'The secret sauce'

DOE deputy secretary says Sandia helps make America great

By Nancy Salem

The work being done at Sandia is vital to the strategic goals of the DOE and is helping define what the United States can become in the future, says the deputy US secretary of Energy.

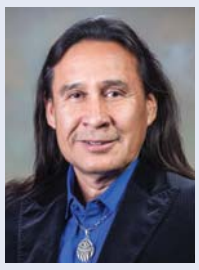
"Your efforts help expand our knowledge of the world and the stuff of which it is made," Elizabeth Sherwood-Randall told a packed house July 1 in the Steve Schiff Auditorium. "Your research helps lay the foundation for more resilient and sustainable energy systems and you make our nation stronger and safer against

> *"Your efforts help expand our knowledge of the world and the stuff of which it is made."*
>
> **— Deputy Energy Secretary Elizabeth Sherwood-Randall**

(Continued on page 5)

JILL HRUBY, right, incoming Sandia president and Laboratories director, joined Deputy Energy Secretary Elizabeth Sherwood-Randall in fielding questions from the audience at an all-hands meeting in the Steve Schiff Auditorium. Sherwood-Randall said she looks forward to working closely with Jill. "How exciting to have you become the next director," she said. (Photo by Randy Montoya)

Meet 68 distinguished Sandians



Sandia's special appointments represent employees from all areas of the Labs' operations. This year, 68 Sandians have been honored with special appointments, including Laurence Brown (163), left, who has been promoted to the distinguished level of his job family. See all the 2015 special appointments on **pages 6-7.**

Sandia LabNews

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Sandia National Laboratories

Testing heats up at Sandia's Solar Tower with high-temperature falling particle receiver

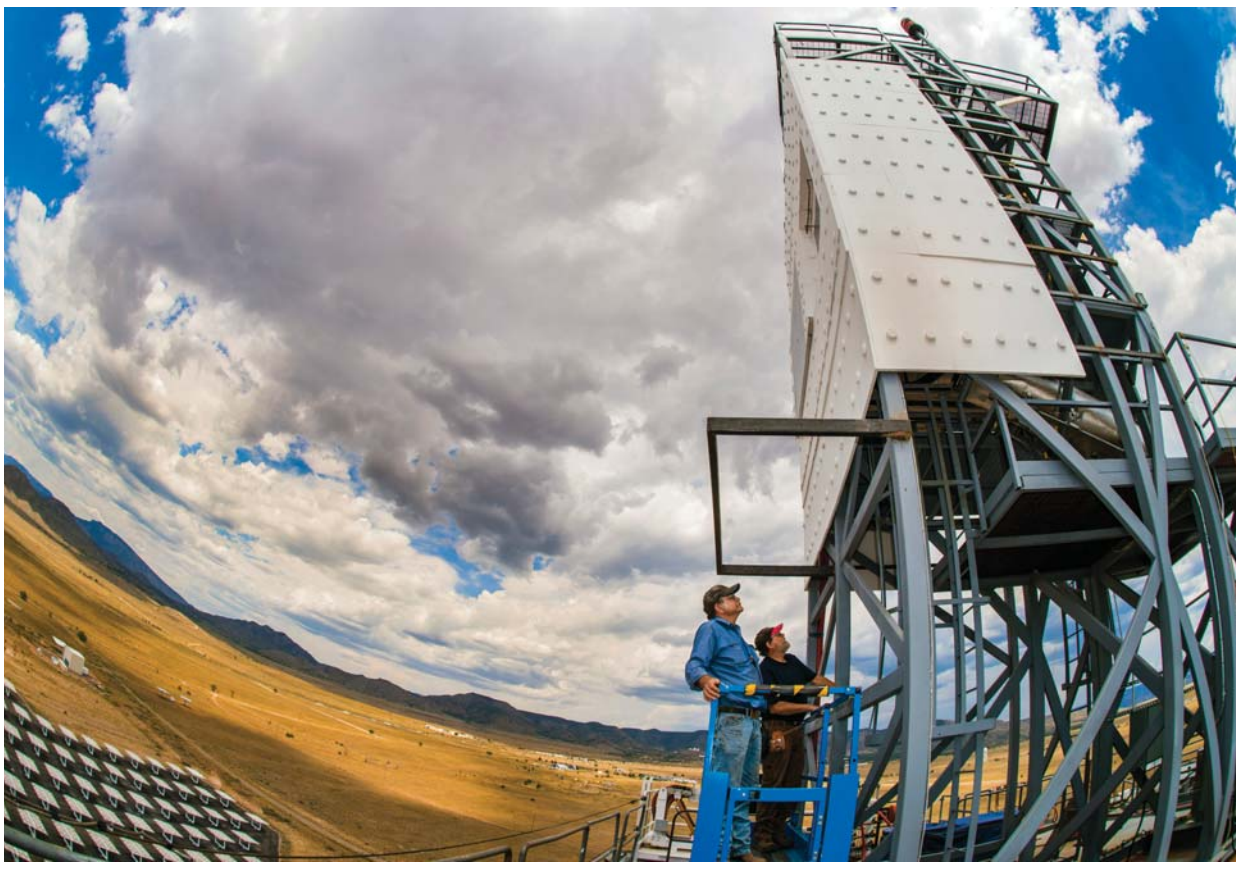
By Rebecca Brock

Sandia researchers are working to lower the cost of solar energy systems and improve efficiencies in a big way, thanks to a system of small particles.

In June, engineers lifted Sandia's continuously recirculating falling particle receiver to the top of the tower at the National Solar Thermal Test Facility, marking the start of first-of-its-kind testing that will continue through 2015. The Sandia-developed falling particle receiver works by dropping sand-like ceramic particles through a beam of concentrated sunlight, capturing and storing the heated particles in an insulated tank. The technology can capture and store heat at high temperatures without breaking down, unlike conventional molten salt systems.

Conventional central receiver technologies are limited to temperatures close to 600 degrees Celsius (1,112 degrees Fahrenheit), while operating temperatures for the falling particle receiver could exceed 1,000 degrees Celsius. Higher temperatures mean more available energy and cheaper storage costs because less material

(Continued on page 4)



TECHNOLOGISTS JOHN KELTON and Daniel Ray inspect the Falling Particle Receiver during a cloud delay atop the National Solar Thermal Test Facility at Sandia National Laboratories. (Photo by Randy Montoya)

Animal planet

A veterinarian at a national lab might sound odd, but Sandia's Melissa Finley helps make the world safer through livestock health and biosecurity. To work effectively in rural Afghanistan, Melissa had to earn the trust of villagers. See **page 12.**

Inside . . .

Meet Jeff Harrell

Priority one for Jeff Harrell, recently named manager of NNSA's Sandia Field Office, is to "make sure we put national security at the forefront of everything we do. That is our core mission and it's incredibly important for our nation." See **page 9.**

That's that

The announcement on June 22 by Sandia Corp. Board of Directors Chair Rick Ambrose that Jill Hruby will be Sandia's new Labs director was greeted with an astonishing wave of media interest from across the country and even beyond.

Speaking about the board's decision, Ambrose said: "We saw right away that Jill has the right combination of technical expertise and strategic vision to lead Sandia into the future. With more than three decades of experience at Sandia, she understands the core national security missions and scientific foundations that are fundamental to the Labs' success."

In the hours and days immediately following the announcement, news outlets large and small, from the *New York Times* to the *Hilton Head Island Packet*, picked up the story about Jill's new role at the Labs. Within just two days of the news, the folks on our media relations team had already logged more than 30 pages of links to the story online. In looking at the incredible diversity of newspapers, professional and trade publications, television newsrooms, and websites that carried the item, it's hard to say who *wasn't* interested in this story.

The fact that Jill was selected to lead the nation's largest national security laboratory in what we all know has been a male-dominated world is the very definition of news. But this wasn't just *any* news. It was the kind of news that signals a fundamental shift in how we think about our world, an expansion of our idea of what's not just possible but routine. I don't think I'm overstating the case here.

On any given day, particularly in the information-saturated environment we live in, news editors are barraged with choices: Should we report this story? Will our readers be interested? In the case of the story about Jill's new job, editors across the country (and at least one news site in the UK) determined that this was information that demanded to be published. Savvy editors know there is a huge amount of interest "out there" in encouraging women to embark on STEM careers. For editors not to share this news with their readers would be something akin to dereliction of duty.

Jill has been a role model for women at Sandia for some time; now that the word is out about her consequential accomplishments, Jill is a role model for girls and women everywhere.

In Sandia's own news release, Jill recognized the significance of her appointment. "I'm proud to be the first woman to lead an NNSA laboratory," she said, "but mostly I'm proud to represent the people and work of this great lab."

I think there are about 10,000 people who are proud right now, too.

* * *

The Trinity test, which occurred just 70 years ago this month near Alamogordo, New Mexico, is one of those historical touchstones that perfectly expresses the urgency with which this nation fought World War II.

Consider the challenges: The Manhattan Project's roots date to 1939, but the project as we know it only got started in June 1942. Within three years and at an expense of $2 billion in 1940s dollars (probably the equivalent of more than $30 billion today), the nation had recruited the top scientists and engineers on the planet to solve problems no one had ever dealt with before. A massive industrial infrastructure was created to produce materials that had never existed as more than benchtop-sized samples. A workforce of some 130,000 people spread across sites around the country was assembled, the vast majority of whom had no idea what they were really working on. That incredible effort culminated in the Trinity test and the subsequent deployment of atomic bombs that destroyed the Japanese cities of Hiroshima and Nagasaki and abruptly ended the war in the Pacific.

In the horrible calculus of war, I believe the use of the weapons ended up saving lives, both Japanese and American. I know that sounds like a gratuitous assessment when made from the safe and comfortable distance of 70 years and written from the victor's perspective. But I do believe there are millions of people — the descendants of those on both sides who would have died in an all-out assault on the Japanese home islands — who are alive today because President Truman made a very difficult decision in the summer of 1945.

— Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)

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Advancing photonic integrated circuit design, manufacture

Sandia, Lumerical Solutions collaborating on compact model library

By Neal Singer

Sandia and Lumerical Solutions Inc. of Vancouver, British Columbia, are collaborating to develop a compact model library (CML) for Sandia's silicon photonics manufacturing process. The calibrated CML will enable designers to simulate the performance of photonic integrated circuits fabricated with Sandia's silicon photonics manufacturing process.

"This is an exciting time in the field of silicon photonics and there is much talk about the potential of the technology across a wide array of applications."

— Bill De Vries, director, product marketing, Lumerical Solutions Inc.

Silicon photonics hold the potential to become a cost-effective, scalable technology to produce photonic integrated circuits. Their applications include high-performance optical networking, data center interconnects, signal processing, and biological and chemical sensing. A comprehensive processing design kit that includes accurate simulation-circuit element models is critical to enabling a methodology that ensures predictable operation and reliable, repeatable fabrication of complex photonic integrated-circuit designs for these demanding applications.

Sandia and Lumerical's collaboration to develop a calibrated CML addresses key challenges in an initiative started in October 2014, when President Barack Obama announced funding for the Institute for Manufacturing Innovation on Integrated Photonics (IP-IMI). The idea, he said, was to create "an end-to-end integrated photonics manufacturing ecosystem in the US," including integrated design tools for efficient simulation and design of integrated photonic circuits and an accessible domestic photonic device foundry service. The combination of Lumerical's suite of photonic design tools and Sandia's foundry services for US national security missions enables photonic designers to innovate in the field of integrated photonics.

Rick McCormick, senior manager of Microsystems Process Science & Technology Dept. 1760, says, "The IP-IMI will accelerate the impact of photonics on information, communication, and sensing technologies, including those in many national security applications, and help facilitate broader industry engagements on Sandia's integrated photonics technology platform. Sandia is committed to supporting the success of IP-IMI and we welcome this collaboration with Lumerical, and future collaborations with other industry partners, to advance the photonic design and manufacturing ecosystem."

"This is an exciting time in the field of silicon photonics and there is much talk about the potential of the technology across a wide array of applications," says Bill De Vries, director of product marketing at Lumerical. "Our collaboration with Sandia aims to create the design ecosystem necessary to ensure integrated photonics reaches its full commercial potential."

"Photonics can improve performance and reduce energy use in metro and data center networks," says Nasser Peyghambarian, professor of optical sciences at the University of Arizona and director of the National Science Foundation-funded Engineering Research Center for Integrated Access Networks (CIAN). "This [Sandia-Lumerical] collaboration enables photonic designers and researchers everywhere to leverage the component knowledge developed by Sandia and CIAN researchers to rapidly and accurately design and simulate increasingly complex silicon-based photonic integrated circuits."

According to a company document, Lumerical has pioneered simulation technologies for photonic products since its inception in 2003. Its software solutions have been licensed in more than 40 countries by global technology leaders like Samsung, STMicroelectronics, Huawei, Agilent, Olympus, and Philips, and prominent research institutions including Caltech, Harvard, Max Planck Institute, MIT, NIST, University of Tokyo, and the Chinese Academy of Sciences.

For further information, see www.sandia.gov/mstc/IPII and http://manufacturing.gov/ip-imi.html.

An Eye on the Unseen

Sandia's BioWatch Indoor Reachback Center

By Holly Larsen

IN A CONTROLLED EXERCISE, the BIRC team examines results from thousands of Sandia-developed air flow scenarios to interpret data from a BioWatch detector.

In the event of a biological incident that threatens human health and property, public health officials nationwide will turn to the recently released Indoor Program Guidance Document to craft their response. Created through a collaboration among Sandia researchers, public health officials, and emergency responders, this instructional handbook distills experience gained at Sandia by operating the BioWatch Indoor Reachback Center (BIRC) for more than a decade.

Through BIRC, Sandia has been a key part of the US response to a potential bioterrorism or biohazard incident. For any indoor release detected by BioWatch — a system of early warning biological-agent detectors placed across the US — BIRC is poised to provide analyses that can rapidly help inform response decisions.

The role of BioWatch is particularly important because most biohazard releases can't be detected otherwise. Without it, a release will only be suspected when people become symptomatic — possibly days or even weeks after exposure.

Fortunately, the BioWatch system can detect and characterize what's happening early and accurately, providing information that can help first responders and public health officials determine how to handle a biohazard incident. The BioWatch program, initiated by the Department of Homeland Security (DHS) in 2003, is a crucial way of putting technology to work for the safety of the American public.

Sandia CaliforniaNews

Rapid response is key

Donna Edwards (8114), the leader of BIRC since August 2014, says that the BioWatch network of biodetectors has been strategically placed in urban areas and transportation centers around the country to continually monitor the air for biohazard releases.

"When the system detects something, an alarm goes off, and the system initiates a BioWatch Actionable Result, or a BAR," says Donna. "If the alarm comes from an indoor detector, the BAR activates BIRC and notifies the jurisdictional coordinator. That's the liaison between the BioWatch Program Office and the local government officials."

In a key development, local public health officials are now authorized to contact BIRC directly in the event of a BAR, whereas previously federal approval was required. This change saves time, allowing the BIRC to immediately begin collecting data for decision-critical modeling and analysis support.

As soon as a BAR comes in, Donna and her team spring into action, aware that speed is of the essence. "Limiting the number of people exposed is absolutely critical to saving lives and ensuring that the local health system isn't overwhelmed," says Donna. Also crucial is reducing the size of the area that might require decontamination — a lengthy and costly process.

"We are on call 24/7, 365 days a year, and we assemble immediately in our facility at Sandia to analyze data. If members of the team are not all physically at the BIRC, we can still work together to develop maps and reports through conference calls and online collaboration."

Thousands of airflow scenarios guide data interpretation

In rapid response to a BAR's declaration, BIRC must provide a preliminary report during a conference call to key response staff, including the jurisdictional coordinator, and DHS personnel. A center at Los Alamos National Laboratory provides a similar service for outdoor incidents.

The report BIRC provides is based on a sophisticated computer model and a library of simulations.

"We have a computer model of airflow in each building or transportation system, and tens of thousands of scenarios of how the bioagent might spread through each," says Donna. "We can look at our scenarios and determine which ones best match the pattern seen by the detectors." She adds that these same scenarios helped Sandia recommend optimal placement of the interior detectors.

Members of the BIRC team collectively analyze the likely scenarios and then apply their expertise to advise the responders using charts, maps, and clear communications. To help ensure that the report is accurate and comprehensive, the BIRC team is diverse, including specialists in public health, systems analysis, emergency response and bioterrorism, indoor airflow, transportation systems, and software development. A dozen team members are located throughout the country, at both the California and New Mexico locations of Sandia; at Argonne National Laboratory in Chicago; and in other urban locations.

Improving preparedness

With this combined expertise, the team works to thoroughly understand the data so it can provide local responders information on where the biohazard release might have originated, where it's spreading, the amount of agent released, and the potential level of human exposure. Team members also focus on how best to present the findings.

"Our goal is to make the information as usable as possible. We want the local responders to be able to quickly decide where to direct their efforts and how best to stem the spread of the particular type of agent they are facing," says Donna.

Since 2004, the BIRC team has achieved a number of milestones to help the BioWatch program become better prepared. The newly prepared Indoor Program Guidance Document is one example. The team also developed a BIRC Overview Video, part of an ongoing effort to develop training materials for the jurisdictional coordinators.

For Donna, being the leader of BioWatch Reachback team is an immense responsibility. However, she is sure she and her team can make a significant difference in mitigating an actual biohazard incident. "We rehearse for biohazard release incidents regularly through controlled exercises, and we'll continue to do so into the future," she says. "We are confident we can respond quickly in an emergency."

THE BIRC TEAM — Sandians on the BIRC team, from left, include Steve Mier (8116), Ann Hammer (8112), Marilyn Hawley (8118), Meghan Peterson (8114), Julie Fruetel (8114), Donna Edwards (8114), Chuck John (8114), and Mark Gerling (8127). Not pictured are Ray Gordon (6630), Nerayo Teclemariam (8112), Nate Gleason (8116), Becky Levinson (8114), Ann Yoshimura (8118), and Stephen Mueller (8114); and Argonne National Laboratory members Dave Brown and Jim Liljegren.

Tracing the evolution of a drug-resistant pathogen

By Sue Major Holmes

To fight a pathogen that's highly resistant to antibiotics, first understand how it gets that way.

Klebsiella pneumoniae strains that carry a particular enzyme are known for "their ability to survive any antibiotics you throw at them," says Corey Hudson (8633) of Sandia/California.

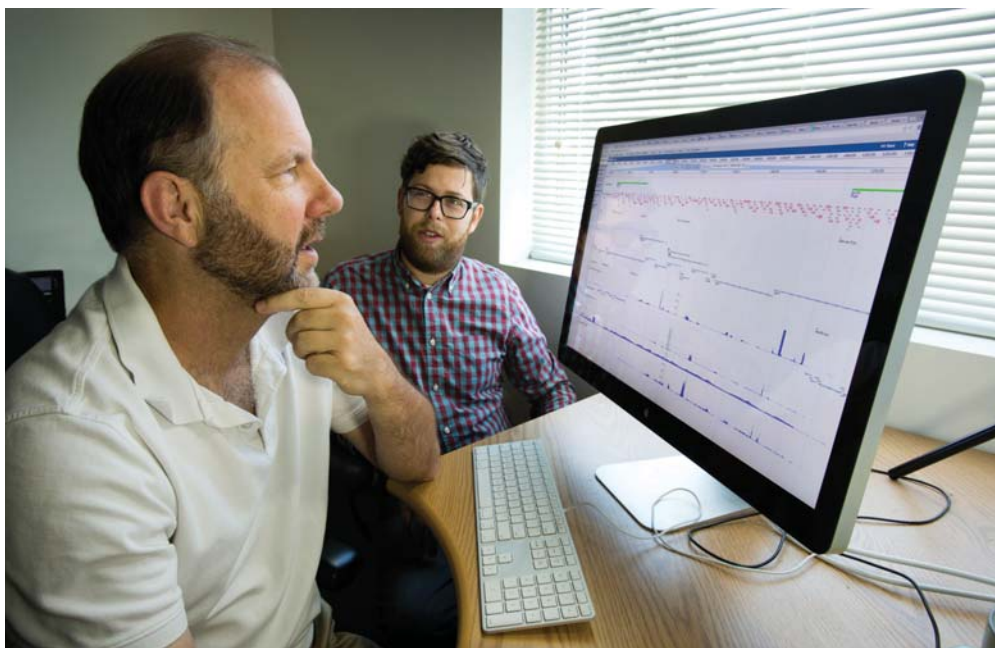
Using Sandia's genome sequencing capabilities, Corey and colleagues Robert Meagher (8621) and Kelly Williams (8633), along with former postdoctoral employee Zach Bent, identified several mechanisms that bacteria use to share genes and expand their antibiotic resistance. They found that in some cases, bacteria can receive a new set of genes all at once and in the process become pathogenic.

To better understand how the process works, they focused on the large mobile DNAs, such as plasmids, which exist as free DNA circles apart from the bacterial chromosome, and genomic islands, which can splice themselves into the chromosome. These mobile DNAs are major mechanisms for evolution in organisms that lack a true nucleus. Genomic islands and plasmids carry genes that contribute to everything from metabolism to pathogenicity, and move whole clusters of genes all at once between species.

Identifying how genomic islands move and their effect on bacterial physiology could lead to new approaches to bypass bacterial defenses, Corey says.

Eventually, the effort might lead to a way to predict new pathogens before they emerge as public health threats.

"We're just starting on this path," Kelly says. "It's a harder problem to predict emerging pathogens, rather than just observe them. Determining what is pathogenic in the first place and how it might become more pathogenic is a research challenge."



IDENTIFYING MECHANISMS BACTERIA USE — Sandia researchers Kelly Williams, left, and Corey Hudson (both 8633) view a segment of the *Klebsiella pneumoniae* genome around two genomic islands. The two researchers and their colleagues have identified several mechanisms that bacteria use to share genes and expand their antibiotic resistance. (Photo by Dino Vournas)

Bacteria share genetic material with other bacteria

Bacteria share genetic material through free virus particles or through a cell-to-cell process called conjugation, where one bacterium sends out a tube from its surface into another's and injects genes into the other cell, Kelly says.

A hypothetical example of sharing: A local water supply is contaminated with a pathogenic *E. coli* strain that is not antibiotic-resistant. *Klebsiella pneumoniae* enters the water, comes into contact with the *E. coli*, and donates genes. Now a pathogenic *E. coli* has acquired resistance, making it harder to eradicate.

"The great challenge is that bacteria can easily share their defenses," Kelly says.

Over the two decades that various bacterial genomes have been sequenced, researchers have found rampant gene sharing. "They are not so much generating new genes all the time — that does happen slowly — but what they mainly do is shuffle genes around," Kelly says. "The new gene combinations can quickly give bacteria a new pathogenic niche. They may then invade more tissues or survive in even more conditions."

For the first time last year, Sandia microbiologists studying infectious diseases sequenced the entire genome of a *Klebsiella pneumoniae* strain that encodes New Delhi metallo-beta-lactamase (NDM-1). This enzyme makes the strain resistant to carbapenems, antibiotics of last resort. *Klebsiella pneumoniae* is the most common species of carbapenem-resistant Enterobacteriaceae (CRE) in the US, often having resistance to nearly all antibiotics in use. CREs also are dangerous because they can spread antibiotic resistance to other bacteria.

These opportunistic bacteria can grow on hospital surfaces or in lungs and tissues. The Centers for Disease Control and Prevention says about one in 25 hospital patients has an antibiotic-resistant infection, and it's lethal in up to one in nine cases.

Since publishing the genomic analysis in June 2014, Sandia researchers have developed an experimental technique that detects genomic islands on the move. The team applies a computational or bioinformatics technique to identify islands in genomes and does particular studies of gene expression to see which antibiotic-resistance and other genes get turned on during an infection.

Research shows 'the bug is always armed'

The research showed the beta-lactamase genes in *Klebsiella pneumoniae* were on all the time, whether or not the bacteria were infecting human cell cultures. In essence, Kelly says, "the bug is always armed" against antibiotics.

The team built a database of genomic islands they found in a survey of all sequenced bacteria. So far, the database contains nearly 4,000 genomic islands — only a partial list of what bacteria share, Corey says. The database reveals both global features of genomic islands and unique features in select groups of bacteria.

Rather than relying solely on such bioinformatics, the team invented a new experimental approach to detect islands as they pop out of the genome. The team stimulates this beginning stage of island mobilization by stressing the cells in certain ways. During this stage, the mobilized islands take circular form, independent of the chromosome. The islands are now free to move into other bacterial cells, bringing with them new sets of genes.

Experiments and bioinformatics work together, each yielding information the other did not and confirming each other. "We do what we can with the computer, but we like to test the resulting hypotheses in the lab," Kelly says.

Falling particle

(Continued from page 1)

is needed to transfer heat.

Sandia engineer Cliff Ho (6123), the project's principal investigator, says the goal of the testing is to develop a prototype, cost-competitive falling particle receiver that demonstrates the potential for thermal efficiency greater than 90 percent, while achieving particle temperatures of at least 700 degrees Celsius.

"This technology will enable higher temperatures and higher-efficiency power cycles that will bring down the cost of electricity produced from concentrating solar power," Cliff says. "In addition, the ability to cheaply and efficiently store thermal energy directly in the heated particles will enable power production at night and on cloudy days."

Falling particle receiver technology is expected to further advance the state-of-the art in concentrating solar power tower systems capable of generating up to 100 megawatts of electricity.

Sandia's partners in the DOE project are the Georgia Institute of Technology, Bucknell University, King Saud University in Saudi Arabia, and the German Aerospace Center. The project is funded by DOE's SunShot Initiative, which aims to reduce solar energy costs and expand the use of solar energy technologies throughout the United States.

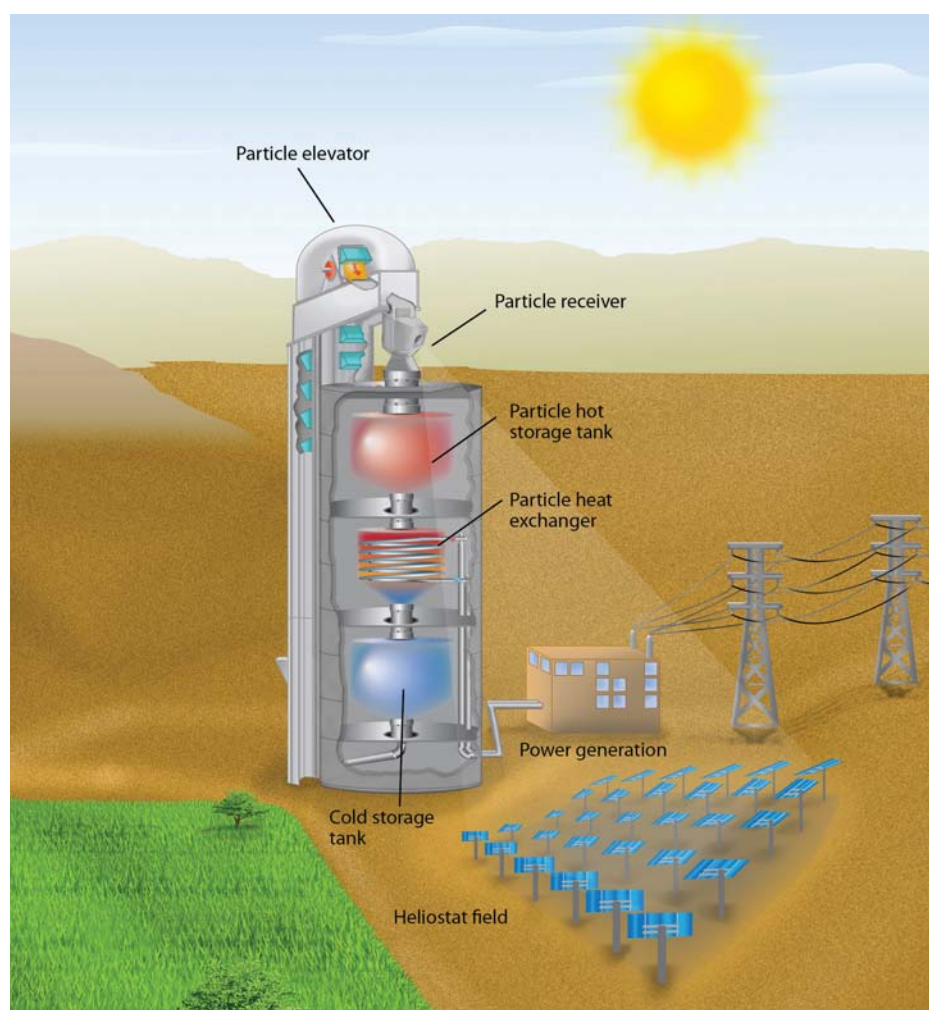
Sandia design engineer Josh Christian (6123) says the on-sun testing at the solar tower will occur in two phases. First, researchers will test an insert designed by Georgia Tech that slows falling particles inside the receiver like a Pachinko board to increase the temperatures of the particles as they fall through.

Later this summer, Sandia engineers will remove the Georgia Tech insert from the receiver and evaluate free-falling curtain configurations.

Weather and other factors will affect the pace of the testing.

"New Mexico is great for this project because our state has pretty consistent solar insolation throughout the year," Josh explained. "However the biggest thing we need to know is how much power is going into the falling particle receiver. So a cloudy or hazy day is a big challenge for us. An ideal day for testing is a clear day with no clouds and no wind."

The tower at Sandia's National Solar Thermal Test Facility stands 200 feet tall and is the only testing facility of its kind in the United States.



THIS DRAWING ILLUSTRATES the high temperature falling particle receiver testing system at Sandia's National Solar Thermal Test Facility. (Image courtesy of Sandia National Laboratories)

Deputy Energy Secretary Elizabeth Sherwood-Randall visits Sandia

MESA TOUR — Deputy Energy Secretary Elizabeth Sherwood-Randall, center, is flanked by dignitaries including Sandia President and Laboratories Director Paul Hommert, right, his successor Jill Hruby, to the left of Sherwood-Randall, and Dave Sandison, far left, Paul's chief of staff. The deputy secretary was touring the Microsystems and Engineering Sciences Applications complex.

(Photo by Randy Montoya)

(Continued from page 1)

nuclear, biological, and cyberthreats."

Sherwood-Randall spent nearly two days at the Labs being briefed on programs and the transition in leadership from Laboratories President and Director Paul Hommert to Div. 6000 VP Jill Hruby, who will take the Sandia helm when Paul retires July 16.

The deputy secretary said she has a personal connection to New Mexico going back to the early 1980s when she moved to Santa Fe to write a book and later took a short-lived job as editorial page editor of *The New Mexican* newspaper. "From that time, our family has kept a home in Santa Fe," she said. "It is our beloved retreat."

She said she has great affection for Sandia and great admiration of its people and work. She said Paul has grown and sustained the Labs as a leading research institution in his five years as director. "The vitality here is in evidence," she said to Paul. "Your work in nuclear security and robotics and energy and climate — the list goes on and on — is extraordinary. You have had a lifetime of service to our nation, and we thank you for that."

Sherwood-Randall said she looks forward to working with Jill. "You have such an outstanding record of achievement across so many research areas," she said. "Energy Secretary [Ernest] Moniz and I welcome you to your new role."

Sandia a leader in technology innovation

In 2014, Moniz put forward a strategic plan that identified three broad goals: science and energy, nuclear security, and management and performance. Sherwood-Randall said Sandia is important to all three.

"The work you are doing here in science and energy is part of the ongoing DOE research, development, and deployment of innovative technologies," she said. "The energy sector is one of the strongest in our economy and has positioned us to lead the world."

She said Sandia has been a leader in technology innovation worldwide for decades and is a key part of what Moniz calls the DOE innovation chain. "Starting with fundamental research, going to new discoveries, then piloting those technologies and bringing them to widespread deployment in the marketplace, Sandia has been a leader," she said. "In the 1960s, Sandia's invention of the cleanroom led to modern electronics. Today you are laying the groundwork for quantum computing and advancing US cybersecurity."

"Starting with fundamental research, going to new discoveries, then piloting those technologies and bringing them to widespread deployment in the marketplace, Sandia has been a leader. In the 1960s, Sandia's invention of the cleanroom led to modern electronics. Today you are laying the groundwork for quantum computing and advancing US cybersecurity."

In nuclear security, Sandia's work is critical to President Obama's call to reduce worldwide stockpiles of nuclear weapons and strengthen nonproliferation while ensuring the US maintains a safe, secure, and reliable nuclear deterrent, Sherwood-Randall said. "I want to underscore a point that is sometimes misunderstood," she said. "As we move to reduce reliance on nuclear weapons in our national strategy, that puts an even greater premium on the safety, security, and reliability of those weapons we retain to defend our nation and allies and partners around the world."

She said she recently testified before Congress about the need for life extension programs such as the B61 as well as nonproliferation efforts to make the world a safer place. "Global nonproliferation relies on Sandia's expertise in detection and monitoring technologies," she said. "The world counts on you and your inventions to detect clandestine activity."

Regarding the third strategic goal, management and performance, Sherwood-Randall said several recent reports have been critical of DOE. "Our contracting approach needs to help and not hinder the mission," she said. "There has been a huge amount of analysis done the past couple of years on the way we manage our labs and sites."

She said Moniz and Under Secretary for Nuclear Security and NNSA Administrator Frank Klotz are pursuing several initiatives to strengthen strategic partnerships and enhance the benefits of the management and operating, or M&O, contracting model. "Of course, in any contracting arrangement the federal government will retain responsibility for adherence to federal laws as well as ultimate responsibility for spending taxpayer dollars," she said. "We think we are making progress in two key areas: first, by reviewing the overall governance model and looking for ways to be innovative; and, second, examining the NNSA M&O contract incentives and evaluation process. The simple focus is on desired outcomes versus burdensome processes. This is something we will have an opportunity to interact with Jill about in the weeks ahead."

Making safety a top priority

She said DOE also wants decision-making that is as close to the work as possible and focuses on high-quality mission performance. Corrective actions are being tracked and managed by a joint DOE/NNSA governance and management performance steering committee, she said.

Sherwood-Randall closed by asking Sandians to continue to make safety a top priority and do work that benefits the American people. She quoted researcher Dahlon Chu (5020) as describing an innovation he was developing as the Sandia "secret sauce."

"The truth is all of you are the secret sauce," she said. "Thank you for what you do every day to make our nation what it is and enable us to be what we can be in the future."

68 Sandians move into Distinguished ranks

Sandia's special appointments represent employees from all areas of the Labs' operations. According to Corporate Policy System documentation, placement in the Distinguished level signifies a promotion to the fourth level of the job. This level is populated with a few exceptional employees who have distinguished themselves in their careers while at Sandia. It is different from the other levels in that it is subject to a 10 percent population limit to preserve the distinction of the level. Divisions are not obligated to fill all their distinguished "slots."

Employees selected for the new levels have been recognized with a special plaque and a nonbase salary award, in addition to this special mention in the *Lab News*.

Also pictured here are individuals appointed to the very select title of senior scientist/engineer or senior administrator, a unique recognition of professional accomplishment.

Photos by Lloyd Wilson and Stephanie Blackwell (New Mexico) and Randy Wong (California)

Senior Scientists/Engineers


Susan Esfahani 2600
Electronics Engineering


Tina Nenoff 1100
Materials Science


Gary Polansky 5400
Systems Engineering


Patrick Sena 2200
Mechanical Engineering


Scott Slezak 400
Systems Engineering


Hy Tran 2500
Mechanical Engineering


Jeffrey Brewer 411
Systems Engineering

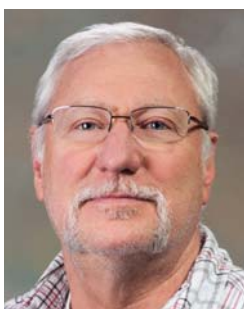

Laurence Brown 163
Program Development


Polly Gutierrez 153
Administrative Support

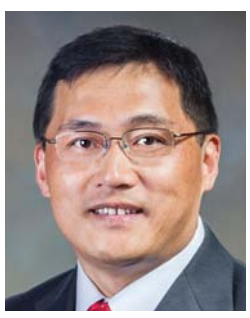

Frances Martinez 91
Administrative Support

Organizations 90, 100, 400

Division 1000


Howard Anderson 1833
Laboratory Support Technologist


Todd Bauer 1746
Electronics Engineering


Hongyou Fan 1815
* Promoted to Manager


Brian Franke 1341
Computer Science


Kathryn Hanselmann 1932
Technical Business Development


John Hewson 1532
Mechanical Engineering


Richard Hills 1544
Mathematics


John Hofer 1521
Laboratory Support Technologist


Patrick Lake 1675
Microelectronics/Semiconductor Technologist


Andrew Landahl 1425
Computer Science


Anthony Lentine 1765
Optical Engineering


Ricky McFarland 1755
Test Operations Engineering


Genaro Montoya 1933
Technical Business Development

Division 2000


Gary Ashcraft 2662
Computer Science


Leonard Buchholz 2521
Solutions Architect


Jeffery Cherry 2159
Mechanical Engineering

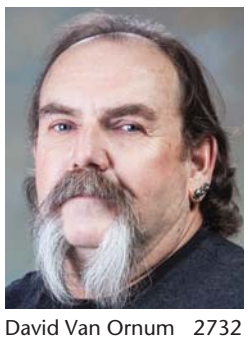

Thomas Denman 2242
Electronics Engineering


Randy Harrison 2137
Systems Engineering


Ian Thomas Kohl 2554
Laser/Optical Technologist


Arlene Lucero 2913
Publications Support


Adrian Miura 2982
Solutions Architect


David Van Ornum 2732
Engineering Support Technologist


Michael Partridge 2627
Electronics Engineering


Daniel Petersen 2613
Mechanical Engineering


Jason Podsednik 2244
Engineering Support Technologist

68 Sandians move into Distinguished ranks

Division 2000

Philip Rodacy 2555
Materials Science

Division 3000

Pamela Catanach 3652
Community Relations

Shelby Green 3522
Organizational Development

Neal Singer 3651
Corporate Communications

Steven Showalter 2547
Chemical Engineering

Danelle Tanner 2632
Electrical Engineering

Michael Tritt 2615
Electromechanical Technologist

Division 4000

Richard Dramer 4824
Facilities Technologist

Andrew Zeitler 4122
Safety Engineering

Division 5000

James Felix 5645
Cybersecurity

Thomas Loughry 5521
Computer Science

Division 6000

Stanley Atcitty 6111
* Promoted to Manager

Timothy Brown 6625
Mechanical Engineering

Division 8000

Scott Bisson 8128
Physics

Arthur Brown 8259
Mechanical Engineering

Robert Copeland 6122
Laboratory Support Technologist

Abraham Ellis 6112
* Promoted to Manager

Ernest Hardin 6224
Nuclear Engineering

Samuel Leininger 6813
Engineering Support Technologist

Winalee Carter 8511
Classification Technical Reviewer

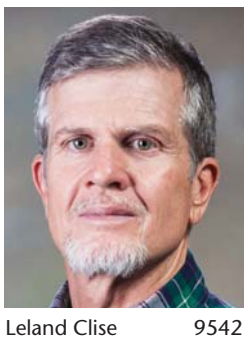
Michele Kahn 8949
LAN/WAN Support Technologist

Albert Talin 8342
Material Science

Division 9000

Roger Adams 9338
Computer Systems

Joseph Brenkosh 9338
Computer Systems



Leland Clise 9542
Solutions Architect

Timothy Meeks 9513
Solutions Architect

Alex Quintana 9317
Cybersecurity

Photos unavailable

Thomas Hafenrichter 5943
Mechanical Engineering

Terrence Kraus 6631
Nuclear Engineering

Deborah Espinosa 10223
Performance Assurance Analyst

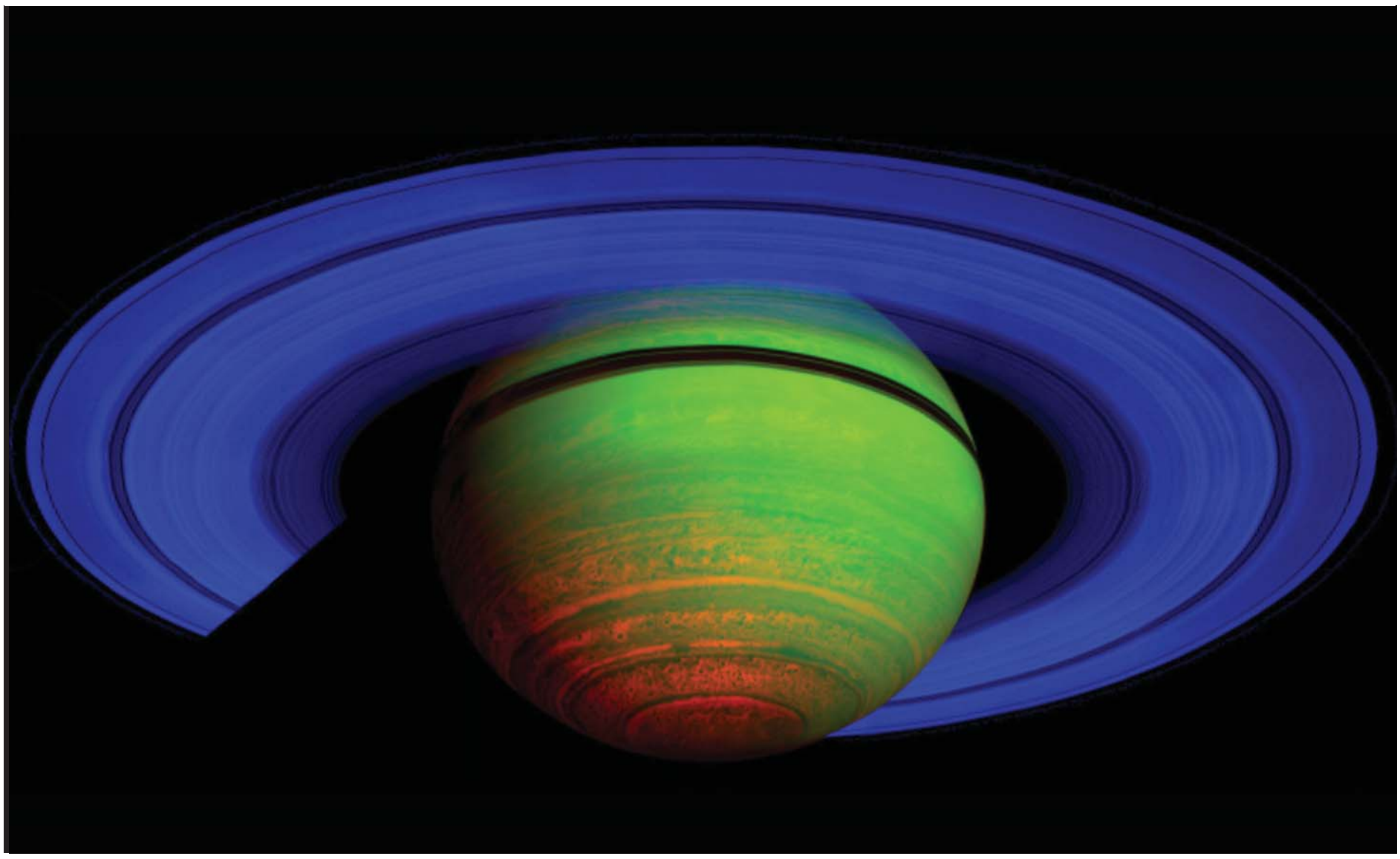
Nikki Lobato 10665
Business Management Professional

Connie Lueras 10675
Administrative Support

MaryAnn Prieto 10598
Administrative Support

Division 10000

How does Saturn hide its age?



RESULTS FROM SANDIA'S Z MACHINE provide hard data for an 80-year-old theory that could correct mistaken estimates of the planet Saturn's age. In this false-color image made from data taken in 2008 by *Cassini's* visual and infrared mapping spectrometer, heat emitted from the interior of Saturn shows up as red. (Image credit: NASA/JPL/ASI/University of Arizona)

Sandia's Z machine helps solve Saturn's 2-billion-year age problem

Research supports 80-year-old prediction regarding molecular hydrogen under pressure

By Neal Singer

Planets tend to cool as they get older, but Saturn is hotter than astrophysicists say it should be without some additional energy source.

The unexplained heat has caused a 2-billion-year discrepancy for computer models estimating Saturn's age. "Models that correctly predict Jupiter to be 4.5 billion years old find Saturn to be only 2.5 billion years old," says Thomas Mattsson, high-energy-density physics theory group manager (1641).

Experiments at Sandia's Z machine may have helped solve that problem when they verified an formerly untested 80-year-old proposition that molecular hydrogen, normally an insulator, becomes metallic if squeezed by enough pressure. Physicists Eugene Wigner and Hilliard Huntington predicted in 1935 that a pressured lattice of hydrogen molecules would break up into individual hydrogen atoms, releasing free-floating electrons that could carry a current.

"That long-ago prediction would explain Saturn's temperature because when hydrogen metallizes and mixes with helium in a dense liquid, it can release helium rain," says Mike Desjarlais (1600). Helium rain is an energy source that can alter the evolution of a planet.

"Essentially, helium rain would keep Saturn warmer than calculations of planetary age alone would predict," says Marcus Knudson (1646). Marcus and Mike are the lead authors of a June 26 *Science* article, "Direct observation of an abrupt insulator-to-metal transition in dense liquid deuterium."

This proposed density-driven hydrogen transition had never been observed experimentally until Sandia's recent experiments.

The tests ran on Sandia's Z machine, the world's most powerful pulsed-power machine, which sends a huge but precisely tuned sub-microsecond pulse of electricity at a target. The correspondingly strong magnetic field surrounding the pulse was used to shocklessly squeeze deuterium — a heavier variant of hydrogen — at relatively low temperatures. Previous experiments elsewhere used gas guns to shock the gas. This increased its pressure but at the same time raised its temperature beyond the range of interest for the density-driven phase transition.

A transition at 3 megabars of pressure

"We started at 20 degrees Kelvin, where hydrogen is a liquid, and sent a few-hundred kilobar shock — a tiny flyer plate pushed by Z's magnetic field into the hydrogen — to warm the liquid," says Marcus. "Then we used Z's magnetic field to further compress the hydrogen shocklessly, which kept it right above the liquid-solid line at about 1,000 degrees K."

Says Mike, "When the liquid was compressed to over 12 times its starting density, we saw the signs that it became atomic rather than molecular. The transition, at 3 megabars of pressure, gives theorists a solid figure to use in their calculations and helps identify the best theoretical framework for modeling these extreme conditions."

The results need to be plugged into astrophysical models to see whether the now-confirmed transition to atomic hydrogen significantly decreases the age gap between the two huge planets.

"The Sandia work shows that dense hydrogen can be metallic, which in turn changes the coexistence of hydrogen and helium in the planet," says Thomas. "The mechanism of helium rain that has been proposed is therefore very plausible, given our results, but the scientific discussion will continue over the next few years in establishing a new consensus."

Interestingly, the determination that a metallic phase was reached was made optically. "There's too much electrical noise in Z to make an electrical test, though we plan to directly measure current down the road," Marcus says.

Optical tests rely on the transition from zero reflectivity (insulators) to the reflectivity achieved by metals.

"The only way you get reflectivity is when a material is metallic," Marcus says. Reflectivity was tested across the visible spectrum because the experiment itself produced light. "We collected it, put it through a spectrometer to disperse it, and passed it into a camera to observe it."

When the hydrogen insulator reached enough pressure to become metallized, the researchers observed 45 percent reflectivity, an excellent agreement with theoretical calculations, says Mike.

"This is a very nice merging of theory and experiment," he says. "We threw all our computational tools — which are significant — at providing verification and interpretation of the complex experimental observations at Z."

The work was done in collaboration with professor Ronald Redmer's research group at University of Rostock in Germany and is a part of the Z Fundamental Science Program at Sandia. The multidisciplinary team included researchers with expertise in innovative experimental design, diagnostics, and pulse-shaping capabilities, matched with theoretical analysis using methods based on quantum mechanics.

Other authors besides Marcus, Mike, and Thomas include Redmer and Andreas Becker at University of Rostock, Ray Lemke and Kyle Cochrane (both 1641), Mark Savage (1651), and Dave Bliss (1675).

The Z machine is a National High Energy Density Science Facility supported by the NNSA.

New NNSA Sandia Field Office Manager Jeff Harrell emphasizes shared mission

By Bill Murphy

Jeff Harrell is clear about the priorities that will drive his leadership as the new manager of NNSA's Sandia Field Office.

"Priority one is what we've had for a long time: to make sure we put national security at the forefront of everything we do," Harrell says. "That is our core mission and it's incredibly important for our nation—especially right now."

Harrell, who since 2009 had served as assistant deputy administrator for NNSA's Office of Secure Transportation, assumed his role as SFO manager in April.

Related to keeping the focus on the national security mission, Harrell adds, "We are here to accept the work we're given and make sure we get it done and get it done right. And when I say 'we' I mean Sandia and the Field Office."

Harrell notes that he stepped into a position in which the relationship between Sandia and the Field Office was already "on a good footing." He says he wants to ensure that the "very positive" relationship continues to mature. "We want to build on that," he says.

A graduate of the US Air Force Academy, Harrell served in the USAF for 25 years, logging 3,300 flying hours, including more than 100 combat hours in the F-16. Serving in roles of increasingly leadership responsibility in the Air Force, Harrell's last assignment before retiring was as vice commander of the 27th Fighter Wing, Cannon Air Force Base, New Mexico.

After leaving the Air Force in 2006, he continued to work for the federal government, joining the Senior Executive Service and heading up DOE's National Training Center in Albuquerque.

NNSA SANDIA FIELD OFFICE Manager Jeff Harrell, right, who has been on the job since April, confers with Tom Zipperian, director of Neutron Generator Enterprise Center 2700, about Sandia's neutron generator-related work. (Photo by Randy Montoya)

"Our job is to see the success of the Labs and we're successful in the Field Office when Sandia is successful. I really do believe it's a partner relationship. In the Field Office, we have responsibilities to ensure that things are done right, are done in a safe and secure manner, that we're doing everything legally, but right along with that we want to make sure that we're helping you get the work done, that we provide assistance when needed. It's working hand in hand, it really is."

— Jeff Harrell, NNSA Sandia Field Officer Manager

Getting the right talent

In addition to the intrinsic challenges of executing a complex portfolio of national security work, Harrell says Sandia — and the Sandia Field Office — face a couple of notable longer-term challenges.

"If you look at the most important thing that we possess, and the most important consideration for the future, it's, first, the right people," he says. "To accomplish our mission, it's essential that we have the right skill set, the right talent. That's especially true in skilled technical positions, where the competition with outside industry is incredibly intense.

"The other piece is the infrastructure: We have buildings all across the NNSA — and not just here at Sandia — that are very old. We have facilities that are old; we have equipment that is old. We need to make sure that we keep that modernized.

"We have a couple of projects that [Sandia Executive VP for National Security Programs] Steve Rottler and I have talked about recently — specifically about the need to update Sandia's microfabrication capability. We need to make sure Sandia stays at the forefront of that technology, because resources outside of Sandia may no longer be there in the future. So, as I see it, the biggest challenges right now are infrastructure and people."

"I really didn't realize the breadth of the work that's done here. When I look at the organizational chart for the Field Office and I see where our SMEs — our subject matter experts — are, it's not just in weapons work. It's in all kinds of things. So whether it's environmental protection, safety, security, whether it's the programs and projects the Labs is working on, it's just incredibly broad."

— NNSA Sandia Field Office Manager Jeff Harrell

Harrell emphasizes that infrastructure is about more than buildings, roads, and equipment. "The cyber infrastructure, cyber software, is going to be critical," he says. "That's been in the news a lot lately and it's a very serious concern for us. Cybersecurity is one of the things we're watching very closely."

When Harrell became head of the Sandia Field Office, he was already familiar with Sandia, particularly its weapons work. But he still found some things that surprised him.

Scope of Sandia's work is impressive

"I really didn't realize the breadth of the work that's done here," he says. "When I look at the organizational chart for the Field Office and I see where our SMEs — our subject matter experts — are, it's not just in weapons work. It's in all kinds of things. So whether it's environmental protection, safety, security, whether it's the programs and projects the Labs is working on, it's just incredibly broad.

"The other thing that has impressed me has been the close relationship between Sandia's leadership and the Field Office. I didn't know what to expect, but the tie-in, especially at the vice president level, and the cooperation between that level and above and the Field Office, has made a great impression."

The relationship between the Labs and the Sandia Field Office is synergistic, Harrell says, noting that the Field Office's responsibility to administer the terms of the management and operations contract between Sandia Corp. and DOE/NNSA includes such routine but important functions as ensuring the bills are paid, but also ensuring that the work performed by the Laboratories is aligned with the terms of the contract as published.

"If I had to define the mission of the Field Office, that's it, but there's really more to it. The important thing is that we work together for the national interest. I am going to use a phrase that's probably been used by every field office manager out there: Our job is to see the success of the Labs and we're successful in the Field Office when Sandia is successful. I really do believe it's a partner relationship. In the Field Office, we have responsibilities to ensure that things are done right, are done in a safe and secure manner, that we're doing everything legally, but right along with that we want to make sure that we're helping you get the work done, that we provide assistance when needed. It's working hand in hand, it really is."

Harrell leads a staff of 83 NNSA/SFO federal personnel to oversee a laboratory that employs more than 10,000 people. That lean team, Harrell says, "is an indication of Sandia's demonstrated ability to manage itself, which is reflected in the number of people we need to oversee the laboratory. If there were greater issues and concerns [with Sandia's self-management and assurance systems] we'd need more presence and more involvement. The fact that we don't says a lot about Sandia's leadership."

An issue that will assume increased visibility over the next year and a half or so is DOE/NNSA's plan to rebid the management and operation contract for Sandia Corp., a contract held by Lockheed Martin Corp. since 1993. Harrell says he doesn't think the rebid process will prove to be a significant distraction for Sandia.

"The Labs and the Sandia Field Office both know that the focus needs to be on the mission at hand," he says. "So as long as we stay focused on getting the mission done — providing service to the nation — there shouldn't be any special concerns. This is a process that NNSA goes through periodically. I really don't see anything that's going to change the strong relationship between NNSA and Sandia Corporation."

Mileposts

New Mexico *photos by Michelle Fleming*
California *photos by Randy Wong*

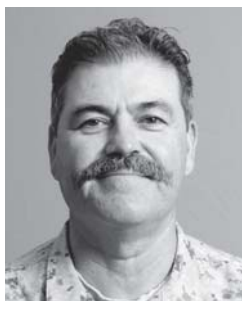

Scott Anderson
35 2221


Jeana Brosseau
35 11000


Cathy Farnum
35 6231


Fran Nimick
35 1010


Graham Yelton
35 1728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Cynthia Caton
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Dennis Lierz
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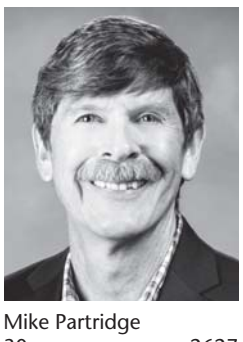
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Barbara Jennings
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Mark Johnson
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Emily Lujan
25 10614


Terri Macias-Torres
25 4824


Rebecca (Becky) Martinez
25 10501


Douglas Nordquist
25 10620


John Parmeter
25 6633


Kent Robbins
25 4122


Kevin Seager
25 5944


Melissa Sisneros
25 2955


Alan Wright
25 1131


R. Sheryl Vahle
25 10656


Ed Brady
20 5339


Timothy Berg
20 8940


John Burns
20 5544


Rich Field
20 1523


Cecily Glissman
20 153


Mark Grazier
20 1831


Matt Hankins
20 2723


Marcey Hoover
20 8040


Chuck Rhykerd
20 2555


Lisa Trainor
20 90

Recent Retirees

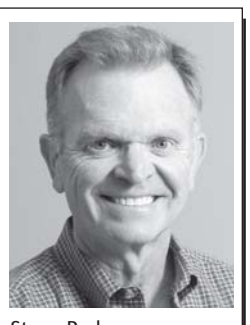

Michael Vahle
37 9000


James Walker
37 421


Jerry McDowell
34 250


Rick White
31 422


Guylaine Pollock
29 5621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Elaine Herrera
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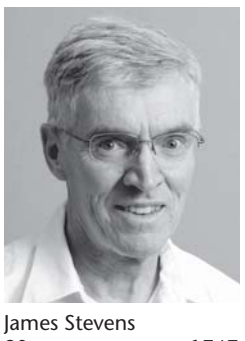
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Terry Hinnerichs
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Dave Arpin
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Gracie Martinez
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Joniva Mondragon
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