



Hammer blows

Geothermal drilling tool can take the heat

By Sue Major Holmes

Sandia and a commercial firm have designed a drilling tool that will withstand the heat of geothermal drilling.

The downhole hammer attaches to the end of a column of drill pipe and cuts through rock with a rapid hammering action similar to a jackhammer. Downhole hammers are not new — the oil and gas industry and mining have used them since the 1950s — but the older design, with its reliance on oil-based lubricants, plastic, and rubber O-rings, isn't suited for the hotter temperatures of geothermal drilling.

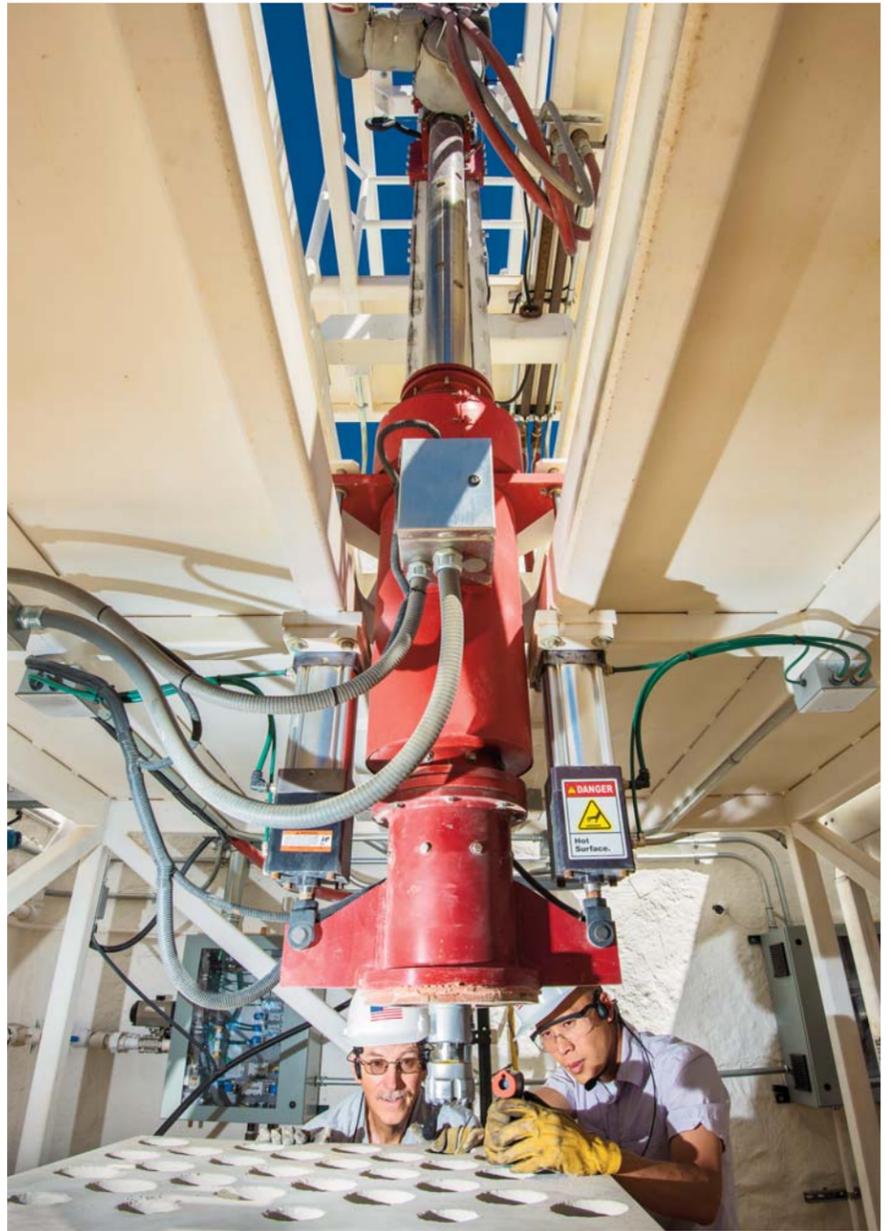
"The technology behind the new hammer is fundamentally the same, but Sandia worked with a Sweden-based company, Atlas Copco, in material selection and dry lubricant technology that will work in the high-temperature environment," says mechanical engineer Jiann Su (6916), Sandia's principal investigator on the project with Atlas Copco, which operates worldwide and makes specialized equipment and systems for drilling, mining, and construction.

DOE's Geothermal Technology Office funded Atlas Copco as prime contractor on the project, and the company partnered with Sandia as the subcontractor.

"Part of what the DOE's Geothermal Program is looking to do is help lower the cost of getting geothermal energy out to customers," says Jiann. "Some of reducing the cost is lowering

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DOWNHOLE HAMMER RESEARCH — Technologist Elton Wright assists as mechanical engineer Jiann Su inspects a down-the-hole hammer used to drill at Sandia's high operating temperature (HOT) test facility. Sandia and Swedish firm Atlas Copco designed, built, and tested the drilling tool that will withstand the heat of geothermal drilling. (Photo by Randy Montoya)



Meet Sandia's grad student rock stars Page 3

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Studying a critical HIV protein

Researchers at Sandia, Northeastern develop method that could also work on other diseases

By Mollie Rappe

More than 36 million people worldwide, including 1.2 million in the US, are living with an HIV infection. Today's antiretroviral cocktails block how HIV replicates, matures, and gets into uninfected cells, but they can't eradicate the virus.

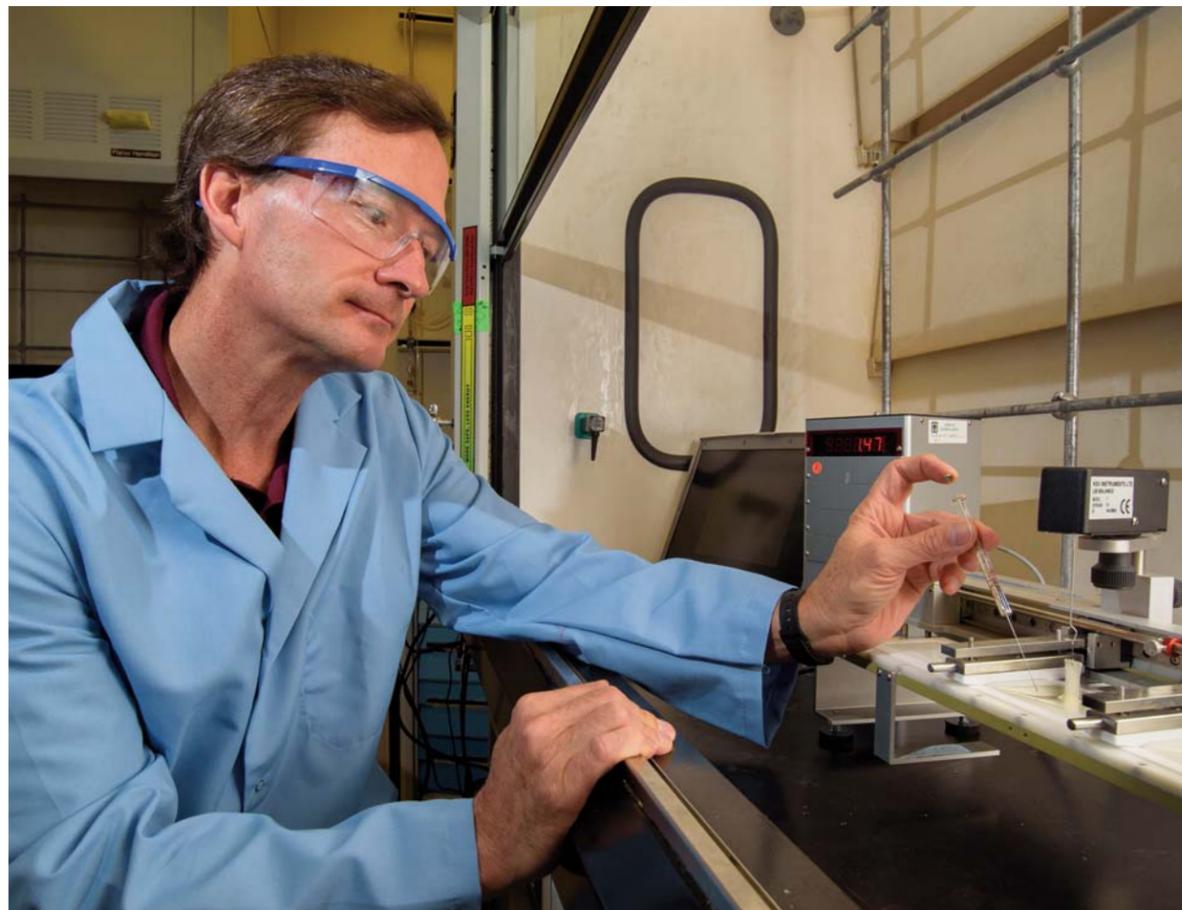
Mike Kent (8635), a researcher in Sandia's Biological and Engineering Sciences Center, is studying a protein called Nef involved in HIV progression to AIDS with the ultimate goal of blocking it. He and his collaborators have developed a new hybrid method to study this HIV protein that compromises the immune system. The method also could work on many other proteins that damage cellular processes and cause diseases.

Nef goes to the membrane of the infected cell and tricks the cell into destroying its own immune system signaling receptors, allowing the infected cell to evade the immune system. Nef also hijacks cellular communications to make it easier for the virus to reproduce. In order to interact with the host proteins, Nef needs to change shape.

This shape-changing protein is so important that rhesus monkeys infected with a version of the closely related Simian immunodeficiency virus that lacks the Nef protein don't develop immune deficiency symptoms.

"Nef is a protein essential for AIDS. It accomplishes its

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MIKE KENT DEVELOPED a new hybrid technique to study how a critical HIV protein changes shape to allow infected cells to evade the immune system. Mike used a specially designed Languir trough for his experiments. (Photo by Randy Montoya)

That's that

In *The Wasteland*, T.S. Eliot wrote "April is the cruellest month," which seems to be an odd way to describe a time of year when, after its winter's sleep, the world is awakening. But for the poem's narrator, the coming of spring re-kindles memories of things that have passed, things painful to think about, things lost to time. In *The Wasteland*, April is a month of memory and desire, but desire unrequited.

It's a depressing perspective, of course, but I understand it. Over the years, as high summer has approached, I've often thought of Eliot's line, but I substitute "July" for "April."

It was in mid-July almost a half-century gone now, that America put Neil Armstrong and Buzz Aldrin on the moon, the culmination of the most exciting, audacious, creative, and demanding technological effort ever undertaken.

We chose to go to the moon, as President Kennedy said, precisely because it was hard. The moon program demanded something from everyone; for some it demanded everything. Lives were lost and families split asunder. Make no mistake: This was an expensive undertaking, expensive in every way that costs can be measured. But we did it.

Following the Apollo 11 triumph, we dipped our toes back into that sea a few more times and then we stopped. After 1972 we never went back. The space shuttle program, while technically impressive and scientifically valuable, was stuck in low Earth orbit and never filled the void left by the abandoned Apollo enterprise.

I watched a documentary a few weeks ago called *The Last Man on the Moon* about astronaut Eugene Cernan. There's a scene where the filmmaker takes him back to Cape Kennedy and follows him as he wanders around some of the infrastructure put in place for the Apollo program. Walking through the crumbling concrete remains overgrown with weeds, a visibly emotional Cernan says he can hardly stand to see it.

When he stepped off the moon for the final time in December 1972, Cernan must have been confident we'd be returning soon, setting up permanent science stations, learning more about living and working in "this new ocean" as President Kennedy, that lifelong man of the sea, called it. After such a heroic effort at such a cost, how could we not go back? But we didn't.

So for me, July can sometimes feel like the cruellest month, but even painful memories have value. If July reminds us of what might have been, it also stands as witness to what we can accomplish when we're "all in" as a society.

And I am not without hope: After several decades where plans to return to the moon were never much more than talk, it appears we may be serious about going back. NASA's building the hardware and training the crews, this time with a budget to back them up. And they're not alone; other nations are in the mix and so are private-sector entrepreneurs.

So, yes, we will go back, but it has been a long 50 years. And even though we've done it before, it's still a hard thing to do, maybe harder than before because we have a much lower tolerance for risk than we did when the Cold War stakes were so huge.

President Kennedy would approve of doing the hard things again. He would understand, too, the words from songwriter Jimmy Webb: *See her as she flies/ Golden sails across the sky/ Close enough to touch/ But careful if you try/ Though she looks as warm as gold/ The moon's a harsh mistress/ The moon can be so cold . . . The moon's a harsh mistress/ She's hard to call your own.*

* * *

A lot of the early astronauts have written memoirs about the Apollo era. I think I've read most of them and enjoyed every single one. My favorite is Michael Collins' *Carrying the Fire*. Collins was the third man in the Apollo 11 mission; he kept station in lunar orbit in the command module as Neil and Buzz made history.

In his book, Collins offered an interesting perspective about Apollo 11 and the earlier Apollo 8 mission. For him, Apollo 8, the December 1968 lunar orbital mission, was, philosophically, the more profound flight. With Apollo 8, humankind for the first time was offered a choice: to stay at home or to shake off Earth's gravitational shackles and travel the cosmos. It was with Apollo 8, not Apollo 11, Collins noted, that we decided to go, to leave. Our final destination? As Capt. James T. Kirk said in *Star Trek: The Motion Picture*: "Out there... thataway."

See you next time.

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

Buster Dial, pictured in iconic 9/11 Sandia photo, passes away



The images from 9/11/2001 stayed in the mind long after the horrific events of that day, seared into the memory, painful to remember and impossible to forget.

But for Sandia employees in 2001, there was another 9/11 image, one of hope and optimism, resilience and pride. That was the image of Security Police Officer Buster Dial silhouetted behind the red, white, and blue of the flag as he prepared to raise it over the Laboratories' main building on a bright September morning.

Sandia photojournalist and *Lab News* photographer Randy Montoya recalls the circumstances of the unforgettable photo.

"I crossed paths with Buster Dial often as he guarded and protected Sandia," Randy says. "He was always humble and was kind to everyone, even photographers."

"I photographed Buster twice — first when he was one of 14 Sandia Pro Force officers to share in a big Powerball lottery win. After that, I thought I'd never see him again, but Buster didn't take well to being a millionaire; he was back on the job a few months later when 9/11 occurred."

"When I shot this second photo of Buster, President Bush had ordered the nation's flags to be flown at half staff. I was looking for a patriotic photo for the front page of the *Lab News* when I saw Buster getting ready to raise the flag in front of Bldg. 800. The morning had been calm but the wind suddenly swirled, bringing the flag to life in his hands. As he raised it to the top of the pole, the flag waved boldly. As he lowered it back down to half staff, the wind died down and the air was peaceful and still."

Almer "Buster" Dial died June 23 in Estancia, where he was a lifelong resident, at the age of 73. Before coming to Sandia, Buster served in the US Army, and was a building contractor and Torrance County deputy sheriff.

Retiree deaths

John Mckiernan (age 93)	April 7
Walter Brock (87)	April 9
C. Brent Williams (53)	April 11
Paul Field (90)	April 13
David Ericson (83)	April 13
William Doyle (89)	April 17
David Davis (77)	April 19
Avelina DuBois (100)	April 20
Paula Webb (57)	April 22
Edward Roth (93)	April 24
Lorraine Sanchez-Guerra (68)	April 26
Theodore Ortega (86)	May 3
Edward Vulgan (90)	May 6
Patricia Anderson (94)	May 10
William Stevens (87)	May 10
William Carroll (83)	May 11
Robert Hughes (85)	May 12
Marcella Watkins (95)	May 15
Joshua Richter (41)	May 16
Donald Graham (88)	May 19
James Craig (90)	May 19
Gerald Esch (68)	May 19
Guadalupe Alameda (76)	May 20
Sencionita Jaramillo (81)	May 22
Helen Gaither (87)	May 23
James Ritson (56)	May 27
David Kendall (84)	May 29
Herbert Floyd (85)	May 29
Lawrence Ford (77)	June 1
G. Michael Heck (75)	June 6
John Simchock (86)	June 6
Merle Elifritz (91)	June 14
Alan Skinrood (85)	June 16
Frank James Conrad (84)	June 16
Richard Volk (87)	June 18
Hermenés Baca (86)	June 18
Harry Morris (81)	June 23

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Bill Murphy, Editor 505/845-0845

Randy Montoya, Photographer 505/844-5605

Patti Koning, California site contact 925/294-4911

Michael Lanigan, Production 505/844-2297

Contributors: Michelle Fleming (Ads, Milepost photos, 844-4902), Neal Singer (845-7078), Patti Koning (925-294-4911), Stephanie Holinka (284-9227), Darrick Hurst (844-8009), Heather Clark (844-3511), Sue Holmes (844-6362), Nancy Salem (844-2739), Tim Deshler (844-2502), Valerie Larkin (284-7879), Lindsey Kibler (844-7988), Rebecca Brock (844-7772), Valerie Smith, manager (844-6167)

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Former Army ranger receives Sandia-Livermore Chamber of Commerce Student of the Year Award

By Michael Padilla

Former Army ranger Damon Alcorn has received the Sandia National Laboratories-Livermore Chamber of Commerce Student of the Year Award. Presented at the chamber's State of the City Luncheon on June 23, the annual award highlights a Las Positas College student who demonstrates exemplary academic achievements and leadership.

Born and raised in the Bay Area, Alcorn graduated cum laude from California State University, East Bay, in 2004 with a bachelor's in history. That same year Alcorn enlisted in the US Army. After completing infantry training, airborne school, and the Ranger Indoctrination Program, he was assigned to the 3rd Battalion, 75th Ranger Regiment.

After his military service, Alcorn received a master's in liberal arts from California State University, Sacramento. Upon graduation he worked in the private sector in corporate communications and public relations.

In 2012 he enrolled at Las Positas College, where he studied computer science and network security and administration. This spring, Alcorn received an associate of science in engineering technology.

In the fall of 2014, Alcorn joined the Engineering Technology Program at Las Positas, a collaboration between the college and Lawrence Livermore National Laboratory (LLNL). In the summer of 2015, Alcorn interned at LLNL's National Ignition Facility and was hired as a student employee by the lab's Institute for Scientific Computing Research. Simultaneously, he participated in NASA's National Community College Aerospace Scholars program at the Armstrong Flight Research Center at Edwards Air Force Base.

Next month he will begin pursuing a master of science in computer science at the Naval Postgraduate School in Monterey.

Madeline Burchard (8524), community relations officer for Sandia/California who helped present the award to Alcorn, says education in science, technology, engineering, and math fields is a key element of Sandia's mission.

"Since Sandia National Labs' inception, we have invested in education," Madeline says. "It is part of our culture to give back and it's a value that we have carried over the past 66 years. We want to inspire the next generation of scientists and engineers."



LAS POSITAS COLLEGE PRESIDENT Barry Russell, left, and Sandia/California community relations officer Madeline Burchard present Damon Alcorn with the Sandia National Laboratories-Livermore Chamber of Commerce Student of the Year Award. (Photo by Michael Padilla)

Sandia physicist Jim Bailey wins APS John Dawson award

By Neal Singer

By testing bits of iron at the temperature of the sun, Jim Bailey (1683) and his team have provided key data to improve the Standard Solar Model, widely used by astrophysicists to help model the behavior of stars.

For this work, Jim will receive the American Physical Society's annual John Dawson Award for excellence in plasma physics research.

Says Jim, "I am thrilled to receive the 2016 APS Dawson Award. It is an honor not only for me, but also for my multi-institutional team and the Pulsed Power Sciences Center at Sandia. I worked on this project for more than a decade and it is an extraordinary feeling to know that my peers believe it was time well spent."

He adds that "the achievement was clearly enabled by my talented Sandia teammates: Greg Rochau (1680), Taisuke Nagayama and Guillaume Loisel (both 1683), and Stephanie Hansen (1684). We benefited from consistently supportive management and the opportunity to perform experiments with the Sandia Z facility, one of the world's preeminent scientific instruments."

The exacting work measured iron's capacity to hinder the migration of energy originating deep in the sun's interior. Jim and his team were able to determine that iron's ability to absorb X-ray radiation near the edge of the sun's radiative zone was much greater than formerly surmised. The new, experimentally derived figures provided a dose of reality to the models of theoreticians.

"The exquisite measurements made by Jim and his colleagues have triggered enormous interest in the stellar and high energy density physics communities," says Keith Matzen, director of Sandia's Pulsed Power Center 1600. "These results, from data collected over years, show the growing importance of pulsed power as an experimental platform to study laboratory astrophysics."

Says Mike Campbell, deputy director at the Laboratory



PHYSICIST JIM BAILEY inspects a wire array at Sandia's Z machine that will heat foam to roughly 4 million degrees until it emits a burst of X-rays that heats a foil target to the interior conditions of the sun. (Photo by Randy Montoya)

for Laser Energetics at the University of Rochester, "While previous Dawson awards for this field have been awarded to work with lasers, this is the first for a pulsed power machine like Z."

In the words of the society, the award was made "for extraordinarily thorough laboratory opacity measurements of plasmas at realistic stellar interior conditions that directly resolve outstanding questions about solar structure, identify new theoretical challenges, and propel a new generation of precision high energy density experiments of direct astrophysical relevance."

John Dawson was among the first to realize that computers had become powerful enough to model clouds of particles that formerly had been the object of laboratory experiments. The simulation method has since spread to many areas of science and technology and is usually considered on an equal footing with experimental and theoretical techniques. However, the three techniques work best when used to check each other.

Jim will receive the award, consisting of a monetary stipend and certificate, at the APS Division of Plasma Physics meeting in San Jose, California, Oct. 31-Nov. 4.

Downhole hammer

(Continued from page 1)

exploration and development costs, and that's one of the areas we're helping to tackle."

The Geothermal Energy Association's 2016 annual production report says the US had about 2.7 gigawatts of net geothermal capacity at the end of 2015. In addition, the US market was developing about 1,250 megawatts of geothermal power, and new renewable portfolio standards in states such as California and Hawaii could create opportunities for geothermal energy, the report says.

Jiann says the high-temperature hammer could help reach those development goals.

A plus for drillers

Jiann considers the just-finished three-year project a success, and says the team and Atlas Copco are looking for opportunities to deploy the tool.

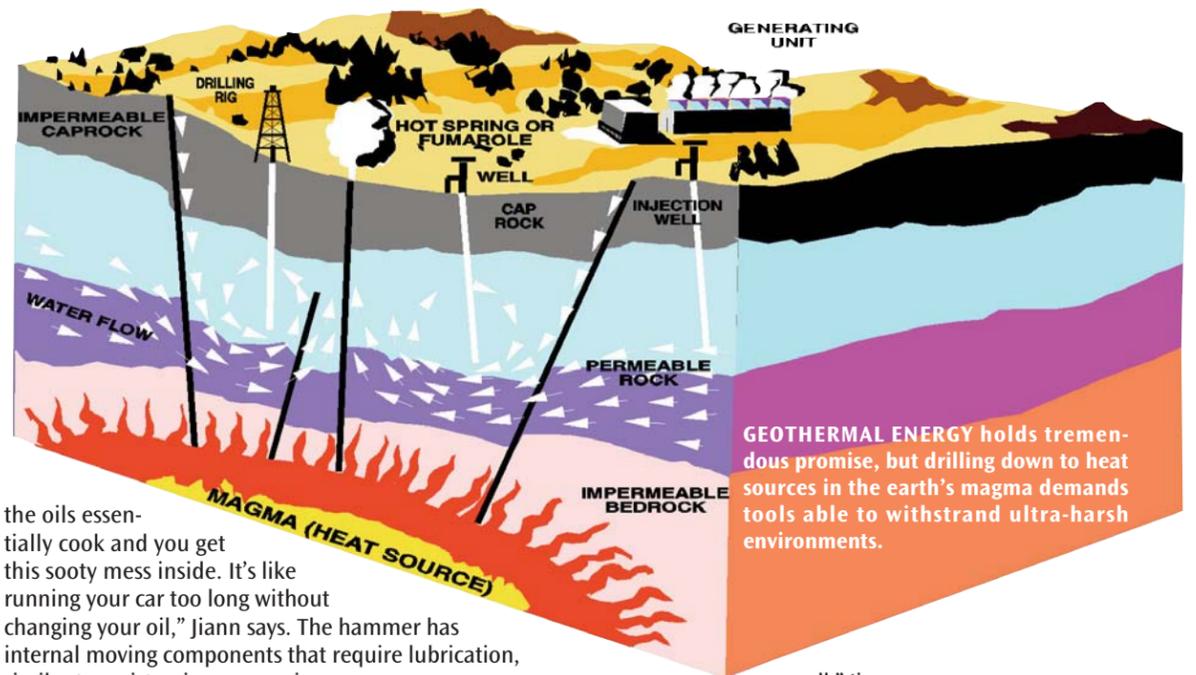
"We developed a tool that can be used in high-temperature environments that can help increase the drilling rates and the rate of penetration to maybe 5 to 10 times that of conventional drilling operations, so that's a big plus for drillers," he says. "It adds to the available options drillers have. This is not necessarily the final option for every drilling situation but it does provide a good option for the right situation."

"This is not necessarily the final option for every drilling situation but it does provide a good option for the right situation."

Atlas Copco turned to Sandia for its expertise in materials, understanding about how moving surfaces interact, and high-temperature testing and operations.

"Atlas Copco is the expert at designing and manufacturing the hammers, but Sandia is better equipped to handle the high-temperature challenges, the lubrication, and materials," Jiann says. "And high-temperature testing isn't something that Atlas Copco typically does."

A critical piece of the project was developing lubricious coatings, which help reduce friction between parts, important in geothermal operations. "As temperatures increase,



the oils essentially cook and you get this sooty mess inside. It's like running your car too long without changing your oil," Jiann says. The hammer has internal moving components that require lubrication, similar to a piston in a car engine.

His team's work on materials and lubricious coatings built on decades of Sandia research in those areas. The team worked with Sandia's Materials Science and Engineering Center on a multilayer solid lubricant capable of operating at high temperatures. Similar solid lubricants are used commercially, for example, to improve the lifespan of moving components in cars, but Jiann's team worked with a formula tailored to the operating conditions and base materials.

"If we were starting from scratch, the difficulty level would have been high, but since Sandia has a history of experience in that arena we had some idea of what to start with," he says. "It made things a lot easier."

Development took three years

The project began by determining whether a high-temperature hammer was even possible. The Sandia team initially tested materials and coating combinations that would survive the expected environments while Atlas Copco designed a hammer without plastic parts, Jiann says. They proved the concept, and the project spent the next two years building hammers and a facility for high-temperature testing.

The hammers proved successful. "We were able to reach our drilling rates, the materials held up, the coatings worked

well," Jiann says.

Sandia's new facility is designed to test hammers under real-world operating conditions, including temperatures up to 572 degrees Fahrenheit (300 degrees C). Conventional drilling generally sees temperatures of less than 320 degrees F (160 degrees C).

The high operating temperature (HOT) test facility, a three-sided open concrete structure, houses a 20-foot-tall drill rig, heating chamber, and process gas heater. Researchers can simulate conditions deep underground and the elevated temperatures affecting the hammer and can drill into different types of rock, like the granite commonly found in geothermal-rich areas. The facility is instrumented to measure drilling parameters.

HOT was in itself a large project. "We took a little more time in the development process but when we put it all together, everything worked pretty much as we expected it to," Jiann says. The work required integrating multiple subsystems, including electrical, mechanical, pneumatic, and control systems. Sandia also worked with Atlas Copco about what instrumentation was required to collect the necessary data.

"We're using the facility for other activities that we're doing now," such as developing drilling automation, Jiann says. "That's a plus for Sandia."

Getting to know you All about Sandia's Early Career Outreach group

By Mollie Rappe

Starting a new job is hard. It's even harder when you've just moved to the area like many new Sandians.

The Early Career Outreach (ECO) group strives to make that transition easier — and provide extracurricular activities accessible to everyone across the Labs — by hosting social and philanthropic events.

"You not only build that network of friends, acquaintances, and co-workers, but also you get to explore Albuquerque and do some things you probably wouldn't do on your own. We're trying to make Albuquerque as a whole more enjoyable because we don't spend all of our time here at work. Also the more people you know at Sandia, the better off you are at work too," says Kara Smith (9540), one of the founders of ECO.

By providing an avenue for people to meet like-minded professionals in informal environments, ECO aims to foster personal and professional networking, encourage career growth and informal mentorship, and even promote stronger ties to Albuquerque. This August, Kara and other members of ECO will spend one weekend working on Sandia's 15th Habitat for Humanity house.

It all started in California

When Kara and her sister Kayla Smith (9540) did a 20-month stint at Sandia/California they felt alone. They didn't have any other family out there. It was hard for them to meet people. There were tons of things to do in the area, but they didn't have anyone to do them with.

When they returned to Sandia/New Mexico, the sisters along with co-founder Lindsey Wareham (9540) set out to fill this need. They gathered a group of like-minded individuals to form the leadership team, they found a champion, they built a SharePoint site, and last December they held their first event — a happy hour at Kelly's Brew Pub.

More than 70 people looking to network outside of work showed up. Ruth Aragon (9540), the group's management champion, was astonished by the turnout. She says,

"Everyone was just there socializing and having fun, but the fact that that many people showed up really opened my eyes to the fact that this is something people are looking for. There is a need for this."

An event for everyone

Since ECO's kickoff event, the leadership team has hosted about one social and one philanthropic event each month, a practice they plan on continuing. They are also considering ways for members to post upcoming events that they are interested in, says Ruth.

These events have included happy hours at Vintage 423, Uptown Bar and Grill, and Green Jeans Farmery. They've played volleyball, bowled, gone rock climbing, and even gotten together at an Isotopes game. On Saturday, July 16, ECO members met at the Route 66 Summerfest to explore Nob Hill, listen to live music, and enjoy local microbrews.

About 20 ECO members volunteered at the Roadrunner Food Bank in February and around 10 volunteered at the Run for the Zoo in May. On Saturday, July 30, ECO members will participate in the Camo Run to benefit Reload Love, a local charity to help children impacted by terrorism in the Middle East.

Kara says she is excited about helping with Sandia's Habitat for Humanity house. ECO volunteered to help Friday and Saturday, August 19-20, to work on the second floor walls. You don't need to be a prior member of ECO or even an early career employee to volunteer, you just need to

want to help out with newer employees and interns, says Kara. Food and water will be provided, but bringing your own sunscreen is recommended. You can sign up at ECO.sandia.gov for one or both days.

"We want to give back to the community, and this is a great way to get involved," says Kara. "It can be hard as just an individual to say 'Hey I want to go volunteer for this,' but as a group it's easier."

Visit ECO.sandia.gov to join or learn more.



EARLY CAREER OUTREACH group members Shivonne Haniff (5421), Matthew Schlau (9529), La Tonya Walker (6926), and Veronica Barraza (850) bowl as part of a bowling league at Kirtland Lanes. (Photo by Mollie Rappe)



MASTER SCHOLARS — Deepu Jose, left, a participant in Sandia's Master's Fellowship Program (MFP), and Kelsie Larson and Sam Carey, both enrolled in the Labs' Critical Skills Master's Program (CSMP), enjoy weekend hiking excursions in the Sandia Mountains. This fall, the three will

be returning to their respective universities to continue their studies, Deepu and Sam at Georgia Tech and Kelsie at Purdue. Some 80 graduate students are employed at Sandia through MFP and CSMP initiatives. (Photo by Randy Montoya)

Graduate students bringing critical skills to Sandia

By Valerie Smith

Summertime at Sandia is intern season, with hundreds of students converging on its campuses in hopes of getting great experience and perhaps even a shot at a job when they graduate.

But not all students at Sandia this summer have to worry about that elusive job. About 80 graduate students already are employees of Sandia through its prestigious Master's Fellowship Program (MFP) or the Critical Skills Master's Program (CSMP). Through these unique special degree programs, participants work full-time at Sandia each summer, and also are full-time regular employees in the spring and fall when they go back to their school campuses to complete their master's degrees. Sandia pays full graduate school tuition and a stipend through the program while at school.

Both programs target degrees in highly sought fields, such as computer science, computer engineering, electrical engineering, mechanical engineering, materials science, and math. The primary difference is that the MFP also is a diversity recruiting program that helps Sandia meet its Affirmative Action goals by encouraging candidates in underrepresented populations to come to work at Sandia.

Once their degree is secured, a career awaits back at Sandia, and they're able to start full-time work with the benefit of having experienced the job for two summers, as well as having customized their coursework in some cases to directly apply to their Sandia jobs.

A perfect next step

For Deepu Jose (rhymes with rose), the MFP was the perfect next step on his career path. He had just received an undergraduate degree in electrical engineering from the University of Texas at Dallas and was considering a second internship at Raytheon followed by graduate school when his dad came across the MFP program on Sandia's website. Deepu applied and was accepted.

His next step was to find a graduate program. Deepu (6620) applied to seven top-tier universities for his graduate studies and to his surprise was accepted to all seven. The one that stood out for him happened to be a Sandia Academic Alliance institution — Georgia Tech, where he'll graduate this December. Launched in 2015, Sandia's Academic Alliance is a partnership with five universities that share an interest in advancing the future of engineering and science.

A Santa Fe native, Deepu was familiar with Sandia, but perhaps influenced by the proximity of Los Alamos National Laboratory being situated on "the hill," he always assumed Sandia was located atop the mountains for which it was named.

The fact that it's not has been the least of his discoveries as he's learned about the real Sandia. His biggest surprise? "The

vast range of work done here," he says. "It's a pretty remarkable place to work."

Deepu's boss, Senior Manager Bob Mata (6620), can easily relate to the feeling of discovery for a newcomer to Sandia. He came to Sandia himself through the predecessor program to the MFP and CSMP called One Year on Campus, earning his master's degree in mechanical engineering from Stanford University in 1983. His recruiter, Dan Arvisu, was also an alumni of the program. Since becoming a manager about 15 years ago, Bob has carried the tradition forward, hiring numerous Sandians through the program.

The breadth of work at Sandia is just one of the selling points Bob uses to attract top students to work on his team. He views the importance of the work in ensuring the nation's security as one of the top reasons to work at Sandia, and it's why he's grateful to have the MFP and CSMP to give Sandia an extra advantage.

"I'm closer to the end of my career than the beginning, and I want to make sure we have the team in place to continue the important work we perform in the future," Bob says. "It's a great selling point for me to be able to offer this benefit. There absolutely is a lot of competition for these students."

Tally Lobato (3550), CSMP-MFP program lead in Sandia's Talent Acquisition organization, agrees that the programs give Sandia the ability to attract students in a highly competitive market. The number of openings in the CSMP varies each year depending on division needs for certain critical technical skills. Typically, about 10 to 15 slots are budgeted for MFP participants. This year, about 40 students joined Sandia through the programs, about 50 are entering their final year of graduate school, and 10 started full-time work at Sandia after graduation during the spring and summer terms.

"There's always a pipeline of participants coming into Sandia as they get their degrees," says Margaret Quinn, manager of Sandia's Recruiting and Student Programs department. "We leverage these programs in a very strategic way by looking forward to the future skill sets that will be needed and by marketing — the MFP in particular — to campus diversity organizations and career services offices."

Too good to pass up

Many, like Kelsie Larson (5960), learned about the program after serving an internship at Sandia while working on their bachelor's degrees. Kelsie earned a degree in electrical engineering and physics from Rensselaer Polytechnic Institute in three and half years and was looking ahead to graduate school when she learned about a CSMP opening at Sandia. The appeal of getting to directly apply what she was learning to Sandia's work while earning a master's degree was too good to pass up.

She's attending Purdue University, another Academic Alliance institution, and has been able to customize her class schedules to incorporate areas that have specific relevance to her work at Sandia. She gets guidance on what to take from co-workers each summer when she's back at Sandia.

"I've been able to directly apply what I'm learning to the work I'm doing here," she says.

Another advantage of attending Purdue is that Sandia's on-site manager, Bill Hart (1910), has helped connect the different Sandia-bound students through periodic events to create a sense of community during the academic year.

Almost missed the signals

While Kelsie followed a more typical path to learn about the CSMP while working as an intern, Sam Carey (2660), a CSMP participant in his final year at Georgia Tech, almost missed the signals the universe was sending him. As an electrical engineering student at Texas A&M, a professor early in his undergraduate studies mentioned the program and advised Sam to look into it. Sam stored the information away but didn't do anything with it. A few months later, he was at a salsa dance club in College Station when he met a participant in the program who heard what Sam was studying and urged him to apply. It wasn't until Sam attended a job fair at A&M and stopped by a Sandia booth where recruiters told him about the program that he finally got the message: this was something he needed to pursue.

Like Deepu, he chose Georgia Tech for his graduate studies, in part because he could focus on radio frequencies in his curriculum, although he says courses with an "amazing professor" have opened up other new areas of concentration. Like Kelsie, he has been able to customize coursework to tie directly back to his work at Sandia.

"When participants in the MFP and CSMP graduate, they're able to start contributing value to Sandia immediately," Bob Mata says. "It's a strategic investment in capabilities."

Bob doesn't leave the students' success to chance. While they're attending college, they report directly to him, and he may even suggest course work. When they come to Sandia after graduation, he partners the participant with a mentor. In some cases, it's an alumni from the program. Currently Blake Reece (6620), who joined Sandia in 2012 through the program, mentors Cody Kirk (6620), who joined Sandia this summer through the program.

Bob thinks the program is vital for Sandia's future success. "I'm so thankful for this program," he says.

Tally says she hears that feedback from managers throughout the Labs.

"They feel the program is very beneficial in bringing top students to Sandia," she says. "These students are our rock stars."

Studying an HIV protein

(Continued from page 1)

missions by altering signaling and receptor trafficking. It binds to critical immune system receptors and then signals your cells to destroy them. If you know how this protein works, you have a better shot at developing drugs to stop it," says Mike.

Revealing Nef structure and function

Mike and John Engen's team at Northeastern University combined two known biophysical techniques to discover how Nef changes structure to perform its functions.

Mike is an expert at neutron reflectometry, a technique that gets nanometer-scale structural information about films and biological membranes. His team used this technique to compare the global structure of Nef in its membrane-bound and active form vs. its inactive, membrane-free form.

Engen's forte is hydrogen-deuterium exchange mass spectrometry, a technique that measures the local structure and flexibility of proteins. The team used it to get information on the local structure and dynamics of Nef when it's bound to the membrane.

The global information from the neutron reflectometry shows only the average location of Nef relative to the membrane. The local dynamics from hydrogen-deuterium exchange mass spectrometry are acquired for many small portions of the protein, showing the flexibility of 30 overlapping sections that collectively cover 90 percent of Nef. Together they construct a more complete picture of Nef and its structural changes.

The global and local, peptide-specific information supported a widely held assumption that, in binding to the membrane, Nef changes its structure to interact with signaling receptors and other host proteins, a hypothesis without support, until now.

"People have been studying Nef for a long time and there was a model of what people thought the protein might look like and might do. Nef is a difficult protein to study because you can only crystalize the folded part of the protein, and about half of the protein is unstructured. In addition, you can't study the membrane-bound form by crystallography," says Mike.

"It's the first time anybody had measured these kinds of structural changes and the results were consistent with the hypothetical model," Mike continues. "Details of these shape

changes provide important new molecular insights into how Nef functions."

To combine the two techniques, the team first needed to make a special apparatus. It needed to contain a flat lipid monolayer, made of saturated fats, which mimicked the biological membrane. It also had to be integrated with equipment at neutron sources for neutron reflection measurements, and allow rapid exchange of the watery support layer for the hydrogen-deuterium exchange experiments.

Another challenge was correctly producing the Nef protein. In infected cells, Nef is tagged with a special lipid that serves to anchor Nef to the cell membrane. Engen's team had to produce Nef that contained this essential lipid, known as a myristate group.

This work was supported by the National Institutes of Health. The neutron reflection measurements were performed at the Center for Neutron Research at the National Institute of Standards and Technology and the Spallation Neutron Source at Oak Ridge National Laboratory.

Method could answer questions about HIV, other diseases

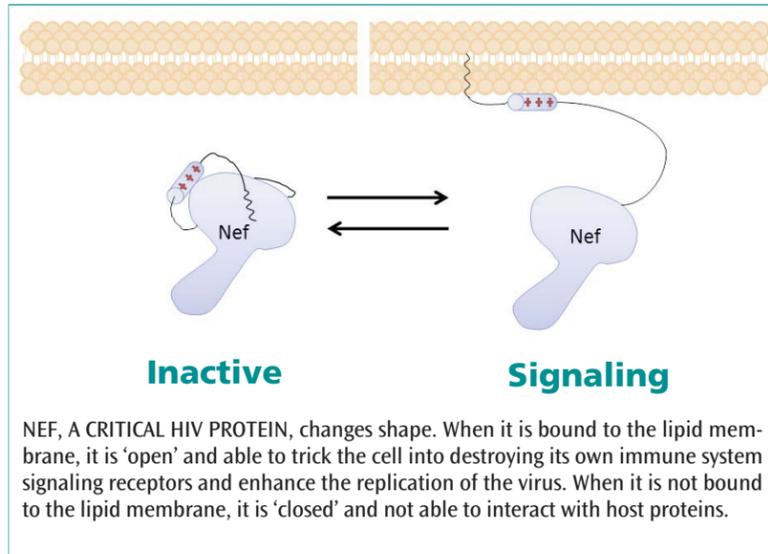
With the hybrid method and unique apparatus in hand, the team is seeking funds to answer additional questions about Nef.

"We studied it alone; now we want to study it with its binding partners, with the host proteins and the complexes that it forms, and in the presence of drug molecules or inhibitors," Mike says. "Stopping it from binding with its partners or inhibiting it from adopting the conformation that leads to receptor degradation would have important medical implications."

Tom Smithgall of the University of Pittsburgh School of Medicine, a co-author on one of the team's papers, is currently screening for potential drugs that might block Nef's actions.

Mike says he hopes to apply this hybrid method to other important structural problems of membrane-associated proteins, including virus maturation; the fusion of viruses with host cell membranes; the workings of bacterial toxins such as botulinum, tetanus and diphtheria; and cell-signaling dysfunctions ranging from cancer to regulating cholesterol levels.

"There is a lot of potential for combining these two techniques in a more general sense. There are no other ways to get this kind of specific, direct information about essential peripheral membrane proteins. This is a significant niche of biological problems that could not be addressed before our work, and we've made some big steps forward. The future benefit depends on how broadly we can apply the method beyond just this one HIV protein," says Mike.



NEF, A CRITICAL HIV PROTEIN, changes shape. When it is bound to the lipid membrane, it is 'open' and able to trick the cell into destroying its own immune system signaling receptors and enhance the replication of the virus. When it is not bound to the lipid membrane, it is 'closed' and not able to interact with host proteins.

Celebrating 30 years of 'hands on, minds on' STEM program



OLGA LAVROVA (6112) helps a student during a HMTech class she instructed June 25.

Story and photos by Lindsey Kibler

Since 1986, Sandia has helped more than 3,000 middle and high school students get involved in fun, hands-on

You're invited



HMTech will mark a successful 30 years with a celebration Friday, July 29. Former students, instructors, and volunteers will showcase displays and participate in demonstrations during the event, to be held at Albuquerque's African-American Performing Arts Center and Exhibit Hall from 5:30-7:30 p.m. For more information on the HMTech 30th anniversary celebration, contact Shauna at sadams@sandia.gov or Theresa at tacarso@sandia.gov.

science and engineering activities and explore a variety of science, technology, engineering, and mathematics (STEM) careers.

The Hands On, Minds On Technology program, or HMTech, is sponsored by Sandia's Black Leadership Committee (BLC). African-American employees began HMTech as an after-school program to inspire African-American students to pursue STEM careers. Ten years later, the educational supplement became a Sandia-sponsored summer program open to all students in grades 6-12, although its primary target is African-American students.

"African-Americans are underrepresented in STEM fields, so our focus is to expose them to areas they may otherwise not be exposed to," says Shauna Adams (422), a subsystem and components surety engineer and HMTech committee member. "When the students see the volunteers and instructors here, they think 'I look like them,' which shows them they can do what we do."

Shauna has volunteered with the program for five years. She also serves as an advisor to the Greater Albuquerque National Society of Black Engineers (NSBE) junior chapter.

A wide range of class offerings

Sandians accounted for 90 percent of the instructors at this summer's event, supported by additional volunteers from around the Labs and the Albuquerque community.

In June, students attended two six-hour Saturday sessions; each day's classes were broken into two, three-hour blocks of instruction and hands-on learning. Students were able to choose classes in such subjects as anatomy, physics, fractals, video game development, coding, computer programming, and radiation detection, measurement, and protection.

"We want people to know this program exists. It's been 30 years and it still has a sustaining power, impacts the young

kids, and has a significant impact on the community," says HMTech coordinator Theresa Carson. Theresa, a senior manager in the Supply Chain Management Center, is the former co-chairwoman of the BLC and was recently presented with the 2016 Outstanding Service Award from the New Mexico Office of African American Affairs.

Sandia Executive VP and Deputy Labs Director Steve Rottler, executive champion of the BLC, is an enthusiastic booster of the program. "HMTech has improved educational excellence in our community, challenging youth to enrich their minds through the fun, hands-on application of science, technology, engineering and mathematics," says Steve. "The sky is the limit for these students who may become the next scientists and engineers, perhaps someday joining us at Sandia. The more we can expose young people to STEM fields, the better the future will be for our community and our nation."

Shauna adds that, for students to have an interest in STEM, they must be exposed to it. They need hands-on experience in STEM fields because the technical work requires out-of-the-box thinking, she says.

Anyone interested in volunteering with HMTech should contact Lydia Coleman at blc-hmtech@sandia.gov.



A STUDENT WORKS ON SOLDERING during one of many classes offered by HMTech.

SANDIA CLASSIFIED ADS

MISCELLANEOUS

ARMOIRE & HUTCH, dark cherry finish, \$600/both. Hennessey, 505-269-6243.

LED TV, Aquos, '13, 70-in., mount, \$1,100; Jamo 5.1 surround sound system, Onkyo receiver, \$600; great condition. Abeyta, 505-573-8195.

CLOTHING: women's sleeveless summer dresses & pants, all w/jackets or blazers, blouses, all size 18-24W, priced reasonably. Burnett, 505-463-8144.

STEREO RECEIVER, Pioneer QX-8000, 4-channel, 2 Pioneer CS77-A speakers, \$300 OBO. Chavez, 505-228-5147, lee.chavez6@gmail.com.

CYCLING COOL BAG, Crivit Germany, brand new, black, 27 cm x 20 cm x 15 cm, \$16; 36-spoke reflectors, \$5. Wagner, 504-8783.

PUTTER, Odyssey 2 baller, 2 yrs. old, half price, \$50. Holmes, 873-5255.

CHILD'S BDR. SET, 6-drawer dresser, nightstand, bookcase & desk, great condition, easy clean, photos available, \$500 OBO. Manzanares, 505-385-6265.

TRUCK CAP, decent condition, 6-ft. length, photos available, \$120. Brewster, 238-4704, ask for Julie.

CHICO'S GIFT CARD, worth \$50, asking \$45. Kaplan, 298-7953.

MATTRESS, queen, 3-in. Tempurpedic mattress topper, Macy's waterproof mattress pad (new), \$200/all or individual prices. Anderson, 505-903-0911.

DAYBED, oak, no mattress, \$90; solid track Teak twin headboard, \$100; both excellent condition, photos available. Drotning, 821-9598.

MEDIA STORAGE SHELVES, 2, Pottery Barn, \$50/both. Elmazi, 856-2197.

PUNCHING BAG & FRAME, \$125; queen-size bed & frame, \$150; La-Z-Boy recliner, beige, leather, \$150. Goins, 821-1287.

CAMPER SHELL, white, fits '02 F250 short bed, back window missing, otherwise great condition, \$20 OBO. Gonzalez, 463-5057.

DAYBED, Hillsdale Dalton, pop-up trundle, upgraded mattresses, oak, 2 drop leaves, you pick up, \$250 OBO. Rosul, 281-4114.

STEPPING STONES, terra cotta, 16-in. square concrete, 60 count, \$60. Lott, 263-6443.

GENERATORS, 2, Honda EU2000i, \$800 ea. or \$1,500/both. Moreno, 294-4268.

WALL MIRROR, rustic oak, 48" x 26", <http://www.wmstubblefield.com/sale-items>, \$40. Stubblefield, 263-3468.

MISC. ELECTRONICS: JVC & Sony DVD players, \$30 ea.; Sony receiver, \$50; Epson scanner, \$30; 36" x 120" heavy plastic runner, clear, \$50. Drebing, 293-3335.

POOL PUMP, Hayward MaxFlo, w/3/4-hp motor, motor needs work, free. Kerschen, 821-2848.

PEDESTAL BIRDCAGE, vintage, elegant, wrought iron stand/base, 14"W x 18"H, sits 5-1/2-ft. off-ground, photos available, \$250 OBO. Rivers, 720-4701.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- EMAIL: Michelle Fleming (classads@sandia.gov)
 - FAX: 844-0645
 - MAIL: MS 1468 (Dept. 3651)
 - INTERNAL WEB: On internal web homepage, go to NewsCenter, then "Submit a Classified Ad." If you have questions, call Michelle at 844-4902.
- Because of space constraints, ads will be printed on a first-come basis.

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

TRANSPORTATION

'15 CHRYSLER 200, 25K miles, \$15,000. Calzada, 505-366-4777.

'09 VOLKSWAGEN EOS, hardtop convertible, 89K miles, fun, great condition, \$10,300. Stevenson, 803-414-3653.

'08 BMW 335i COUPE, midnight blue, maintained regularly, only 53.7K miles, great condition, \$21,000. Martinez, 505-453-2419.

'02 HONDA ACCORD EX, V6, leather interior, 96K miles, great condition, \$3,600. Elmazi, 505-856-2197.

'05 LEXUS ES330, runs & looks great inside/out, well maintained, recent timing belt, 140K miles, \$6,200. Vigil, 505-553-9596.

'14 SUBARU FORESTER, CVT, fog lights, premium sound, tow pkg. 32.5K miles, excellent condition, \$16,900 OBO. Martin, 623-687-7673.

'13 CHEVY MALIBU LT, charcoal gray, 52K miles, excellent condition, \$12,900. Lifke, 505-382-9448.

'81 FERRARI 308 GTSi, red w/tan interior, Targa roof, 76K miles, text for more details, \$20,000. Nicholas, 505-259-3025.

'03 CHEVY MONTE CARLO SS, new struts, excellent tires, heated leather seats, great AC, OnStar, more, 88K miles. Siegrist, 293-4148.

'84 ODAY 23 SAILBOAT, trailer, 8-hp Johnson outboard, port-a-potty, stove, spinnaker, kept under cover, \$6,900. McLaughlin, 977-3842.

'10 COLEMAN COBALT EVOLUTION POP-UP CAMPER, sleeps 4, heater, electric brakes, wide tires, good ground clearance, \$4,500. Turner, 452-7297.

ROAD BIKE, Bianchi Vertigo, 54-in., never ridden, all original components, \$1,500 firm. Galbraith, 505-269-2889.

REAL ESTATE

3-BDR. HOME, located on the Rio Grande in T or C, NM, fish from your own deck, \$195,000. Ronquillo, 505-836-1882.

.5 ACRE LOT, Los Lunas, fenced, shared well, septic tank, phone, terrific view, call for more detail. Crosby, 260-1070.

VACANT LAND, Tome, NM, near Tome Hill & UNM extension, \$55,000/acre, owner willing to negotiate. Ramos, 304-593-3425 or 304-562-8546.

WANTED

PART-TIME CAREGIVER, for disabled/paralyzed male, East Mountains, Saturdays & fill-in hours/days for established caregiver. Dotson, 281-9057.

RECREATION

'08 HARLEY-DAVIDSON ROCKER C, maroon, 23K miles, selling to fund college tuition, \$12,000. Chavez, 934-2186.



Mileposts

New Mexico photos by Michelle Fleming

Bob Cutler
35 6626

Ed Duckett
30 2632

Recent Retirees

New Mexico photos by Michelle Fleming

Melissa Wilson
29 2242

Kent Geib
22 1764

 Julie Bouchard 25 6923	 Teresa Cajete 25 10244	 Richard Neiser Jr. 25 5942	 Rita Candelaria-O'Toole 20 2662	 Nathan Brannon 15 2220	 Colette Bristol 15 5620	 Michael Busse 15 1747
 Eric Coker 15 1815	 Marcella Davis-Sneddon 15 3653	 Mike Flores 15 151	 Mellisa Heller 15 5556	 Jennifer Lovejoy 15 4847	 Lily Marquez 15 5640	 James McCloskey 15 2716
 Mike Olewine 15 1747	 Dennis Owens 15 423	 Eric Pulling 15 1557	 John Sandusky 15 5944	 Melody Teixeira 15 2555	 JoAnna Trujillo 15 2155	 Randy Wells 15 5635

Chapter 6: Nothing down: an entrepreneur steers his young company

By Neal Singer

Note: Entrepreneurial life holds both attractions and unknowns for Sandians considering that path. In an effort to shed more light on the realities of starting a high-tech business, the Lab News is following the efforts of the fledgling company mPower to grow its own wings. On Oct. 2, 2015, our first installment was titled "Why attempt the entrepreneurial life?" What follows here is Chapter 6. Previous installments in this ongoing saga are at tinyurl.com/jfzx5o2, tinyurl.com/jzs6mca, and tinyurl.com/hqnhydz.

Sitting innocently in a local restaurant with two members of his startup company mPower (a cool way to write "empower," but it means what it says), former Sandian Murat Okandan lets his two associates Pete Atherton and Yun Li do the talking in describing why they chose to work for shares in his solar company rather than requiring cash for their services.

Pete, former senior manager of Industry Partnerships at Sandia, buys cookies for the group at the table and explains his reasoning for spending time with a company trying to sell very thin, flexible photovoltaic material: "I'm retired, I get to do what I want, it's fun, and I believe in it."

Murat nudges, "And there is potential to make an impact." Pete responds, "Something really good for society!" Pete, who has worked on two successful tech startups, also worked on a solar project some 30 years ago and remembers it fondly.

Technology commercialization consultant Yun Li has a doctorate in material science from Arizona State University and worked in Fortune 500 companies for a number of years before starting her own business in leadership coaching and business consulting. She says, "The incentive is the potential to bring a venture to market. It's exciting. That's why we entrepreneurs invest time and energy into it."

Her background in semiconductors and business are a good match for the company, says Murat.

It is obvious the team has shared Murat's vision about the moral and economic advantages of solar, and the benefits in particular of mPower's technology.

But now it's more than a vision.

Currently, mPower has a purchase order "for delivery and joint evaluation of a first set of photovoltaic samples with colleagues at NASA, with the possibility of further engagement," Murat says. His interactions with the US space agency started early when samples from his Sandia group were sent



DOWN TO BUSINESS — Murat Okandan, second from right, took advantage of Sandia's innovative entrepreneurial leave program to try his hand in the private sector, launching mPower, a solar energy business built on Sandia technology. With Murat are, from left, Jennifer Granata, Yun Li, and Pete Atherton discussing mPower's path forward. (Photo by Neal Singer)

up to the international space station and were returned to Earth for post-flight evaluation. Murat has talked with NASA engineers and expects the agency eventually to request variations in his product's shape, size, and thickness. He sees that as an avenue for future commercialization. "We've had similar conversations with other companies," he says.

The light weight and small volume of the tiny solar cells make them ideal for packaging on a space ship, to spread out over a much larger volume of outer space to snag sunlight.

And there's more. After spending time at a commercialization event showcasing Labs technologies, Murat spoke with the president of Aquila, Judy Beckes-Talcott, about using the tiny photovoltaic cells as a component in a new class of radiation sensors. After all, it's radiation in the form of sunlight that activates the cells. Why not adapt it for this application?

"If Murat sees a potential application," says Yun Li, "he

will chase it down."

Additional business tasks for the group include the finalization of licensing terms with Sandia, as well as delivery of early products to potential customers and further interactions with potential partners.

"We're moving ahead with licensing with Sandia," Murat says. "We're working toward an arrangement that provides the necessary flexibility for a startup with constrained capital — that would be us — to proceed in a challenging environment, conditions especially true in the renewable energy field. We need to find the right partners to generate commercial value and Sandia has been very good in allowing that to happen by providing intellectual property protection through a license option during this time."

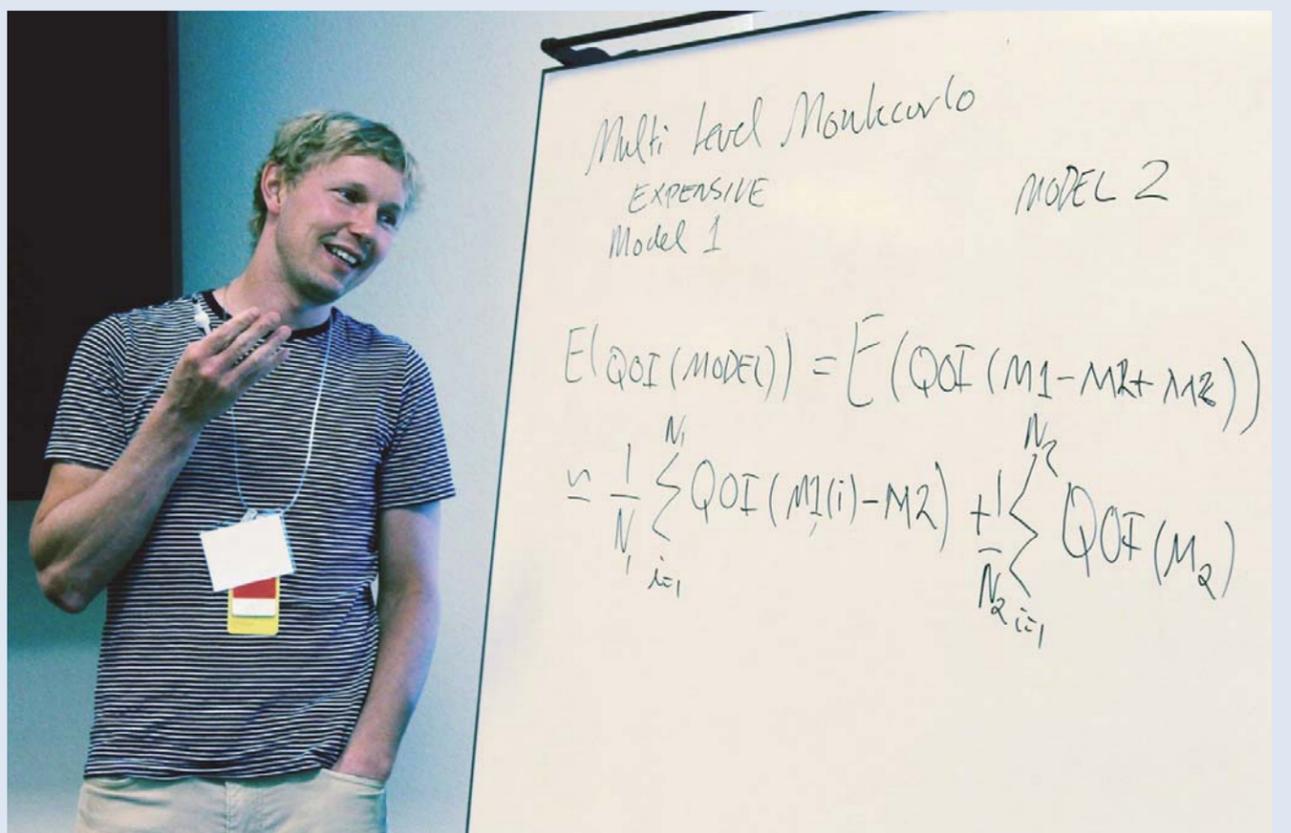
Continued traction with customers, partners, and deliveries is critical to further business development, says Yun Li.

Validation of complex systems workshop

By Mollie Rappe

More than 50 Sandians and six faculty partners from Academic Alliance schools met for a two-day workshop in late June hosted by the Resiliency in Complex Systems Research Challenge and Energy, Nonproliferation, and High-Consequence Security Div. 6000. Following the recommendations of the 2015 Complex Systems external advisory board and CTO Red Team reviews, the goal of the workshop was to explore applying Sandia's long-standing expertise in verification, validation, and uncertainty quantification (VVUQ) to complex systems of growing interest to national security, such as the US electric grid.

"What we're trying to do in this workshop, and in the pre- and post-work surrounding this workshop, is bring together two communities — the complex systems modeling community, and the VVUQ community — to scope out the intellectually exciting and impactful work they might do together at their intersection," says Jeff Tsao (1120), the technical orchestrator of the workshop. The workshop identified a number of potential areas of future research, which the workshop attendees plan to share with the larger academic community in the form of a peer-reviewed journal article.



THAT'S WHY THEY CALL IT 'COMPLEX' — Daniel Appelo, an applied mathematics professor at the University of New Mexico, discusses applying VVUQ techniques to complex systems at a Sandia workshop in late June. (Photo by Marie Arrowsmith)