

Sandia adapts: Optical clamp proves simpler, less expensive than traditional adaptive optics



JENS SCHWARZ (1672) adjusts his group's newly patented Sandia optical tool that precorrects for laser distortions. (Photo by Randy Montoya)

'Poor man's' tool sufficient for many uses

By Neal Singer

The ingenious system called adaptive optics, known for its computer control of subdivided, individually angled mirrors, is an efficient but expensive way to correct distortions in laser beams. The mirrors automatically adjust until an undistorted beam is obtained in a way formerly thought unachievable by a single large mirror.

Now a Sandia tool that efficiently but inexpensively uses a single mirror to achieve some of the same effects has received a US patent, issued June 12.

The Sandia device, which resembles an inexpensive vise similar to those bolted to many home workshop benches, functions as a kind of poor man's adaptive optics. It corrects optical distortions simply through pressure that changes the convexity or concavity of a single reflecting surface.

"We can't compensate for small-scale aberrations," says principal investigator Jens Schwarz (1672), "but certain large-scale beam distortions are correctable with this tool."

The method already has improved the beam quality of Sandia's huge Z-Beamlet laser, which can now fire every two hours instead of every four because the device precorrects for distortions caused by heat, Jens says.

Similar beam corrections, of course, can be achieved with tens to hundreds of thousands of dollars through traditional adaptive optics. Many

small reflecting mirrors controlled by a computer can adjust in milliseconds to correct beam distortions reported by sensors farther down the line.

But for the overwhelming majority of laser users who do not need such fine control, deformation of a single mirror through convex or concave deformation applied through only a single actuator may be the ticket, especially when the price is expected to be only a few thousand dollars.

Commercial interest in the inexpensive device already has been expressed.

A reverse use of the technique could deliberately focus the beam to interrogate points of distant interest. This use would detect chemical or biological agents introduced at battlefields many miles away, a technique called laser-induced fluorescence spectroscopy. "Because the mirror can change the focus of a laser beam quickly and rapidly, a laser beam could interrogate molecules at a variety of distances and the results would be visible through backscattered light," Jens says.

Coping with beam distortions

Distortions happen when new energies are injected in the lasing system to create more powerful beams. These injections are achieved by racks of lamps that flare briefly, like old-fashioned photographer's flashbulbs, sending an energy pulse into the laser medium of doped glass in

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ILMS: More enterprise info, fewer data calls

Contractor assurance gets spotlight

A new release of Sandia's Integrated Laboratory Management System (ILMS) "provides more enterprise-wide content and tools to help executive management make informed decisions, while assuring our DOE customer, NNSA's Sandia Site Office (SSO), that we are meeting their expectations," says Integrated Laboratory Management Senior Manager T.J. Allard.

In ILMS 3.0, T.J. notes, the Assure, Assess, and Improve Process (AAIP) now aligns the seven assurance-related Corporate Process Requirements (CPRs) devoted to Contractor Assurance with all strategic management units, divisions, and policy areas. The term "Contractor Assurance" refers to Sandia's contractual relationship with DOE/NNSA.

"Assurance is an essential and critical part of our intent to make the laboratory more effective. It is the heart of our commitment to our customers and will be the focus of our efforts for FY07," says Labs Director and President Tom Hunter.

For all policy areas, divisions, and SMUs, the ILMS team has identified owners, delegates, and subject-matter experts who will fill in the details of AAIP. Once completed, this process will help management and SSO evaluate the Labs' performance.

Changing oversight

ILMS 3.0 supports an evolution in the nature of Sandia's relationship with SSO, says IES and Laboratory Management Systems Director Joe Polito. As a result of the enterprise-wide information available through ILMS, he says, SSO can increasingly shift its oversight from individual transactions and particular events to high-level

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Home for developmentally disabled children becomes site for Sandia arsenic water removal experiment

Casa Angelica to benefit from Sandia research

By Chris Burroughs

Casa Angelica, a home for developmentally disabled children and young adults in Albuquerque's South Valley, is the site of an innovative Sandia water treatment system known as "in tank filtration," designed to remove arsenic from drinking water.

"The Sisters who own and operate Casa Angelica are always proactive — whether it's taking our young people into the community or, like now, trying a new method of arsenic water removal from our well water," says Casa Angelica Administrator Louise Turner. "We are excited about being able to help Sandia with this research."

Directed by the Canossian Daughters of Charity, Casa Angelica provides a family-centered program for 16 developmentally disabled young people. It is located on 15 grass-landscaped acres and

has a facility featuring family rooms, a light/sound therapy room, and playground area. There is also a pool where the children and young adults, who all use wheelchairs, receive therapy four afternoons a week.

The Sandia project is an experiment to help small water systems, like that used by Casa Angelica, inexpensively and easily lower arsenic levels to meet new Environmental Protection Agency standards. The revised regulations, which went into effect in January 2006, reduce the maximum arsenic water contaminant level from 50 to 10 micrograms per liter.

Casa Angelica's water comes from a well that has naturally occurring arsenic levels of 15 micrograms

per liter. Lowering the arsenic concentration to meet the new 10 microgram per liter standard is readily attainable with commercially available

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RON TRAMMELL AND YVONNE FLORES work with a Casa Angelica resident at the facility's therapeutic pool. The pool's water will be treated with a Sandia-modified arsenic removal system. (Photo by Bill Doty)



Sandia/California researchers search for ways to process cellulosic biomass cheaply and efficiently for the production of lignocellulosic ethanol. Story on **page 3**.



The \$25 million Exterior Communications Infrastructure Modernization (ECIM) project, has come in more than four months early and under budget. Story on **page 9**.



The Sandia Labs Logistics Team took second place in the annual Roadrunner Food Bank Food Boxing Olympics. Team members packed 56 boxes of food for New Mexico seniors in 10 minutes. Story on **page 12**.

What's what

Despite the dire budget projections we've seen and heard in news reports over the last couple of weeks, it's a little early to sell the house, restock the trailer, and start looking for a camping spot with a view. As Labs Director Tom Hunter and Deputy Director Joan Woodard pointed out in a letter to all of us, the budget plan issued by the House Appropriations Committee that set off alarms is "an early step in the federal budget process."

That proposal has to be debated and amended by the full House before it reaches a final version on that side of the Capitol. Meanwhile, the Senate version has to work its way through the committee system and be debated and amended on the other side of the Capitol. Then the two separate versions have to be reconciled by yet another committee comprising members from both chambers of Congress, taking into consideration the still different budget proposed by the White House.

To put it into sports perspective, the NBA season is just ended, baseball is in full stride, and if past performances are any indicator, we'll all see lots of football games before we see a final budget.

* * *

Despite budget alarms, roller-coaster gasoline prices, and national polls that tell us we're just not happy about much of anything, a little cheerful news drifted into our offices last week.

The *Ragan Report*, probably the most widely read publication addressing corporate journalism, has cited the *Lab News* repeatedly over the years as one of the best institutional publications in the country. The latest appeared in the "What's Working" column of the June 11 edition. It said Iris Aboytes' (3651) May 25 *Lab News* story about Brian Griego's (4211) recovery from severe injuries suffered in a home accident and return to work after months of surgery and physical therapy was one of those "heartwarming features" that fellow employees might otherwise never have known about. "Not only is the piece well written," the column added, "but the photography (featuring the subject running on a track) is excellent." The photo was by Randy Montoya (3651).



BRIAN GRIEGO

As the column citation was circulating through our offices, *Lab News* editor Bill Murphy pointed out that Iris then "up and outdoes herself in the very next issue with her story about Dick Fate (6486), which drew praise from John Fleck," who covers the lab for the *Albuquerque Journal*. If you missed those inspiring stories about true spirit, take a look at the back issues.

—Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)



HOWARD KERCHEVAL

Divisions 4000, 9000, and 10000 undergo reorganization

Sandia Labs Director Tom Hunter this week announced a reorganization that involves Divisions 4000, 9000, and 10000.

Among the principal changes are Lenny Martinez has taken on a new assignment as vice president of Regional Technology (100), and Joe Polito will replace Lenny as vice president of Enterprise Transformation (9000). Joe also will lead the Integrated Enabling Services SMU.

Tom cited Joe's broad experience in nuclear weapons and IES, strategic planning, and industry, and called him "a welcome addition" to executive management. "He brings an in-depth history of our journey toward contractor assurance, and the established relationships at SSO, NNSA, and at LM headquarters to facilitate the changes needed for our future," Tom said.

Lenny's new assignment includes shepherding a broad set of development strategies that involve the New Mexico national laboratories, NNSA, the DOE, and the State of New Mexico. These include specific opportunities in high-performance computing, border security, alternative energy, and improved technology partnerships within the state.

Deputy Labs Director John Stichman said, "Lenny's assignment supports NNSA's 2030 plan, which emphasizes greater collaboration within our statewide community. His past experience working with small business, applying innovative manufacturing processes, and involvement in laboratory enterprise transformation, all fit nicely with his new responsibilities."

Tom said the reorganization will help provide focus to the implementation of the Integrated Laboratory Management System (ILMS).

Among other changes in the reorganization are Jennifer Crooks will become acting CFO and vice president for division 10000, Business Operations; Dori Ellis will become acting vice president for division 4000, newly renamed Infrastructure Operations; and Tom Blejwas will become director of Center 9700, formerly Center 10700, IES Support & Lab Mgmt. Systems.

The new org chart is on Sandia's internal web.

New org numbers

Many organizations within the three divisions will change numbers. Here are the newly constituted organizations and their leaders. The former org numbers are in parentheses:

- 100, Regional Technology, Lenny Martinez, VP
- 700 (7000), Principal Scientist, Gerry Yonas, VP
- 9000, Enterprise Transformation, Joe Polito, VP
- 9200 (9200), Management Assurance, Joe Polito (acting)
- 9300 (4300), Computing & Network Services, Robert Leland
- 9500 (4500), Information Solutions & Services, David Williams
- 9600 (4600), CIO, Art Hale
- 9700 (10700), IES Support & Lab Mgmt. Systems, Tom Blejwas
- 10000, CFO & Business Operations, Jennifer Crooks, acting VP
- 10100 (9100), Strategic Relationships, David Goldheim
- 10200 (10200), Supply Chain Management, Bonnie Apodaca
- 10500 (10500), Controller & Pension Operations, Jennifer Crooks
- 4000, Infrastructure Operations, Dori Ellis, acting VP
- 4100 (10300), ES&H & Emergency Management, Philip Newman
- 4200 (4200), Safeguards & Security, Michael Hazen
- 4800 (10800), Facilities Management & Operations, Jeffery Quintenz
- Other changes:
- 2500, Energetic Component Realization, James Woodard (acting)
- 6900, Line of Business Director Global Security, Henry Abeyta (acting)

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LOCKHEED MARTIN

Classical guitarist to perform at July Thunderbirds meeting

Classical and flamenco guitarist José Salazar will perform at the July 9 meeting of the Sandia Thunderbirds (Sandia's retiree organization) at the Mountain View Club on Kirtland Air Force Base.

The monthly Thunderbird Club business meeting starts at 1:30 p.m. with the flamenco program following at 2 p.m. An optional buffet-style lunch will be available around noon.

Salazar, a New Mexico native, studied with Hector Garcia en route to a degree in music from the University of New Mexico. He has also attended a master class taught by legendary classical guitar master Andres Segovia.

Salazar has participated in the annual Santa Fe Guitar Festival and has presented recitals in Spain and Mexico, as well as in Albuquerque and Santa Fe. Since 1988, he has performed annually at Carnegie Hall. He was the recipient of the 1984-85 Solo Performance Grant from the National Endowment for the Arts. Said the *New York Daily News* of a Salazar performance: "[There was] incredible fluidity to his music as he traversed it."

There is no charge for the programs; the optional lunch is extra. The meeting is open to all with access to KAFB. For information, contact Genelia Boenig at 836-6977.

Researchers look to biology in extreme environments to help solve extremophiles ethanol puzzle

By Mike Janes

Buried beneath a sulfurous cauldron in European seas lies a class of organisms known as “extremophiles,” so named because of the extreme environmental conditions in which they live and thrive. Almost as radical, perhaps, is the idea that these organisms and their associated enzymes could somehow unlock the key to a new transportation economy based on a renewable biofuel, lignocellulosic ethanol (ethanol derived from plants).

That’s the concept behind a Laboratory Directed Research and Development (LDRD) project now in its second year. As researchers search for ways to process cellulosic biomass cheaply and efficiently for the production of lignocellulosic ethanol, the Sandia project aims to demonstrate various computational tools and enzyme engineering methods that will make extreme enzymes relevant to the technical debate.

Blake Simmons (8755) says the primary hurdle currently preventing lignocellulosic ethanol from becoming a viable transportation fuel is not the availability of lignocellulosic biomass, but rather its efficiency and cost-effective processing.

“Production is not a concern. More than a billion tons of biomass are estimated to be created each year in the timber and agricultural industries, as well as a variety of grasses and potential energy crops,” Blake says. “Unfortunately, you can’t just take a tree trunk, stick it into an enzymatic reactor, and ferment the sugar produced into ethanol with any kind of efficiency. The process of turning certain lignocellulosic materials into ethanol is very difficult and costly.”

That process typically involves several pretreatment steps that break up lignocellulosic material into easily converted polymers.

Continuing with the tree trunk analogy, Blake says the laborious process typically begins by chopping the biomass to reduce its size and then delivering it into a dilute acid pretreatment reactor. The reactor then would break down the

“Production is not a concern. More than a billion tons of biomass are estimated to be created each year in the timber and agricultural industries, as well as a variety of grasses and potential energy crops.”

— Blake Simmons



RAJAT SAPRA (8321) examines assays for the screening of engineered enzymes, originally from the organism *Sulfolobus solfataricus*, which show increased activity and stability at acidic conditions and high temperatures. (Photo by Randy Wong)

biomass into cellulose, hemicellulose, and lignin. The hemicellulose and cellulose polymers released from the biomass must go through additional processing and acid neutralization before the final product is recovered and placed back into an enzymatic reactor to deconstruct the polymers into fermentable sugars. Not exactly swift and efficient, says Blake, and very costly.

Enter enzymes isolated from extremophiles, which may solve this vexing processing riddle. Sandia’s current biological object of interest is *Sulfolobus solfataricus*, an organism whose extreme enzymes were isolated and discovered years ago by the German researcher Georg Lipps. *Sulfolobus* expresses cellulase enzymes known to exist in organisms that prosper in sulfuric acid environments and, through an inexplicable quirk of nature, efficiently break down cellulose into sugars.

“Biology generally likes sugar,” Blake says. “Since it offers an easy energy intermediate that can be converted into some usable output.”

The Sandia team members are one of a handful of research teams looking at enzymes expressed by the *Sulfolobus* organism and manipulating them in a laboratory setting with the objective of processing biomass into cellulosic ethanol.

Extreme enzymes can be found in a variety of locales, including hot springs, gold mines, even within the rust found under a leaking hot water heater. While other researchers are examining common biomass sources and attempting to express their enzymes at higher temperatures and lowered pH, Sandia has, in effect, taken the opposite approach.

“Instead of trying to create an extremozyme from sources that live in rather benign environmental conditions, why not just manipulate a real one isolated from its natural state?” asks Blake.

Sandia has brought the DNA that produces these extreme enzymes into the lab, where researchers then employ a technique called “site-directed mutagenesis” to manipulate and optimize the enzymes’ genetic sequence in hopes of improving performance. These mutations are identified using computational modeling techniques at Sandia that compare the structure and sequence of the extremozymes with their more benign counterparts to identify key genetic sequences of interest.

“The ultimate dream — and it’s only a dream right now — would be to take a poplar tree, put it into a tank, let it sit for three days, then come back and watch as the ethanol comes pouring out of the spigot,” says Blake. “Though we’re probably decades away from that, this project aims to consolidate the pretreatment steps and get us one step closer to realizing that vision.”

The benefits of developing biomass-to-ethanol technology are well known, says Grant Heffelfinger (8330), senior manager for molecular and computational biosciences and Sandia’s lead on biofuels programs. He points to increased national energy security, reduction in greenhouse gas emissions, use of renewable resources, and other oft-cited advantages.

“But corn ethanol must compete with food



BIOCHEMIST JOANNE VOLPONI (8321) prepares samples of cellulase enzymes for activity assaying in a high-throughput, fluid-handling robotic system. Sandia is demonstrating various computational tools and enzyme engineering methods that can help process cellulosic biomass. (Photo by Randy Wong)

Sandia California News

markets, leaving lignocellulosic ethanol as the fuel most likely to make the most meaningful short-term impact in reducing gasoline’s stranglehold on the transportation sector,” says Grant.

Although the end product with cellulosic ethanol and corn ethanol is the same, the difference is in the complexity of the starting material. While corn is a simple, starch-based material that is easily processed into fermentable sugars, cellulosic biomass consists of a cellulose polymer, wrapped within a complex vascular structure of lignin, hemicellulose, and other components.

“Because lignocellulosic biomass is such a multifaceted material, we need to have a fundamental understanding of how it works,” says Blake.

While various industry researchers are investigating new technologies and facilities that will allow for processing cellulosic biomass into ethanol, Blake and his team are hopeful that their method can be efficiently and cheaply integrated with current and future pretreatment steps.

“We believe extremophile enzymes — and the technology that demonstrates how to use them — can be a very powerful resource for the research and industrial community to draw upon,” Blake says.

Blake presented his team’s preliminary findings from the extremophile project recently at the 4th World Congress on Industrial Biotechnology & Bioprocessing. Sandia hopes to publish more advanced findings soon and is finalizing several proposals that could lead to further funding. According to Blake, Sandia would be open to conducting collaborative R&D with other commercial partners or research entities, or to licensing its research capabilities.

In addition, this and other efforts at Sandia are expected to be a vital component of the Joint Bio-Energy Institute (JBEI), a multilab/university effort to bring a Department of Energy-funded bioenergy research facility to the San Francisco Bay Area. Sandia is planning a key role in that facility, which will focus on cost-effective, biologically based renewable energy sources to reduce US dependence on fossil fuels.

“We believe the use of enzyme engineering to enable the next generation of ethanol bio-refineries, with a focus on extremophile enzymes, is a realistic and achievable goal,” says Blake. “But we need others to believe, too.”

Casa Angelica

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arsenic adsorption media, says Sandia researcher Brian Dwyer (6316).

He and his colleagues at Sandia chose the Casa Angelica water system from about 20 systems in New Mexico as a research site because of its small size and relatively low levels of arsenic. The Casa Angelica well currently provides drinking and bathing water to 16 medically fragile children and young adults who live there, 50 staff, and the Canossian Daughters of Charity, who own and operate the facility. It is also used for grounds irrigation.

The "in-tank filtration" technology uses a small pump to continuously circulate stored drinking water through a small vessel containing commercially available arsenic adsorption media. Conventional systems remove arsenic in a single filter pass that requires the filter vessel to be sized based on peak water demand.

In contrast, the Sandia technology continuously recirculates water from the community storage tank through a much smaller filter vessel and back into the storage tank thereby removing most arsenic during off-peak water usage. This results



SANDIA RESEARCHER Brian Dwyer checks out arsenic removal equipment at Casa Angelica. The facility's well provides drinking and bathing water to 16 medically fragile children and young adults who live there.

in a gradual lowering of the entire storage tank arsenic concentration, providing the ballast capacity to meet peak demand with a very small treatment unit, which translates into a significant cost savings for the small water systems.

The New Mexico Environmental Department (NMED) Drinking Water Bureau has identified roughly 100 small, predominantly rural water systems that exceed the new arsenic standard. In the past the only water treatment these small water systems have conducted is chlorination (disinfection). Systems exceeding the new 10 micrograms per liter of arsenic must now install and operate a treatment system for the first time.

Casa Angelica, like many of the small water suppliers, obtained an extension to install the modifications necessary to bring their water into arsenic compliance.

"I want to assure everyone that Casa Angelica's water is in no way dangerous," Brian says. "We just want to make sure it meets the new standards."

The Sandia treatment system, which was designed and built at the Labs and recently installed at the agency, will be used until later this year when Casa Angelica is expected to be connected to the City of Albuquerque water system. Then all water for drinking, bathing, and the therapeutic pool will be supplied by the city. Well water will continue to be used as the irrigation source for the lands.

The Casa Angelica arsenic research is sponsored by the Arsenic Water Technology Partnership, a consortium of Sandia, the Awwa Research Foundation (AwwaRF), and WERC, a consortium for Environmental Education and Technology Development. US Sen. Pete Domenici, R-N.M., secured funding for the project through DOE when he was chairman of the Senate Energy and Water Development and Appropriations Subcommittee.

Other experimental arsenic removal sites in New Mexico that have been part of the program are in Socorro, Anthony, Jemez, and Rio Rancho.

About Casa Angelica

Casa Angelica, a nonprofit organization, is an Intermediate Care Facility for children and young adults with pervasive needs. Directed by the Canossian Daughters of Charity since 1967, Casa Angelica provides a family-centered program for 16 children with personalized, active treatment plans. A team of program staff and consultants include administrators, program director, medical director, director of nursing, family coordinators, dietitian, social worker, educators, and therapists. People can make donations directly to Casa Angelica at 5629 Isleta Blvd. SW, Albuquerque, N.M., 87105.

Thanks

Casa Angelica would like to give special thanks to the Rodgers Pump Company, which modified the agency's water system at no charge to prepare it for the Sandia experiment.

ILMS

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processes and systems-level oversight.

Ultimately, what this change means to Sandia managers, says Joe, is that they will get fewer ad hoc data calls, and they will see more standardized data through the ILMS system. Starting in FY08, Sandia managers should see a reduction in requests for detailed data at the department and center level, and more performance

and assurance information will be available to them and to SSO through ILMS.

Example: Expanding LESA

A number of tools that started life in one part of the Labs are being expanded, through ILMS, to serve everyone, says T.J. For example, he notes that the software known as LESA was originally developed to help manage and report Line ES&H Self-Assessments. But after extensive meetings with users, the software has now been upgraded to handle current and potential corporate, SMU, policy area, and division self assessments across the Labs. LESA now stands for Laboratory Enterprise Self-Assessment.

A pending update of CPR001.3.10, "Corporate Self-Assessment Process," will require the use of LESA by all Sandia organizations, unless specifically exempted by the executive policy sponsor. Organizations that have already conducted a self-assessment in FY07, or are going to conduct one, must now enter that data into the new LESA by Sept. 30.

The revised software pulls together information in a consistent way, allowing

more complete and accurate analysis and comparisons in reports to management and SSO.

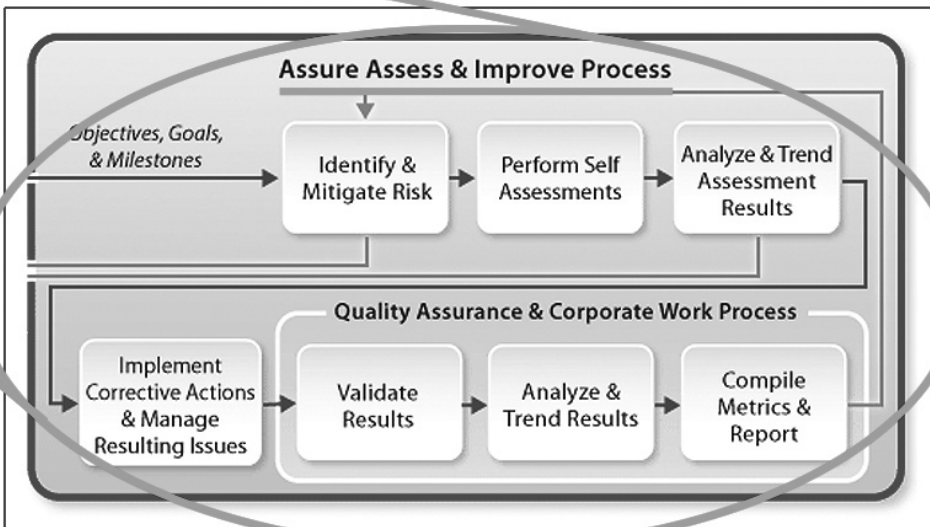
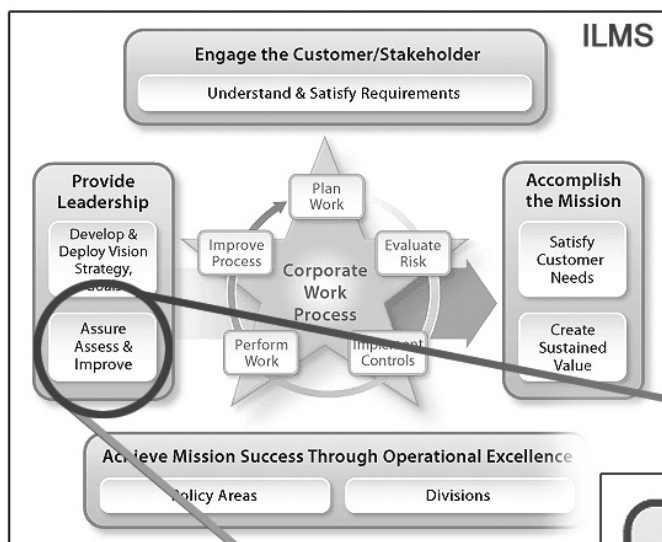
"By providing this new view of self-assessments across the whole enterprise, LESA provides us with a capability to see performance trends across our management systems. Our stakeholders have great interest in the performance of our systems as well," says Joe. "Improved performance in these areas will mean that we'll be able to apply more attention to the core work of the Labs."

Maturing our standards

"As it matures, ILMS will increasingly reflect best practices in business processes and continuous improvement," says Joe. "Future processes will be designed around the ISO standard 9001:2000, with an eye to integrating the many separate efforts already undertaken, so that we can continuously improve while communicating easily with each other, with our DOE customer, and with all stakeholders."

For more information

To view ILMS, go to Sandia's Techweb homepage and click on the ILMS icon located in the upper left corner. As part of a continuing dialog, the ILMS team holds frequent awareness sessions. (Call Linda Gillis [9251] at 844-7964 for more information.)



ASSURE, ASSESS & IMPROVE — A new Sandia process now aligns the seven assurance-related Corporate Process Requirements (CPRs) devoted to Contractor Assurance.

Optical clamp

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which the beam is forming.

When the laser beam traverses the doped glass, it stimulates the material to release energy that adds to the beam's strength, an effect known as gain. But the exterior of the doped glass — closer to the flashlamps — is unavoidably heated more than its interior. This modifies its refractive index, focusing the beam to a point some meters away instead of allowing it to continue to infinity.

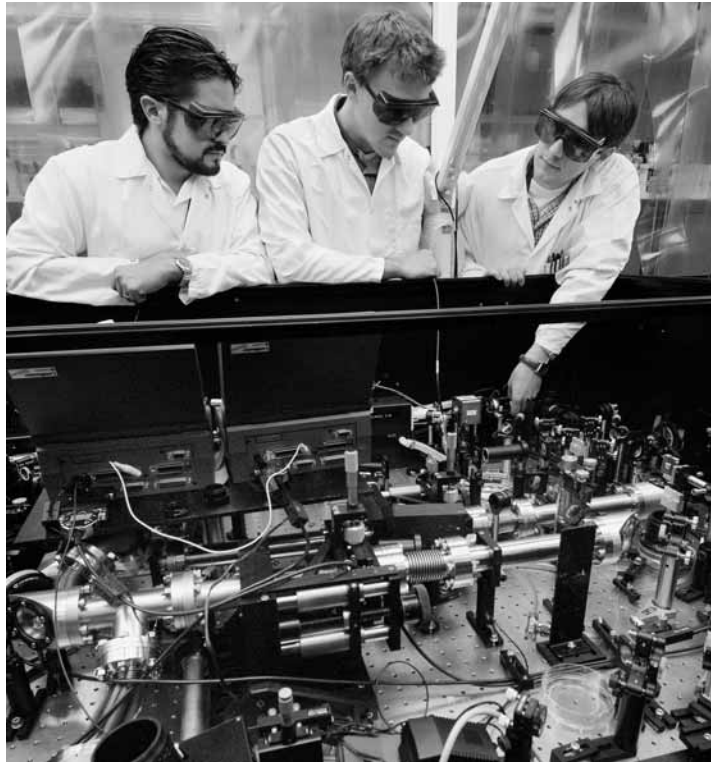
Rather than alter the flashlamps or gain medium, Jens, with the aid of Marc Ramsey and Daniel

Headley (both also 1672), used a single flexible mirror to precorrect for the distortion to take place later in the beam's passage.

The motivation for the work, Jens says, is that "It's customary to use a static concave mirror — or a combination of appropriate lenses — and hope it's correcting well for distortions in the lensing system you have. But rather than buy a

"Let's see if we can do the job more simply and inexpensively."

— Jens Schwarz



DANIEL HEADLEY, Marc Ramsey, and Jens Schwarz (all 1672) examine the performance of one of their optical clamps as it corrects for laser beam distortion in Sandia's Z-beamlet laser.

(Photo by Randy Montoya)

succession of lenses or mirrors, we thought: Let's see if we can do the job more simply and inexpensively by using only one mirror with a flexible focal length."

The corrective effect is achieved by placing a flat mirror between two concentric rings of different sizes, one stationary and the other free. A screwdriver turned either by fingertips or by motor (the motor raises the price) applies a force to the free ring and bends the mirror a few microns, changing its focal length. The orientation of the large and small rings determines whether the distortion is concave or convex.

The method has been shown to work over a wide range of laser beam energies ranging from 30 millijoules to 500 joules.

Descriptions of the work and its applications have been published in the February 2006 *Applied Physics B: Lasers and Optics* and the November 2006 *Optics Express*. Other authors in addition to Jens, Marc, and Daniel include Ian Smith (1672) and John Porter (1670).

The device, listed as a "Variable Focal Length Deformable Mirror," will issue as US Patent No. 7,229,178.

Sandia inventions win key awards from Federal Lab Consortium, praise from Secretary of Energy Samuel Bodman

PASD technique garners unique recognition

By Neal Singer

In 2007, only one research team in the nation received the Federal Laboratory Consortium's Interagency Partnership Award for Excellence in transferring federal technology to the commercial marketplace.

Larry Schneider (1650), R. Kevin Howard, Michael Dinallo, and Steve Glover (all 1653) won for their team's work in creating a commercially viable technique capable of spotting potential short circuits in airplanes before their misfirings cause damage, thus reducing risks of catastrophic in-flight failures.

The PASD (pulse arrested spark discharge) technique was developed largely through a partnership with the Federal Aviation Administration. The technique, proven after years of development and testing at Sandia, was transferred last year to the private sector.

Wrote DOE Secretary of Energy Samuel Bodman, "PASD is the world's first wiring diagnostic tool that can detect and locate a broad range of aircraft defects, such as breached insulation, chafing, and small insulation cracks, and because of this detection will save lives."

Sandia VP Rick Stulen: "This is a perfect example of innovation stemming from the intersection of world-class science and engineering capabilities at Sandia that I'm eager to stimulate further throughout our technical communities. Congratulations [Larry and your team] on an extraordinary accomplishment."

Says Larry, "The final step was finding the right commercial partner. Astronics Advanced Electronics Systems recognized PASD's capabilities and then brought to bear their significant expertise to field a system within months. PASD's first use in a National Transportation Safety Board accident investigation yielded exceptional results. ArcSafe® [the commercial name for PASD and other test technology] is just now coming to market, but its future looks very bright."

Sandia also had three winners in the more populated but still selective "Award for Excellence in Technology Transfer" category. Those selected also received a congratulatory letter from Bodman.

Craig Smith (8529) and Ernest Friedman-Hill (8964) were winners for "Jess® — the Rule Engine for the Java™ Platform." The program is a tool for building intelligent software that can be repeatedly applied as an expert system to difficult or ill-defined systems when rote computation won't do.



Mike Dinallo and Larry Schneider (left) prepare to employ the PASD diagnostic on a wiring bundle in the cockpit of a retired Boeing 737 at Sandia's FAA Airworthiness Assurance NDI Validation Center. (Photo by Randy Montoya)

It has been applied to problems in technology, insurance, and financial services, as well as in academic artificial intelligence research, and has been licensed to hundreds of academic institutions.

Nathan Golden (9104), Tom Anderson, Bill Camp (ret.), Art Hale (4600), and Mark Allen (5434) won for Novint's 3-D haptic technology software that adds interactive, realistic virtual touch capabilities to human-computer interactions. Among the uses might be medical applications, remote vehicle or robotic control, military applications, and video games. Users are said to feel realistic weight, shape, texture, dimension, dynamics, and force effects.

An improved solar design won an award for David King, Paul Smith (9104), James Gee, Mark Allen (5434), and Jeffrey Nelson (6337). The breakthrough photovoltaic cell design and fabrication process for Advent Solar moves current-carrying electrical circuits from the front surface of the cell, where they unavoidably block sunlight, to the back surface where the backside wiring carries the current away. In addition to being more efficient, the advance — which uses a laser to drill holes through a silicon substrate and

form conductive channels from front to rear surfaces — is said to lower costs by eliminating front-to-back assembly. And the design is aesthetically pleasing, a quality not often mentioned in connection with Sandia advances.

National winners were culled from a field of more than 250 federal laboratories, research centers, and facilities represented by the FLC.

In regional victories, Sandia itself won a Mid-Continent Region Award for overall achievement.

The "Athena Radar-Responsive Tag Sensor" garnered an Outstanding Technology Development Award. In Outstanding Partnerships, the University Alliance program and the Sandia Science and Technology Park were winners.

Sandia's "Computational Analysis Tools for Goodyear Assurance Tires — Featuring Triple-Tred Technology" received an honorable mention.

Organized in 1974, the Federal Laboratory Consortium for Technology Transfer serves as a loose nationwide network of federal laboratories that provides a forum to develop strategies for linking laboratory mission technologies with the marketplace.

Sandia Safety Fair speaker emphasizes the impact decisions have on all areas of life

PNM Sr. Safety Consultant Randy Fellhoelter made one routine-type decision that nearly ended his life

By Jacqueline Cieslak

Before beginning his talk, Randy Fellhoelter stood at the front of Steve Schiff Auditorium and embraced an old friend. His left arm went around her back, while his right arm, ending in a covered stub a few inches below his elbow, curved just enough to go around her shoulder.

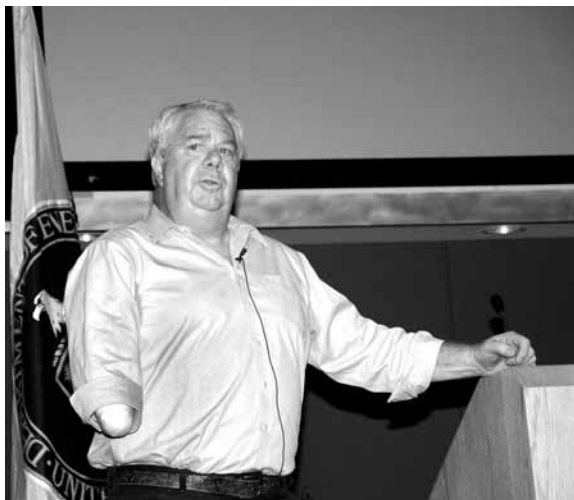
"Here's a challenge, folks, for all of you," he said during his talk. "Make a peanut butter and jelly sandwich. Stipulation: one hand."

Embracing friends, preparing food, getting dressed — these are just a few examples from an infinite list of tasks Fellhoelter has had to learn to do with just one full arm after an electrical accident 17 years ago. As the keynote speaker at Sandia's annual Safety Fair, held June 7, Fellhoelter shared his story with the audience to emphasize the rule "safety first."

"I stand before you this morning as a man who screwed up," he said. As an electric lineman for PNM, Fellhoelter was working with a coworker to repair a 7,200-volt primary cable. The night before, another crew had found the cable, isolated it, attached warning tags, and stood it off on portable stand-off bushings.

"The safety rule in working on high-voltage cables is always to identify, test, and ground them before working on them," he said. "However, I had not brought grounding equipment, and my 20 years of high-voltage line experience gave me the confidence to take a shortcut as I 'knew' the line was dead."

To illustrate the severity of his accident, Fellhoelter used photographs he got from the hospital and some his wife took in the following months of recovery. Before showing anything too graphic, he warned the audience and asked anyone who might be offended or uncomfortable to leave. The worst damage, aside from his right arm, was to his left upper thigh, where much of



RANDY FELLHOELTER speaks at Sandia's annual Safety Fair held June 7. He shared his story with the audience to emphasize the rule "safety first." (Photo by Bill Doty)

the electricity left his body. The photos show mangled skin and dark pink scar tissue.

"This is Randy," he said as he ran through the photos. "A man that felt comfortable, a man that took a shortcut, and this is what my family lives with." One of the less apparent negatives of the accident was the impact it had on Fellhoelter's family, an impact he emphasized as one of the worst. He had to spend months in recovery, not working, and relying on family care to facilitate his successful recovery.

"The reality is you're not the only one that pays the price for your decisions," he said. "I can't teach my grandchildren some of the same things I taught my children. I had to start totally new."

Taking shortcuts, Fellhoelter said, is something everyone does. And depending on the situation or sequence of events, he said anyone could easily have consequences as drastic as his, or worse. Several times he reemphasized that: "You are three times more susceptible to general

electrical contact in your own home than in all the general industries combined."

Now, 17 years after the accident, Fellhoelter is the senior safety consultant at PNM. He has shared his story with more than 60,000 listeners, always promoting "safety first" and reminding people that their decisions do not affect just them. About 200 people watched his presentation at Sandia in Steve Schiff Auditorium, while another 82 (mostly from California) watched a live streaming video from their desks.

In a discussion after the presentation, Fellhoelter said that seeing the photos doesn't bother him as much as seeing the emotions on the faces of people in the audience. "I know that people have been through things in their lives that were very painful," he said. "My presentation may have rekindled that pain, and that hurts me."

After the talk, Fellhoelter spoke to several Sandians. Some thanked him for sharing his story, others complimented him on his courage, and a few shared their own stories with him.

"People coming up and sharing, that is flattering to me," he said. "It's amazing, this woman who was talking to me, she hasn't sought a support group, but she came up and opened up to me. She was apparently comfortable confiding in me; now that's very flattering."

As for Sandia's Safety Fair, Fellhoelter said he thinks it's great.

"Safety should be integrated into everything we do," he said. "Unfortunately, it's often not. I think what's important here at Sandia is a whole rekindling of the safety emphasis, and accountability and individual responsibility. At the end there when I said safety's number one, it really is that simple."

Want to watch Fellhoelter's full talk?
Visit: <http://labnews.sandia.gov/shortcuts>.

2007 Safety Fair draws 3,000 people

On June 7, the area in and around Steve Schiff Auditorium was crowded with safety-loving Sandians. Signs displaying slogans like "Have a totally safe day!" and "Safety pays!" decorated 65 vendor displays, where items (pens, badge holders, magnets, flashlights, tape measures) sporting the same slogans sat in baskets for passersby to pick up.

"The planning effort that goes on to prepare for this event is incredible," says Bryan Drennan (10322), Safety Engineering team lead. "This is the most fantastic Safety Fair that's been put on in a long, long time."

This year's fair was organized by a committee in ES&H. According to committee member Sandy Portlock (4546), about 3,000 people attended. About 200 attended the keynote speaker in Steve Schiff Auditorium, and another 82 (mostly in California) watched a live streaming video from their desks.

"This year was bigger and better organized," Sandy says. "Next year, we're just going to improve on what we did this year. We're also going to try to work with the other contractors on the base. A big base-wide safety fair — in the future that's kind of what we'd like to do."

Committee members: Willie Johns (10322), Ernest Sanchez (10322), Debi Angeli (10330), Sandra Jiron (10322), Sandy Portlock (4546), Denise Tafoya (10322), Bill Wolf (10336), Ralph Fevig (10322), Don Rideout (10322)



Scenes from 2007 Safety Fair

Photos by Bill Doty



Exterior Communications Infrastructure Modernization project completed

New capabilities will support Labs' increasing bandwidth demands

The largest telecommunications project in Sandia's history — is history.

The Exterior Communications Infrastructure Modernization (ECIM) project, a \$25 million line item project, was completed more than four months early and under budget.

The ECIM project was designed to provide high-speed/high-fidelity networking capability to support advancing information systems technology, particularly advanced computing initiatives for the next generation of Sandia problem solvers.

The outdated Tech Area 1 communications infrastructure, parts of which served Sandia for more than 50 years, had limited capacity, flagging reliability, increasing maintenance costs, and was unable to meet long-term technology requirements. As more work requiring the transfer of large amounts of data among Tech Area 1 groups was needed, it became apparent that the infrastructure would have to be upgraded.

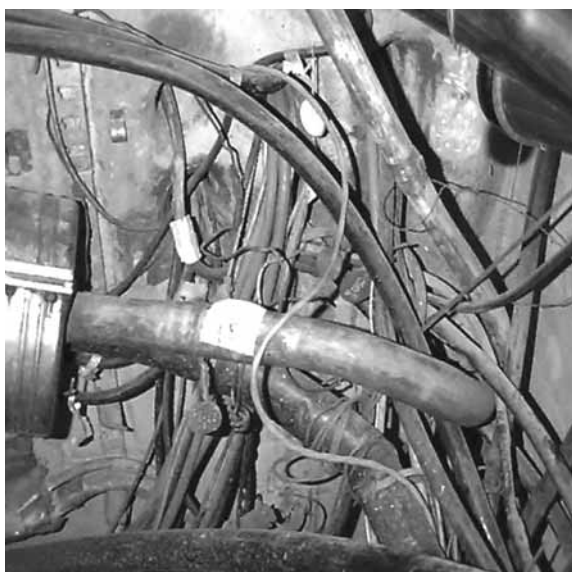
Conceptual planning and design for the project began in 1999 and from the beginning focused on ensuring the infrastructure would be robust, upgradeable, serviceable, and secure for the foreseeable future. Construction began in 2004.

Project construction

ECIM construction work took 31 months to complete. The underground work involved tearing up streets, sidewalks, landscaped areas, and parking lots and trenching as deep as 16



ECIM CONSTRUCTION WORK took 31 months to complete. The underground work involved tearing up streets, sidewalks, landscaped areas, and parking lots and trenching as deep as 16 feet so that duct banks could be installed. (Photo by David Hendrix)



OLD WIRES were replaced in the ECIM project.

feet so that duct banks could be installed. The construction of 16,400 linear feet of new underground duct bank was required to replace the existing duct bank system, which had neither the capability nor capacity for expansion. Fifty-two new 12-by-10-by-7 feet precast concrete telecommunications manholes were installed in excavated holes that were between 11- and 18-feet deep.

Interior work on the project involved the installation of interior conduit systems in 47 Tech Area 1 buildings and then the installation of fiber optic cables into those interior conduit systems and into the exterior communications duct bank and manhole system.

Challenges

"As with any major construction endeavor, there were challenges along the way," says ECIM project manager Steve Fritz. "Our first challenge occurred during the first six months of the project. Work on the underground duct bank and manhole system fell behind schedule. To get back on schedule, the contractor doubled the number of excavation crews in order to work simultaneously in multiple locations."

Maintaining a safe workplace was an ongoing

challenge — and a high priority. The project had to be stopped twice because of safety concerns. Keeping in mind Sandia's goal to put safety first, two additional people were assigned to the field, working daily with the contractor to improve safety performance on the ECIM project. As a result of the additional oversight there were no safety incidents during the final four months of construction.

The ECIM project was carried out in a way to minimize impact on the environment. For example, where the ECIM work might have affected the active nests of migratory birds, smaller trees or shrubs were relocated away from construction activities between November and February, the period when there is no nesting activity. Large trees that couldn't be transplanted were removed, but were replaced with new trees upon completion of construction.

So what's in it for Sandia?

The new communications infrastructure of manholes, duct banks, and building service entrances has a designed life of 50 years, and the new fiber optic media within that infrastructure has a service life of 30 years. The new infrastructure, DOE's most modern and capable, will enable Sandia to fully leverage new computational facilities such as the Joint Computational Engineering Laboratory, the Supercomputing Annex, the Microsystems Engineer-

ing Sciences Application Complex, and the Distributed Information Systems Laboratory at Sandia/California.

The new infrastructure also acts as the gateway to the petascale computing environment, the next generation of supercomputers that will be the dominant force in the next decade. Sandians will have access to the multi-gigabit network that connects the tri-lab community of Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia. The petascale environment will provide the raw capabilities necessary to underpin and enable the revolution in engineering and its emphasis on modeling, simulation, and analysis.

Other benefits provided by the ECIM project include:

- An annual savings of tens of thousands of dollars in field survey and repair costs;
- An inter-building system that reduces the risk of service outages, resulting in lower annual costs of lost productivity and lost opportunity; and
- A safer environment for outside plant and construction workers.

The project was designed to accommodate new missions with increasing need for new bandwidth support by installing extra ducts, providing flexibility, and allowing for future expansion. Online maintenance of the system is possible due to the diverse routing capabilities designed into the project.

ECIM Statistics

- End to end, the 5-inch PVC conduit used in the duct bank system would extend for approximately 40 miles.
- Placed 5,300 cubic yards of concrete around the PVC ducts.
- Placed 1,400 cubic yards of lean concrete as backfill under existing utility systems and around manholes.
- Recycled 3,300 tons of asphalt pavement removed to install the duct bank/manhole system.

- Recycled 170 tons of concrete sidewalk, curb and gutter, and drive pads removed to install the duct bank/manholes.
- The underground general contractor and subcontractors worked 170,185 man-hours or 86 man-years.
- Installed approximately 37 miles of fiber optic cabling and 2 miles of copper cabling, all within a duct bank system that included approximately 78 miles of Maxcell innerduct.

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong



George Clark
45 2626



Leland Byers
40 4334

Recent Retirees



Alvin Du Charme
38 8512



Renee Foster
35 3554



G. Ronald Hadley
35 1742



Pete Royval
35 8228



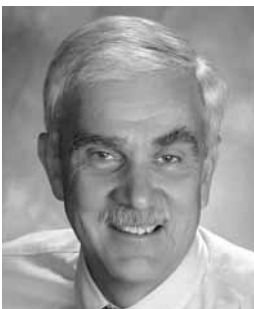
Bob Bastasz
30 8758



Yvonne Mak
17 8944



Dennis Floyd
22 1535



Rich Behrens
30 8368



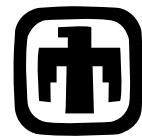
Billy Brock
30 5345



Christopher Cameron
30 6335



John Dunton
30 24314



Larry Walker
30 2110



Mary Chapel
25 5054



Veronica Chavez-Soto
25 5733



Mike Daniels
25 6754



Kevin Davidson
25 8512



Jeff Manchester
25 8528



Daryl McCollister
25 12330



Dave Nagel
25 8947



John Norwalk
25 10827



Roger Watson
25 8758



Jimmy Brown
20 5577



Steve Hurd
20 8965



Jerry Langheim
20 5060



Brian Maxwell
20 8949



Timothy O'Hern
20 1512



Janice Washington
20 1711



Brad Altman
15 12334



Andrew Ambabo
15 4343



Kevin Kartchner
15 1055



Jim Orsbn
15 8517



David Schoenwald
15 1433



Daniel Sherman
15 2112



Eva Wallace
15 5415



Can you spell 'prodigy'?

Sandia scientists mentor spelling champ in math

By Patti Koning

Next month the Sandia/California site is in for a special treat when National Spelling Bee Champion Evan O'Dorney performs at the annual intern talent show. Thirteen-year-old Evan won't be showing off his spelling prowess; rather, he'll dazzle the audience by performing an original piano composition.

Music is one passion Evan puts above spelling; the other is math. For nearly four years, he's been visiting Sandia every week for tutoring in math from Ken Perano (8964) and former Sandian Jessie Davis.

On a "Good Morning America" appearance following his spelling victory, Evan explained why he prefers math, saying, "I like the patterns that the numbers make, and the way that it is so logical. You can't argue about something if you've proven that it's true."

Eilene Cross (8350) met Evan about five years ago when she was grading papers in Sandia's Go Figure Mathematics Challenge. After seeing Evan's paper, she made a point of meeting him.

Eilene is the head mentor for the Physical Sciences Institute in Center 8350 and the intern programs in Centers 8320 and 8750. In that role, she seeks out promising youth for internships in all three centers.

"I'm always on the lookout for young talent," she says. "When I saw Evan's paper, I said to myself, 'I've got to meet this kid — this is someone we need to follow.'"

The goal of the internships is to provide a unique opportunity for high school- and college-age students interested in physical sciences. Internships are also an important recruiting tool for Sandia. Eilene hopes Evan might one day pursue his career here.

Not long after that meeting, Ken was also impressed by Evan's mathematical abilities during a tour of the Center for Cyber Defenders for advanced math students.

"I just assumed Evan was a younger sibling of one of the kids on the tour," says Ken. "But he came right up to the front and started asking

questions beyond the ability of most high school students."

Ken struck up a conversation with Evan's mother Jennifer, who homeschools her son. She said she was reaching the limit of what she could teach Evan, who was 9 at the time, in math.

Evan was eager for the opportunity to learn from Ken, who holds a PhD in engineering from the University of California, Davis, and Eilene. The tricky part was convincing security that it was necessary to bring a 9-year-old on site.

In the tutoring sessions, Evan has been learning college- and graduate-level differential and integral calculus, graph theory, differential equations, tensor analysis, matrix analysis, fractals, chaos theory, and computer science.

"This experience has been very rewarding," says Ken. "I look at it as a rare opportunity to work with a truly gifted student. The rate at which Evan learns is phenomenal. He universally gets things the first time."

The partnership has proven rewarding for Evan as well. Jennifer says working with Ken and Eilene has really expanded his knowledge. The Sandians have also influenced him in other ways.

"He's matured a lot from working with Ken and Eilene. They've helped him see what the world is really like and how you relate to people on the job," she says.

After Evan's appearance on the Jimmy Kimmel show, both Eilene and Ken contacted Jennifer to make sure his feelings weren't hurt by the satire.

"Evan was fine with how the show went,"



NATIONAL SPELLING BEE CHAMPION Evan O'Dorney dazzles Sandia with his musical prowess at the 2006 intern talent show. (Photo by Eilene Cross)

says Jennifer. "But it just shows how nurturing Eilene and Ken are. They really know him."

The night Evan won the 2007 Scripps National Spelling Bee with his correct spelling of "serrefine" (a small spring forceps used to clamp a blood vessel), an ABC television news crew tracked down Eilene at a restaurant in downtown Livermore. After breaking the news of Evan's victory, which Eilene says she expected, the crew filmed her watching the final round. The footage showed up on the evening news.

Evan is currently attending the Mathematical Olympiad Summer Program (MOSP) in Nebraska, a program for select students who have risen to the top on American Mathematics Competitions. This fall he'll be taking calculus at University of California, Berkeley.

Eilene is looking forward to composing a piano duet with Evan when he returns to Sandia. Ken plans to continue working with him in the fields of math, engineering, and physics.

Food Boxing Olympics

A Sandia logistics team took second place in the annual Roadrunner Food Bank Food Boxing Olympics. The team packed 56 boxes of food for New Mexico seniors in 10 minutes. A second Sandia logistics team packed 51 boxes in 10 minutes. The total number of boxes completed by 30 city-wide teams was 1,600. Members of both teams: Carolyn Lucero, Shannon Letourneau, Denise Lopez, Raeanne Armijo, Jan Wallner, Pauline Bruskas, Scott Neely, Rudy Sanchez, Eric Williamson, Steve Phillips, Louis Lucero, Anthony Leyba.

(Photos by Pauline Bruskas)

