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... (Continued on page 4)

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... (Continued on page 6)
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 awaking. For the poet’s narrator, the coming of spring re-kindle 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.

I’m perceiving, of course, but I understand it. ... 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

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 foliage through 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 National Laboratories’ Lab News photographer Randy Montoya recalls the circumstances of the unforgettable photo.

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 started, 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 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 Mckennan (age 93) . . . . . . . . . . . . . . . . . . . . . April 7
Walter Brock (87) . . . . . . . . . . . . . . . . . . . . . . . . . . . April 9
C. Brent Williams (91) . . . . . . . . . . . . . . . . . . . . . . . April 11
Paul Field (90) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . April 13
David Emerson (83) . . . . . . . . . . . . . . . . . . . . . . . . . April 16
William Doyle (88) . . . . . . . . . . . . . . . . . . . . . . . . . . April 17
David Davis (77) . . . . . . . . . . . . . . . . . . . . . . . . . . . . April 19
Avelda Dubois (109) . . . . . . . . . . . . . . . . . . . . . . . . . April 28
Paula Webb (57) . . . . . . . . . . . . . . . . . . . . . . . . . . . . April 22
Edward Roth (93) . . . . . . . . . . . . . . . . . . . . . . . . . . . April 24
Lorraine Sanchez-Guerra (60) . . . . . . . . . . . . . . . . . . . May 5
Theodore Ortega (86) . . . . . . . . . . . . . . . . . . . . . . . . May 1
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
Patricia Anderson (94) . . . . . . . . . . . . . . . . . . . . . . . May 19
Merle Elifritz (91) . . . . . . . . . . . . . . . . . . . . . . . . . . May 23
Edward Roth (93) . . . . . . . . . . . . . . . . . . . . . . . . . . May 27
David Kendall (84) . . . . . . . . . . . . . . . . . . . . . . . . . . May 29
Herbert Floyd (85) . . . . . . . . . . . . . . . . . . . . . . . . . . May 29
Lawrence Ford (77) . . . . . . . . . . . . . . . . . . . . . . . . . June 1
G. Alan Smirnoff (90) . . . . . . . . . . . . . . . . . . . . . . . . June 6
John Simchick (86) . . . . . . . . . . . . . . . . . . . . . . . . . . June 6
Merle Elifritz (91) . . . . . . . . . . . . . . . . . . . . . . . . . . June 14
Alan Smirnoff (90) . . . . . . . . . . . . . . . . . . . . . . . . . . June 16
Frank James Conrad (84) . . . . . . . . . . . . . . . . . . . . . June 16
Richard Volk (87) . . . . . . . . . . . . . . . . . . . . . . . . . . June 18
Hermeses Baca (92) . . . . . . . . . . . . . . . . . . . . . . . . . June 20
Harry Morris (81) . . . . . . . . . . . . . . . . . . . . . . . . . . June 23

**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 sum 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 Lab’s inception, education has been a key component of our mission,” Burchard says. “Education 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.”

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**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.

“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 exciting 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.

“Many of 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.”

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)

John Dawson was among the first to realize that computing power 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.
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 has 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 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 manufactur- ing the hammers, but Sandia is better equipped to handle the high-temperature challenges, the lubrication, and ma- terials,” Jiann says. “And high-temperature testing isn’t some- thing that Atlas Copco typically does.”

A critical piece of the project was developing lubricious coatings, which help reduce friction between parts, impart- tant 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 in 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-tempera- ture 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 120 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 subsys- tems, 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

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 pro- vide 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 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 environ- ments, ECO aims to foster personal and profes- sional 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 or friends 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, EARLY CAREER OUTREACH group members Shivonne Haniff (5421), Matthew Schlaf (9528), La Tonya Walker (6926), and Veronica Barraza (850) bowl as part of a bowling league at Kirtland Lanes.

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“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 Aragon.

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 hotspots games. 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 100 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.
S
ummer at Sandia is intersession, with hun-
dreds 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 Fel-
lowship Program (MFP) or the Critical Skills Master’s Program
(CSMP). Through these unique special degree programs, par-
ticipants 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 engi-
neering, mechanical engineering, materials science, and
math. The primary difference is that the MFP also is a diver-
sity 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 per-
fert next step on his career path. He had just received an
undergraduate degree in electrical engineering from the Uni-
versity of Texas at Dallas and was considering a second intern-
ship 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 Acade-
ic Alliance institution — Georgia Tech, where he’ll gradu-
ate 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 per-
haps influenced by the proximity of Los Alamos National Labo-
ratory 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 remark-
able 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 com-
petitive 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 30 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, man-
ger of Sandia’s Recruiting and Student Programs depart-
ment. “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 pro-
gram after serving an internship at Sandia while working on
their bachelor’s degrees. Kelsie earned a degree in electrical
engineering and physics from Kennesaw 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
coworkers 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 Sta-
tion 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 AddM and stopped by a
Sandia booth where recruiters told him about the pro-
gram that he finally got the message: this was something
he needed to pursue.
Like Deepu, he chose Georgia Tech for his graduate stud-
ies, in part because he could focus on radio frequencies in his
curriculum, although he says courses with “an amazing pro-
fessor” 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
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 (6628), 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 stu-
dents to Sandia,” she says. “These students are our rock stars.”

By Valerie Smith

S
ummer at Sandia is intersession, with hun-
dreds 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 Fel-
lowship Program (MFP) or the 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)
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 tech-

niques 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 mem-

branes. 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 exchange neutron mass spectrometry, a technique that measures the local structure and flexibility of proteins. The team used it to get information on the local struc-
ture 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 10 overlapping sections that collectively cover 90 per-
cent 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 recep-
tors 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 crystallize the folded part of the protein, and about half of the protein is unstruc-
tured. 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 biologi-
cal membrane. It also had to be integrated with equipment at neutron sources for neutron reflection measurements, and allow rapid exchange of the wet layer support layer for the hydrogen-deuterium exchange experiments.

Another challenge was purposely converting 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 pro-
duce Nef that contained this essential lipid, known as a myristate group.

This work was supported by the National Institutes of Health. The neutron reflection measure-

ments 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 complex 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 poten-
tial drugs that might block Nef’s actions.

Mike says he hopes to apply this hybrid method to other important structural prob-
lems 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 regulat-
ing 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 essen-
tial 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.

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Inactive

Signaling

Nef. A CRITICAL HIV PROTEIN, changes shape. When it is bound to the lipid mem-
brane, 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.

NEF, A CRITICAL HIV PROTEIN, changes shape. When it is bound to the lipid mem-
brane, it is ‘closed’ and not able to interact with host proteins. When it is free, it is ‘open’ and able to trick the cell into destroying its own immune system signaling receptors and enhance the replication of the virus. The local dynamics from hydrogen-deuterium exchange mass spectrometry are acquired for many small portions of the protein, showing the flexibility of 10 overlapping sections that collectively cover 90 per-
cent of Nef. Together they construct a more complete picture of Nef and its structural changes.

Science and engineering activities and explore a vari-
ety of science, technology, engineering, and mathemat-
ics (STEM) careers. The Hands On, Minds On Technology program, or HM Tech, is sponsored by Sandia’s Black Leadership Committee (BLC), African-American employer,

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

You’re invited

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

You’re invited

SANDIA TECHNICAL SERVICES

service to the National Institute of Standards and Technology. The neutron reflection measure-

ments 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.

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MISCELLANEOUS

ARMORO & HUTCH, dark cherry finish, $600/both. Hennessey, 505-269-2423.

LED TV, Apples ‘13, 70-in., mount, $1,100. James S lives in surround sound system, Onkyo receiver, $660, great condition. Abuya, 505-573-8199.

CLOTHING: women’s sleeveless summer dress & pants, all chaps or blazers, blouses, all size 18- 24W, priced reasonably. Burnett, 505-463-8144.

STEREO RECEIVER, Pioneer QE-6000, 4-channl, 2 Pioneer CS77-A speakers, $150. OBO. Chavez, 505-228-8147. lee.chavez@gmail.com.

CYCLING COOL-BAG, Cnest Germany, brand new, black, 27 cm x 20 cm x 13 cm, $16, 36-spoke reflectors. $3. Wagner, 505-8783.

UOBD, Odyssey 2 baller, 2 yrs. old. $120. Wight, 505-698-0788.

How to submit classified ads: DEADLINE: Friday noon before week of publication always challenged by holiday. Submit one of these methods:

• EMAIL: Michelle Fleming (Classifieds@sandia.gov)
• FAX: 844-0645
• MAIL: 18440 (Dept. 3851) INTERWEB: On internal web home page, go to Classifieds, then “Submit a Classified.” If you have questions, call Michelle at 505-269-8162.

Because of space constraints, ads will be:

1. Limit 18 words, including last name and phone number. No phone-ins.
2. Type or print ad legibly; use accepted abbreviations.
4. Ad rules: No commercial ads. We will not run the same ad more than twice. No “for rent” ads except for employees on temporary assignment. No mobile home or trailer, or boats, or campers. One ad per issue. One ad per week. Don’t use offensive or in bad taste.

In our classifieds, we publish any ad that may be considered offensive or in bad taste.

REAL ESTATE

3-RD, HOME, located on the Rio Grande in T or C NM, 6-bath from your own deck, $195,000. Ronquillo, 505-836-1882.

SACRED LOT, Los Lunas, fenced, shared well, part clear, 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. Ramon, 504-975-1427 or 304-562-8546.

WANTED

PART-TIME CAREGIVER, for disabled or paralyzed male, East Mountains, Saturdays & fill-in hours/days for established caregiver. Dotson, 816-2017.

RECREATION

‘88 DODGE 2500 PICKUP, 7.2 miles, $3,900. Siegrist, 293-4148.

Mileposts

New Mexico photos by Michelle Fleming

Recent Retirees

New Mexico photos by Michelle Fleming

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Because of space constraints, ads will be on a first-come basis.

Ad rules:

1. Limit 18 words, including last name and phone number. It will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
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 mobile home or trailer, or boats, or campers.
9. No ‘for sale’ ads except for employees on temporary assignment.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to 18 words, including last name.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

TRANSPORTATION


’09 VOLKSWAGEN EOS, hardtop convertible, 89K miles, fun, great condition, $10,500. Stevenson, 803-414-3633.

’08 BMW 315i COUPE, midnight blue, maintained regularly, only 37K miles, great condition, $21,000. Martinez, 505-453-2419.

’02 HONDA ACCORD EX, V6, leather interior, 94K miles, great condition, $3,600. Eimao, 505-836-2179.

’06 LEXUS ES330, runs & looks great inside/out, well maintained, recent timing belt, 148K miles, $6,200. Vitt, 505-533-9396.

’14 SUBARU FOREST, CVT, fog lights, premium sound, low profile 32K miles, excellent condition, $16,900 OBO. Martin, 623-687-7673.

’11 CHEVY MALIBU LT, charcoal gray, 52K miles, excellent condition, $12,900 LCD, OBO, 550-382-9448.

’81 FERRARI 308 GTSi, red w/tan interior, Targa roof, 76K miles, text for more details, $20,000. Nicholas, 505-359-3025.

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

RECREATION

’08 HARLEY-DAVIDSON ROCKER C, maroon, 238 miles, selling to fund college tuition, $12,000. Chavez, 934-2186.

’84 ODAY 21 SAILBOAT, trailer, 8-hp Johnson outboard, port-a-potty, spinnaker, kept under cover, $6,900. McLaughlin, 977-3842.

10 COLEMAN COBBT EVO LUTION POP-UP CAMPER, deep, 4 heater, electric brakes, side view, good ground clearance, $4,500. Turner, 452-2297.

BICYCLE, Bianchi Vertigo, 54-in., never ridden, all original compo- nents, $1,300 firm. Cabrith, 505-269-2889.
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/jxzsoz, tinyurl.com/jzs6mca, and tinyurl.com/hqphydzt.

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 collaborators at NASA, with the possibility of further engagement,” says Murat. His interactions with the US space agency started early when samples from his Sandia group were sent 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-Falcon, 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 licencing 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 deliverables 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 Tiao [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)