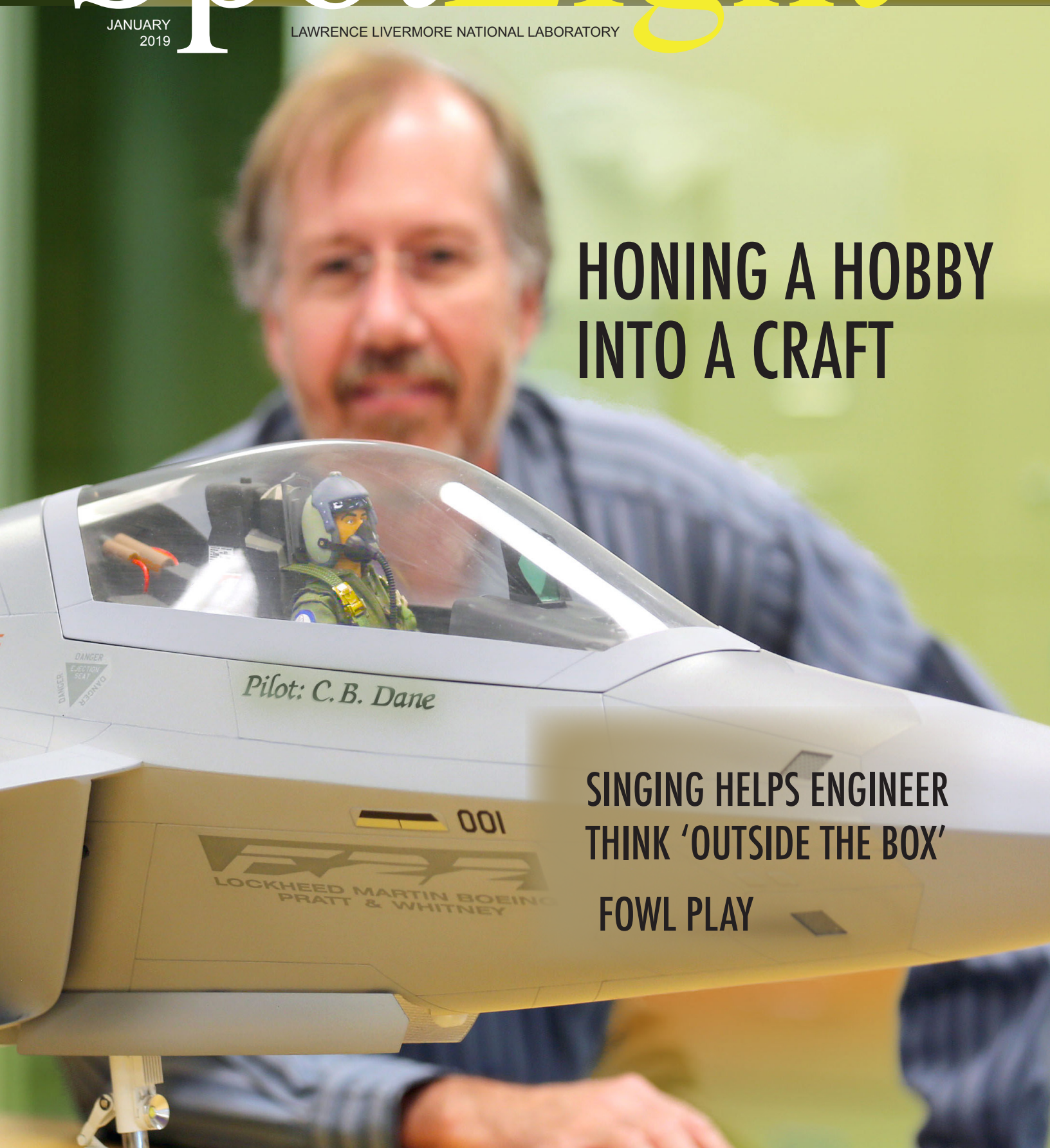
SpotLight

THE PEOPLE WHO DRIVE OUR SCIENCE & TECHNOLOGY

JANUARY 2019

LAWRENCE LIVERMORE NATIONAL LABORATORY



HONING A HOBBY INTO A CRAFT

SINGING HELPS ENGINEER THINK 'OUTSIDE THE BOX'

FOWL PLAY

WELCOME TO SPOTLIGHT

Welcome to the latest edition of *Spotlight:* A look at the people who make up Lawrence Livermore National Laboratory.

In this issue, we profile two former Lab scientists, Lloyd Hackel and Brent Dane, who have played important parts in one of the most successful technology transfers in LLNL history — and have some very interesting hobbies as well. Another profile looks at Lab engineer Lynda Tesillo who says that singing is just like math: Singing helped her improve her math skills by realizing the importance and significance of patterns and frequencies and how they relate to engineering.

We hope you enjoy this issue of *Spotlight.* We'd also like to hear from you. Send us your thoughts and suggestions, whether it's what you like — or even if you don't — about this magazine, or if there is something you would like to see in coming editions. You can reach us at pao@llnl.gov.

ABOUT THE COVER

Former Lab employee Brent Dane peers at his 7-foot-long replica of an F-22 fighter, composed of fiberglass and reinforced with carbon fiber, that has a rated speed of 200 miles per hour. Dane and Lloyd Hackel, another former LLNL employee, have played key roles in one of the most successful technology transfers in LLNL history. Their laser metal treatment technology has saved the worldwide aviation industry several billion dollars. At the same time, on evenings and weekends, they've followed their hobbies, with Dane flying radio-controlled planes and Hackel building homes. Photo by Julie Russell/LLNL

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SpotLight

THE PEOPLE WHO DRIVE OUR SCIENCE & TECHNOLOGY

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IN THIS ISSUE

HONING A HOBBY INTO A *Craft*

Almost every weekday for the past three decades, two former Lab scientists have partnered as a team, working on some of the world's highest peak power lasers.

On nights and weekends, they've employed their scientific and technical skills as craftsmen in other ways, building houses and flying radio-controlled planes.

By Stephen Wampler/LLNL

The two researchers, Lloyd Hackel and Brent Dane, left the Laboratory about 15 years ago and have been the driving force behind one of the most successful technology transfers in LLNL history. Their laser metal treatment technology has saved the worldwide aviation industry several billion dollars, has helped build the president's new Air Force One airplanes and has had a major impact on several other industries.

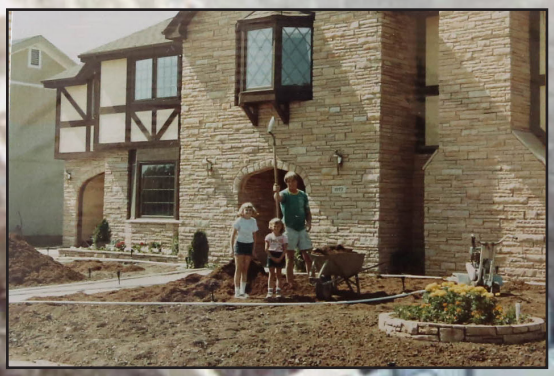
Before they left the Lab, the two laser scientists played instrumental roles in taking a laser peening process that had been developed in the 1970s for treating metal and worked with Metal Improvement Co. (MIC) Inc., a New Jersey subsidiary of Curtiss-Wright Surface Technologies, to turn it into a commercially viable process. Once they went to work at MIC's north Livermore operation, they led the metal treatment work.

Both Rich Rankin and Roger Werne, the director and deputy director respectively of the Lab's Innovation and Partnerships Office, view the two laser scientists' work as critical to the success of the MIC technology transfer. "They've been the whole story for making this technology successful. Their ability to work with customers to solve problems has been almost unparalleled," Werne said.

And while Hackel and Dane have been highly successful in their day jobs as laser scientists, they also used their skills as craftsmen in other ways once they leave the workplace.

Lloyd Hackel (left) and Brent Dane inspect the interior of the high-power laser beam director used for imaging square laser spots onto components with one-tenth of a millimeter precision, ensuring uniform laser peening. Photo by Julie Russell/LLNL

> "For me, building our home was a form of relaxation. Some people jog or go to the gym; I lifted beams and trusses."
>
> – Lloyd Hackel



Lloyd Hackel has built four homes with others and constructed his own English Tudor home in Livermore, doing all of the work except laying the carpets. In the background photo, he is building his basement shop under the garage. In the upper left photo, Hackel works on landscaping in the early 1980s with his two daughters, Katie (left) and Laura. The other photo, taken last year, shows his completed home.

Through the years, Hackel, age 69, has built four homes with others (one with his father, one with a brother and two with former Lab colleagues) and, in addition, constructed his own English Tudor home in Livermore.

When he built his family home in the early 1980s with his family's support, Hackel "did all the work except lay the carpets." He poured the concrete foundation, framed the house, built the trusses, applied the shingles, performed the plumbing and electrical, installed the dry wall and windows and constructed the cabinets and doors.

"For me, building our home was a form of relaxation," Hackel said. "Some people jog or go to the gym; I lifted beams and trusses.

"The scientific work at the Lab and MIC has been mostly mental and a little physical. The evening and weekend craftsman work was heavily physical, with a little help from my engineering and scientific background."

When Hackel's colleague and longtime laser development partner, Brent Dane, age 57, wasn't working at the Lab or now at MIC, his off-hours craftsmanship skills have been focused on building radio-controlled (RC) planes and helicopters.

Over the past three decades, he has constructed about 20 RC model airplanes, including a Cessna 182 and a Piper Cherokee, as well as 12 helicopters.

Dane's tour de force airplane, built from a Yellow Aircraft kit, is a 7-foot replica 1:9 scale F-22 fighter, outfitted with a jet engine with 46 pounds of thrust that can fly at close to 200 miles per hour.

"It's all fun," Dane said. "For me, there is a close connection between my laser research at work and RC planes and electronics at home. It's continuous. The problem-solving creativity and craftsmanship that are involved with the RC planes are similar to what's required to build a large laser system. One advantage of my off-hours is that I get to set the agenda."

A dream of building a house

As a teenager growing up in Little Chute, Wisconsin, about 20 miles south of Green Bay, Hackel dreamed that one day he would build his own house. To get some practice, at age 19, he persuaded his father to build a house with him from "end to end." His father purchased a lot from a farmer and together with his dad and younger brothers, built the house in seven months, with Hackel helping during the summer and returning from college on weekends.

During his youth, he learned all kinds of construction skills, including stone masonry and woodworking. "I grew up in a construction family in upstate Wisconsin. My father worked for Oscar Boldt, who started with one pickup truck and built the 10th largest construction firm in the U.S."

After graduating from the Massachusetts Institute of Technology with a Ph.D. in instrumentation in less than three years, Hackel journeyed westward with $3,000 and started at LLNL in 1976.

He and a fellow Lab employee (Mary Spaeth) built a house on Sherry Way — later sold to former Lab manager, Ed Moses, across the street from Hackel's current home — in which he sold his interest to buy a lot to build his house.

In October 1980, he started construction. In something almost like a Horatio Alger story, Hackel would work a full day at the Lab,

then take a bus to College Avenue, walk to his lot, plug in his saw and lights (during the winter) and work until 9 p.m. before taking the last bus home. Beyond his night construction efforts, he worked on weekends and vacation time to complete the house.

As a part of his home, he constructed a basement shop under his garage. The house passed city inspection and on Memorial Day 1982, about 18 months after starting, Hackel and his family moved in.

He still had about 40 tons of Arizona sandstone to cut and set on the house's exterior, a task he completed over the next several months. Some of his other construction featured woodworking jobs, as he built cabinets, tables, chairs, hutches, doors and mantels.

In his garage basement workshop, Lloyd Hackel works on a drill press to bore out the centers for a set of napkin rings destined to be Christmas presents. In the foreground are some items made in his shop, including mahogney and maple bowls, a hot dish trivet, napkin rings of walnut, maple and mahogany and a single-bud vase of teak, maple and black walnut.

Photo by Lee Kornstedt

Brent Dane participates in model jet meets three or four times a year with his F-22 replica plane. He kneels by his plane during the October 2017 Best in the West Jet Rally at Buttonwillow.

Left-most photo by Danny Melnik

See a YouTube video of Dane flying his plane at:
https://www.youtube.com/watch?v=ovVyZRK0vdQ

Building and flying RC airplanes

For nearly as long as Hackel has been constructing homes, Dane has been building and flying RC airplanes and helicopters. His "career" flying model aircraft started as he was beginning a postdoctoral fellowship at Rice University in electrical engineering in the 1980s.

"This is something that I had always wanted to do and I never had the time or the money until I completed my Ph.D. in physical chemistry," he said.

The star of his constellation of planes and helicopters is a 7-foot-long replica of an F-22 fighter, composed of fiberglass and reinforced with carbon fiber that took three years to build. Dane's F-22, which uses "Jet A" fuel, the standard fuel for regular-sized aircraft, has a rated speed of 200 mph, but he almost never flies the plane faster than 160 mph. Dane is concerned how high speeds will impact the aircraft's structural integrity, and he wants his plane to last for many years.

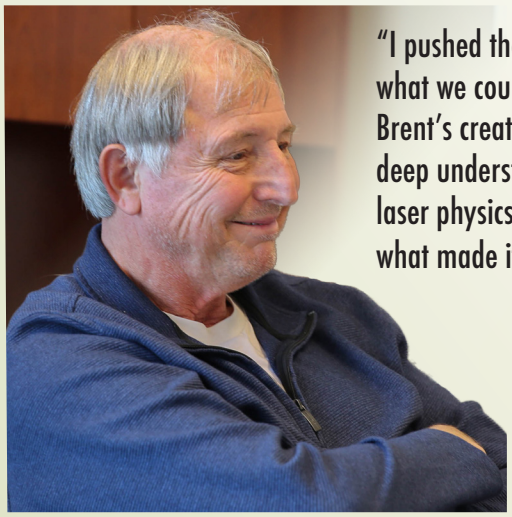
"I have a strong connection to the F-22 because we had the first F-22 that ever flew, minus its engines and wings, in our Livermore MIC high bay for a year back in 2009," said Dane, who hopes to obtain a pilot's license to fly regular aircraft within the next year or two. The markings on his model were chosen to match those of that first plane and a titanium bolt from the actual full-scale aircraft is built into the tail of his model.

Dane participates in model jet meets three or four times a year. His F-22 flew in the Thunder in the Valley meet in September near Davis, sponsored by the Associated Modelers of Sacramento — where his plane won a second-place trophy in the "best military jet" category — and the "Best in the West" meet in October in Buttonwillow.

"I enjoy the challenge and skill involved in building and flying radio-controlled planes, as well as the technology and controls that are a part of them," he said

In the 1990s, Dane developed one of the first telemetry systems for RC planes, measuring engine revolutions per minute, air speed, voltage, temperatures and "G" forces. Some of the technologies that he developed for his planes have been licensed and commercialized by RC plane manufacturers.

In another endeavor, Dane has developed and commercialized a microprocessor-controlled lighting device that is used for BMW motorcycles and is installed on thousands of motorcycles around the world.



"I pushed the reality of what we could achieve, and Brent's creative genius and deep understanding of the laser physics was always what made it happen."

– Lloyd Hackel

A partnership for developing lasers

Through their years at the Laboratory and MIC, Dane (who worked at the Lab for 13 years and joined MIC in 2003) and Hackel (who worked at LLNL for 28 years and went to MIC in 2004) formed something of a Laser Inc. partnership.

Using money from the Defense Advanced Research Projects Agency (DARPA), Hackel and Dane developed a laser for X-ray lithography. They later found an application for satellite space imaging, delivering lasers to the Kennedy Space Center and to the Starfire Optical Range in Albuquerque, and providing a laser to an observatory on the Big Island of Hawaii. These lasers turned out to be early versions of peening lasers.

"Around this time, Jim Daley, who was a senior vice president for MIC, visited the Lab looking for expertise in laser peening," Hackel recalled. "He asked us what we knew about laser peening. We weren't aware of it, but we recognized that it needed two things – expertise in shock physics and high-power lasers, two of the Lab's premier capabilities."

In time, MIC concluded two cooperative research and development agreements (CRADAs) with LLNL to develop laser peening and also agreed to two technology licenses. Hackel and Dane worked extensively on the first CRADA, a six-and-a-half-year, $6.4 million deal that started in August 1997. The second CRADA was an 18-month, $6.3 million project. Altogether, the two CRADAs produced 21 new inventions.

"My job has always been to make what Lloyd has envisioned real," Dane said. "He has the vision and the contacts to think of what could be. It's been a great partnership."

One of Hackel's main motivations in his job, he said, has always been to find useful applications for MIC's high-power laser, which puts out 1,000 megawatts of peak power for 20 billionths of a second, the peak equivalent of a nuclear power plant. The laser's capability to continuously generate these pulses with diffraction-limited beam divergence at high-repetition frequencies is still unmatched in any research setting, much less in an industrial application.

MIC's peening lasers instill deep compressive residual stress into metal, to a depth of one-fifth of an inch or more beneath the surface, about 10 times deeper than conventional shot peening making components more resistant to fatigue stress and corrosion cracking. This added depth is important to inhibit crack initiation and propagation.

"Laser peening required a laser reliability that could produce billions of reliable shots in a hands-off manner. I pushed the reality of what we could achieve, and Brent's creative genius and deep understanding of the laser physics was always what made it happen," Hackel said.

While Hackel was at MIT, his department head told him he should expect only one out of 10 technologies he worked on would become successful. "Laser peening was it for me. As it transitioned from research to commercial applications, it was natural for me to follow the technology to MIC. Laser peening was my baby."

Hackel, who has won six R&D 100 awards and two Federal Laboratory Consortium tech transfer awards, along with being named a Distinguished Alumnus of the University of Wisconsin, Madison Physics Department, and Dane, also with six R&D 100 awards (five shared with Hackel) and 30 patents, have been inducted into LLNL's 19-member Entrepreneurial Hall of Fame. They both enjoyed their years at the Laboratory and found it a first-rate place to work.

"The Lab was absolutely spectacular over the top," Dane said. "It was *the* place in the world to work on lasers. It was the center of

Laser peening technology saving $ billions

Beyond saving the world's aviation industry several billion dollars, nearly 100,000 jet engine fan blades and 1,000 discs have been treated by laser peening for Boeing 787s, Boeing 777s, every Airbus A340, Airbus 350s, plus Gulfstream and Bombardier regional jet planes. The laser peening technology also has been used to form aerodynamic curvatures in 105-foot-long wing panels for 200 Boeing 747-8 planes, including the new Air Force One planes. In the energy sector, the technology has been used to treat the metal gas and steam turbine blades produced by Siemens and all major companies for the production of electric power. MIC's laser peening technology also has benefited military aircraft.

In conjunction with Boeing, a manufacturing partner on the F-22 Raptor airplane, MIC developed a laser peening procedure for strengthening the wing attachment to the F-22's fuselage. The process, which has been performed for 51 F-22 airplanes, can exponentially extend the lifespan of the F-22's airframe. Working with Lockheed Martin, laser peening also is now underway on large structural components for the nation's newest fighter aircraft, the F-35 Lightning II. In a recent large project, the 16-ton dry storage nuclear canisters for installation at the retired California San Onofre nuclear reactor were laser peened to protect the welds against stress corrosion cracking.

Lloyd Hackel (left) and Brent Dane work on the large-scale parts handling robotic setup at the north Livermore operation of Curtiss-Wright Surface Technologies. The robot in the foreground handles heavy objects, including 500-pound jet engine fan blade discs and large 18- foot bulkheads for jet fighters. Photo by Julie Russell/LLNL

solid-state lasers, with the National Ignition Facility and Nova. It was hard to leave. The decision was made easier because I planned to return to the Lab, but I never have. This work has been way too exciting."

For his part, Hackel considers the Lab is a "tremendous place to work. When a project got into a technical area unfamiliar to me, there always was a Lab expert who was very willing to answer questions and guide me through. We had almost unbelievable resources and support and true leadership, not just management. I have learned over time that there is a major difference between management and true leadership."

Even though Hackel and Dane left the Laboratory, they have retained ties with LLNL and have continued to collaborate with Lab scientists.

"MIC and Lloyd and Brent in particular have been the very best in partners," Rankin said. "Lloyd has spoken to our entrepreneurial groups and told his success story, which is very motivating to the Lab staff, on a number of occasions. They continue to work with the Lab on new ideas and new applications."

Hackel has a collaboration underway with Lab materials scientist Wayne King and Lab physicist Ibo Mathews to speed the qualification of additively manufactured metal parts under a Technology Commercialization Fund grant.

In the past, he has worked with Lab scientists Sasha Rubenchik and Joe Farmer (now retired) on the High Velocity Laser Accelerated Deposition project to explore the use of lasers and potential applications for explosively bonding one metal to another.

During the period from 2008 to 2012, when Erik Stenejham headed the Lab's then Industrial Partnerships Office (now Innovation and Partnerships Office), Hackel served on an Industrial Advisory Board that evaluated Lab technologies for possible commercialization.

In the early years after he left the Laboratory, Dane worked closely with the Heat Capacity Laser Program at the Lab, a program that he laid the groundwork for and managed while he was there. This U.S. Army-funded effort led to the demonstration of what was at that time the world's most powerful diode-pumped solid-state laser with a goal of protection against rockets, mortars, artillery and land mines. In 2017, Dane collaborated with Lab laser scientist Mary Norton to examine possible modifications to a slab laser system that Dane had developed in the 1990s to look at nuclear decontamination of surfaces. "It was always fun to go back to the Lab," he said.

In the approximately 15 years since Dane and Hackel (and four other Lab employees, Scott Fochs, Randy Hurd, Jon Rankin and Jack Rybak) left the Lab to go to MIC, the MIC-LLNL laser peening technology has become the Lab's fifth-highest, royalty- producing technology. The laser peening technology has achieved success in the aviation, military aircraft, energy and nuclear power industries.

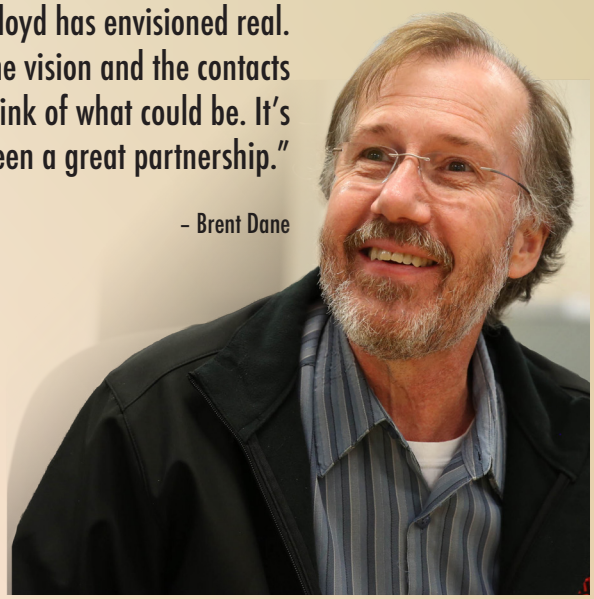
In the 1990s, after the fall of the Berlin Wall, there was a major push by the federal government and many Department of Energy national laboratories to collaborate with and transfer technologies to U.S. industry. At the time, then-LLNL Director John Nuckolls noted that on occasion it might be best for some technologies not simply to be handed over the fence to industry, but for some Lab researchers to join the company receiving the technology to smooth the transition.

Dane agrees with Nuckolls' view. "We would not have been successful in transferring the laser peening technology without some of us moving from the Laboratory to MIC."

Some 21 years after the first MIC CRADA was signed, MIC and LLNL's IPO leadership agree – the laser peening technology transfer has been one of the best that Livermore has ever done.

"My job has always been to make what Lloyd has envisioned real. He has the vision and the contacts to think of what could be. It's been a great partnership."

– Brent Dane



Singing helps engineer

Singing has been a part of Lynda Tesillo's eduction, starting with grade school and moving on to middle (pictured left) and high school and onto the graduate level. She credits singing for helping her in her studies.

Tesillo, a weapon response analyst in training, works as systems engineer in the Defense Technologies Engineering Division for both the W80-I and W84. Photo by Carrie Martin/LLNL

think 'outside the box'

By Carrie Martin/LLNL

"Singing gives me a means to be creative and create beautiful music with my voice and it allows me to meet people outside of my typical engineering and science bubbles, which I greatly enjoy."

Lynda Tesillo always loved math, science – and singing. While many do not associate science and the creative arts together, for Tesillo, it went hand in hand.

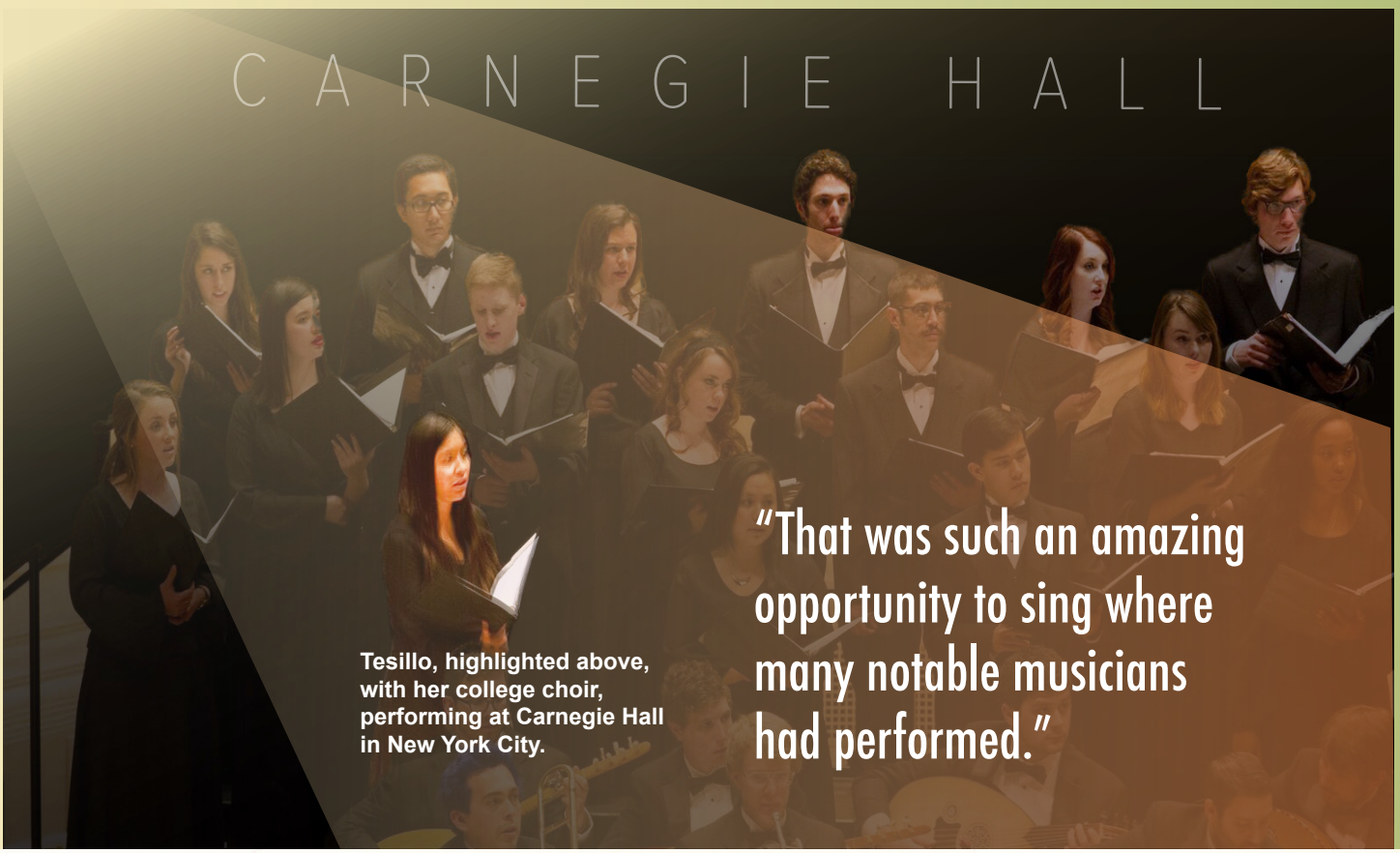
As a child, Tesillo, an LLNL engineer, always was singing. "It just came naturally to me and was a creative outlet. I have been singing since before I can remember."

She grew up in Beverly Hills, an only child with a single mother. Her mother was able to support them by working as a paralegal and legal secretary for most of her career. When the housing prices in Beverly Hills rose so high that they could no longer afford to live there, Tesillo and her mom moved to Bakersfield because they had family there.

Tesillo explored other creative outlets and for short periods of time played the violin, piano and guitar. "I never became very proficient at playing any of them, so I decided to stick to singing," she said.

From an early age, in addition to singing, Tesillo was drawn to math and science. "All throughout school, I loved math and science, so engineering seemed to be a natural fit for me pretty early on," Tesillo said. "My physics teacher in high school was an engineering alumna from Cal Poly, San Luis Obispo and convinced me to apply to his alma mater and pursue engineering. I really attribute him with giving me the guidance I needed to jump into engineering."

Despite having once considered pursuing a career as a professional vocalist, Tesillo chose math and science at Cal Poly, where she received both a bachelor's and a master's degree in mechanical engineering with a concentration on mechatronics.



Tesillo, highlighted above, with her college choir, performing at Carnegie Hall in New York City.

"That was such an amazing opportunity to sing where many notable musicians had performed."

"I have had quite a lot of experience with singing. I participated in elementary school, junior high, high school and college choir almost every single year as a soprano."

Tesillo's most memorable experience was performing in Carnegie Hall in New York City with her college choir. "That was such an amazing opportunity to sing on a stage where many notable musicians had performed."

People would often tell Tesillo and her mom that she should get an agent or audition for various shows. "I never really wanted to pursue that path since it seemed so unstable and uncertain to me, as opposed to a career in STEM. Singing is literally just math. Singing helped improve my math skills early on and made me realize the importance and significance of patterns and frequencies and how they relate to engineering. Singing also aided me in becoming much more creative, which enabled me to think outside the box in my engineering work."

Tesillo works in the Defense Technologies Engineering Division (DTED) at LLNL as a systems engineer for both the W80-1 and W84, and also as a weapon response analyst in training. She even furthered her education while working at LLNL and participated in a yearlong graduate certification course for System Design and Management at MIT, sponsored by the Engineering Directorate.

"This one-year course really taught me all about project management, system architecture and systems engineering, all disciplines that can be applied to my projects here at LLNL."

Tesillo has been at LLNL for just three and a half years, yet she has become deeply involved in that short amount of time and is very active with employee resource groups at the Laboratory, educational outreach and recruiting.

She serves as the vice president of the Lawrence Livermore Laboratory Women's Association (LLLWA) and has served as co-chair for the LLLWA's Women in Science and Engineering (WISE) group and co-chair for the Early Career Employee Resource Group. She also is active in STEM outreach.

"I present to the Engineering Club at Amador Valley High School at least once a year to share with them what it is like to be an engineer. I also participate in 'Dinner With a Scientist' in the Tri-Valley area, where engineers and scientists meet with high school students over dinner and answer any questions they may have about careers in STEM," she said. "I also sit on career panels at LLNL for visiting high schools and community colleges to share what it is like to be an engineer at LLNL."

Professional association memberships include Alpha Omega Epsilon (Engineering Sorority) Alumni and Cal Poly, SLO Chapter Founder, Society of Women Engineers (SWE), American Society of Mechanical Engineers (ASME), Pi Tau Sigma (Mechanical Engineering Honor

"Singing helped improve my math skills early on and made me realize the importance and significance of patterns and frequencies and how they relate to engineering. "

Above: Tesillo, chatting with longtime nuclear physicist Luisa Hansen at a mentoring event at LLNL.

Right: Tesillo is dedicated to recruiting efforts. She recently worked with fellow LLNL engineers Monica Moya, Israel Lopez, David Galvez and Lemuel Xavier Perez manning a recruitment booth at the Society of Hispanic Professional Engineers Conference in Cleveland.

Society) and the Society of Hispanic Professional Engineers (SHPE).

She participates routinely in recruiting activities, particularly at her alma mater. "I go recruiting a few times a year and try to bring bright, new engineers to LLNL. I also have recruited at the Society of Hispanic Professional Engineers (SHPE) Conference for two years and once at UC Berkeley. Recruiting is something that I hold near and dear to my heart, as I strongly value introducing new talent to LLNL. I have been very fortunate through all these recruiting events to have found LLNL several promising full-time employees and interns.

Tesillo believes participating in employee resource groups and recruiting activities is a way to promote diversity and inclusion and reach out to a greater Lab audience to display "the vast diversity present at the Lab and the importance of that diversity. I also have an opportunity to make the voices of these groups heard and affect positive change. As a bonus, I am able to meet amazing people from all across the Lab that I would not normally have a chance to meet in my daily job."

Tesillo spends a lot of time traveling for her job. "When I am on work travel, which tends to be about 40 to 50 percent of my time now, I travel all around the country to observe and/or oversee nuclear weapons work and testing and attend important meetings."

While her career takes up most of her time, she still makes time for her first passion. To provide an outlet to sing, Tesillo became a member of the Valley Concert Chorale in Livermore. After one year in that choir, she left to join the Oakland Symphony Choir where she is still a member. She has taken a temporary leave, "as my work travel schedule introduced many conflicts with the rehearsals," but vows she will return.

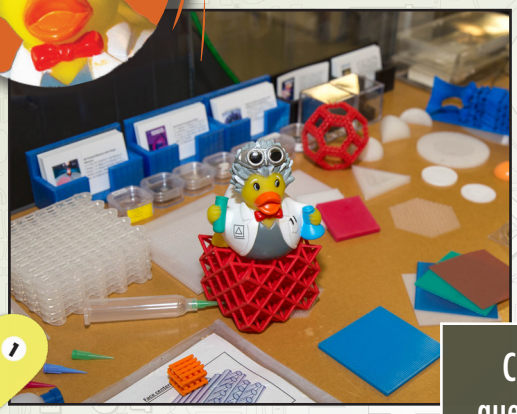
Her future goals are to continue learning and growing into an even stronger female engineer, then move on to a management role here at LLNL.

"Another goal I have is to continue promoting women and minorities at the Lab and in STEM in general. Considering that I am a minority woman, this is an effort that is very near and dear to my heart."

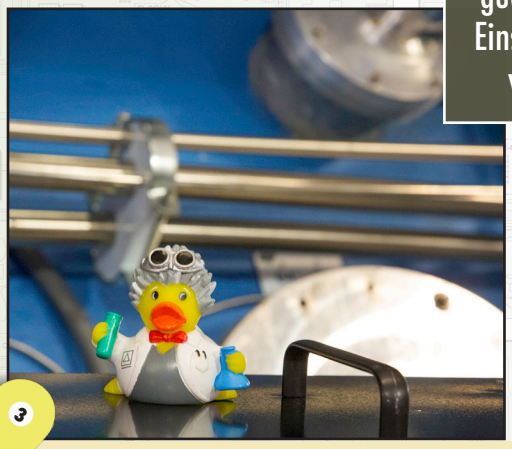
Tesillo hopes to get back to singing as soon as possible. "It's my means to be creative and create beautiful music, which brings me so much joy. I love being able to harmonize with other singers and generate sounds that give me and the audience the chills."

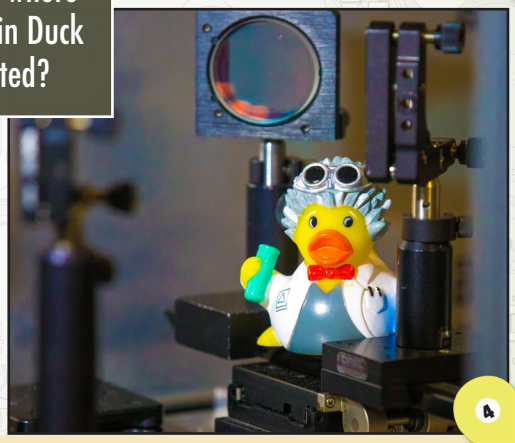
Tesillo lives in Dublin with her "adorable" cat Joules. On the rare occasion she has time to herself, she also enjoys tennis, trying new foods, spending time with friends and loved ones, binge watching her favorite shows on TV and Netflix and playing with Joules.

FOWL Play



Can you guess where Einstein Duck visited?





The Lab's latest unofficial mascot is a rubber ducky, dressed in Einstein garb and armed with some of the tools of science. The little duck has run amok and has popped up in a number of places about the Lab. Your challenge is to find it.

Be among the first 10 to correctly identify all four locations above and we'll send you your own rubber ducky — suitable for desktop décor, bathing or becoming your new best friend.

Send your entries to *Spotlight,* at pao@llnl.gov. Good luck.

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