The ART OF SCIENCE

With the City of Livermore declaring February “Science and Engineering Month, “ Lawrence Livermore National Laboratory is pleased to join in the celebration by showcasing the Laboratory’s scientific research and commitment to community through “The Art of Science”. This month–long exhibit at the Livermore Library will feature a unique perspective of LLNL science-themed photos that are intriguing enough visually to be featured as art.

For almost 65 years, Lawrence Livermore National Laboratory has been applying premier science, engineering and technology to address issues of national importance — from safeguarding the nation to improving public health, from energy security to protecting the environment, from advancing basic science to promoting innovation and education.

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The Art of Science

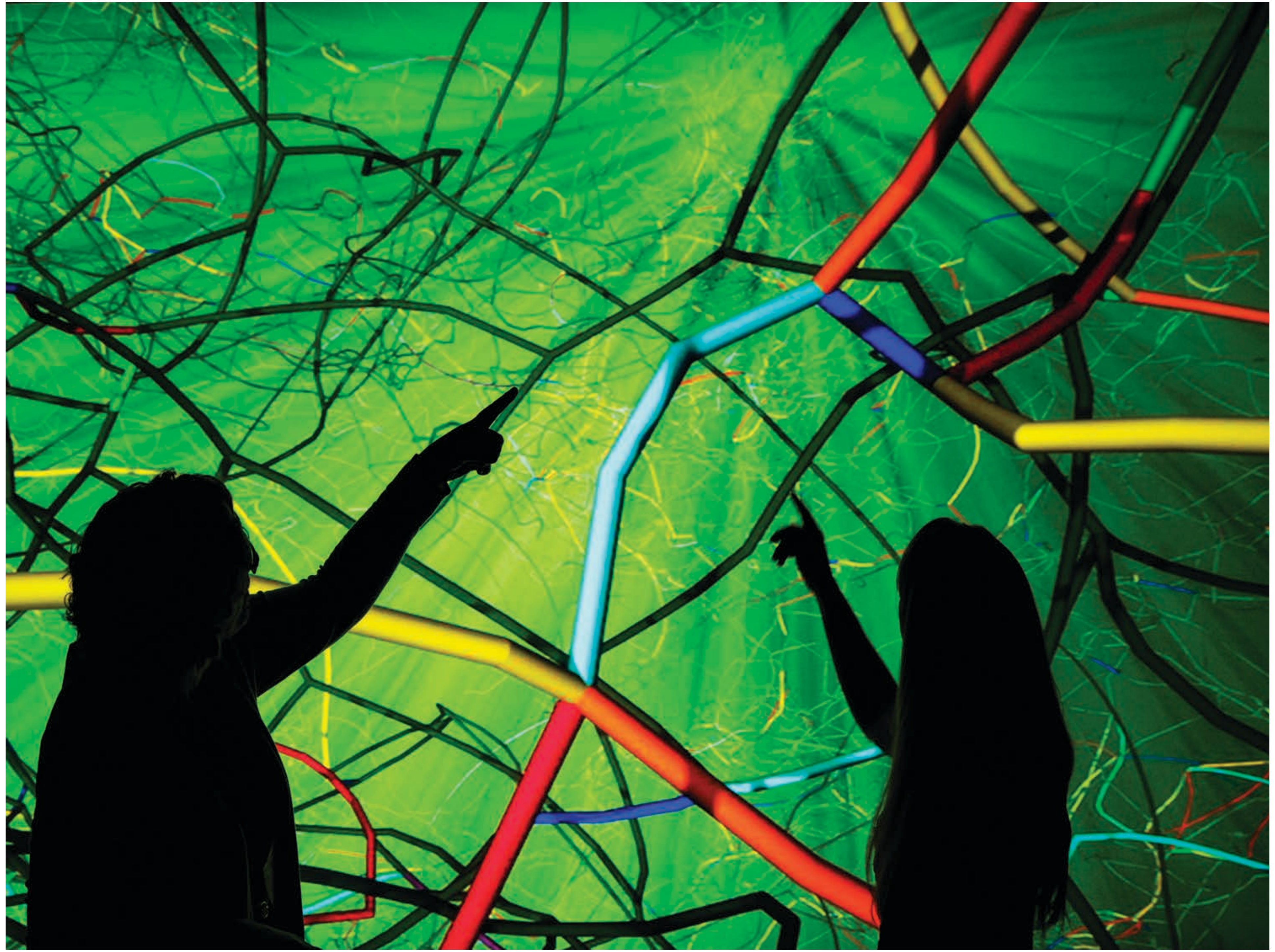
Explore the interplay between science and art through imagery produced by Lawrence Livermore National Laboratory. As the images on the following pages will show, art is not just paint on canvas, ink on paper or carved wood or stone. Today, powerful imaging tools capture the scientific world — whether larger than life or down to the atomic scale — in ways never before contemplated. LLNL researchers use this imagery to answer vital questions to fulfill the Lab's missions as well as to discover new frontiers. These works, chosen for their aesthetic quality as well as their scientific interest, prove that science is not stodgy, and art is not brainless.

The Exhibit

Through February 2016, visit the "The Art of Science" exhibit at the Livermore Civic Center Library, located at 1188 South Livermore Avenue.

At Lawrence Livermore National Laboratory, the art of science often begins at the “Powerwall,” a massive video screen where scientists and engineers study simulations produced by the Laboratory’s supercomputers. These supercomputers are among the world’s most powerful machines, creating simulations at the atomic scale. What looks to many to be a roadmap is actually a Parallel Dislocation Simulator (ParaDiS) simulation, created by the Lab’s Richard Cook, exploring the characteristics of the metal molybdenum.

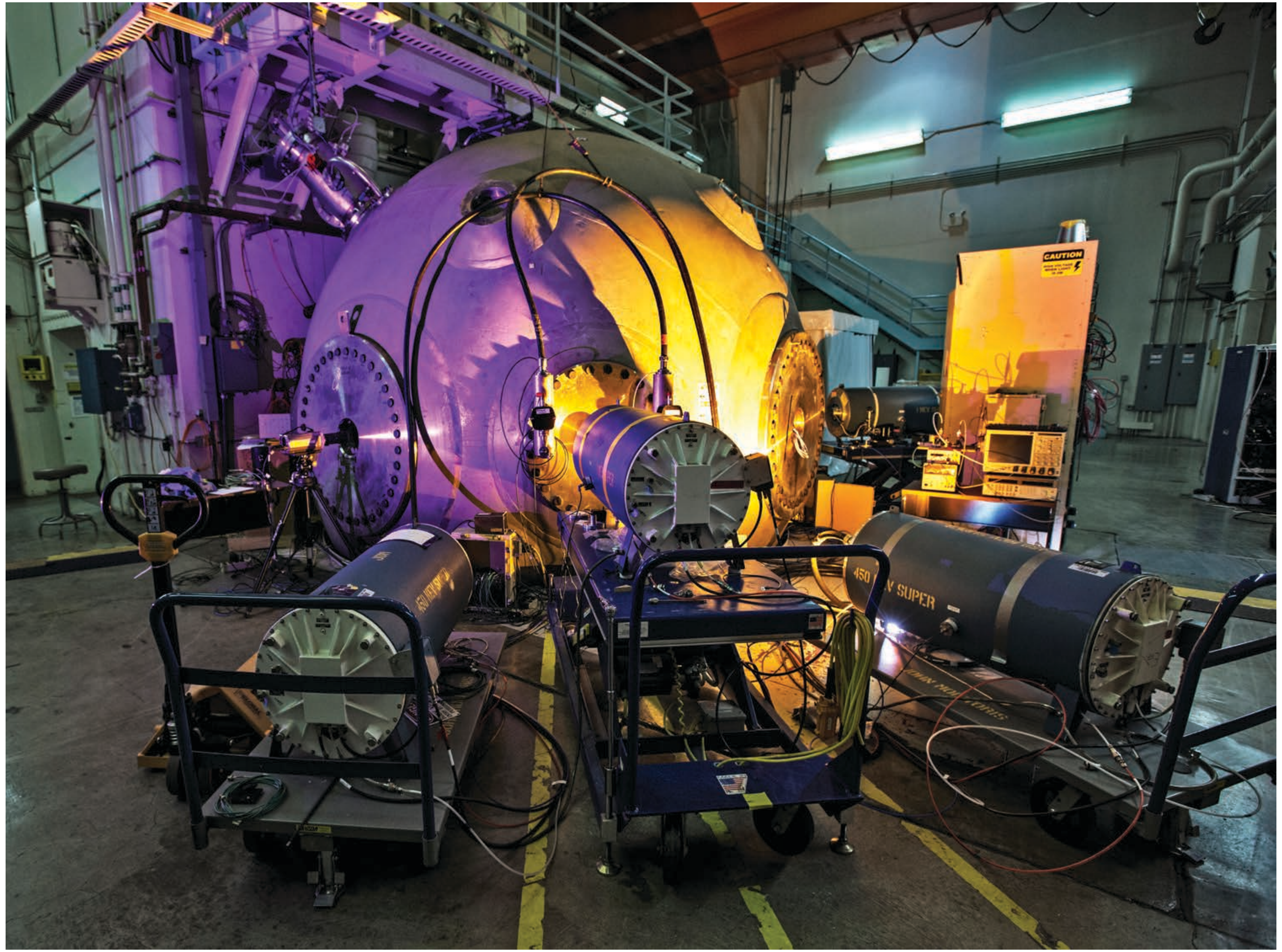
Photo by George Kitrinos/LLNL



Science can be artistic and explosive at the High Explosives Application Facility, a unique and fully contained indoor testing ground at Lawrence Livermore National Laboratory. Each day firing chambers such as this are used to conduct experiments vital to the Lab's work in:

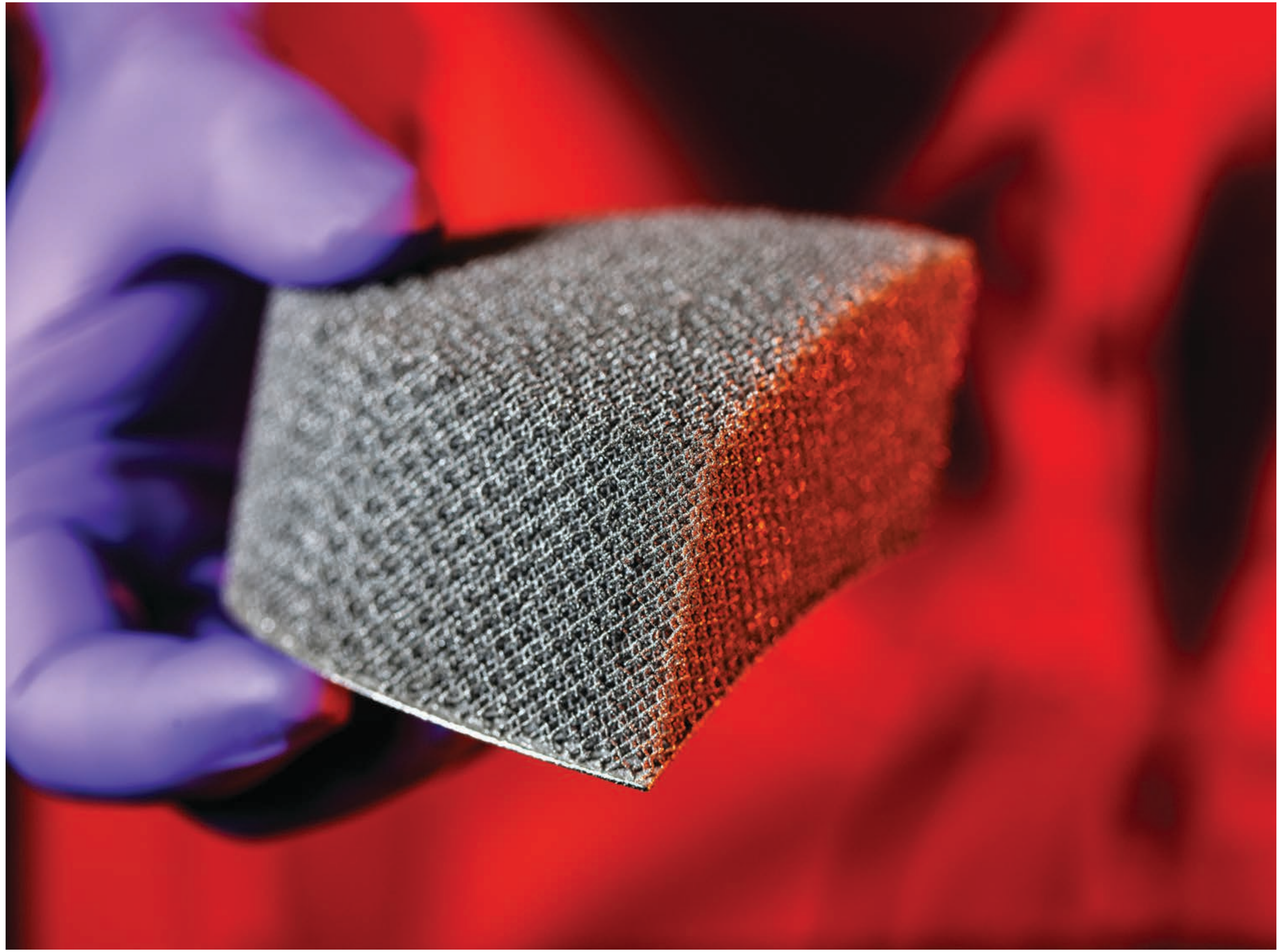
- Stockpile stewardship – assuring the reliability and safety of the nation's nuclear weapons
- Homeland security – airport transportation safety as well as countering terrorist threats
- Health care – preventing traumatic brain injury through better helmet design

Photo by George Kitrinos/LLNL



Start your rocket engines: Traditional methods of manufacturing critical components for space launch and strategic deterrence can be time consuming and cost intensive. At Lawrence Livermore National Laboratory, engineers are leveraging metal-based manufacturing to revolutionize the production of rocket engines. This intricate weaving of metal mesh, produced on a 3D printing machine, results in parts that are lighter in weight and cheaper in cost than their traditionally cast or wrought counterparts.

Photo by George Kitrinos/LLNL

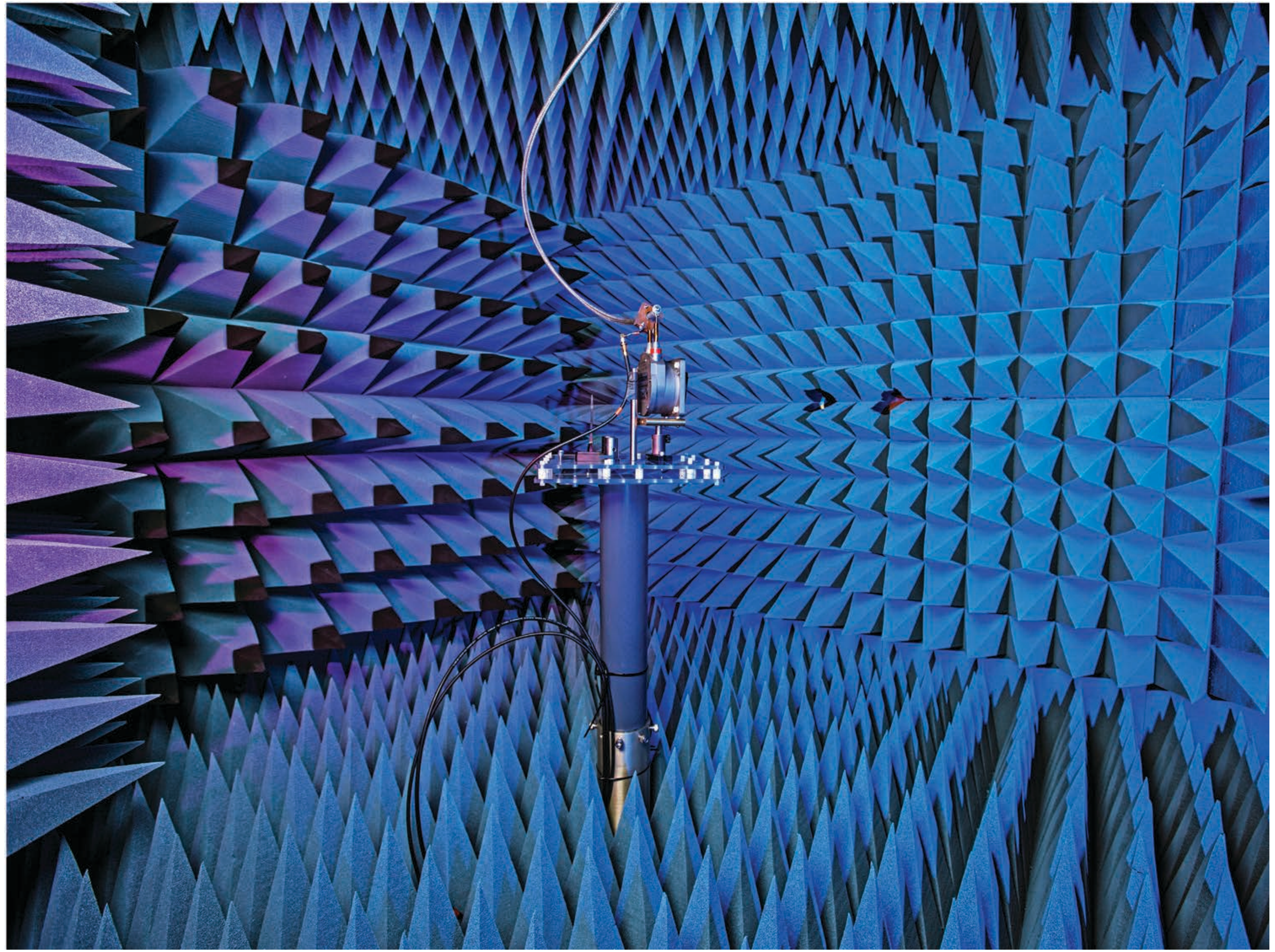


These glass-like beads may be depicted as larger than life, yet they are microscopic in scale. Lawrence Livermore National Laboratory researchers developed these permeable polymer shells surrounding a solution of sodium bicarbonate – or baking soda. These capsules can be used to capture carbon dioxide as it is released into the atmosphere from fossil fuel use in power generation and other industries. The mesh holding these beads allows many capsules to be tested at one time while keeping them separated and exposing more of their surface area.

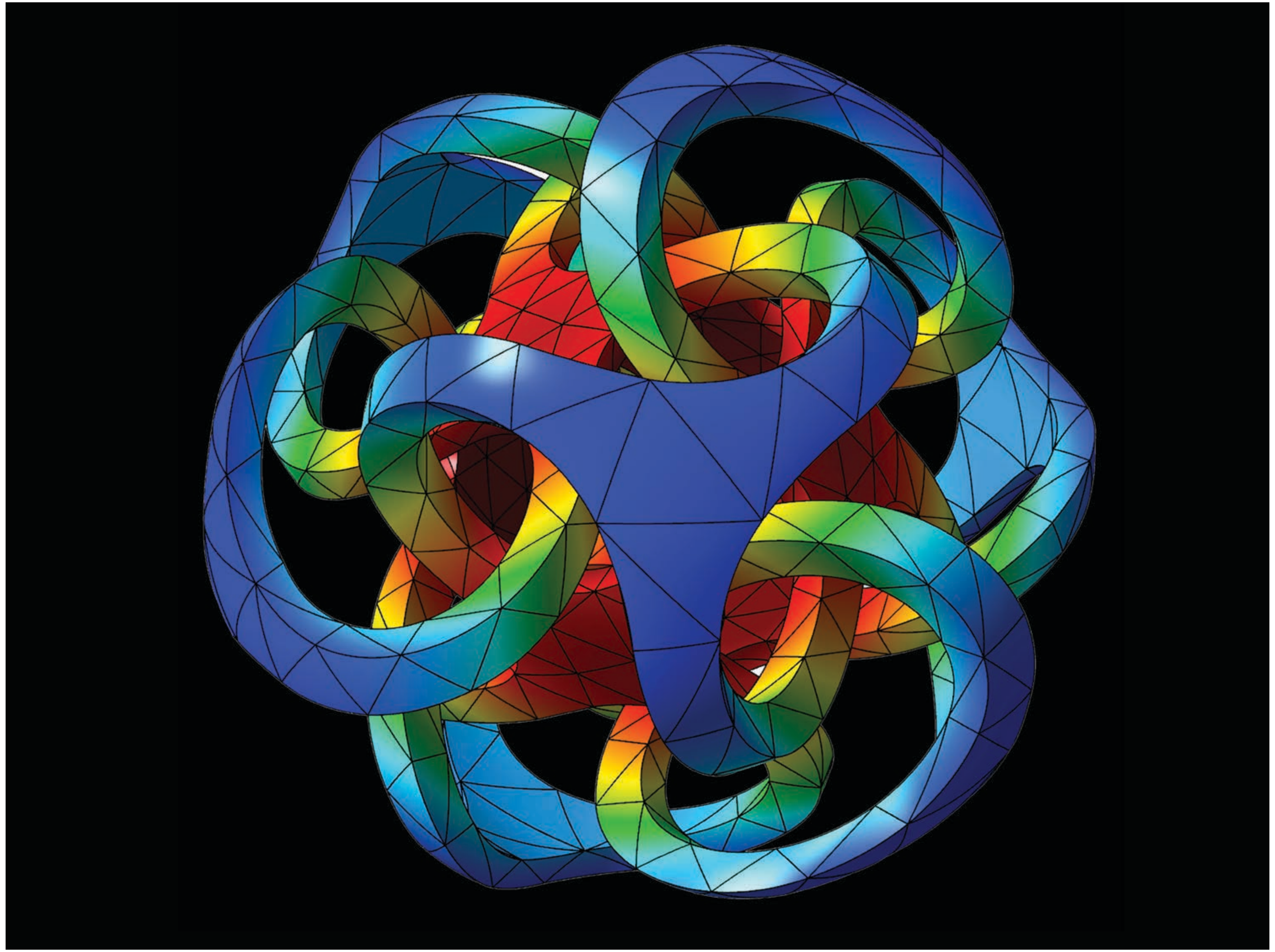
Photo by John Vericella/LLNL

They say lightning never strikes twice, but even if it strikes just once, safeguards must be in place to protect Lawrence Livermore National Laboratory's highly technical equipment. One such safeguard is this lightning protection system, also known as an LPS switch. In this chamber Laboratory scientists simulate how to safely deflect bolts from the blue and keep critical equipment running.

Photo by George Kitrinos/LLNL

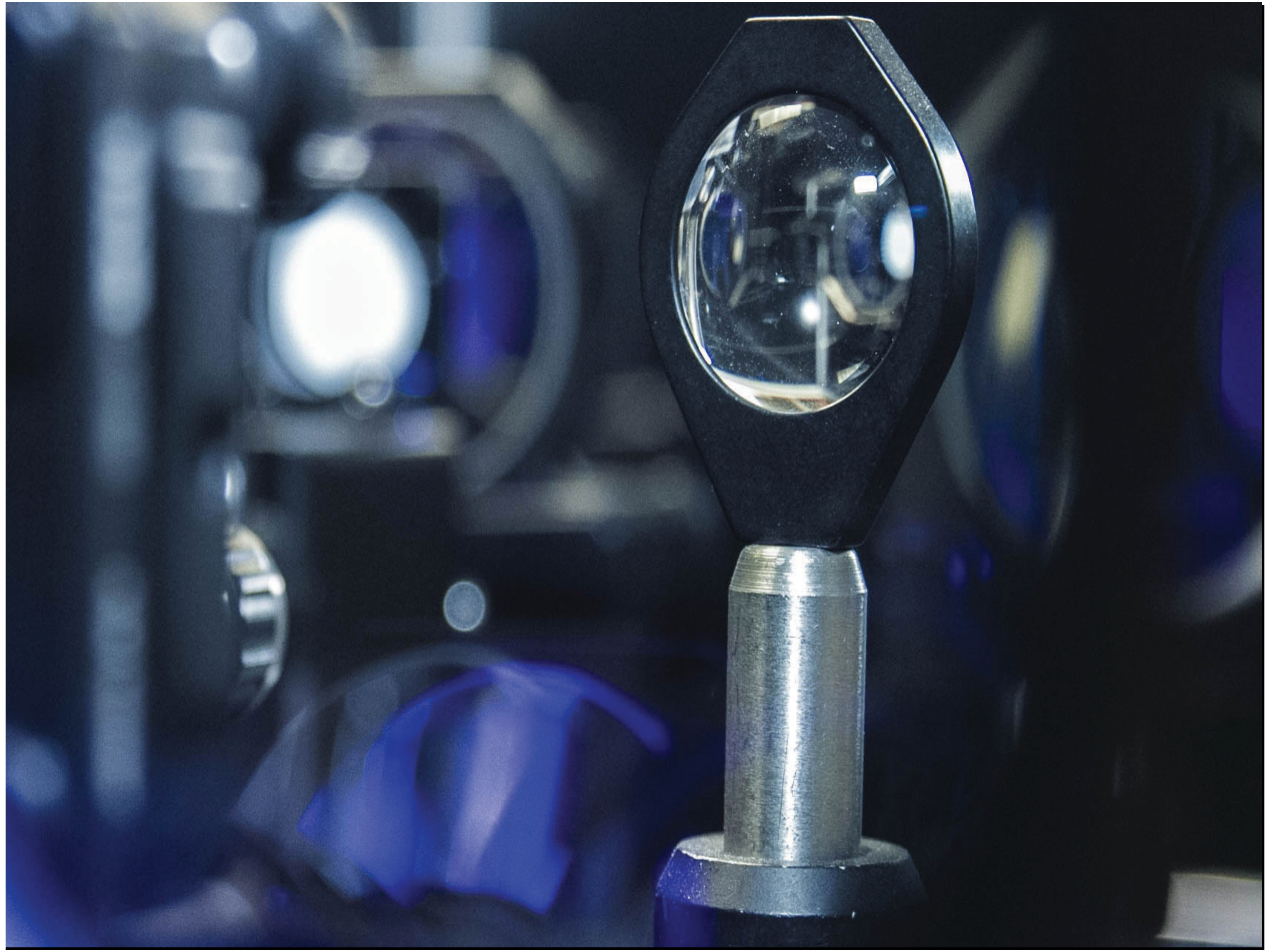


This simulation, performed on Lawrence Livermore National Laboratory supercomputers, depicts multi-mode Rayleigh-Taylor instability. Rayleigh-Taylor is the instability of an interface between two fluids of different densities, which occurs when the lighter fluid is pushing the heavier fluid. Water sitting atop oil or the fluids interacting in a lava lamp are common examples of Rayleigh-Taylor instability. Rayleigh-Taylor comes into play in many facets of science, from astrophysics to hydrodynamics to meteorology, oceanography and more.



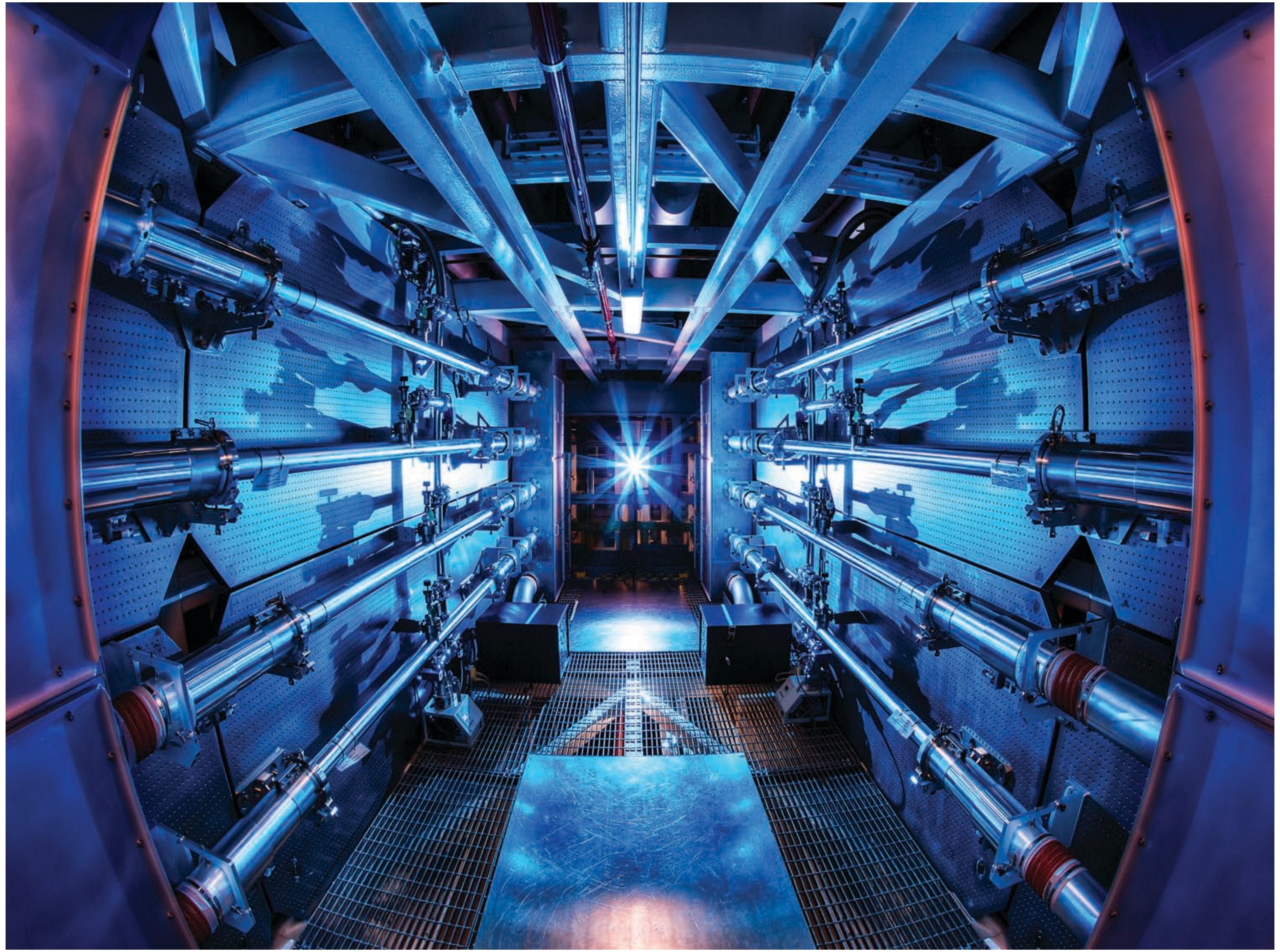
Scientists at Lawrence Livermore National Laboratory do not need to travel the world to study materials at extreme conditions. Instead they need go no further than Jupiter – in this case the Lab's Jupiter Laser Facility. Jupiter is a glass laser system composed of two beams, each capable of producing 200 picosecond (trillionths of a second) to 10 nanosecond (billionths) pulses. Researchers use Jupiter for high energy density science experiments that explore states of matter under extreme conditions of pressure and temperature.

Photo by Julie Russell/LLNL



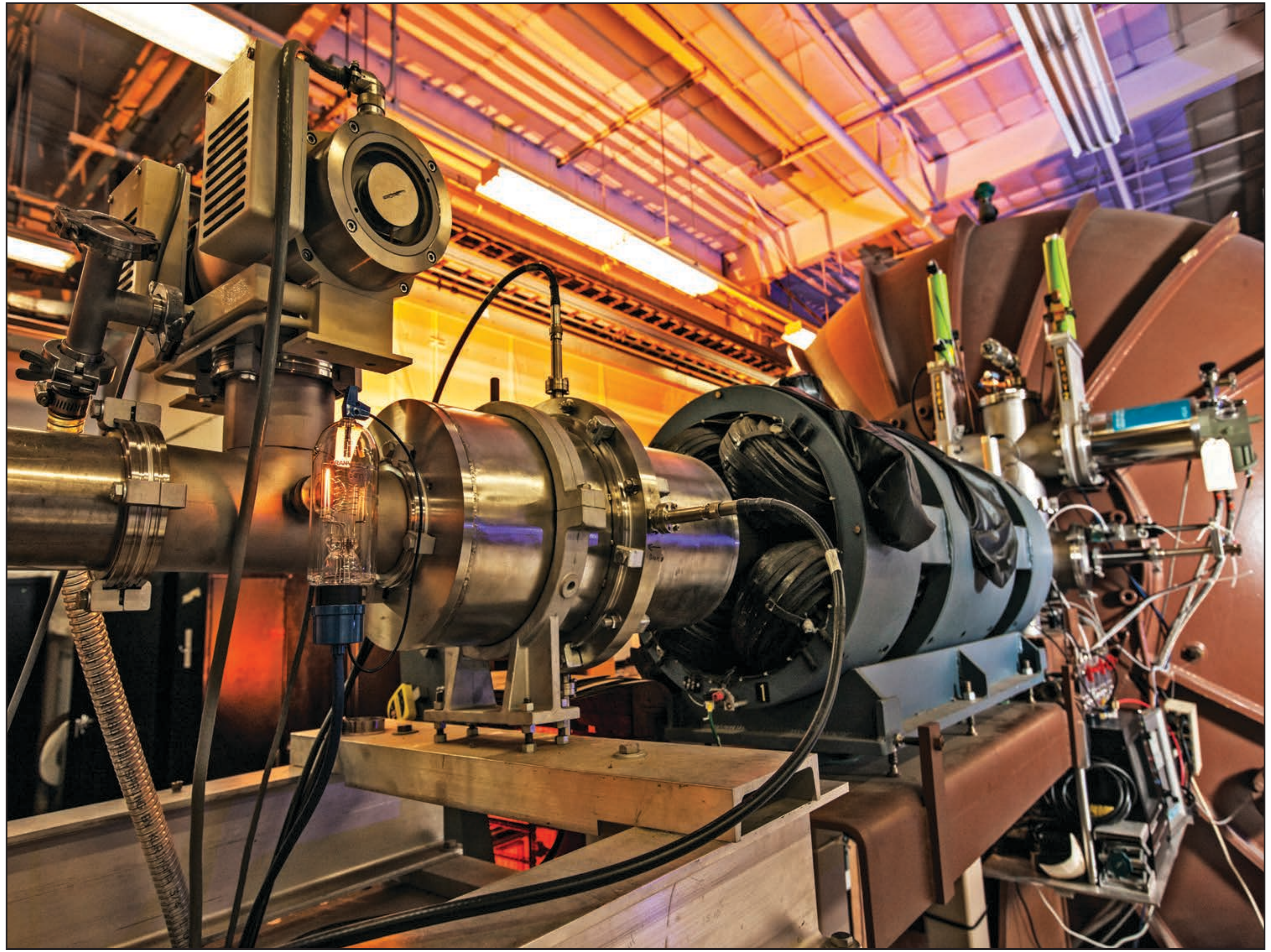
Through this portal of the National Ignition Facility – or NIF – pass 192 beams of light that make for the world's largest and most energetic laser. This is one of the preamplifiers of NIF, where laser beams embark on their path toward the target chamber. Those beams start at one billionth of a joule (one joule is equal to the amount of electricity required to light a one-watt LED bulb for one second) and must be amplified a quadrillion times before they are sent to the NIF target. Lawrence Livermore National Laboratory scientists use NIF for national security, astrophysics and basic science research as well as energy research. Fans of the most recent "Star Trek" film recognize NIF as the inner workings of the Starship Enterprise.

Photo by Damien Jemison/LLNL



This massive mix of metal, electrical and mechanical wizardry makes up CAMS – the Center for Accelerator Mass Spectrometry. CAMS is a globally recognized, state-of- the-art facility designed to apply ion-beam analytical techniques for studies in forensics, biology, environmental science, atmospheric chemistry and public health, to name just a few areas of study. Few facilities can match the capabilities of CAMS: Lawrence Livermore National Laboratory researchers as well as their counterparts around the world, use the facility to measure isotope ratios with high selectivity, sensitivity and precision – which is why CAMS often runs around the clock.

Photo by George Kitrinos/LLNL



In support of national security, gamma ray spectroscopy helps locate radioactive materials at shipping ports and border crossings. It also accurately identifies and quantifies the isotopes present. In space, gamma ray spectroscopy is used to determine the composition of intergalactic objects. GeMini, developed at Lawrence Livermore National Laboratory, is a palm-sized instrument – the "Ge" stands for germanium, the element used for detecting nuclear materials, while "Mini" refers to its size. GeMini was used onboard NASA's MESSENGER spacecraft, yielding important information on how the planet was formed.

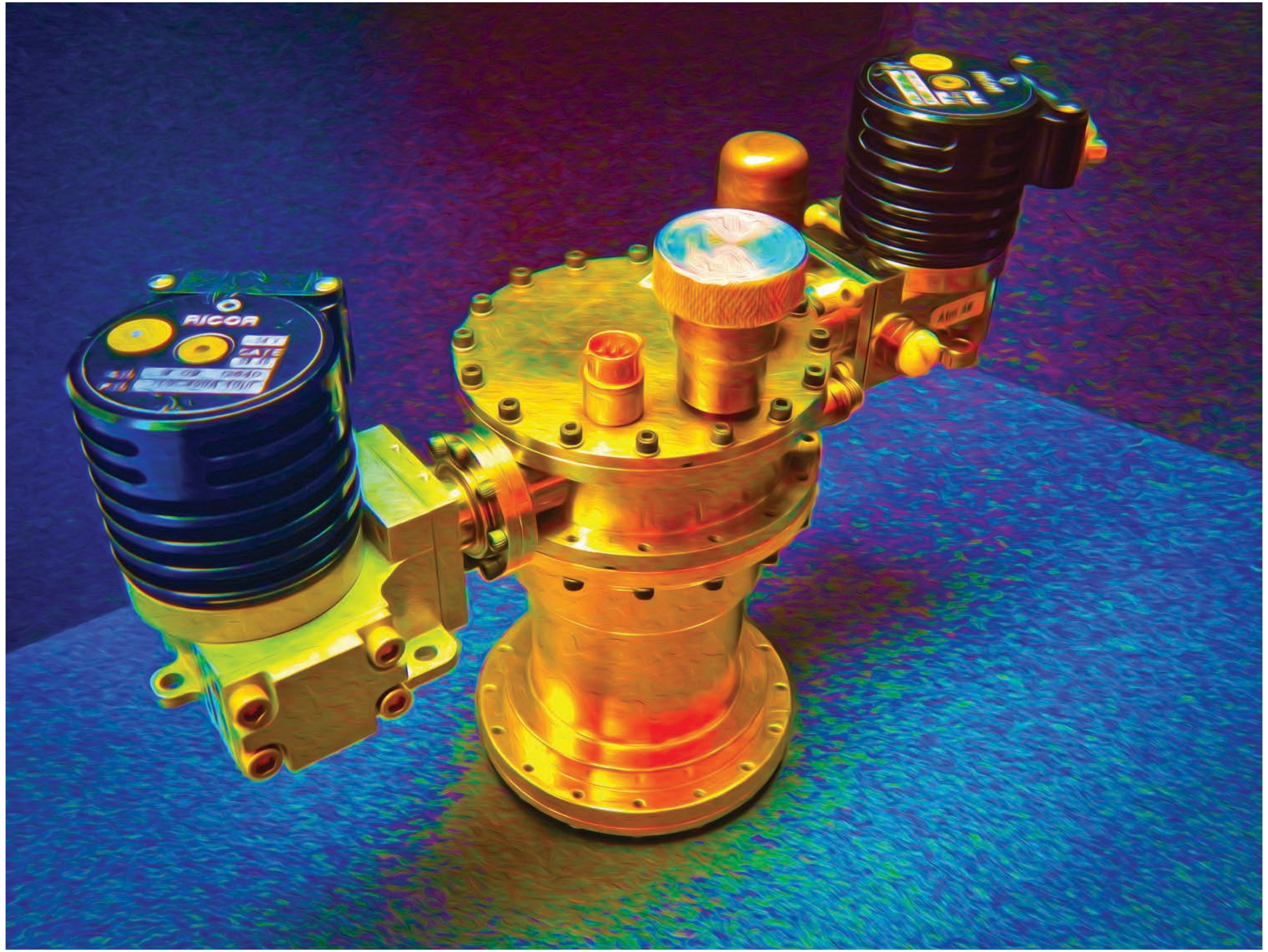
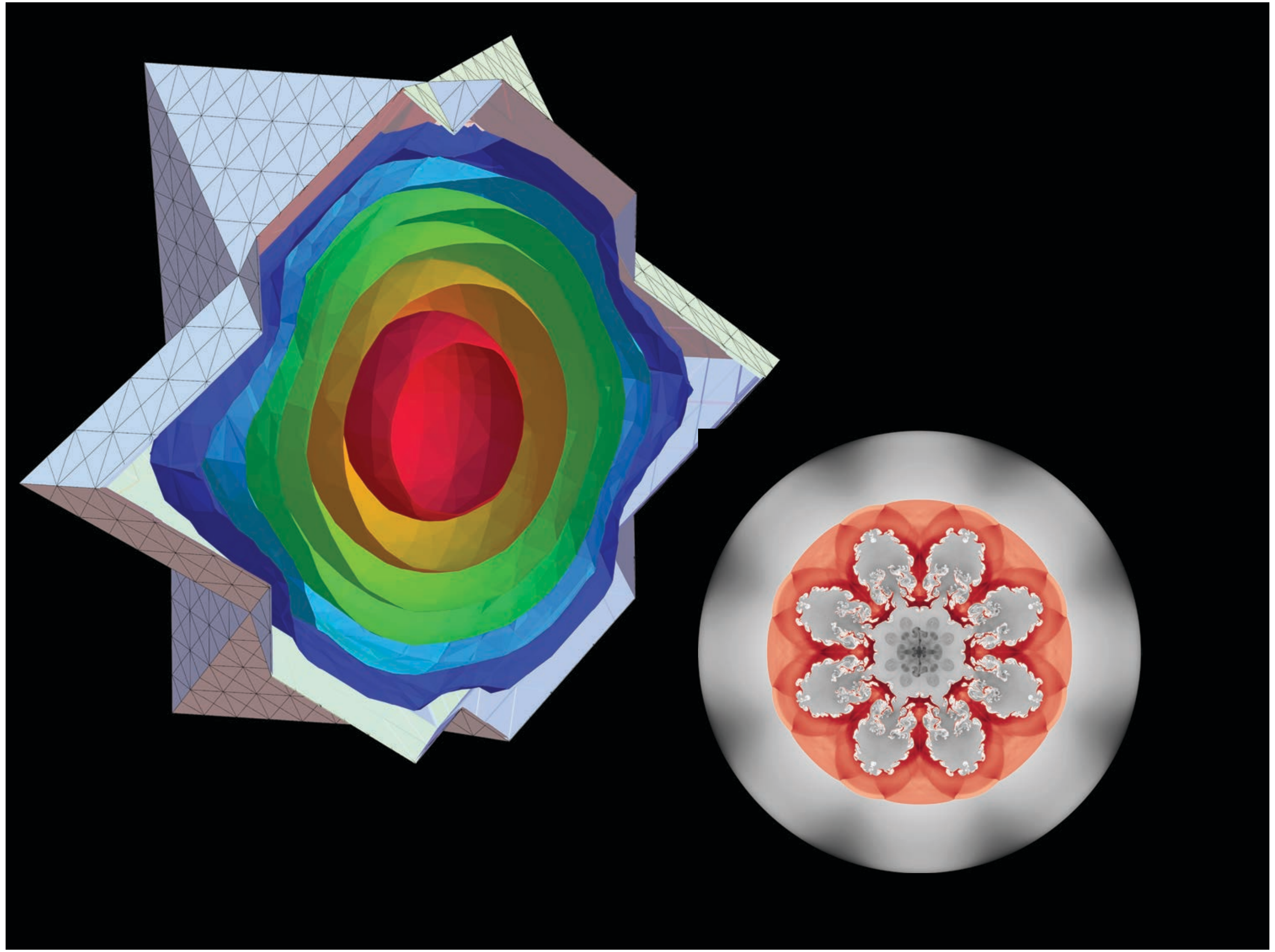


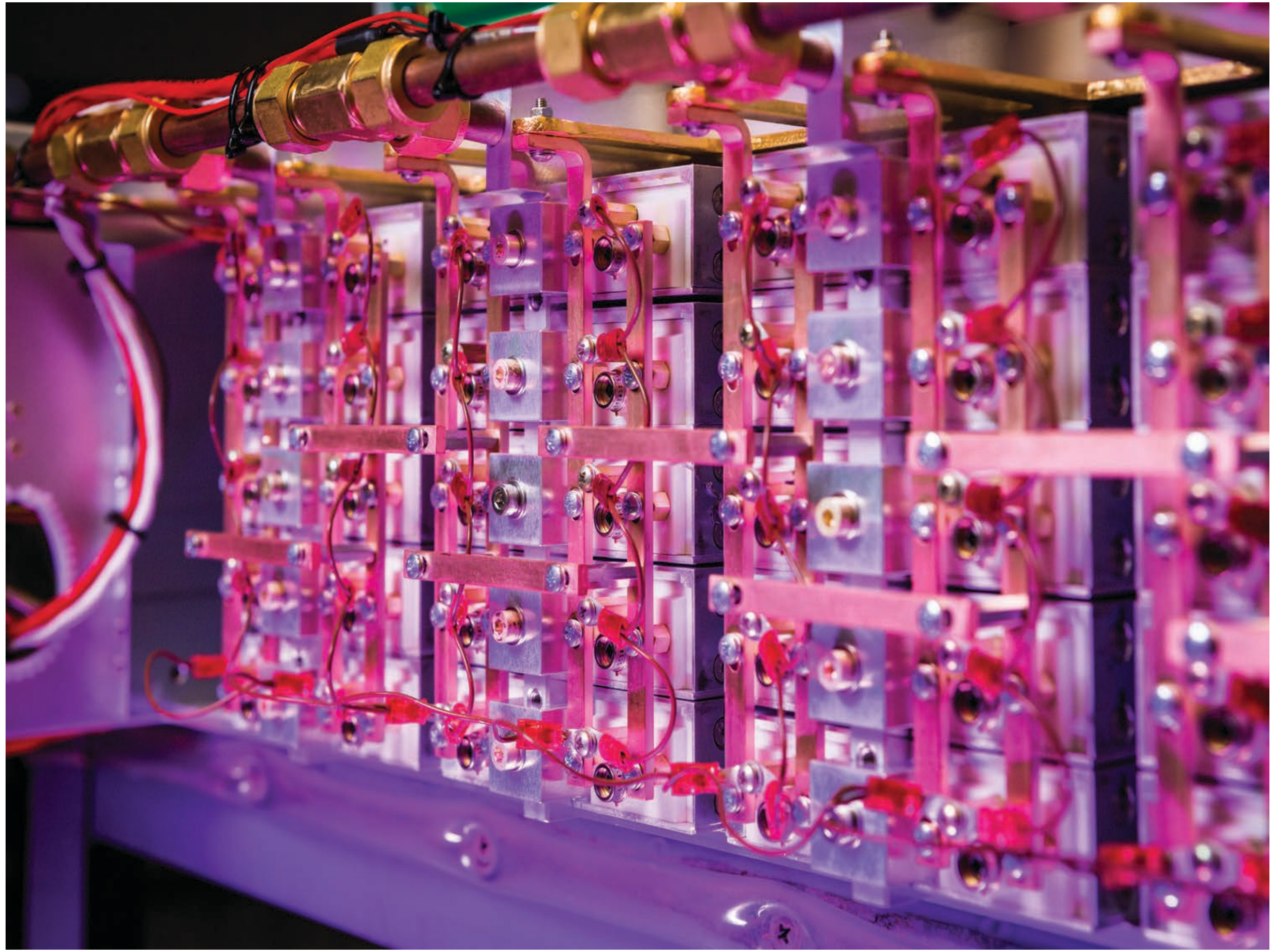
Photo by Julie Russell/LLNL

At Lawrence Livermore National Laboratory, computational scientists have multiple codes at their disposal to achieve the detailed simulations they need to execute research. The visualization at left depicts a high-order multi-material finite element simulation of a cylindrical inertial confinement fusion implosion performed using the computer code BLAST. Such simulations are important to experiments at the National Ignition Facility, the world's largest and most energetic laser. At right, this tetrahedral simulation depicts the magnitude of the projection of a smooth vector field using fourth order methods employed in electromagnetic simulations.



Lawrence Livermore National Laboratory is known for its expertise in laser physics. In 2015, Laboratory researchers deployed the world's highest peak-power laser diode arrays. To drive those diode arrays, they needed to develop this new type of pulsed-power system, which supplies the arrays with electrical power by drawing energy from the grid and converting it to extremely high-current, precisely-shaped electrical pulses.

Photo by Damien Jemison/LLNL



This simulation depicts surfaces of a constant electric field generated by uniformly distributed charges inside a complicated insulated computational domain; a simulation with high-order finite elements. The domain is actually the same polyhedron as in “Waterfall” by M.C. Escher, the Dutch graphic artist famous for his math-inspired work.