in the ensemble of low-pressure flame data," Nils said. "For example, useful targets for model validation can be gleaned from a database with more than 30,000 data points."

#### Analyzing flames

After analyzing 55 individual flames involving 30 different fuels, researchers found that correlated properties provide new validation targets accessible only when examining the chemical structures of a wide set of low-pressure flames.

Nils said the comprehensive chemical kinetic models for combustion systems increasingly are used as the basis for engineering models that predict fuel performance and emissions for combustor design. These models are often poorly constrained because of the large set of model-input parameters, but synchrotron-based single-photon ionization mass spectrometry measurement, pioneered in DOE's Gas Phase Chemical Physics program, has created an unprecedented surge of detailed chemical data.

Traditionally, only sets of data from a single fuel were analyzed together to obtain a chemical mechanism. Combining and analyzing these datasets together and using informatics tools lead to better species-specific validation targets, including individual kinetic processes that need to be studied further. Quantifying correlations improves species prediction, resulting in more reliable models with broader applicability and more rigorous uncertainty limits.

The research took advantage of the detailed flame chemistry data available because of species detection and characterization breakthroughs spawned due to investments by DOE's Basic Energy Sciences in synchrotron photoionization mass spectrometry and data science.

nakers and utility representatives met to discuss how to enhance and improve energy resilience throughout the Caribbean.

Led by Sandia, the workshop included speakers from the DOE, the Organization of American States, the Caribbean Community, the National Renewable Energy Laboratory, energy providers, professors from the Universidad de Puerto Rico at Mayaguez and regional stakeholders.

About 50 participants, stakeholders and experts from 15 countries across the region learned about the tools and methodologies to address energy resilience through the application of microgrids.

The workshop was organized through the State Department's U.S.-Caribbean Resilience Partnership, whose goal is to develop and advance resilience in the Caribbean region.

The workshop showcased design tools and methods developed by the DOE and its national labs, such as Sandia's Microgrid Design Toolkit. The workshop shared best practices developed and disseminated through DOE's Energy

Photo Courtesy of Matt Lave hydroponic garden.

Transitions Initiative that can be applied to island electric grids.

Participants also learned about the governance, institutional and financial considerations necessary to develop strategies that ensure resilient electric supply to critical infrastructure.

As a part of the workshop, participants visited the El Coqui community and met with leaders who are working on energy resilience solutions there.

"Presentations at the workshop gave participants an idea of how microgrids and energy resiliency can benefit their countries and communities," said Matt Lave of Sandia. "While the workshop focused on the technical and regulatory aspects of microgrid development, we felt it was important for the participants to understand the community motivation by interacting with those residents and leaders who are currently developing energy resilience solutions."

#### Long-term benefits

The work eventually will help to assemble more accurate chemical mechanisms for describing combustion processes, Nils said.

"Our goal is to better understand and ultimately control the chemistry of ignition behavior and pollutant formation," he said. "Subsequently, this will lead to clean and efficient internal combustion engines."

Nils said that his team's findings unlock an entirely new avenue for research at Sandia's Combustion Research Facility.

"Applying data science and machine-learning tools extracts even more information from large datasets," he said. "Our work has opened the gate wide to show that data science can be applied to combustion research."

The data from the study is available to the wider combustion community to support the development of new data science extraction techniques.



SEEING DOUBLE — Jonathan Scott (center), who stars with his twin brother in the home improvement TV show "Property Brothers," recently visited Sandia to learn about renewable energy for a documentary he's developing about solar power and energy delivery in the U.S. After talking with Cliff Ho next to a reflecting mirror at the National Solar Thermal Test Facility, he toured solar panel testing at the Photovoltaics Systems Evaluation Laboratory, saw systems to integrate residential photovoltaics into the grid at the Distributed Energy Technologies Laboratory and discussed large-scale energy storage technologies, such as flow batteries, at the Energy Storage Test Pad. — by Melissae Fellet. Photo by Randy Montoya

# Sandia California mentors high school girls in math, science

#### By **Paul Rhien** Photos By **Randy Wong**

The Sandia Women's Connection last month recognized the academic achievements of 35 girls from area high schools at its annual Math and Science Awards program in a ceremony held at the California site.

#### **Connecting with female mentors**

Before the program began, the young women were paired with Sandia mentors to discuss academic plans and careers in STEM. At the ceremony, students said their mentorships inspired them and increased their interest in STEM fields.

Heidi Ammerlahn, director of homeland security and defense systems, spoke of the importance of the Math and Science Awards at Sandia.

"These awards allow young women to engage with a community of their peers as well as make connections with Sandia women who have chosen STEM fields for their careers," Heidi said. "We receive feedback from their parents and teachers that this experience has helped these high school juniors have the confidence to select STEM majors in college and recognize that they have a community supporting their success and impact." Associate Labs Director Dori Ellis told award recipients and their families that the awards program helps introduce young women to the many available careers in math and science and to future internship opportunities at Sandia. "As a woman engineer, I am especially thrilled that Sandia Women's Connection sponsors these Math and Science Awards," Dori said. "At Sandia, we are committed to increasing our leadership and overall diversity as we move forward. One pathway for supporting diversity and inclusion at Sandia Labs is through our educational opportunities."

Although more women are pursuing careers in the biological sciences, a significant gap remains in the number of women working in chemical and mechanical engineering, mathematics, physics and computer science compared to men, particularly in senior positions. The Math and Science Awards program helps provide area students with female mentors in these fields.

Dori encouraged award recipients to pursue future education and careers in math and science.

"I hope that each of you tonight will continue on your journey in math and science. I commend each of you for your hard work and achievement so far," she said. "Everyone in this auditorium including your parents and teachers — are rooting for you, and the women scientists and engineers here at Sandia will always be a resource for you."

#### **Encouraging girls in technical careers**

wonderful and terrifying part — the part where you take control, where you decide how you will impact this world and where you take responsibility for those decisions," Eva said. "These next few years will be pivotal in developing your adaptability and your resilience for the rest of your life. So relax, and enjoy it, and make the most of it."

Eva further encouraged attendees to surround themselves with mentors, advisers and peers who believe in them and encourage them, and to ignore those who make them feel like they aren't good enough.

Nominated by their teachers, award winners received a certificate from the Sandia SWC and from state officials.

"We all have a role in making this world a better place, and with your help, we will solve some of our biggest challenges like stopping and reversing climate change," said State Assemblywoman Rebecca Bauer-Kahan. "I commend Sandia for their commitment to increasing the representation of women in STEM, because women often bring a different perspective to their work, and we all benefit from that."

Representatives were also on hand from the offices of other state legislators, including Reps. Rob Bonta, Buffy Wicks, Susan Eggman and



**CAREER CHAT** — Sandia Women's Connection host Lindsay Dugan (left) visits with award recipients prior to the ceremony at Sandia/California. The young women are paired with Sandia female mentors.

Sandia systems analyst Eva Uribe also spoke to awardees, sharing personal experiences and imparting words of encouragement.

"You are in the middle of the journey of your education, and you are about to enter the most

**KEYNOTES** — Sandia systems engineer Eva Uribe (left) encourages award recipients to seek out supportive mentors. State Assemblywoman Rebecca Bauer-Kahan (right) of Orinda, California, presented certificates to the winners. Heath Flora.

The awards event is organized each year by a group of volunteers. Those interested in helping or being a host for next year's ceremony should contact Rachael Gutierrez or Myra Blaylock, SWC co-chairs.



MATH MAVENS — Recipients of the Sandia Women's Connection Awards for Outstanding Achievement in Math met Associate Labs Director Dori Ellis (right) during the awards ceremony at the California site.

