Experimental Physical Sciences

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Los Alamos
NATIONAL LABORATORY

Eve Bauer

Eagerly seeking new scientific directions

Every day that Eve Bauer conducts experiments at Los Alamos National Laboratory, she is amazed at the research she gets to perform.

"I can't believe some of the things I get to do, the instruments I work with, and the people I meet," Bauer said. "I have ideas and I get to see if they work." Sometimes they do, she said; sometimes they don't.

As a chemistry technician in Materials Chemistry (MPA-MC), Bauer primarily aims to better understand metal oxides, nitrides, and carbides by using a newly developed polymer-assisted deposition (PAD) technique to create high-quality films. She is a co-inventor on three patent applications related to thin film PAD.

"She is always excited to try new things and eager to collaborate to find the best possible solutions," said MPA-MC Group Leader Mark McCleskey, who has worked with Bauer for five years. "She can't wait to get projects going."

One of Bauer's recent projects is making and studying actinide oxide, nitride, and carbide thin films for possible use as fuels. She prepared the first single-crystal-like films of plutonium oxide, which allows researchers to verify theoretical predictions of the electronic properties.

"The films are allowing us to measure properties of these oxides that have not been measured before," Bauer said. "So little is known about them, so we need to study them. We want to understand these materials better and how they react in different environments."

One of Bauer's most enjoyable projects involves fabricating and coating photonic crystals for developing new lighting materials, for light-emitting diode (LED) applications, as well as for new catalysts. These nanoporous materials have a regular pattern of 300-nanometer interconnected holes. The PAD technique is unique in that it can coat within the materials' pores and dramatically changes their optical properties. Materials that start off almost white become a bright iridescent green with only three nanometers of coating. Bauer is investigating the coating's nature and exploring the broad range of possible applications.

"This project is my favorite because I get to work with colorful crystals that luminescence beautifully under (ultraviolet) light," Bauer said.

Wanting more

Bauer, who is from Southern Colorado, spent much of her life as a housewife or working odd jobs to help support her family. But when her children got older and with the desire to improve her future, she went back to school in 1991. She attended San Juan Community College and in 1998 graduated with a bachelor's degree in chemistry from Fort Lewis College in Colorado. "This was something I needed to do for myself," she said. "I needed more skills as I got older. I felt I needed this for fulfillment."

Bauer was unsure what she wanted to do when she attended the Farmington, New Mexico community college—until an algebra teacher suggested she take a chemistry class. "I fell in love with it," Bauer said. "And I have never looked back."

She joined Los Alamos as an undergraduate student in Isotope and Nuclear Chemistry after a postdoctoral researcher advised her of the opportunities available at the Laboratory. She became a technician in the Chemistry group in 1999, working on the Shared Forest Project, researching and developing new proliferation detection technologies for treaty verification.

Bauer was a member of Structural Inorganic Chemistry for a year before the group reorganized as MPA-MC, where she continues to make significant contributions. Recently, Bauer was part of a team recognized by the Department of Energy for its research to develop new materials to lower the cost of organic light-emitting diode manufacturing. Bauer used her PAD skills to fabricate thin films for transparent conductors and then investigate numerous possibilities for new materials for lighting.

"She is a very conscientious person," said Kevin Ott, of Science Program Office-Applied Energy Programs, who was Bauer's former group leader in MPA-MC. "She is very good at taking on new tasks. She learns everything she needs to know to complete the task at hand."

Jose 'Alfredo' Caro

Master materials scientist fills a strategic need at Los Alamos

Over the past 25 years Alfredo Caro has researched nuclear materials at government laboratories on three continents, gaining experience that has made him a successful materials scientist. In March, Caro joined Los Alamos National Laboratory as crystal growth and material preparation team leader in Structure/Property Relations (MST-8) and as a member of the Center for Materials at Irradiation and Mechanical Extremes (CMIME).

"There are always experiences and challenges in different times in your life," said Caro. "With the journey that I have taken, I felt that the time was right to take this great opportunity and continue to do some stimulating work."

Caro, who came to Los Alamos after seven years at Lawrence Livermore National Laboratory, has been a researcher at the Swiss Federal Institute of Technology and Paul Scherer Institute in Switzerland and the Instituto Balseiro in Argentina. Caro has also taught condensed matter physics and materials science at the Latin American research center and served as director of the country's Bariloche Atomic Center.

"The work was different, as was the culture and language, but there was always the same theme–my research–which helped me become comfortable quickly with the different backgrounds and cultures," said Caro, who grew up in Argentina and speaks four languages. "Experiencing so much diversity has taught me much."

Proven expertise

Caro was drawn to Los Alamos, he said, because of the integration of his research focus with the wealth of expertise and tools available at a national laboratory.

"This is the best place to study nuclear materials research because it has so many capabilities in regards to the scientists and the facilities," he said.

Recruiting a senior scientist, with such a wealth of experience and proven ability, is rare for the Laboratory, according to CMIME Director Michael Nastasi. "In my 25 years here, I have not seen it happen many times…but he was a strategic hire," said Nastasi (MST-8). Caro "is a talented guy who fills the gap needed for our research area."

CMIME is one of two Energy Frontier Research Centers at Los Alamos. These multimillion-dollar centers, funded by the Department of Energy, are enlisting the talents and skills of scientists and engineers to address the fundamental scientific roadblocks to U.S. energy security.

As a member of CMIME, Caro supports the center's mission to understand, at the atomic scale, the behavior of materials subject to extreme radiation doses and mechanical stress in order to synthesize new materials that can tolerate such conditions.

Caro said his goals as the crystal growth and material preparation team leader include using the team's intellectual resources and material capabilities to effectively coordinate the relationship between theories and experiments and to better respond as a team to funding opportunities.

"Our main purpose as scientists is to maintain the enthusiasm in doing research at the highest possible level," he said.

Caro's research interests include computational materials science, in particular the interface between electronic structure and the atomic scale, including the thermodynamic aspects of multicomponent systems. His models and algorithms are applied to properties of nanostructured materials and to materials under extreme conditions of irradiation and mechanical deformation.

His objective is to continue expanding the capabilities of computational materials science to predict properties of new materials, specifically for nuclear, high-temperature, and high strength applications that would otherwise require expensive and long-term experimentation.

"The study of defects, interfaces, and phase stability under irradiation will allow us to develop materials with unprecedented performance under these extreme conditions," Caro said.

John Charles

Energized to improve electrical safety

John Charles has seen much improvement in electrical safety in his 27 years at Los Alamos National Laboratory, especially so in the last 10, something he attributes to the creation of the electrical safety program and the electrical safety officers (ESO) who do the ground work.

When Charles was asked to become the Polymers and Coatings (MST-7) ESO a year ago, he assumed responsibility for continuing to improve the Laboratory's electrical safety standards. He also recently became acting ESO for Structure/Property Relations (MST-8).

"Electrical safety has become a high priority at the Lab so it was a privilege to be asked," Charles said of the MST-8 addition to his duties. "It was an easy decision because I have a lot of experience in the electrical arena."

As an ESO Charles said his goal is to educate workers about ways to prevent electrical fires, injuries, and fatalities at the workplace. He spends about 30 percent of his time on his ESO duties, which includes serving as the primary group-level focal point for electrical safety, providing consultation, assistance, and facilitation for safe electrical work within MST-7 and MST-8, and assisting in providing an electrically safe workplace.

Charles began amassing his wealth of electrical experience in 1977 as a Zia Company refrigeration, heating, and air-conditioning technician at the Laboratory. In 1983, he joined Los Alamos as an electrical/mechanical technician, working for several groups over the next 16 years. In 1999, he joined Materials Engineering as a lead technician helping with a rapid prototyping process, which produced physical models directly from computer-aided design solid models. In 2008, he was the lead technician in helping the group transition smoothly into MST-7.

"My background gives me a pretty firm grip on safety issues," Charles said. "I have experience as a technologist and handling electrical and mechanical equipment. I have done all kinds of things."

As an MST-7 research technologist, Charles conducts mechanical load frame testing of materials as well as manages and repairs research equipment. A recent project involved helping to build, troubleshoot, and test a set of solvent vertical column extractors to remove plutonium from residue materials dissolved in hydrochloric acid media.

"He has extensive experience building instrumentation packages and thus has a wealth of practical knowledge regarding best practices (in electrical safety)," MST-7 Group Leader Ross Muenchausen said.

Sharing best practices

To promote electrical safety, Charles started a weekly newsletter for MST-7 and MST-8. *"Electrical Safety Moments"* contains topics of the week, a summary of recent electrical safety issues, and a video on electrical safety dos and don'ts.

"It makes people aware in the back of their minds and gets them thinking," Charles said of the newsletters, for which he has received positive feedback.

"It keeps us on our toes," said Manny Chavez (Nuclear Materials Science, MST-16), who worked with Charles for five years. "Many people don't pay attention to some of these electrical safety things and this makes them aware of them. It's nice to have that."

"If it's anybody who I trust to handle that stuff, it's him," Chavez said. "The electrical and mechanical stuff are his specialty. He's been doing that a long time so he knows a lot."

Leonardo Civale

Superconductor scientist can't resist fundamental and applied research

Leonardo Civale is going back to his research roots–and looking forward to it. In doing so he brings together two areas of his scientific expertise—fundamental and applied superconductor research—and, he said, he hopes "to help bridge the gap" between the two.

As the principal investigator of a DOE Basic Energy Sciences Single Investigator and Small Groups Research project on understanding vortex physics in superconductors, Civale returns to the fundamental studies that have fascinated him since early in his career. Superconductors are materials that conduct electrical current without resistance, and are therefore of great interest for use in new energy applications.

"This is his first love–basic fundamental physics," Superconductivity Technology Center (MPA-STC) Group Leader Ken Marken said. "He enjoys solving problems and he is very passionate about it."

Civale's fundamental studies seek a universal description of vortex matter in superconductors through comparative studies on materials spanning a broad spectrum of parameters. His main focus is on vortex pinning. Civale, the physics team leader in MPA-STC, and his team are researching how nanosized inhomogeneities–tiny deviations from uniformity–in the lattice structure of superconducting materials behave as "pinning centers," by trapping vortices and precluding their motion that would dissipate energy, and therefore reduce the current-carrying capacity of the superconducting material. These studies could provide guidelines to enhance the performance of high temperature superconductors.

"This research is more in my background, back to what I used to do–fundamental science," Civale said. "I am very excited about that."

In his applied research, Civale and co-workers have recently patented a process for improving the performance of YBCO thin films, the most appropriate and attractive high temperature superconducting material used for a variety of electric power applications under development. The efficiency of YBCO diminishes in a magnetic field. Their process reduces this deficiency, without the need for additional fabrication steps or modifications in the YBCO deposition conditions. "There is a large interest in these methods to increase the performance of YBCO wires," Civale said. "They are important for technologies such as superconducting cables, motors, transformers, and high field applications."

Learning the superconductor ropes

Civale became interested in superconductor research as an undergraduate student when he took an experimental course in the Low Temperatures Laboratory of the University of Buenos Aires in Argentina. He eventually obtained his PhD from the country's Balseiro Institute and Bariloche Atomic Center in 1989.

One of the most fascinating and intellectually rewarding periods of his career, Civale said, was in the late 1980s when he was a graduate student at Bariloche. It was then that scientists working in Switzerland discovered the first high temperature superconductors. Energized by their breakthroughs, Civale and colleagues began fabricating their own samples, conducting continuous experiments, having non-stop discussions with fellow researchers, and reevaluating their research plans each time they read a new paper on the novel materials.

As a postdoctoral fellow at the Thomas J. Watson Research Center in New York, he gained the attention of the high temperature superconductor community for his studies of irradiation effects on the vortex pinning properties of high temperature superconductors. His research included the first demonstration of the strong directional pinning produced by columnar defects induced by heavy-ion irradiations.

Civale, who joined Los Alamos National Laboratory in 2002, has also worked at Oak Ridge National Laboratory and research laboratories in Europe. He then returned to Bariloche for eight years, where he continued his vortex physics studies while also teaching undergraduate courses and mentoring graduate students.

"Leonardo is very detail-oriented in his research," said Lev Boulaevskii of Physics of Condensed Matter and Complex Systems, who has known Civale for 15 years. "That is a big help for people working with him because he has a lot of broad experience that he gained from working all over the world."

Paula Crawford

Experimental materials scientist on a mission

While watching the launch and expedition of the 2011 NASA Mars Science Laboratory, Paula Crawford will take pride in knowing that her and her team at Los Alamos National Laboratory helped in the voyage.

"It is neat to know that you are helping out in the process," Crawford said. Crawford is leading the restart of the Isotope Fuels Impact Tester (IFIT), an instrument being used to certify a new generation of radioisotope thermoelectric generators for use in space missions. "Nobody really is going to realize, except a select few, that we are a part of it. When the Mars Science Laboratory lands successfully on Mars there will be some fulfillment."

The IFIT tests are being performed to ensure the generators, which are powered by ^{238}plutonium, can survive and remain contained in the event of re-entry into the earth's atmosphere. Plutonium is an efficient power source for deep space probes, such as the Mars mission, as solar panels do not receive enough sunlight at such distances to produce the required power. Nuclear-powered spacecrafts use the radioisotope thermoelectric generators to produce electricity from the heat of radioactive decay.

The generators will provide the energy for the fall mission, which will send a next-generation rover with unprecedented research tools to study the early environmental history of the Red Planet.

Crawford, a member of Nuclear Materials Science (MST- 16) described her role as "intense and exciting."

"I have learned a lot so far and continue to do so, especially regarding management skills. I did not realize at first what a big project it was, but it has evolved into an important task," she said.

For the certification process, IFIT heats the fuel clads, the material containing the plutonium dioxide, to the desired temperature and launches them at velocities up to 150 m/s into a steel impact block. The clads are then recovered and analyzed. The IFIT restart team accomplished the daunting task of restarting the instrument after nearly eight years of inactivity, performing a series of readiness assessments and the first successful impact test in April.

"This is a high priority project for the DOE and NASA, and Paula is central to making things happen," MST-16 Group Leader Deniece Korzekwa said. "There are a lot of people involved in the project, and Paula has very good people skills to handle such a large group."

Team leadership

Crawford, who has a PhD in materials science and engineering from Rensselaer Polytechnic Institute in New York, joined the Laboratory as a postdoctoral researcher in 2002 in the former Hydrodynamics group, where she designed, executed and analyzed small-scale high explosive experiments in support of the Stockpile Stewardship program.

"Very early on she impressed people with her knowledge of experimental materials science," said Paul Rightley, of Focused Experiments, who hired Crawford as a technical staff member in 2005.

In August, Crawford was selected as the MST-16 dynamic testing team leader, overseeing experiments investigating the dynamic properties of radioactive and engineering materials. In addition to the IFIT, her team operates the 40mm Impact Test Facility and the Kolsky Testing Facility, all of which are used to study how high strain rates effect materials behavior. Adding to the complexity of the operations, the instruments are located in the Plutonium Facility.

"As a new team leader, my current focus is on learning the facilities and the dynamics of the team so that I can help them overcome obstacles that impede the performance of science," Crawford said.

The team's general focus is performing experiments with actinide materials, primarily plutonium. Team members collaborate with scientists in both Structure/Property Relations (MST-8) and Shock and DET Physics in conducting experiments and analyzing data.

In addition to her team leader duties, Crawford is also interested in researching plutonium behavior at high strain rates in order to better understand its materials properties. "Plutonium is a complex material and each experiment adds more intriguing information to the story," Crawford said. "I find great interest in learning about the connection among materials properties, microstructure, and synthesis."

Brenda Dingus

High-energy astrophysicist begins new project

Brenda Dingus has always enjoyed studying the night sky. Yet she wants to see beyond what traditional optical telescopes can show of the universe; she wants to research and capture details that are unseen to the human eye. "I prefer to build new detectors to see things never seen before," said Dingus, an astrophysicist probing the high-energy universe through the study of gamma and cosmic ray science. "I want to create new techniques to make pictures of the highest energy phenomena in the universe."

Unlike starlight, which is visible to the naked eye and examined through optical telescopes, cosmic rays and gamma rays are invisible and require specialized instruments for detection and measurement. "There is so much to learn about gamma rays and cosmic rays—really the entire universe in general," said Dingus, astrophysics team leader in Neutron Science and Technology (P-23).

And with the High Altitude Water Cherenkov (HAWC) experiment, Dingus hopes to do so. She is the U.S. spokesperson and deputy project manager of this second-generation, ground-based high sensitivity gamma-ray telescope that will observe the entire high-energy sky every day from its perch on the side of Sierra Negra, one of Mexico's highest peaks. "This novel detection technology will help us see things we have never seen before and study extreme phenomena in space, such as neutron stars, supernova explosions, and black holes," Dingus said.

HAWC builds on the lessons learned from Milagro, a New Mexico-based high-energy gamma-ray observatory that during its seven years of operation recorded more than 200 billion cosmic-ray collisions with the Earth's atmosphere, producing the most detailed teraelectronvolt map of the galaxy to date. A unique detector for cosmic-ray studies HAWC is being constructed at an altitude of about 14,000 feet by a collaboration of approximately 100 scientists from 14 institutions in the United States and Mexico. Due to the location's high altitude, the telescope's large physical area, and recent advances in detector design, HAWC will have the ability to detect gamma-ray sources with more than 10 times the sensitivity of Milagro.

The project is in its beginning stages, with one water Cherenkov detector constructed and 299 more to go over the next three years. Los Alamos National Laboratory scientists will help operate the observatory for another five years. "We have a lot to do in the next eight years," Dingus said. "This is the exciting part. We worked for several years to get funding. Now that we have funding, it's time to do the research. It's kind of scary, but fun."

Dingus was instrumental in obtaining funding for HAWC, finding the site, and engaging a group of Mexican scientists in the project. HAWC funding is provided by the National Science Foundation, DOE Office of Science, and CONACyT (the Mexican scientific funding agency). The Laboratory Directed Research and Development program also supported prototype and design studies and is now funding a digital trigger system.

"She is one of the most knowledgeable scientists I have ever worked with," said John Pretz (P-23), a fellow Los Alamos scientist on the HAWC project. "Everyone considers her the expert on the project. She has such a broad understanding of what the experiment is and what needs to be done at every level."

Energetic and engaged astrophysicist

Dingus, who has a PhD in experimental cosmic-ray physics from the University of Maryland, has been at the Laboratory eight years. Previously she was a tenured professor at the University of Wisconsin and prior to that at the University of Utah. She was also a scientist at NASA on the Gamma-ray Large Area Space Telescope project and led the gamma-ray burst analysis of data from EGRET (Energetic Gamma Ray Experiment Telescope), discovering the highest energy emission from gamma-ray bursts.

She is a Fellow of the American Physical Society for her pioneering work on understanding the highest energy gamma-ray emission from gamma-ray bursts, a Los Alamos National Laboratory Fellow, and a recipient of the Presidential Early Career Award for Scientists and Engineers, the highest honor bestowed by the U.S. government to outstanding scientists early in their careers.

"Brenda is an internationally recognized astrophysicist," said Chris Fryer, of Computational Physics and Methods. "She is greatly respected because of the contributions she has made in understanding high-energy gamma and cosmic rays. She is so energetic in the projects that she is involved with that it rubs off on other people."

Her enthusiasm is apparent as she reflects on her studies. "There is still so much to learn about this field," Dingus said. "That's what makes it exciting. Everyday there is a possibility to see something no one has ever seen before."

Aundrea Espinosa

Connecting the LANSCE user community

As the first person that users and visitors of the Los Alamos Neutron Science Center (LANSCE) usually see at the national user facility, Aundrea Espinosa wants to ensure their experience is a pleasant one.

Walking into Building 1, the first stop for many LANSCE newcomers, guests can admire a billboard-like display of the user facility. Just to the right is Espinosa, at the reception desk, ready to assist them.

"You definitely can't be grouchy in this job," Espinosa said. "I get to meet scientists from all over the world and I want to set a good example of what to expect at LANSCE."

Eventually, all LANSCE users and visitors interact with Espinosa, who became the user office administrator in April. Yearly, roughly 1,150 users conduct research at the neutron science center and hundreds more visitors tour the facility.

Espinosa is their LANSCE liaison, conducting training and orientation sessions and guiding them through the badge process. She also supports the Division Office with administrative duties.

"She is the face of LANSCE, considering she is the first person most people interact with at the facility," said LANSCE Deputy Division Leader Alex Lacerda. "If she wasn't there, the users would not be able to do their research here."

"I have met a lot of foreign nationals and I get to hear all their stories," said Espinosa, "from where they have been and their experiences at other facilities to the science they have done all over the world."

Facilitating communication

More than being just a friendly face, Espinosa provides vital support facilitating communication between LANSCE management and users by helping produce a user program electronic publication that is distributed to more than 3,000 individuals around the world.

"She plays a crucial role in streamlining communication between us and the community, especially the user community," said Lacerda, who described Espinosa as persistent, friendly, and outgoing. And "she enjoys the science, too."

In particular, Espinosa said she is intrigued by the research conducted at the Protein Crystallography Station, the only resource of its kind in the country, used to determine the detailed structures of large biological molecules, essential in the field of bioscience. Espinosa enjoys reading the research proposals and hearing the scientists talk about their research using the instrument.

"I find biology interesting, studying all the different living organisms," said Espinosa, who is studying biology in college.

Espinosa, who has about one year remaining at Northern New Mexico College until she earns her bachelor's degree, said she wants to eventually work in the biological medicine field at the Laboratory, whether at LANSCE or another division.

"I really like it here because there are a lot of good things happening," Espinosa said. "And I am a science geek."

Espinosa began working at the Laboratory in 2004 as an undergraduate student performing data entry in Information Management. She returned in 2008 as an assistant experimental coordinator at the Lujan Neutron Scattering Center, where she helped support the user program through a variety of responsibilities, including managing safety orientation and training and assisting with organizing conferences and creating posters.

"She always goes above and beyond her duties to help the users," said Lujan Center Experimental Coordinator Leilani Conradson, who was Espinosa's supervisor at the time. "She interacts really well with the users who come from all over the world. She is friendly and responsible, and the users appreciate that."

James Gallegos

Smooth operator

Staring intently through the glass window into the hot cell, James Gallegos concentrates on maneuvering the remote manipulator's long arms to move radioactive material from one container to another. Shielded from the radiation by the containment chamber's thick concrete walls, Gallegos squeezes the arm's metal hinge with his left hand to grab and pull tight the cable tie, closing the container. Then, with his right hand, he clenches the device's right arm and nimbly moves it left, so the arm shifts into position. "It's like doing things backwards," said Gallegos, a material technician on the Nuclear Materials Science (MST-16) materials property team. "Every activity has to be thought out and carefully constructed."

Gallegos is adept at operating the remote manipulator, a mechanical device that allows a human operator to safely handle hazardous materials. "Some people make it look easy; they develop a flow to their actions," Gallegos said. "For me, it became easy to operate because I understand the movements. It came naturally to me."

Gallegos has put those skills to work on the Laboratory's Off-site Source Recovery Project. Created in the late 1990s, the project, which supports the Laboratory's efforts to reduce global nuclear danger and secure nuclear materials, aims to remove excess, unwanted, abandoned, or orphan radioactive sealed sources that pose a potential risk to health, safety, and national security. "It is nice to be working on a project that is important to the Lab's environmental and national security emphasis," Gallegos said. "We are doing a lot of great things to clean up radioactive material."

The project has recovered more than 25,300 sources from more than 900 sites, including Puerto Rico and several foreign countries, resulting in more than 800,000 curies of radioactive material being removed and secured. Gallegos joined the project in 2001 when a supervisor recommended him to officials who were searching for an experienced manipulator operator. He frequently travels the Southwest in support of the project. "I feel comfortable with the work. It's nice to be known as an expert in this area," said Gallegos, who has been at the Laboratory 26 years, 22 of them working with radioactive materials.

Gallegos began working with radioactive materials in 1989 as a measurement technician in Health Physics Measurements, repairing tools for handling radioactive materials. Three years later, his experience helped him become a radiological control technician for Health Physics Operations, where he used the tools to store radioactive material.

"He has a knack for making techniques more streamlined," said Jeremy Mitchell (MST-16), who has worked with Gallegos for six years. "He finds ways to improve a technique or tool. He takes it as a challenge."

For example, Gallegos has patented a ratcheting tool that makes closing and locking radioactive containers more efficient. He has a patent pending on a snap ring insert tool and has submitted for patents two other fixture tools.

Preparing samples

Currently, Gallegos's focus is preparing, mounting, polishing, and loading plutonium samples for two projects–one using Sandia National Laboratories' Z machine accelerator, the other a diamond anvil cell, a hand-held device that allows compression of a small piece of material to extreme pressures. Both projects aim to understand the behavior of plutonium in other materials under extreme environments.

Each project requires samples with specific dimensional requirements and prepared with a specific tolerance, polish, and assembly. The diamond anvil project requires plutonium material 30 microns in length and a specialized sample holder. For the Z machine project the material needs to contain a certain thickness and feature a disc shape 15 millimeters in diameter.

"James plays an integral role," said Nenad Velisavljevic, of Shock and Detonation Physics, who works with Gallegos on the diamond anvil project. "He is able to take metal samples that are already well studied and characterized by MST-16, cut down samples to a very small sample size, and load them into a diamond anvil cell."

What Gallegos enjoys most about Los Alamos is being able to interact with different people and the variety of work he encounters. "I don't get bored because I get to do a lot of different activities," Gallegos said. "I get to do so much and learn all the time."

John George and Chad Olinger
Dueling deputies

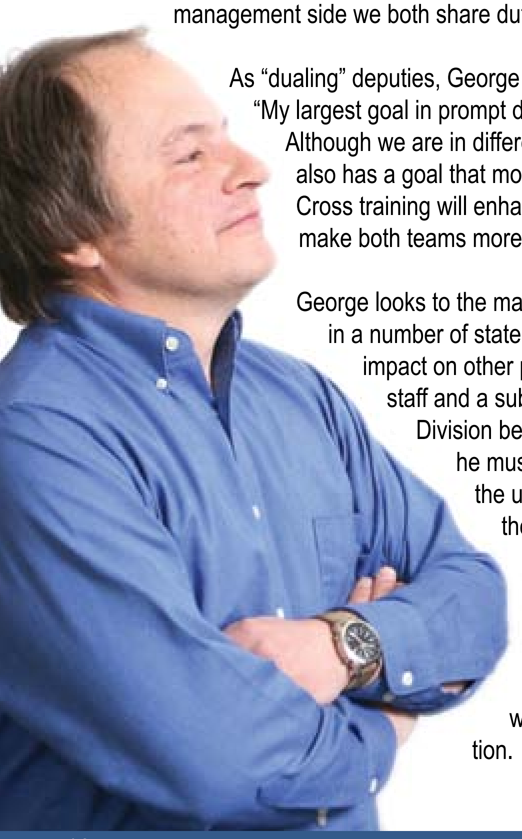
Main street, Applied Modern Physics (P-21), high noon. John "MRI" George squints into the bright sun. Down the way, past the Science Emporium, Chad "diagnostics" Olinger flexes his scroll-wheel finger and stares back. It's come to this. Five, six . . . ten steps and the two deputies square off. "Someone's gotta go," George grumbles. "Lunch?" Olinger remarks. "Good thinking. We've got proposals to review." The two amble off to the Otowi Steak House in this fictitious high-plains conurbation of P-21.

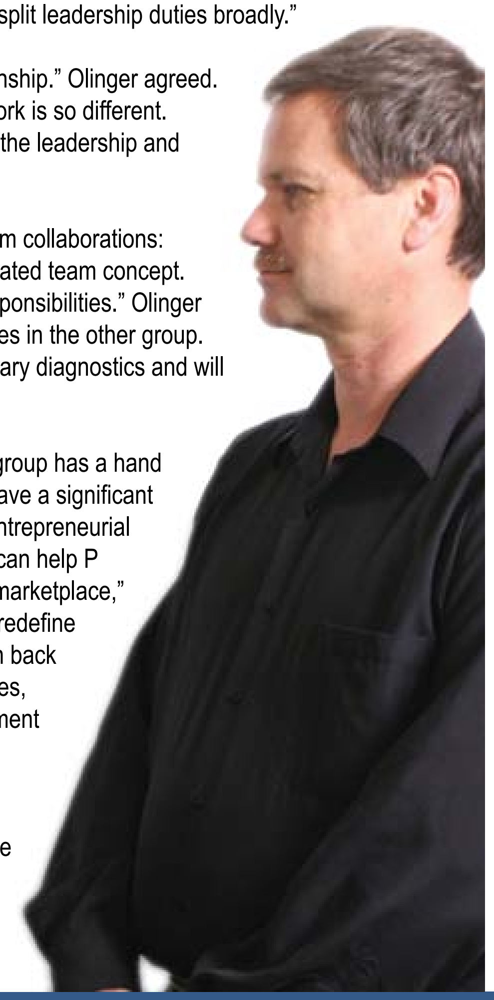
Dueling deputies? Maybe not. Applied Modern Physics has a lot of territory and plenty of room for two deputy group leaders. In fact, it's a necessity. In fact, there's so much work to go around that these two not-so dueling deps work as partners.

Olinger has worked at Los Alamos for 26 years, starting as a postdoctoral researcher with Isotope Geochemistry. As a deputy group leader, he supports management and leadership issues across the group. His technical contributions involve close work with the weapons analysis team in prompt diagnostic of historical underground nuclear tests and as a project leader for nuclear and non-nuclear data for the Advanced Simulation and Computing (ASC) program. "In this role," Olinger said, "I coordinate with X Division program management to support radiochemistry and radiography as well as prompt diagnostics." George has served as a P-21 deputy group leader for a little more than a year and manages between a third and a half of an approximately 50-person group. His responsibilities include program development, budgets, personnel and performance management, approvals, mentoring, responding to innumerable requests for data, and demonstration of compliance with policy. George's technical contribution includes leading two Laboratory Directed Research and Development (LDRD) projects, "Synthetic Cognition through Petascale Models of Primate Visual Cortex" and "Probing Brain Dynamics by Ultra-Low Field MRI," as well as an LDRD-Exploratory Research project on the development of high density brain interface employing an array of novel sensors that detect individual nerve cells (in collaboration with Shadi Dayeh, Tom Picraux, Andrew Dattelbaum and others in the Center for Integrated Nanotechnoloigies), serving on a DOE project to build an artificial retina, and leading a DARPA "Neovision" project to develop computer systems that mimic visual processing in the brain. "Altogether," he said, "it fills up my days and much of my nights."

OK, but what about the duel; two deputy group leaders? George explained P-21's management architecture. "There are some good, practical reasons for this arrangement, stemming from the variable but substantial administrative and managerial workload." The diversity of both staff and projects—from ultrasensitive measurement technology and applications (the SQUID team), to brain imaging and modeling, quantum communication, and weapons radiography and test analysis—creates a "variable and substantial administrative and managerial workload." Said Olinger, "Our functions are different in that our technical focuses are on different aspects of the group, but beyond that we split leadership duties broadly."

"Clearly," George said, "we are dual-ing, but I don't consider it a blood sport! We have a good working relationship." Olinger agreed. "We have worked well together from day one. There really is no reason for us to 'duel' in that our technical work is so different. Even if working for the same funding sources, both of our styles are more collaborative than competitive. On the leadership and management side we both share duties to a reasonable, level load."





As "dualing" deputies, George and Olinger have specific goals for P-21. Olinger focuses on team collaborations: "My largest goal in prompt diagnostics is to ensure that P-21 and P-23 work toward an integrated team concept. Although we are in different groups, both teams can benefit from the other's technical responsibilities." Olinger also has a goal that most team members from each group will be able to support analyses in the other group. Cross training will enhance the ability to take full scientific advantage of the complementary diagnostics and will make both teams more robust against attrition issues.

George looks to the marketplace and Physics Division's role in being competitive: "Our group has a hand in a number of state-of-the-art imaging, analysis and modeling techniques that can have a significant impact on other projects across the Division and the Lab." He described P-21's entrepreneurial staff and a substantial portfolio of work for nontraditional sponsors. "I think we can help P Division become more agile and more competitive in the broader research marketplace," he mused. P-21 is poised on the edge of a scientific revolution that will redefine the understanding of intelligence. "We are uniquely positioned to push back the frontiers through development of new neuroimaging technologies, experimental and computational modeling studies, and development of systems that exploit our emerging understanding of neural computation," George said.

The sun hangs bright over the high-plains. P-21 thrives under the watchful eyes of its dual deps, a critical and successful collaboration.

Jennifer Hollingsworth
Connecting the dots through collaboration

The Center for Integrated Nanotechnologies (MPA-CINT) offers scientists access to world-class facilities and advanced tools that enables nanoscience discoveries. However, it is not CINT's capabilities that make it special, said Jennifer Hollingsworth; instead, it's the national user facility's collaborative environment.

"You combine the capabilities and the researchers at CINT and you have breakthrough research happening here," said Hollingsworth (MPA-CINT). "It's a good model for doing interdisciplinary science."

Collaboration and integration are central to CINT. Teaming with external users is at the core of the user facility's mission and developing the principles that govern the integration of nanoscale materials is at the heart of its vision.

Hollingsworth herself embodies the sort of cross-disciplinary expertise required in nanoscience. Originally trained as a classical inorganic chemist with a materials science inclination, she is now well versed in the science and language of her physicist and biologist collaborators. As a CINT scientist, she supports the center's nanophotonics and optical nanomaterials science thrust and is the Los Alamos lead for its nanowires integration focus area.

Hollingsworth joined the Laboratory's Chemistry Division in 1999 as a Director's-funded Postdoctoral Fellow after earning her PhD in inorganic chemistry from Missouri's Washington University in St. Louis.

"She is really enthusiastic and energetic so that makes her fun to work with," said CINT Chief Scientist Tom Picraux. "She is very important to CINT because she adds the chemical synthesis of nanomaterials aspect that we count on for our studies. She's also a good collaborator because she does her homework and understands things that are needed for the project."

A new class of nanocrystal quantum dots

As part of her CINT research, Hollingsworth recently collaborated with Laboratory scientists to develop a new class of nanocrystal quantum dots (NQDs) that benefit research ranging from bioimaging to solid-state lighting. NQDs are semiconductor nanoparticles with remarkable size-tunable optical properties, including the ability to efficiently emit light. Compared with molecular dye fluorophores, optically excited NQDs are more stable. However, NQD applications have been limited due to a property known as fluorescence intermittency, or blinking.

Under continuous illumination, single nanocrystal quantum dots turn "on" and "off" in an unpredictable fashion. Blinking limits the utility of conventional NQDs for applications requiring continuous and reliable emission of photons, such as single-particle tracking in advanced bioimaging and as single-photon light sources in quantum cryptography.

Hollingsworth and her team applied an ultrathick and structurally perfect shell of a higher bandgap semiconductor to the core NQD to create giant NQDs, which have suppressed blinking and remarkable photostability. The ability to follow the trajectory of single molecules as they perform their biological functions is an important goal for advanced bioimaging.

"Without her, the project would not have been possible," said collaborator Han Htoon, of Physical Chemistry and Applied Spectroscopy, who has worked with Hollingsworth for 10 years. "She and her postdocs created the inorganic shell that helped stop the blinking. Her expertise in this area is invaluable."

Since this discovery, Hollingsworth has begun collaborating with external researchers interested in capitalizing on the new properties of these nanomaterials and enhancing them by combining them with other nanoscale structures, such as plasmonic nanoparticles. The work, which supports the Laboratory's national energy security efforts, recently received a patent.

Hollingsworth and Htoon are also co-principal investigators on a project exploring the use of giant NQDs for high-efficiency solid-state lighting. Their work has received a Single-Investigator and Small-Group Research (SISGR) project grant from the Department of Energy's Office of Science, Basic Energy Science.

Ann Kelly
Characterized by a passion for metallography

When Ann Kelly talks about metallography, her voice gets louder and intensifies. When she gets excited about a micrograph, she tries to show it to everybody. When she describes her micrographs, she uses words like "cool," "awesome," and "pretty." It's hard to miss Kelly's passion for her work.

As a metallographer with the Materials Technology-Metallurgy (MST-6) characterization team, Kelly uses a microscope to take magnified photographs–micrographs–of metals and alloys in order to characterize their physical composition or structure.

"Her excitement for metallography is the first thing you notice about Ann," said James Foley, MST-6 characterization team leader, who has worked with Kelly for four years. "And that excitement rubs off on other people."

"People probably think I'm crazy because I love my job so much," said Kelly, who during 26 of her 31 years at Los Alamos National Laboratory has studied everything from aluminum to zirconium. "I have fun. I love it. Where else do you get the opportunity to work with such a wide variety of materials?"

That same passion is evident when Kelly uses her vast experience and knowledge to teach others about her field.

"If a person shows any interest in it, she will go the extra mile to help in any way she can," said teammate Robert Forsyth (MST-6), who was mentored by Kelly for nearly five years. "She has great attention to detail in everything she does."

As a teaching aid she produced *Basic Metallographic Preparation Techniques*, a Laboratory training manual stressing the importance of and detailing each process in preparing a variety of materials for optical and scanning electron microscopy. Since 2004 she has revised several chapters in the yearly editions of the *American Society of Metals Handbook*. She has also developed several metallographic sample preparation techniques featuring mechanical, chemical, and electrochemical processes that reduce preparation time and are user and environmentally friendly. Her metallographic techniques developed for refractory metals and uranium are used in industry.

"Seeing other people get a charge out of (my field of work) gets me excited as well," Kelly said. "I want to pass along what I know and why I enjoy it so much. It was a struggle for me to create these techniques so I want to make it easier for others."

Kelly joined the Laboratory in 1980 as an MST-6 nuclear fuels quality assurance clerk for the TREAT (Transient Reactor Test) program. Five years later, when the program ended, she was given the opportunity to receive on-the-job metallography training. "I fell in love with it," she said. "I am so lucky I got the opportunity to get into this field. It is perfect for me. The passion doesn't go away."

Award-winning micrographs

Kelly's micrographs have won numerous awards at competitions designed to advance the state of microstructural analysis. And recently, her silver-copper micrograph was the January image in the judged 2011 Buehler Microstructure Calendar, published by the U.S. manufacturer of materials analysis equipment and supplies. The image is similar to gazing through a kaleidoscope with varying shades of silver, copper, grey, and turquoise streaming outward from a round silver-colored center. Describing the calendar, Kelly said, "Every micrograph has its own unique characteristic and the photos are so interesting."

Kelly shows the same kind of passion in other aspects of her life as well. Several years ago, she started an informal gathering for all MST-6 members to interact outside the work environment. The social gatherings include snacks or potlucks. She also led the effort to plant a flower garden in front of the Sigma Building because she said she wanted to "bring a little piece of home" to work.

Outside of work, Kelly's interest is hummingbirds. "Those are my babies," she said. "They are curious creatures and fascinating to watch." She has five feeders at her house to attract and feed the hummingbirds, taking photos and playing with them.

Kelly's enthusiasm draws admiration from her colleagues. "She is a really upbeat and social person," Forsyth said. "And she has a great sense of humor. She is a great resource for the team because of her energy and knowledge of metallography."

Hye Young Lee
Putting together pieces of the nuclear astrophysics puzzle

As a nuclear astrophysicist, Hye Young Lee has discovered that her research is like finding the right pieces to the puzzle. "Personally it is a great feeling when my data can rule out or narrow down some theoretical uncertainty, so it could make the theoretical calculations fit better with the observables; as if we just found the last piece in the big puzzle game," Lee said.

A postdoctoral researcher in Neutron and Nuclear Science (LANSCE-NS) at the Los Alamos Neutron Science Center (LANSCE), Lee performs fundamental research that helps advance understanding of the physics behind nuclear reactions and provides critical information for several applications.

"I am an experimentalist so I like being in the lab," she said. "I want to provide information for a larger scale, not just for one section of research. One cross section can change a lot of stories. It's exciting to provide the right measurements to theorists to improve modeling in astrophysics."

Lee came to the United States from her home country of South Korea because, she said, she wanted to conduct research with some of the world's most renowned nuclear physicists. She is doing just that at Los Alamos National Laboratory. "I am at a place where I am able to do what I have always wanted to do and work with some of the most talented nuclear physicists," said Lee, who joined the Laboratory in 2009. "LANSCE is a great place to provide all kinds of neutron beams with well-equipped detector systems. I am getting to research and learn new and fascinating things."

Pieces of the puzzle

One puzzle piece Lee provides is data for the upgrade of the Fast-Neutron-Induced Gamma Ray Observer (FIGARO) array of gamma ray and neutron detectors. FIGARO is part of the Chi Nu project, which studies fission-induced neutron output at the Weapons Neutron Research facility at LANSCE. "[FIGARO] will improve data quality and help create potentially numerous applications," Lee said.

For example, FIGARO will contribute to advances in fission physics as well as fast reactor design, development of accelerator-driven systems for transmutation of nuclear waste, and homeland security applications.

For FIGARO, Lee reconfigures the electronics for calibration measurements using neutron tagging and for testing the lithium-6 glass detectors for detecting fission neutrons below 1 million electron volts (MeV). She also interprets data analysis codes and develops data analysis software.

FIGARO "is her first experience with nuclear physics and she picked it up quickly," said FIGARO Principal Investigator Bob Haight (LANSCE-NS). "I depend on her for data analysis."

Lee will also put her puzzle solving and data analysis skills to use as part of a team that recently received funding to develop a gamma ray detector array to be constructed for use inside the Helical Orbit Spectrometer (HELIOS) at Argonne National Laboratory. As part of HELIOS, which studies proton reactions with radioactive beams in inverse kinematics, the Array for Photon Observing LanL Output (APOLLO) will provide additional data in the gamma-ray spectrum that will advance understanding of nuclear astrophysics, energy, and fission.

Coming to a new country

During her graduate studies at Ewha Womans' University in Seoul, Lee worked at the Korea Cancer Center Hospital of the Korea Atomic Energy Research Institute. There she helped design and test the penning ionization gauge ion source for negative ions, a device used in the 13-MeV positron-emission-tomography cyclotron for nuclear medicine and radiation therapy applications.

In 2000, Lee enrolled at the University of Notre Dame, where she received a PhD in physics in 2006. Before joining Los Alamos, she was a postdoctoral researcher at Argonne National Laboratory primarily working on the development of HELIOS and transferring reaction studies on radioactive beams using the spectrometer.

"Hye has excellent insight into problems," said Aaron Couture (LANSCE-NS), who has worked with Lee since the two were doctoral students at Notre Dame. "This is invaluable in helping create solutions to further experiments. She has very good technical skills and is very dedicated in the projects she is involved in."

Christopher Mauger

Detecting opportunities on the Long Baseline Neutrino Experiment

Christopher Mauger had a mix of emotions when he was chosen—just six months after joining the Laboratory—to lead the development of an essential piece of the Long Baseline Neutrino Experiment (LBNE). Mauger is the principal investigator responsible for the billion-dollar project's near detectors.

"I was really shocked, like 'oh no' and really excited at the same time," said Mauger of Subatomic Physics (P-25). "I was surprised considering the short time I was here, but it is a wonderful opportunity."

Originating at Fermilab, located outside Chicago, the most intense neutrino beam ever created will travel hundreds of miles deep underground to one of the largest particle detectors ever built. When completed in approximately 2020, LBNE will explore fundamental physics questions about the cosmos, including one of most perplexing: why there is more matter than antimatter in the universe.

"Neutrinos are exceptional particles," Mauger said. "They are hard to detect, but they are as numerous as photons. This project opens up opportunities for great discovery, to push the technological limits and explore ideas that can be used at the Lab."

LBNE is a collaboration between FermiLab, Brookhaven National Laboratory, which is responsible for designing the far detector, and Los Alamos, which leads the near detector design. Also involved are approximately 60 university groups.

Understanding the characteristics of the neutrino beam at the Fermilab site is essential in order to correctly interpret the physics measurements at the far site. Mauger and his team's task is to optimize the sensitivity of the LBNE by using the near detectors to measure neutrino processes that contribute to the signal and background in the far detector.

For his design proposal Mauger won a 2010 DOE Early Career Award, receiving a five-year grant for salary and research expenses. DOE's Early Career Research Program is designed to bolster the nation's scientific workforce by providing support to exceptional researchers during their crucial early career years, a period when many scientists do their most formative work.

"It gives me a great leadership opportunity," Mauger said. "I think they were impressed with my ideas for the project."

According to Mauger, the award also serves to fund continuation of the project's physics studies, which will help attract postdoctoral researchers and students, and provides the ability to conduct detector simulations.

"He has the right background, the right interests: he is very organized and he has a lot of energy to do this very demanding job," said co-worker Bill Louis (P-25). "He is a great fit for the position and he is doing a great job leading the efforts so far."

A supportive community of researchers

Mauger, who earned a PhD in physics from the University of New York at Stony Brook in 2002, came to Los Alamos in 2008 after six years as a neutrino physicist at the California Institute of Technology, where he primarily performed particle physics research using KamLAND, a liquid-scintillator anti-neutrino detector in central Japan.

Mauger said he is excited to be part of the Laboratory's neutrino community because of the numerous research opportunities and strong science being conducted. "It's an embarrassment of riches here," he said. "These guys are top-notch, renowned in their field, and garner great respect around the world. But at the same time, they are very supportive."

"I hope to be involved in this project for awhile," Mauger said of his role in LBNE. "It is a very long-term project and we are just in the planning stages. But I hope in 10 to 15 years that we have something significant to say about the structure of the universe."

Ross McDonald

Aiming for the heart of the matter

Since he was a toddler, Ross McDonald has been fascinated by how things work. When he was 3 years old, he dismantled his parent's vacuum, piece-by-piece, down to the motor. Luckily, instead of punishing him, his parents praised his ingenuity. "I've always wanted to find out how things worked," McDonald said. "That's why I enjoy physics so much. It's about seeking an understanding, with less emphasis on remembering facts than other areas of science. It's about trying to understand-often quite obscure-phenomena."

McDonald is a condensed matter physicist at Los Alamos's National High Magnetic Field Laboratory Pulsed Field Facility. There, he explores the physical properties of matter in an attempt to understand their behavior using well-established physical laws, such as electromagnetism, quantum mechanics, and statistical mechanics. "I always try to answer the 'why' question—why does something happen or not happen," said McDonald of Condensed Matter and Magnet Science (MPA-CMMS). "I am naturally curious. I enjoy being in the lab and trying to find out things no one else has discovered yet."

At the magnet lab, McDonald has developed new instrumentation for conducting gigahertz-frequency complex-conductivity experiments in millisecond duration pulsed magnetic fields, which he is currently extending to higher intensity and shorter duration magnetic fields. His expertise includes a wide variety of experimental techniques to measure correlated electron systems in high magnetic fields.

Recently he helped a group of external collaborators develop a novel approach to isolate signs of electrical current flowing along the surface of a topological insulator, a material with intriguing electrical properties, and which could lead to new fundamental physics discoveries. "It's exciting because we are exploring something new, and we were able to use the high magnetic fields at the magnet lab to solve the problem," McDonald said.

The researchers are currently concerned with exploring the fundamental properties of the material, but are also interested in how this research might enable future applications of topological insulators.

"Ross went the extra mile to help make the experiment successful," said MPA-CMMS Deputy Group Leader and Pulsed Field Facility Director Chuck Mielke.

Attracted to new ideas, new experiments

McDonald, who is from London, earned his PhD in condensed matter physics from the University of Oxford in 2001. While at the university, he took a short educational trip to Los Alamos, where he learned of a postdoctoral research position at the magnet lab. After graduation, McDonald began working at the Laboratory with his mentor Neil Harrison (MPA-CMMS).

"He is a highly gifted experimentalist," Harrison said of McDonald. "He can do a variety of things in the lab and he develops concepts quickly." According to Harrison, McDonald's broad knowledge of condensed matter physics spreads into piezoelectric cantilever magnetometry, optical conductivity, electron-paramagnetic resonance, and high-pressures and magnetic fields.

McDonald said his favorite aspect of working at the magnet lab is the user program, in which he spends about 25 percent of his time supporting users. Through a National Science Foundation grant to aid visiting magnet lab scientists, McDonald collaborates with international scientists and offers his scientific expertise to ensure successful experiments. He assists users with all aspects of the experiment, from set up to development of samples to scientific advice.

McDonald said he enjoys the user support program because it provides opportunities to be exposed to new ideas and topics, to work with different scientists, and to start new collaborations. "It's a very refreshing environment because things are changing all the time," he said. "You are doing new things all the time and learning what other scientists are doing with their research."

McDonald happens to be good at it, too. "He is one of the best user support scientists the magnet lab has," Mielke said. "He goes above and beyond to help users. They explicitly ask to work with Ross."

That's because he seeks to understand.

Christopher Morris

Developing national security solutions through innovative technology

After years of navigating the ins and outs of technology commercialization, Christopher Morris is about to see his muon tomography scanner, which detects nuclear and other weapons of mass destruction, put into action. Within the next year, muon tomography scanners will be installed at several U.S. ports, the result of a 2008 Cooperative Research and Development Agreement between Los Alamos National Laboratory and California security company Decision Sciences Corporation. *Popular Science* magazine recently named the device one of the 100 best inventions of 2010, describing it as "the surest way to detect nukes."

Principal inventor of the technology Morris, of Subatomic Physics (P-25), described the real-world implementation of his technology as "very satisfying and exciting...Its use will hopefully help make our country much safer."

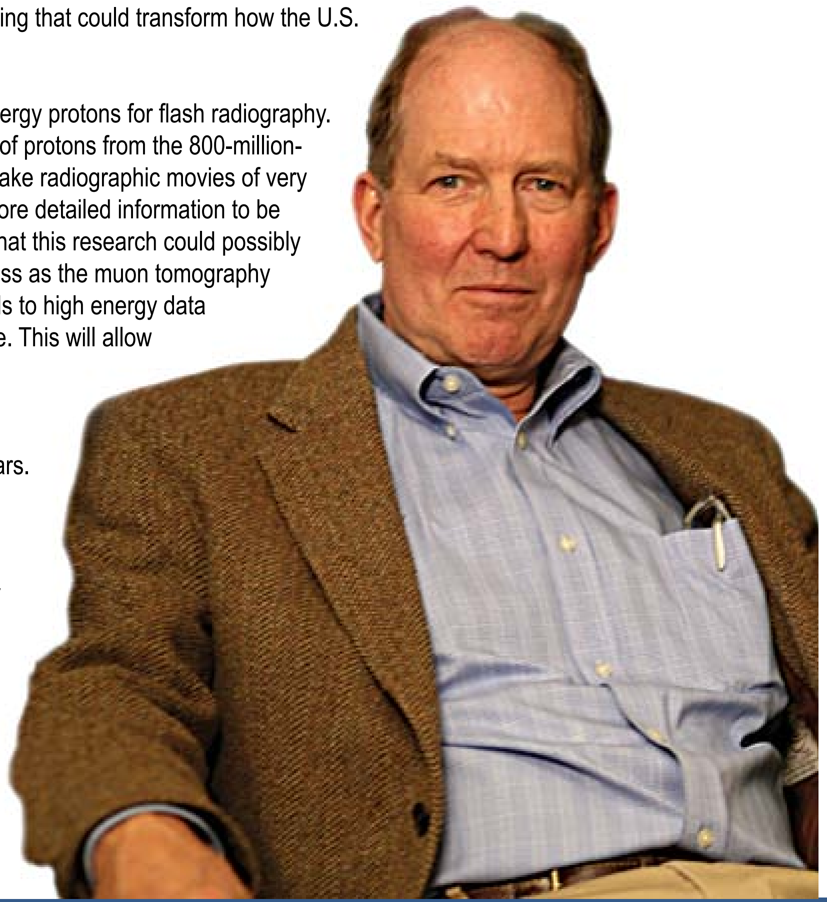
According to Erica Sullivan of Technology Transfer, the muon tomography scanner "is an excellent example of the technology transfer process—taking the device from the research phase to the commercial world to be sold as a final product."

"Working collaboratively through this process, we were able to develop the detection technology that supports our national security mission that might otherwise not have been developed fully," she said.

The muon tomography scanner uses naturally occurring high-energy subatomic particles produced by the interaction of cosmic rays with the earth's atmosphere to identify and locate specific materials based on their atomic density. Detectors and algorithms trace the muons' path and uses that data to produce detailed, three-dimensional images of complex objects. Standard detectors can miss nuclear material hidden behind lead or steel, and naturally radioactive cargo produces false positives, requiring a labor-intensive hand-search. Suited for detecting and identifying nuclear and explosive threats concealed within cargo containers and vehicles, Morris's scanner can penetrate lead or other materials used for concealment and can quickly deliver information without exposing operators or examined objects to radiation. "People recognize muon tomography scanners need to be put to use," said Morris, who received a PhD in medium energy nuclear physics from the University of Virginia. "It is a phenomenal device using a unique technique that will be instrumental for our national security."

In search of the next spin-off

Morris developed his muon tomography scanner from a spin-off of his initial research expertise, proton radiography. An imaging technique using high-energy protons, rather than x-rays, proton radiography allows researchers to make short movies and obtain detailed information on the motions and densities of materials when driven by shock compression. The technique provides new opportunities for quantitative experiments, accurate model development, and designer training that could transform how the U.S. nuclear stockpile is stewarded in the future.



Recently Morris and his team have been experimenting with using high-energy protons for flash radiography. This technique, called charged particle radiography, employs short pulses of protons from the 800-million-electron-volt proton beam at the Los Alamos Neutron Science Center to make radiographic movies of very fast phenomena, such as high-explosive driven experiments and allows more detailed information to be obtained from dynamic experiments than ever before. The expectation is that this research could possibly lead to another spin-off technique that would enjoy the same kind of success as the muon tomography scanner. "We hope this fundamental research into proton radiography leads to high energy data machines," Morris said. "We hope to uncover something never seen before. This will allow for better measurements and better resolution."

"In P Division, he is one of the best, if not the best, idea guys," said P-25 Deputy Group Leader Frank Merrill, who has worked with Morris for 10 years. "He is very good at taking mildly mundane technology and finding new applications for them for big, important purposes."

Morris, an American Physical Society and Los Alamos National Laboratory Fellow, is a co-author of more than 250 refereed journal papers and has given more than 150 invited presentations. He enjoys collaborating with scientists and conducting experiments in an attempt to make new discoveries in the science field. "We need to do these experiments, and it's a fun job, too," Morris said. "I like having different things to work on because it keeps things fresh. It's exciting work in Los Alamos because nowhere in the world is the research so supportive."

Fredrik Tovesson

On track to a better understanding of nuclear fission

As a physics graduate student at Sweden's Örebro University, Fredrik Tovesson became captivated by what happens when the nucleus of an atom splits. At a time of great scientific discussion about the construction of accelerator-driven nuclear reactors, he undertook the challenge to learn more about nuclear fission.

"I find nuclear fission fascinating because of the many open questions about this complex process, even though it was first discovered more than 70 years ago," said Tovesson, of Neutron and Nuclear Science (LANSCE-NS). "By developing a better understanding of fission we can also better predict behavior in nuclear devices, reactors, and even astrophysical events."

Tovesson leads the Los Alamos effort on the Time Projection Chamber. The project, a collaboration between three national laboratories and six universities, is designed to allow the first-ever three-dimensional visualization of nuclear fission events. A prototype chamber has been installed and is being tested at the Weapons Neutron Research (WNR) facility at the Los Alamos Neutron Science Center. The Time Projection Chamber is part of the Neutron Induced Fission Fragment Tracking Experiment, which through the more exact study of nuclear fission hopes to aid in the construction of safer, more efficient, and less waste-producing nuclear reactors.

"The next generation of nuclear reactors will use different technology than the current fleet, and there is a need for more accurate nuclear data to support this effort," Tovesson said. "Also, defense-related technologies such as nuclear forensics rely on accurate nuclear data to make reliable decisions on nuclear events after the fact."

Far superior to other detectors used for fission research, the Time Projection Chamber measures fission cross sections of the major actinides to better than 1% precision over a wide incident neutron energy range, allowing for unprecedented accuracy in observing neutron-induced fission events. The research is funded by the Department of Energy.

Previous fission detectors only registered quantity and magnitude of events. The Time Projection Chamber will reconstruct a track for each fragment detected, thus allowing for identification of all charged particles emitted from fission and other reactions, as well as the removal of backgrounds that limited the accuracy of previous measurements, and enabling a better understanding of systematic errors.

"I am very excited about this new instrument, not only for measuring fission cross sections, but also for all the possibilities it opens up," Tovesson said. "Nuclear fission is a highly complex process, and there are many unanswered questions related to this nuclear reaction. By studying properties of radiation emitted, such as mass yields of the fission products, one can gain insight in the process and hopefully improve current models of fission."

Leading experimental work

Tovesson also leads the experimental work for the Spectrometer for Ion Detection Fission in Fission Research (SPIDER). This proposed new instrument at WNR would be used to perform high-precision mass measurements of fission fragments in support of nuclear applications and improvement in theoretical modeling of the fission process.

The SPIDER team, which includes scientists from LANSCE, Computational Physics, Nuclear and Radiochemistry, and Nuclear and Particle Physics, Astrophysics, and Cosmology, received Laboratory Research and Development program reserve funding for 2011 for a feasibility study that will demonstrate the impact the project will have on applications related to national security and advanced nuclear reactors.

"Fredrik is a young, talented and enthusiastic scientist," LANSCE-NS Group Leader Stephen Wender said. "He has a general understanding of fission research and has a lot of passion for his research."

Gang Wu

Getting a charge out of exploring new avenues to clean, renewable energy

For the first time Gang Wu is taking on the challenge of leading a project at Los Alamos National Laboratory—and he's looking forward to the tests presented. "I am really excited to take the next step in my career," said Wu, principal investigator of a venture using a novel approach to designing and synthesizing an efficient air cathode for use in lithium-air batteries. "This is a leadership opportunity. It gives me a chance to manage a project from start to finish rather than just doing one part. Now I see the whole thing through."

Lithium-air batteries have the potential to power a family car for 500 miles on a single charge—a distance up to 10 times greater than provided by traditional lithium-ion batteries in electric vehicles. The air cathode in the lithium-air battery appears to offer this promise, because it takes oxygen from atmosphere, and, if focused correctly, can catalyze the unlimited cathode reactant, greatly increasing the electricity that batteries usually can store. However, to realize the potential of these devices, critical scientific challenges must be overcome, especially the development of efficient and cost-effective cathode catalyst.

In addition to setting the experiment's goals and managing their completion, Wu, a member of Sensors and Electrochemical Devices (MPA-11), performs the catalyst synthesis and testing. The project includes Wu's mentor Piotr Zelenay (MPA-11), who oversees electrochemistry testing, and Yusheng Zhao of the Lujan Neutron Scattering Center, who conducts complementary neutron scattering to study the behavior of lithium-ions in air cathodes during the charging and discharging process.

Wu and his collaborators in the Laboratory Directed Research and Development Early Career Research program project envision the creation of a sustainable, high-energy-density, low-cost electrochemical storage device. The work supports the Laboratory's energy security mission. The Early Career Research Program is designed to strengthen the Laboratory's scientific workforce by providing support to exceptional researchers during their crucial early career years. The program provides funding up to $225,000 a year for up to two years.

"This is a very important experience for him," said Zelenay. "It's coming at the right time for his research career. He has done very well in the first six months of the project."

In his newest role, Wu can call upon his previous experience as a principal investigator. In 2004, as a postdoctoral fellow at Tsinghua University in Beijing, he was awarded science funding and led a group that performed fundamental studies into electrolysis of water as a means of producing hydrogen for use as an energy source. In 2008 Wu joined the Laboratory as a postdoctoral researcher and a year ago became a technical staff member. A member of the MPA-11 fuel cell team, Wu has more than 11 years of experience in materials electrochemistry and electrochemical characterization and analysis. During that time he's also shined as a team member.

Most recently, Wu and Zelenay developed a platinum-free catalyst in the cathode of a hydrogen fuel cell. As reported in *Science*, the catalysts—which Wu synthesized using carbon (partially derived from polyaniline in a high-temperature process) and inexpensive iron and cobalt instead of pricey platinum—yielded high power output, good efficiency, and promising longevity. The use of non-platinum group metal (non-PGM) catalysts could help reduce cost and accelerate commercialization of fuel cells.

Wu has also put his polyaniline-based catalyst synthesis expertise to work as a member of Zelenay's team that earned a 2010 Department of Energy Hydrogen Program R&D Award for its outstanding contributions to the advancement of fuel cell catalyst development, in particular its dramatic improvements in the performance of non-PGM catalysts. "His synthesis skills are invaluable to us," Zelenay said. "He is the main expert in synthesis skills of new materials with specific properties."

In 2009, the polyaniline-derived cathode catalyst Wu developed at Los Alamos was selected by The United States Council for Automotive Research as a technical accomplishment, describing it as "the most convincing work to date showing the potential of non-PGM catalysts for fuel cell applications."

Intrigued by alternative energy sources

Wu became interested in alternative energy sources at China's Harbin Institute of Technology, where he earned his PhD in electrochemical engineering. After two years as a postdoctoral fellow at Tsinghua University, he performed fuel cell catalyst and lithium ion battery studies for two years as a postdoctoral researcher at the University of South Carolina. "I came to the U.S. because it may give me a chance to join the top research institutes and work with the most outstanding scientists to do the best research possible," Wu said. That's the same reason he came to Los Alamos. "I really like all the facilities the Laboratory has to offer and the collaboration possibilities, as well as the positive teamwork atmosphere," he said.

Experimental Physical Sciences

Vitae

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