America's National Laboratory System

A Powerhouse of Science, Engineering, and Technology

U.S. DEPARTMENT OF ENERGY

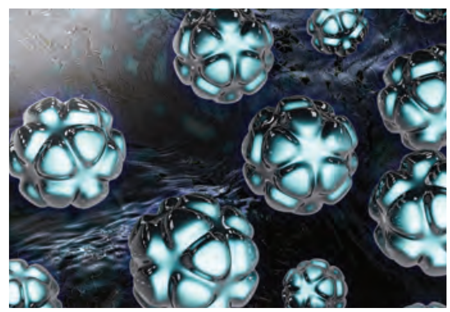
The 17 U.S. Department of Energy (DOE) National Laboratories are a cornerstone of the United States' innovation ecosystem, performing leading-edge research in the public interest.

Launched as part of a wave of federal investment in science around World War II, the DOE National Laboratories have evolved into one of the world's most productive and sophisticated research systems. Over this time, DOE National Laboratory scientists have won 80 Nobel Prizes in the sciences. Today, this system maintains one-of-a-kind multidisciplinary research capabilities, large scale scientific tools, and teams of experts focused on the Department's and the nation's most important priorities in science, energy, and national security.

NATIONAL LABORATORY MISSIONS

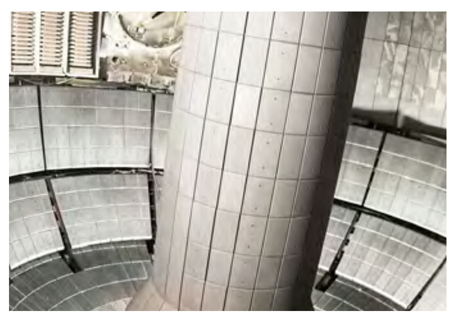
DISCOVERY SCIENCE

DOE is the nation's largest funder of the physical sciences. Every day, researchers at the National Laboratories make discoveries in basic science that advance knowledge and provide the foundation for American innovation. From unlocking atomic energy to mapping the human genome and pushing the frontiers of nanotechnology, National Lab scientists have led the way in making breakthrough discoveries and are recognized by their peers as global leaders.



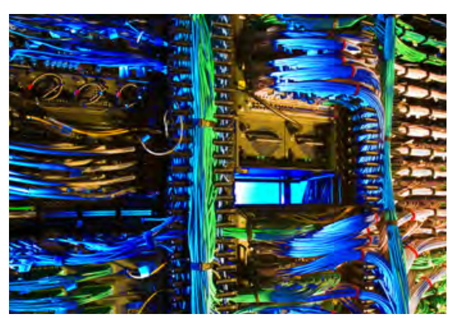
ENERGY SECURITY AND INDEPENDENCE

With research underway on a host of next-generation energy technologies, the National Labs are key to an "all-of-the-above" energy strategy that advances U.S. energy independence. From developing much of the horizontal drilling and drill bit technology that helped spark today's domestic oil and gas boom to developing the critical technology behind many of today's electric vehicles, solar panels, and wind turbines, the National Labs have pushed the boundaries of the nation's energy technology frontier.



NATIONAL SECURITY

With origins in the Manhattan Project, an enduring mission of the National Labs has been to enhance national security by ensuring the safety and reliability of the U.S. nuclear deterrent, helping prevent the proliferation of weapons of mass destruction, and securing the nation's borders. The National Labs also play a central role in homeland security, development of advanced technologies for counterterrorism, detection of nuclear and biological weapons, and cybersecurity.



ECONOMIC PROSPERITY AND GLOBAL COMPETITIVENESS

Through scientific discovery and technology innovation, the National Laboratories advance U.S. economic competitiveness and contribute to our nation's prosperity. The National Labs' unique ability to partner with private industry and academia—through research agreements, national user facilities, and technology transfer programs—drives technology solutions to the marketplace, creates jobs, and spurs economic growth.

For more information about our National Laboratory System:

DOE Website: energy.gov/science-innovation/national-labs
Facebook: www.facebook.com/energygov
Twitter: twitter.com/energy

U.S. DEPARTMENT OF ENERGY

NATIONAL LABORATORY CAPABILITIES

UNIQUE SCIENTIFIC USER FACILITIES

The National Laboratories are stewards of a network of 30 unique scientific instrumentation and research facilities that are available to the public and private sectors. Last year alone, nearly 30,000 researchers from academia, government, and industry at large took advantage of these world-class facilities, which are staffed by recognized leaders in their fields. Because user facilities house specialized and large scale instruments that require major investments beyond the means of individual universities and firms, such as some of the world's most powerful supercomputers, x-ray light sources, and particle accelerators, they play an indispensable role as engines of innovation and scientific discovery.

SUPERCOMPUTING

As a direct result of DOE investments, historically more than half of the world's 500 fastest computers, presently including five of the top ten, are located in the United States. Industry has used DOE facilities to improve development of wind energy in cold climates, to model and develop high-efficiency natural gas engines for power generation, and to study, at the molecular level, chemical processes that can limit the shelf life of consumer products.

A HISTORY OF INNOVATION

With roots going back to the 1930s, the National Laboratory system has a long record of advancing basic science and applied technology to serve America's economic, energy, environmental, and national security interests. Research at the National Labs has:

- Contributed to the discovery of more than 20 elements on the periodic table, including one that revolutionized the field of medical imaging and another that is widely used in smoke detectors
- Increased the efficiency of wind turbines, helping to reduce the cost of wind power by more than 80% over the past 30 years
- Developed optical digital recording, the basic technology behind CDs and DVDs
- Created the world's smallest synthetic robots as well as the toughest and lightest ceramics, perfect for energy and transportation applications
- Explained the biological processes of photosynthesis, laying the groundwork for new bio-based technologies
- Confirmed the Big Bang and discovered dark energy in collaboration with NASA
- Applied nuclear capabilities to the understanding and production of isotopes for medicine and industry
- Revolutionized materials with widespread applications in manufacturing, transportation, and medicine—including life-saving devices for cancer detection and treatment
- Greatly improved our ability to detect explosives and weapons, including nuclear and biological agents and plastic devices
- Ensured the safety, security, and reliability of the nation's nuclear stockpile without testing

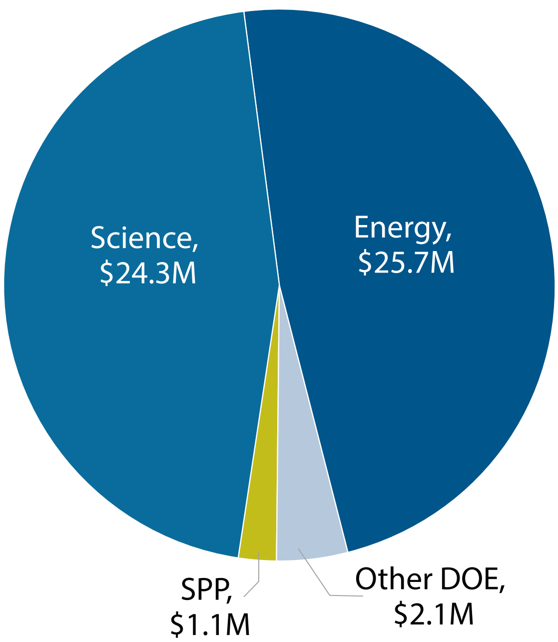
Through these and countless other achievements, the National Laboratories have saved lives, generated new products, spawned new industries, uncovered secrets of the universe, and helped establish and sustain U.S. global preeminence in science and technology.

Ames Laboratory

At a Glance

Ames Laboratory is DOE's materials laboratory focused on the design, discovery, fundamental understanding, and application of materials to energy technologies. We provide the national and global scientific communities with roadmaps to create and discover new materials. Our synthesis, exploration, mapping, and tuning of the physical properties of materials set the research agenda for the scientific community for decades to come. The transition from generating fundamental knowledge of materials to applying this knowledge to solve salient technological and industrial challenges is a significant strength and notable focus for Ames. Through the specialized capabilities and expertise of our world-renowned research teams, we serve the scientific community by making seemingly "impossible" to create materials available to other national laboratories, universities, and industry—enabling and accelerating science and technology across the nation.

FY 2016 Funding by Source



Lab operating costs: **$53.2M**
DOE/NNSA costs: **$52.1M**
SPP (Non-DOE/Non-DHS) costs: **$1.1M**
SPP as % total Lab operating costs: **2.1%**

Facts

Location: Ames, Iowa
Type: Single-program Laboratory
Year Founded: 1947
Director: Adam Schwartz
Contractor:
Iowa State University of Science and Technology
Responsible Site Office: Ames Site Office

Physical Assets

10 acres and **13** buildings
340,968 GSF in buildings
Replacement plant value: **$88.6M**

Human Capital

303 full-time equivalent employees (FTEs)
82 joint faculty
43 postdoctoral researchers
83 undergraduate students
102 graduate students
268 visiting scientists

Core Capabilities

- Applied Materials Science and Engineering
- Chemical and Molecular Science
- Condensed Matter Physics and Materials Science

Mission Unique Facilities

- Sensitive Instrument Facility
- Critical Materials Institute—DOE Energy Innovation Hub
- Materials Preparation Center
- Powder Synthesis Facility for Additive Manufacturing

Ames Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

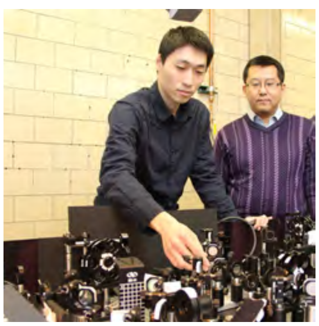
Unique Facility

Safeguarding National Energy Security - The Critical Materials Institute

The Critical Materials Institute (CMI), a collaboration of DOE national laboratories and academic and industrial partners led by Ames Laboratory, provides critical knowledge in supplying, replacing, and recycling rare-earth materials. These materials play essential roles in a host of energy technologies ranging from wind turbines to battery technologies that are important to our national energy security. CMI has aggressively accelerated technological developments related to critical rare-earth and lithium-based materials. In less than four years, CMI has filed 35 U.S. patent applications and 61 records of invention that address primary production of critical materials, new materials and processes that do not contain critical materials but match or exceed the performance of those that do, and manufacturing and recycling processes that optimize existing resources. CMI is fully equipped to take on the nation's urgent challenges of critical materials—and to adapt as the nature of criticality evolves over time.

Research Highlight

Seeing and Harnessing Quantum Switching



Scientists at Ames Laboratory are now able to "see" how a new class of photovoltaic materials—organometallic halide perovskites—is able to convert light into electricity. Perovskites are magnificent materials for light harvesting and electronic transport devices, as they combine the best of both worlds—the high-energy conversion performance of traditional inorganic photovoltaic devices, coupled with economical material costs and fabrication methods of organic versions. Ames Laboratory's expertise in precision materials synthesis and exploration, paired with new techniques in laser light terahertz spectroscopy, resulted in being able to directly observe, describe, and quantify a photon-to-exciton event, by which a photon transfers its energy to an electron. Being able to observe and ultimately control this behavior holds significant potential for both advancing photovoltaic technology, and in making new quantum switches for next generation computer architectures and electronic transport devices.

Technology to Market Highlight

Revolutionizing 3D Printing Capabilities for Metals

Fine, uniform, high-purity spherical metal powders required to meet the high-tech demands of metals additive manufacturing are made possible through the advanced gas-atomization process developed at Ames Laboratory. This cutting-edge process uses high-pressure gas flow to disperse molten metal and form the powders needed to mass produce complex metallic 3D printed engineering parts at lower cost. Strict control over the powder synthesis provides the ability to control the quality of the final product. Ames Laboratory partnered with industry to meet the manufacturing challenges of printing the distinctive components with specialized metallic alloys and developing production processes and raw material powders to suit industry's specific needs. The resultant technology has been the subject of more than 16 patents over the last two decades and has generated a spin-off company, acquired by Praxair, that produces titanium powder for the manufacturing market.

Argonne National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

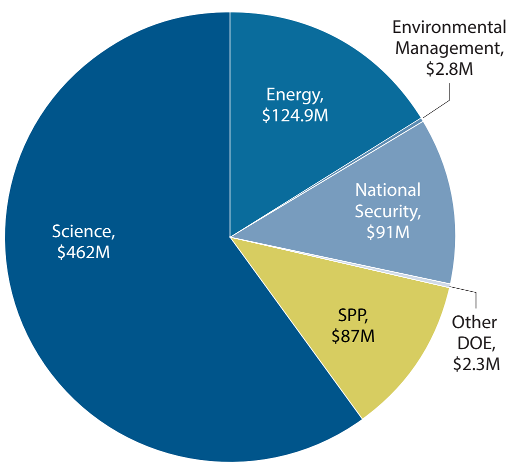
Argonne was founded as a chemistry, materials and nuclear engineering laboratory in 1946. Today, Argonne serves America as a science and energy laboratory distinguished by the breadth of its research and development capabilities combined with a unique portfolio of experimental and computational user facilities. Argonne has been managed since its founding by The University of Chicago, one of the world's preeminent research universities.

In its science program, Argonne delivers new knowledge not only in chemistry and materials, but also in nuclear and particle physics, mathematics, and earth science. This work is enriched by collaborations with University of Chicago researchers, reflected in joint efforts in fields such as cosmological physics and computational materials.

Argonne's early-stage R&D in energy encompasses nuclear, chemical, materials, bioprocess and systems engineering and drives advances in reactors, energy generation and storage, electricity distribution, and transportation systems. The Laboratory nurtures strong connections with industry to support transfer of new technology concepts to the private sector.

The Laboratory's science and energy programs both support and benefit from Argonne's integrated user facilities. Each year, Argonne is a nexus of research for 8000+ scientists and engineers from other institutions, whose work is advanced by access to the Laboratory's research centers and user facilities and by collaborations with Argonne's staff.

FY 2016 Funding by Source



Lab operating costs: **$770M**
DOE/NNSA costs: **$655M**
SPP costs (non-DOE/non-DHS): **$87M**
SPP as % total Lab operating costs: **11.3%**
DHS costs: **$28M**

Facts

Location: DuPage County, Illinois
Type: Multiprogram Laboratory
Year Founded: 1946
Director: Paul Kearns (interim)
Contractor: UChicago Argonne, LLC
Responsible Site Office: Argonne Site Office

Physical Assets

1,517 acres and **157** buildings
5.0 million GSF in buildings
Replacement plant value: **$3.29B**
56,656 GSF in **20** excess facilities
339,673 GSF in leased facilities

Human Capital

3,206 full-time equivalent employees (FTEs)
256 joint faculty
268 postdoctoral researchers
260 undergraduate students
322 graduate students
7,422 facility users
1,005 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Applied Mathematics
- Biological and Bioprocess Engineering
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Computational Science
- Condensed Matter Physics and Materials Science
- Cyber and Information Sciences
- Decision Science and Analysis
- Large Scale User Facilities/ Advanced Instrumentation
- Nuclear Engineering
- Nuclear Physics
- Nuclear and Radio Chemistry
- Particle Physics
- Systems Engineering and Integration

Mission Unique Facilities

- Advanced Photon Source
- Argonne Leadership Computing Facility
- Argonne Tandem Linear Accelerator System
- Center for Nanoscale Materials
- Transportation Research and Analysis Computing Center

Argonne NATIONAL LABORATORY

Argonne National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

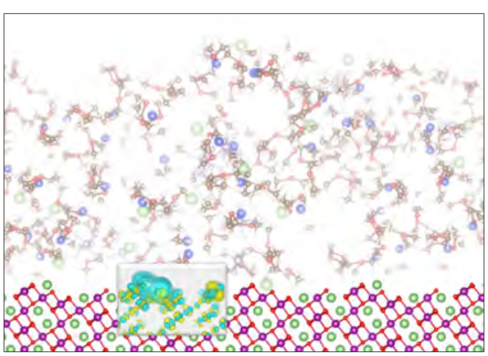
Unique Facility
Advanced Photon Source

The Advanced Photon Source (APS) serves as the Nation's highest energy synchrotron light source and is used for studies in nearly every scientific discipline. It houses several unique beamlines and the Nation's premier consortium for high pressure studies. More than 5,500 researchers use the APS annually, making it the most frequented DOE user facility. The winners of the 2009 and 2012 Nobel Prizes in Chemistry used the APS for their research. Numerous drug discoveries and products have grown from work at the APS, including the 2016-approved leukemia drug Venclexta developed by AbbVie and Genetech. Plans for an upgrade of the APS in the early part of the next decade will make the APS four hundred times brighter and vastly expand the available research opportunities.

Unique Facility
Argonne Leadership Computing Facility

The Argonne Leadership Computing Facility (ALCF) designs and provides world-leading computing facilities in partnership with the computational science community. Research in biology has identified the molecular basis of Parkinson's disease and identified how bacteria quickly become drug resistant. Engineering breakthroughs have included designs of cleaner, quieter, and less expensive engines and wind turbines. Simulations have explained how materials breakdown under extreme stress and identified a process to purifying otherwise unusable natural gas. Supercomputing has guided the design of materials and is being used to explore the algorithmic requirements to bring quantum computing to reality. The ALCF is also a planned site for a DOE exascale system in 2021, which will fuel a vast range of breakthroughs and accelerate discoveries using simulation, big data and deep learning applications across a wide array of disciplines.

Technology to Market Highlight
Argonne materials help power Chevy Volt



Batteries power the world, enhance our security and drive industrial opportunities. Argonne develops energy storage technologies that dramatically increase energy and power densities. Argonne researchers, along with other collaborators, are paving the way for batteries with increased lifetimes, safety and range by developing strategies to select electrolytes for specific functionality using computer simulations. Argonne's all-encompassing battery research program spans the continuum from basic materials research and diagnostics to scale-up processes and can be found in real world applications, like the Chevy Volt, which leverages an Argonne battery chemistry breakthrough. Scientists also use our unique facilities like the APS and ALCF, above, as part of their toolkit to better understand the reactions that happen inside a battery thru simulations and in real time.

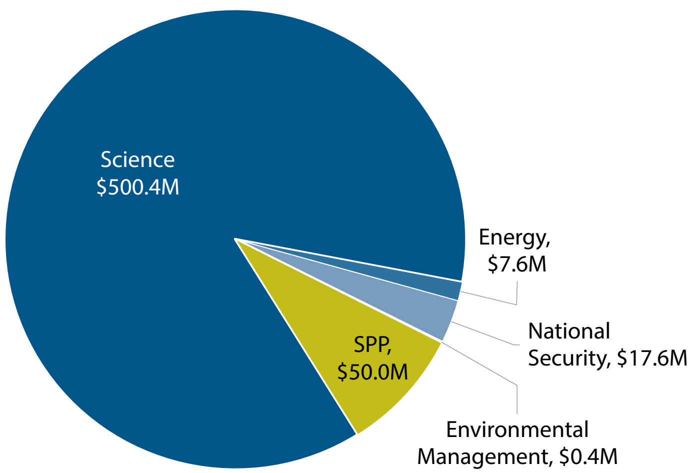
Brookhaven National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

BNL brings world-class facilities and expertise to advance fundamental research in nuclear and particle physics to gain a deeper understanding of matter, energy, space, and time; apply photon sciences and nanomaterials research to energy challenges of critical importance to the Nation; and perform cross-disciplinary research on climate change, sustainable energy, computation, and earth's ecosystems.

The Lab's 2,750 scientists, engineers, and support staff are joined each year by thousands of visiting researchers who use its large-scale scientific facilities. BNL is operated and managed by Brookhaven Science Associates, founded by the Research Foundation for the State University of New York on behalf of Stony Brook University, and Battelle, a nonprofit applied science and technology organization.

FY 2016 Funding by Source



Lab operating costs: **$576.1M**
DOE/NNSA costs: **$524.9M**
SPP costs (non-DOE/non-DHS): **$50M**
DHS costs: **$1.3M**
SPP as % total Lab operating costs: **8.9%**

Facts

Location: Upton, New York
Type: Multi-program Laboratory
Year Founded: 1947
Director: Doon Gibbs
Contractor: Brookhaven Science Associates
Responsible Site Office: Brookhaven Site Office

Physical Assets

5,322 acres and **316** buildings
4.85M GSF in buildings
Replacement plant value: **$5.23B**
95,702 GSF in **11** excess facilities

Human Capital

2,618 full-time equivalent employees (FTEs)
121 joint faculty
122 postdoctoral researchers
203 undergraduate students
140 graduate students
2,594 facility users
2,134 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Condensed Matter Physics and Materials Science
- Large Scale User Facilities/ Advanced Instrumentation
- Nuclear Physics
- Nuclear and Radio Chemistry
- Particle Physics
- Systems Engineering and Integration

Mission Unique Facilities

- Accelerator Test Facility
- Center for Functional Nanomaterials
- National Synchrotron Light Source II
- Relativistic Heavy Ion Collider

BROOKHAVEN NATIONAL LABORATORY

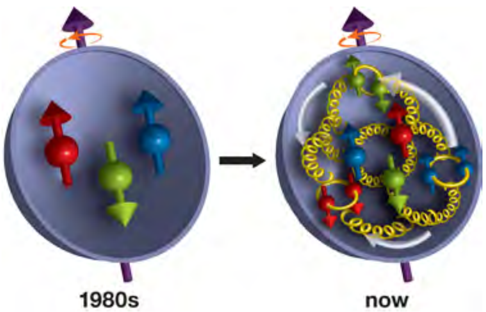
Brookhaven National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
World's most advanced synchrotron light source

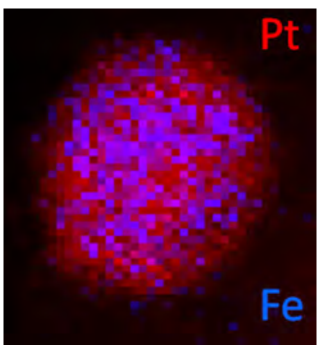
BNL is entering an exciting new chapter of discovery with one of the newest and most advanced x-ray facilities in the world. The National Synchrotron Light Source II (NSLS-II) delivers beams of extremely bright x-rays used by researchers to study a material's properties and functions with nanoscale resolution and exquisite sensitivity. This facility is open to scientists from academia, industry, and other Labs, and provides the research tools needed for basic and applied research, thereby fostering key discoveries in biology and medicine, materials and chemical sciences, geosciences and environmental sciences, and nanoscience. These discoveries will advance new technologies and generate breakthroughs in energy security, human health, and more.

Research Highlight
Gluons make big contribution to proton spin



"Spin" is a fundamental property that influences a proton's optical, electrical, and magnetic characteristics—put to use every day in MRI scans. But the source of spin is a mystery: quarks, the proton's inner building blocks, account for only about a third. New data from high-energy collisions of spin-aligned protons—possible only at the Relativistic Heavy Ion Collider—indicate that gluons, glue-like particles that bind quarks, play a substantial role in spin, possibly more than the quarks. These high-resolution experiments gave scientists access to gluons that carry the lowest fraction of the proton's overall momentum. Though these gluons are "lightweight," they're abundant, which explains their outsized contribution to spin.

Technology to Market Highlight
Custom nanocatalysts advance fuel cell vehicle production



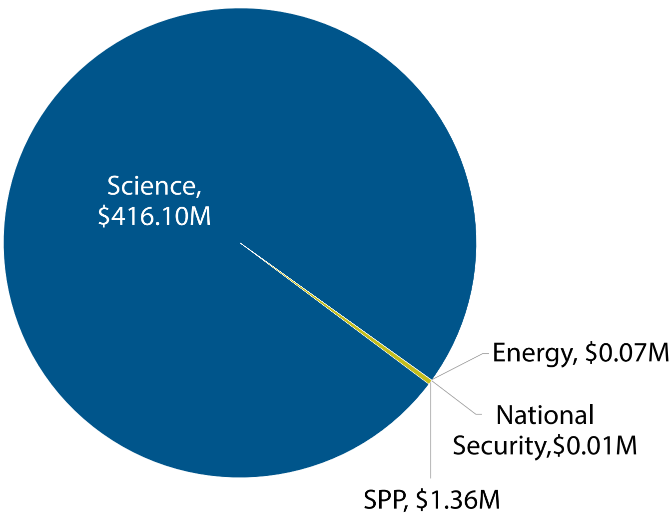
Hydrogen fuel-cell electric vehicles could significantly reduce the harmful emissions associated with fossil fuels, but these fuel cells rely on costly precious metals for peak performance. To reduce reliance on platinum—the most expensive, fragile, and critical fuel cell catalyst component—BNL scientists developed a breakthrough nanocatalyst that uses just a one-atom thick platinum coating over less-expensive metals like palladium. Experiments showed that the new nanocatalyst outperformed its expensive precursors. N.E. Chemcat Corporation, Japan's leading catalyst manufacturer, has licensed the nanoparticle design and synthesis process and is working with leading automotive manufacturers to accelerate production of an eco-friendly fleet of zero-emission vehicles.

Fermi National Accelerator Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

Fermi National Accelerator Laboratory is an international hub for particle physics located 40 miles west of Chicago. Fermilab is home to a vast complex of particle accelerators that powers research into the fundamental nature of the universe. The flagship Deep Underground Neutrino Experiment, supported by the Long-Baseline Neutrino Facility, will together be the first international mega-science project based at a DOE National Laboratory. Fermilab integrates U.S. universities and national laboratories into the global particle physics enterprise through its Large Hadron Collider (LHC) programs, neutrino science and precision science programs, and dark-energy and dark-matter experiments. The Laboratory's scientific R&D infrastructure and expertise advance particle accelerator, particle detector and computing technology for use in science and society.

FY 2016 Funding by Source



Lab operating costs: **$417.5M**
DOE costs: **$416.2M**
SPP costs (non-DOE/non-DHS): **$1.36M**
SPP as % total lab operating costs: **0.3%**

Facts

Location: Batavia, Illinois
Type: Single-program laboratory
Year Founded: 1967
Director: Nigel Lockyer
Contractor: Fermi Research Alliance, LLC
Responsible Site Office: Fermi Site Office

Physical Assets

6,800 acres and **366** buildings
2.4M GSF in buildings
Replacement plant value: **$2.098B**
18,849 GSF in **9** excess facilities
19,771 GSF in leased facilities

Human Capital

1,793 full-time equivalent employees (FTEs)
8 joint faculty
59 postdoctoral researchers
3,245 facility users
12 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Large-Scale User Facilities/Advanced Instrumentation
- Particle Physics

Mission Unique Facilities

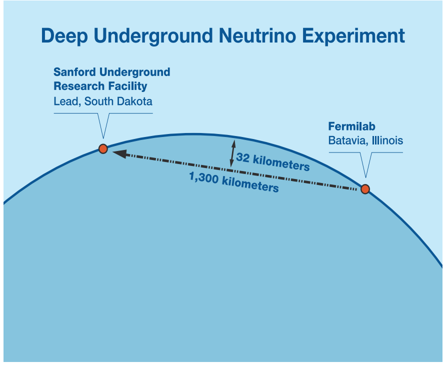
- Fermilab Accelerator Complex

Fermilab

Fermi National Accelerator Laboratory
Accomplishments

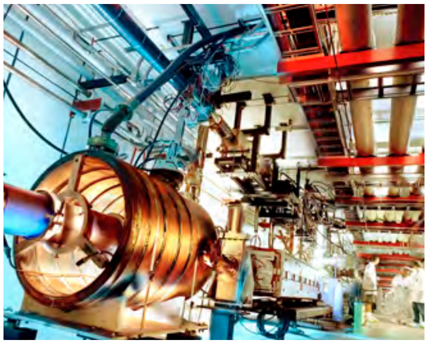
U.S. DEPARTMENT OF ENERGY

Research Highlight
Capturing the Elusive Neutrino



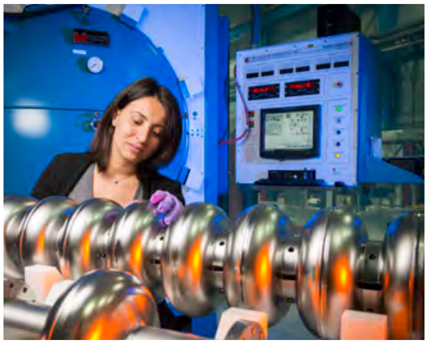
Our universe is permeated with neutrinos: nearly massless particles that interact so rarely with matter that trillions of them pass through our bodies each second without leaving a trace. Neutrinos could reveal how matter originated and point the way to discovering new particles and forces. The US flagship Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE), hosted by Fermilab with installations in Illinois and South Dakota, will be the largest experiment of its kind ever built to study these particles. Fermilab currently operates NOvA, the most powerful accelerator-based neutrino experiment in the United States, and has two more neutrino experiments in operation and two more under construction, all of which are milestones on the path to LBNF/DUNE.

Unique Facility
High-Energy Beams for Discovery



The Fermilab Accelerator Complex powers forefront research into the particles and forces that make up our universe. Comprising seven particle accelerators and storage rings, it is the only facility in the world that simultaneously operates two accelerator-based neutrino beams. These beams drive an ensemble of experiments that study neutrinos at both low and high energies and over both short and long distances. Upgrades to the complex will position Fermilab as the world center for the study of muons, with the first experiment using high-intensity beams beginning operation in 2017.

Research Highlight
Advancing Technology to Accelerate Science



Fermilab is an international leader in the research, development and testing of superconducting radio-frequency (SRF) accelerating cavities, the technology at the heart of the next generation of particle accelerators for science and society. Accelerating cavities transfer energy to particle beams as they pass through. SRF cavities enable large amounts of energy to be transferred over a short distance due to their ability to conduct high electrical currents without resistance. Fermilab accelerator scientists have developed a technique called nitrogen doping to increase the efficiency of SRF cavities, helped transfer the know-how to other laboratories and industry, and successfully implemented the techniques in an accelerator.

Idaho National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

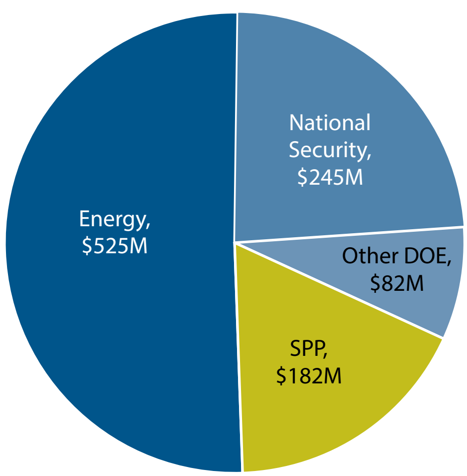
INL serves as the U.S. leader for advanced nuclear energy research and development, and is home to an unparalleled combination of nuclear energy test-bed facilities, including a focus on fuel development and fabrication, steady-state and transient irradiation, and macro- and microscale post-irradiation examination.

INL's applied science and engineering discipline and problem-solving approach helps the Defense and National and Homeland Security departments, as well as industry partners, solve significant national security challenges in critical infrastructure protection, cybersecurity, and nuclear nonproliferation. Scientists and engineers are also exploring solutions to grand challenges in energy technologies and improving the water and energy efficiency of industrial manufacturing processes.

Under direction of DOE-NE, INL is leading the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative to provide the nuclear community with access to the technical, regulatory and financial expertise necessary to move innovative nuclear energy technologies, such as small modular reactors, toward commercialization while ensuring the continued safe, reliable and economical operation of the existing nuclear fleet.

INL is managed by Battelle Energy Alliance (BEA) for DOE's Office of Nuclear Energy. BEA is a partnership of Battelle, BWX Technologies Inc., AECOM, the Electric Power Research Institute (EPRI), a national university consortium (Massachusetts Institute of Technology, The Ohio State University, Oregon State University, North Carolina State University and University of New Mexico), and Idaho university collaborators (University of Idaho, Idaho State University, and Boise State University).

FY 2016 Funding by Source



Lab operating cost: **$1,034M**
DOE/NNSA Costs: **$852M**
SPP (Non-DOE/Non-DHS): **$182M**
SPP as % total lab operating costs: **21%**
DHS costs: **$35M**

Facts

Location: Idaho Falls, Idaho
Type: Multiprogram Laboratory
Contractor: Battelle Energy Alliance
Responsible Site Office: Idaho Operations Office

Physical Assets

890 square miles and **534** real property assets
2.3 million GSF in owned-operating buildings
40.2K GSF in operational standby buildings
$4.8B in replacement plant value
69K GSF in 8 excess facilities
1 million GSF in leased facilities
61-mile test grid (dual-fed power loop with 7 substations and control center, linked with state-of-the-art communications/instrumentation)

Human Capital

4,272 full-time equivalent (FTE) employees
20 joint faculty
41 postdoctoral researchers
198 undergraduate students
105 graduate students
72 facility users
470 visiting scientists

Core Capabilities

- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Biological and Bioprocess Engineering
- Chemical Engineering
- Chemical and Molecular Science*
- Condensed Matter Physics and Materials Science*
- Cyber and Information Sciences
- Decision Science
- Environmental Subsurface Science and Analysis
- Large Scale User Facilities and Advanced Instrumentation
- Mechanical Design and Engineering
- Nuclear Engineering
- Nuclear and Radiochemistry
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

*Emerging capabilities

Mission Unique Facilities

- Advanced Test Reactor
- Transient Reactor Test Facility
- Hot Fuel Examination Facility
- Irradiated Materials Characterization Laboratory
- Fuel Manufacturing Facility
- Experimental Fuels Facility
- Space and Security Power Systems Facility
- Critical Infrastructure Test Range Complex
- Specific Manufacturing Capability
- Biomass Feedstock National User Facility
- Wireless Test Bed

INL Idaho National Laboratory

Idaho National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
Advanced Test Reactor and World-Class Nuclear Research Facilities

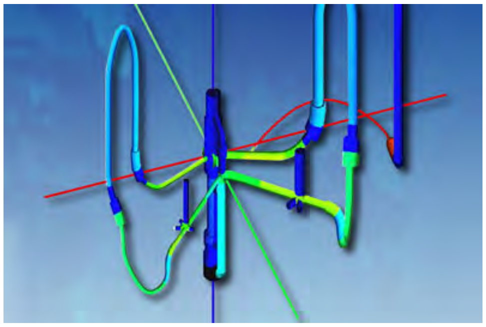
INL hosts an expansive array of nuclear research facilities that center around the Advanced Test Reactor (ATR). The ATR is a pressurized water test reactor with a unique serpentine core that allows the reactor's corner lobes to be operated at different power levels, making it possible to conduct multiple simultaneous experiments under different testing conditions. The ATR is the only U.S. research reactor capable of providing large-volume, high-flux neutron irradiation in a prototype environment. The reactor makes it possible to study the effects of intense neutron and gamma radiation on reactor materials and fuels.

In addition to the ATR, the Materials and Fuels Complex on the INL Site is a prime testing center for advanced technologies associated with nuclear power systems. This complex is the nexus of research on new reactor fuels and related materials. As such, it contributes significantly to the development of increasingly efficient reactor fuels and the important work of nonproliferation.

Research Highlight
INL's Test Grid Modernization Project

INL is breaking ground on several projects over the next three years as part of the $220M Grid Modernization Initiative. DOE-OE enables investment in INL to meet RD&D needs of utilities interested in the secure adoption of new smart grid technologies. The upgrades provide more reliable, resilient and flexible energy delivery while increasing security and efficiency of the system. The dedicated test system provides additional lines and a mesh framework to ensure the environment is more consistent with current industry distribution practices. INL works with industry, universities and government stakeholders to provide a testing environment that reduces the risks and facilitates real-world validation and verification of new and innovative concepts, technologies and systems including smart grid devices, distribution automation, communication tools, renewable energy and grid-scale energy storage.

Technology to Market Highlight
INL Software RELAP5-3D Widely Used for Reactor Safety Analysis



INL's Reactor Excursion and Leak Analysis Program5-3D (RELAP5-3D) is used primarily for analysis of potential accidents and transients in water-cooled nuclear power plants, and for analysis of advanced reactor systems.

Since it was first introduced in 1996, RELAP5-3D has become one of the most widely licensed software products within DOE. Use of the code has grown steadily, nearly doubling in the last five years, and continued growth is expected. Licensees, both international and domestic, include universities, government agencies, nuclear steam supply system providers and utilities with operating power plants.

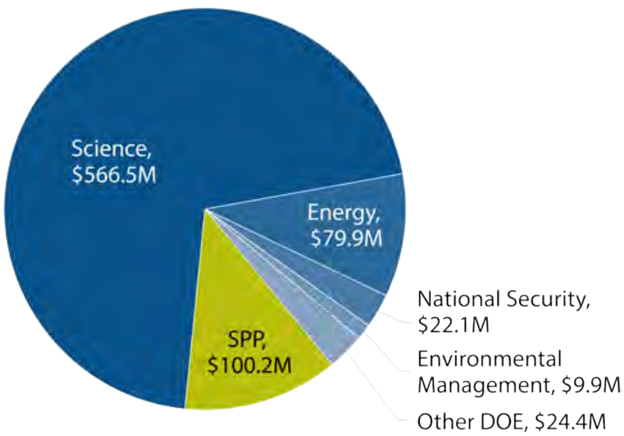
Lawrence Berkeley National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

Berkeley Lab performs research at the forefront of science. We search for cleaner and novel sources of energy. We study the planet to understand how our climate is changing and what we can do about it. We explore the universe to understand how it began and where it's going. We are leaders in energy conservation, designing better materials and greener buildings.

We design and build the most powerful microscopes, brightest x-ray light sources and fastest computers. Our research aims to coax more power from solar cells, build better batteries and develop clean biofuels for the future. We are the home of five state-of-the-art DOE user facilities, where more than 11,000 scientists from across the nation perform advanced research.

FY 2016 Funding by Source



Lab operating costs: **$802.9M**
DOE/NNSA costs: **$697.3M**
SPP costs (non-DOE/non-DHS): **$100.2M**
SPP as % total Lab operating costs: **12.5%**
DHS costs: **$5.4M**

Facts

Location: Berkeley, California
Type: Multiprogram Laboratory
Year Founded: 1931
Director: Michael Witherell
Contractor: University of California
Responsible Site Office: Berkeley Site Office

Physical Assets

202 acres and **94** buildings and **26** trailers
1.68 million GSF in DOE-owned buildings
Replacement plant value: **$1.335B**
338,778 GSF in leased facilities
326,086 GSF in contractor-leased buildings

Human Capital

3,302 full-time equivalent employees (FTEs)
232 joint faculty
486 postdoctoral researchers
263 graduate students
148 undergraduate students
11,403 facility users
2,241 visiting scientists and engineers

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Applied Mathematics
- Biological and Bioprocess Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Computational Science
- Condensed Matter Physics and Materials Science
- Condensed Matter Physics and Materials Science
- Cyber and Information Sciences
- Decision Science and Analysis
- Earth Systems Science and Engineering
- Environmental Subsurface Science
- Large Scale User Facilities/Advanced Instrumentation
- Mechanical Design and Engineering
- Nuclear Physics
- Nuclear and Radio Chemistry
- Particle Physics
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

Mission Unique Facilities

- Advanced Light Source
- The Molecular Foundry
- National Energy Research Scientific Computing Center (NERSC)
- Energy Sciences Network (ESnet)
- Joint BioEnergy Institute
- Joint Genome Institute
- Advanced Biofuels Process Demonstration Unit
- FLEXLAB

BERKELEY LAB

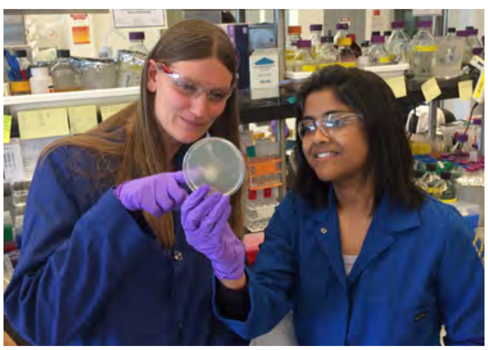
Lawrence Berkeley National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
Advanced Light Source

The Advanced Light Source (ALS) is one of the most sophisticated scientific instruments ever built. It produces hair-thin beams of x-rays and ultraviolet light, precisely focused and a billion times brighter than the sun. The ALS hosts more than 2,000 visiting scientists annually. Experiments range from environmental, materials, and energy sciences to physics and biology. ALS beams have revealed the structures of nearly 3,300 proteins and analyzed bacteria found in the Gulf of Mexico oil spill. Its beamlines are vital analytical tools leading to better medicines, stronger materials, and more efficient solar cells and batteries.

Research Highlight
Berkeley Lab Scientists Brew Jet Fuel in One-Pot Recipe



Researchers at Berkeley Lab have engineered a strain of bacteria that enables a "one-pot" method for producing advanced biofuels. The *Escherichia coli* (*E. coli*) is able to tolerate the liquid salt used to break apart plant biomass into sugary polymers. Because the salt solvent, known as ionic liquids, interferes with later stages in biofuels production, it needs to be removed before proceeding, a process that takes time and money. Developing ionic-liquid-tolerant bacteria eliminates the need to wash away the residual ionic liquid.

The achievement is critical to making biofuels a viable competitor to fossil fuels because it helps streamline the production process.

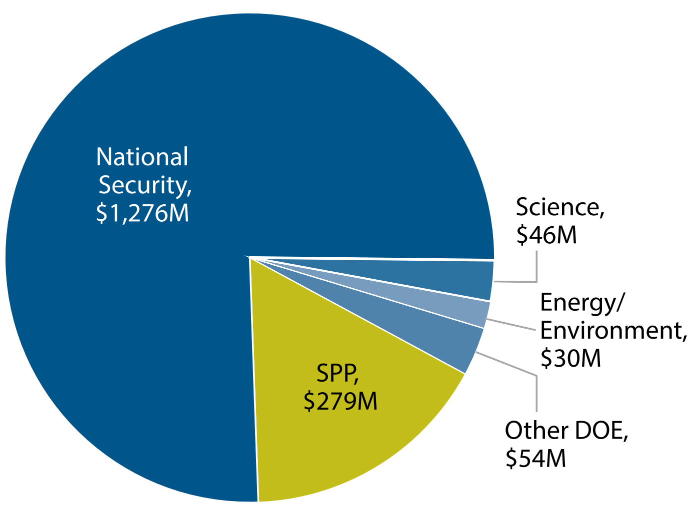
Technology to Market Highlight
Automating Drug Discovery with Robots

Most available pharmaceuticals target proteins. Crystalizing a protein to map out its atomic structure and determine whether a potential drug might bind with it is now a common path to drug discovery. In the late 1990s, crystalizing a protein could take months and even years. Berkeley Lab's bioinstrumentation group helped create a solution by designing a nanodroplet protein crystallization robot, which sped up the crystallization process by a factor of 10. Syrrx licensed the Lab's technology in 2000 and designed a series of robots to create an automated drug discovery system. One drug Syrrx developed using the system received FDA approval in 2013 to treat type 2 diabetes.

Lawrence Livermore National Laboratory
At a Glance

Science and technology on a mission— These are the hallmarks of LLNL. In service to DOE/NNSA and other Federal agencies, LLNL develops and applies world-class science, technology, and engineering (ST&E) to ensure the safety, security and reliability of the Nation's nuclear deterrent. LLNL also applies ST&E to confront dangers ranging from nuclear proliferation and terrorism to energy shortages and climate change that threaten national security and global stability. Using a multidisciplinary approach that encompasses all disciplines of science and engineering, and employs unmatched facilities, LLNL pushes the boundaries to provide breakthroughs for counter-terrorism and nonproliferation, defense and intelligence, and energy and environmental security. Lawrence Livermore National Security, LLC has managed the Lab since 2007.

FY 2016 Funding by Source



Lab operating costs: **$1,706M**
DOE/NNSA costs: **$1,434M**
SPP costs: **$271M**
SPP as % of total Lab operating costs: **16%**

Facts

Location: Livermore, California
Type: Multidisciplinary National Security Laboratory
Year Founded: 1952
Director: William H. Goldstein
Contractor: Lawrence Livermore National Security, LLC
Responsible Site Office: Livermore Field Office

Physical Assets

7,700 acres and **535** buildings/trailers
6.4M GSF in active buildings
0.8M GSF in 142 non-operational buildings
24,000 GSF in leased facilities
Replacement plant value: **$6.8B**

Human Capital

6,500 full-time equivalent employees (FTEs)
20 joint faculty
200 postdoctoral researchers
500 undergraduate students
50 graduate students
4,300 facility users
1,500 visiting scientists

Core Capabilities

- Advanced Materials and Manufacturing
- Bioscience and Bioengineering
- Earth and Atmospheric Sciences
- High-Energy-Density Science
- High-Performance Computing, Simulation, and Data Science
- Lasers and Optical Science and Technology
- Nuclear, Chemical, and Isotopic Science and Technology
- All Source Intelligence Analysis
- Nuclear Weapons Design
- Safety, Risk, and Vulnerability Analysis

Mission Unique Facilities

- National Ignition Facility
- Livermore Computing Complex
- National Atmospheric Release Advisory Center
- High Explosives Applications Facility
- Contained Firing Facility
- Forensic Science Center
- Center for Micro and Nanotechnology
- Center for Bioengineering
- Jupiter Laser Facility
- Center for Accelerator Mass Spectrometry

Lawrence Livermore National Laboratory

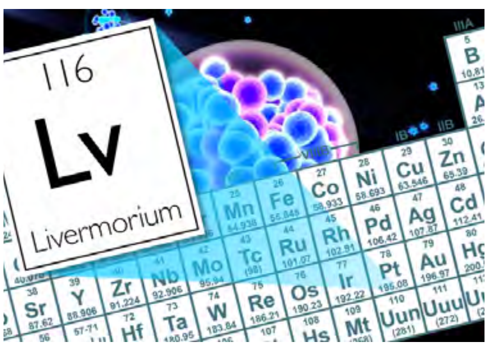
Lawrence Livermore National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
The World's Largest, Most Energetic Laser

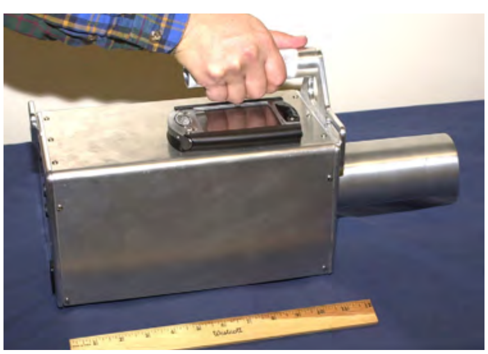
LLNL is home to one of the complex's flagship user facilities, the National Ignition Facility (NIF). The world's largest and most energetic laser, NIF conducts experiments to generate data relevant to understanding nuclear weapon performance – information critical to DOE's stockpile stewardship mission. NIF also is used to study fundamental properties of matter at high energies and densities, such as astrophysical plasmas and planetary cores. NIF will begin using complex new diagnostic capabilities to directly observe the burning hot spot in fusion experiments. LLNL's long-standing leadership in high performance computing is indispensable for effectual design and interpretation of these complex NIF experiments.

Research Highlight
LLNL: a pioneer of super-heavy element research



In recognition of its pioneering work in nuclear science, LLNL has been awarded a place on the periodic table of elements. In collaboration with researchers in Dubna, Russia, LLNL scientists discovered super-heavy elements 114 and 116. These discoveries provide new insights into fundamental nuclear physics and formation processes for elements in the universe. In 2011, the International Union of Pure and Applied Chemistry (IUPAC) approved the name of Livermorium for element 116. In 2015, IUPAC confirmed that LLNL scientists and their collaborators had also discovered elements 115, 117, and 118. In November 2016 these elements were officially named moscovium (115), tennessine (117) and oganesson (118).

Technology to Market Highlight
Rapid Radiation Detection



A public-private partnership between LLNL and Tennessee-based ORTEC helped speed critical homeland-security technology to the marketplace. Radscout is a portable radiation detector developed byLawrence Livermore National Laboratory for emergency first responders and inspection personnel for detection and rapid identification of material to determine the nature and scope of a threat. The product, now called Detective and Detective-EX, has been used to screen for dangerous radioisotopes in luggage and shipping containers, and rapidly reports its results on-the-spot. The detector also is being used at border crossings, cargo ship docks, and transportation terminals.

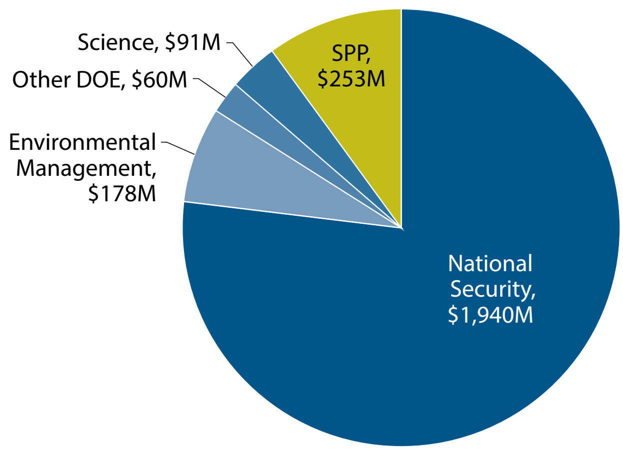
Los Alamos National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

As the Nation's premier national security science Laboratory, LANL applies innovative and multi-disciplinary science, technology, and engineering to help solve the Nation's toughest challenges and protect the Nation and world.

In delivering mission solutions, LANL ensures the safety, security, and effectiveness of the U.S. nuclear deterrent and reduces emerging national security and global threats. The multidisciplinary focus of the Laboratory's mission extends to nuclear nonproliferation, counterproliferation, energy and infrastructure security, and technology to counter chemical, biological, radiological, and high yield explosives threats.

FY 2016 Funding by Source



Lab operating costs: **$2,116M**
DOE/NNSA costs: **$1,878M**
SPP costs (non-DOE/non-DHS): **$253M**
SPP as % total Lab operating costs: **10.3%**
DHS costs: **$20M**

Facts

Location: Los Alamos, New Mexico
Type: National security Laboratory
Year Founded: 1943
Director: Charlie McMillan
Contractor: Los Alamos National Security LLC (LANS)
Responsible Site Office: Los Alamos Field Office

Physical Assets

22,400 acres and **1,280** buildings
9 million GSF in buildings
Replacement plant value: **$14.2B**
346,000 GSF in **100** excess facilities
385,000 GSF in leased facilities

Human Capital

11,300 full-time equivalent employees (FTEs)
375 postdoctoral researchers
1,100 students
1,228 facility users
582 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Applied Mathematics
- Biological and Bioprocess Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Computational Science
- Condensed Matter Physics and Materials Science
- Cyber and Information Sciences
- Decision Science and Analysis
- Earth Systems Science and Engineering
- Environmental Subsurface Science
- Large Scale User Facilities/ Advanced Instrumentation
- Mechanical Design and Engineering
- Nuclear Engineering
- Nuclear Physics
- Nuclear and Radio Chemistry
- Particle Physics
- Plasma and Fusion Energy Science
- Systems Engineering and Integration

Mission Unique Facilities

- Dual-Axis Radiographic Hydrodynamic Test Facility
- Plutonium Science and Manufacturing Facility
- Los Alamos Neutron Science Center
- Metropolis Center for Modeling and Simulation
- Center for Integrated Nanotechnologies
- Electron Microscopy Lab
- National High Magnetic Field Laboratory
- Nonproliferation & Internal Security Facility
- Trident Laser Facility
- SIGMA Complex for Materials Manufacturing and Machining
- Center for Explosives Science

Los Alamos NATIONAL LABORATORY

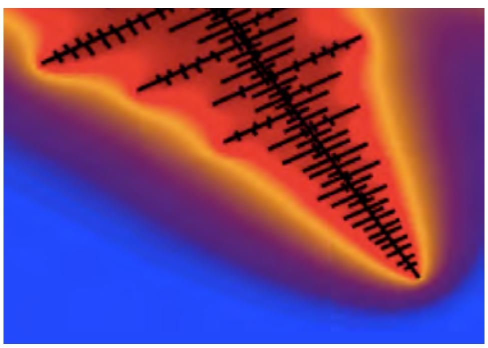
Los Alamos National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
Advanced Technology for National Security

LANL houses mission-essential facilities that ensure the safety, security, and effectiveness of the Nation's nuclear deterrent in the absence of testing, including the DARHT facility and one of world's fastest supercomputers, Trinity. DARHT, the world's most powerful x-ray machine, analyzes nuclear weapons mockups. The facility produces freeze-frame radiographs of materials imploding at speeds greater than 10,000 miles an hour, freezing the action of an imploding mockup to less than a millimeter, and providing 3D information. The Trinity supercomputer, at 40 petaflops, is the first platform large and fast enough to begin to accommodate 3D, full-scale, end-to-end weapons simulations. By combining Trinity's 3D modeling and DARHT's experimental data, LANL enhances the confidence and credibility of the Nation's nuclear deterrent.

Research Highlight
Predicting Materials Properties and Performance



By coupling experimental and modeling approaches in materials science, LANL is developing an integrated predictive process, structure, property, and performance capability that optimizes manufacturing processes and ensures performance. For example, LANL routinely uses casting simulations to guide manufacturing processes supporting stockpile stewardship. By adding a microstructural model to the code (TRUCHAS), researchers can predict microstructure variations in a casting. Proton radiography experiments then validate the predicted macroscopic fluid flow and solidification behavior. Ex-situ characterization validates the microstructural models. With these integrated capabilities, LANL is developing the ability to predict materials properties and performance, including aging phenomena, and modifying this capability to address new technologies such as additive manufacturing.

Technology to Market Highlight
Innovation in Oil Flow Measurements

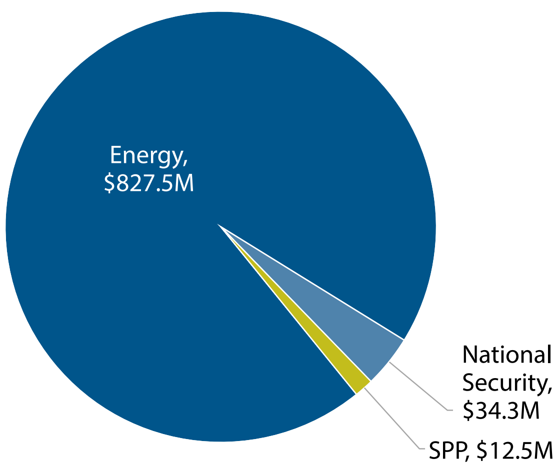
Like many LANL innovations, technology leading to the Safire multiphase flow meter originated in national security work. LANL developed swept frequency acoustic interferometry to noninvasively identify static liquids (chemical warfare agents) inside sealed containers. LANL teamed up with Chevron Energy Technology Corporation and General Electric (GE) to adapt the technology to multiphase fluids (oil, water, and gas) in motion within pipes. The resulting simple-to-use Safire meter provides noninvasive, continuous, and accurate estimates of fluid production for wells, resulting in better reservoir management, improved production, and huge cost savings by eliminating environmentally unsafe separations tanks. Chevron has begun installing and evaluating meters in its oil fields, and GE is marketing the meters internationally.

National Energy Technology Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

The National Energy Technology Laboratory's (NETL) mission focuses on the discovery, development, and deployment of technology solutions to enhance the nation's energy foundation and protect the environment for future generations. These advanced technologies enable fossil fuels to produce the clean, reliable, and affordable energy needed to support increased domestic manufacturing, improve infrastructure, enhance global competitiveness, revitalize the workforce, and free the U.S. from dependence on foreign oil. As DOE's only Government-Owned, Government-Operated (GOGO) Laboratory, NETL possesses the competencies, capabilities, and authorities to lead critical strategic imperatives and initiatives that will advance America's energy, economic, and manufacturing priorities. Partners in NETL's research programs number in the thousands and include small and large U.S. businesses, national research organizations, colleges and universities, and other government Laboratories.

FY 2016 Funding by Source



Lab operating costs: **$874.3M**

DOE costs: **$861.8M**

SPP costs (non-DOE/non-DHS): **$12.5M**

SPP as % total Lab operating costs: **4.7%**

Active Research, Development, Demonstration, and Deployment (DOE + Cost Share): **$9B+**

Facts

Locations: Pittsburgh, Pennsylvania; Morgantown, West Virginia; Albany, Ohio; Houston, Texas; Anchorage, Alaska
Type: Single-program laboratory
Year Founded: 1910
Director: Grace M. Bochenek

Physical Assets

242 acres and **109** buildings
1,154,000+ GSF in buildings
Replacement plant value: **$565M**
38,000+ GSF in **8** excess facilities
14,000+ GSF in leased facilities

Human Capital

1,497 full-time equivalent employees (FTEs)
56 joint faculty
62 postdoctoral researchers
16 undergraduate students
52 graduate students

Core Capabilities

- Applied Materials Science and Engineering
- Chemical Engineering
- Decision Science and Analysis
- Environmental Subsurface Science
- Systems Engineering and Integration

Mission Unique Facilities

- Simulation-Based Engineering Laboratory
- Energy Conversion Technology Center
- Advanced Alloy Development Facility
- Materials and Minerals Characterization Facility
- Geological Science and Engineering Facility
- Mobile Environmental Monitoring Laboratory
- Energy Data Exchange
- Computational Engineering Laboratory

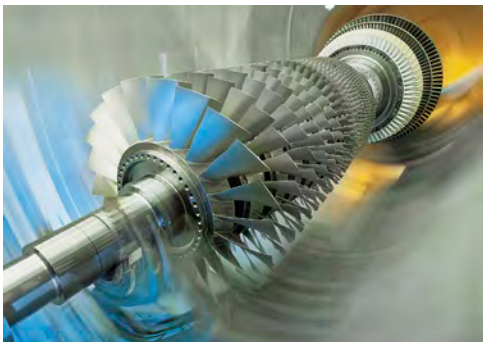
NATIONAL ENERGY TECHNOLOGY LABORATORY

National Energy Technology Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

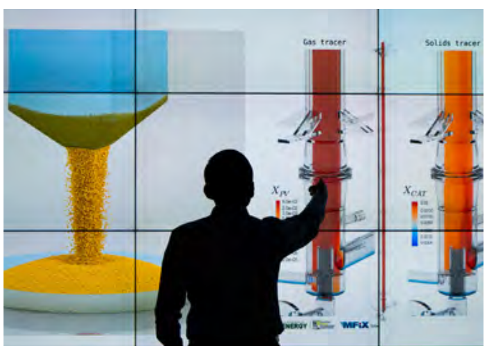
Successes

Technology Development and Deployment



Notable NETL successes over the decades include development and demonstration of technologies enabling the production of synthetic fuels from domestic fossil resources, the mitigation of trans-boundary acid rain, and steep reductions in mercury and other power plant emissions. NETL's technical expertise was leveraged to help mitigate the Deep Water Horizon Oil Spill and the Aliso Canyon Methane Leak. In addition, NETL research has stimulated the development of high-efficiency, next-generation combustion turbines; generated technology solutions for using captured carbon to increase domestic oil production through enhanced oil recovery; and created the applied technology allowing for recovery of the nation's abundant shale oils and gases.

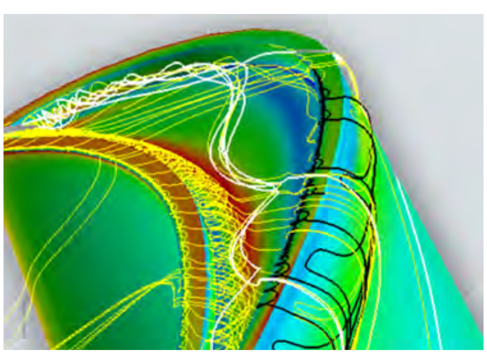
Leveraging Resources for Maximum Impact



NETL's current staff profile includes a broad spectrum of scientists; engineers; undergraduate, graduate and post-graduate interns;research support personnel; and project managers. Today, NETL's research portfolio has a total value exceeding $9 billion, including $5 billion in cost-sharing investment, committed by our academic and private sector collaborators. Partners in NETL's research, discovery, development, and deployment programs number in the thousands and include small and large American businesses, national research organizations, colleges and universities, and other government laboratories, including nine of NETL's sister DOE National Laboratories. NETL leverages its competencies, its unique authorities, and its partnership-convening power to accelerate transfer of affordable energy technologies to the public, delivering a continual impact on the nation's bottom line.

Technology to Market Highlight

Building a Better Turbine Blade



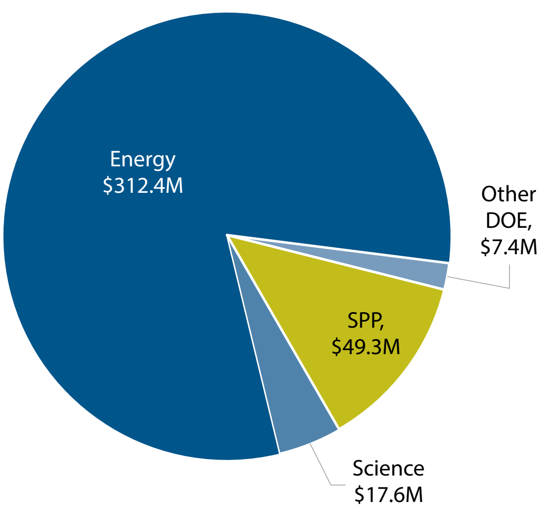
NETL and its collaborators developed a new gas turbine airfoil manufacturing technology that enables higher efficiency by minimizing cooling air and potentially increasing firing temperature. NETL and the University of Pittsburgh optimized turbine airfoil architectures made possible with MikroSystems Inc.'s ceramic manufacturing technology. Mikro adapted its technology for gas turbine airfoil cores and then collaborated with Siemens to cast a full row of F-class turbine blades that are currently operating in a customer's machine. Siemens then built a new facility in Charlottesville, VA, to manufacture airfoil components. The first commercial airfoils will be available in 2017.

National Renewable Energy Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

For 40 years, NREL has expanded American leadership and prosperity through world-class research that delivers foundational science and innovations. The laboratory's work catalyzes the development of an advanced energy industry, creating economic opportunity and jobs and enhancing U.S. energy security. NREL's world-renowned researchers and facilities create insights that provide opportunities and reduce risk for energy companies, manufacturers, and consumers. Through hundreds of partnerships, NREL bridges the gap from concept to market, giving U.S. companies a competitive edge in growing energy markets worldwide. NREL regularly links R&D with real-world applications – it's our mission.

FY 2016 Funding by Source



Lab operating costs: **$386.8M**
DOE/NNSA costs: **$337.5M**
SPP costs (non-DOE/non-DHS): **$48.7M**
DHS costs: **$0.06M**
SPP as % total Lab operating costs: **12.6%**

Facts

Location: Golden, Colorado
Type: Single-program Laboratory
Year Founded: 1977
Director: Martin Keller
Contractor: Alliance for Sustainable Energy, LLC
Responsible Site Office: Golden Field Office

Physical Assets

628.7 acres, **60** buildings, **4** trailers (owned)
1,081,131 GSF in buildings/trailers (owned)
Replacement plant value: **$508,136,610**
182,827 GSF in leased facilities

Human Capital

1,710 full-time equivalent employees (FTEs)
6 joint appointments
84 postdoctoral researchers
45 undergraduate students
42 graduate students
21 facility users
4 visiting scientists

Core Capabilities

- Advanced Computer Science, Visualization, and Data
- Applied Materials Science/Engineering
- Biological and Bioprocess Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Decision Science and Analysis
- Large Scale User Facilities/Advanced Instrumentation
- Mechanical Design and Engineering
- Power Systems/Electrical Engineering
- Systems Engineering and Integration

Mission Unique Facilities

- Battery Thermal and Life Test Facility
- Controllable Grid Interface Test System
- Distributed Energy Resources Test Facility
- Energy Systems Integration Facility
- High-Flux Solar Furnace
- Integrated Biorefinery Research Facility
- Outdoor Test Facility
- Renewable Fuels and Lubricants Laboratory
- Science and Technology Facility
- Solar Energy Research Facility
- Thermal Test Facility
- Thermochemical Process Development Unit
- Thermochemical Users Facility
- Vehicle Testing and Integration Facility
- Wind Dynamometer Test Facilities
- Wind Structural Testing Laboratory
- Wind Turbine Field Test Sites

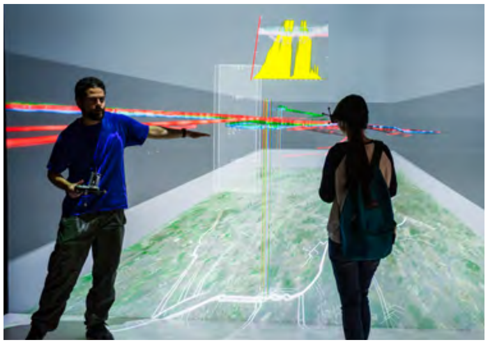
NREL NATIONAL RENEWABLE ENERGY LABORATORY

National Renewable Energy Laboratory

Accomplishments

Unique Facility

Energy Systems Integration Facility Takes on Nation's Energy Challenges



The Energy Systems Integration Facility (ESIF) is the Nation's premier facility for research, development, and demonstration of the components and strategies needed to optimize our energy system. Since 2013, the ESIF team and more than 100 industry and academic partners have tackled the Nation's biggest energy challenges—how to incorporate new technologies into our existing infrastructure and operate a system with higher levels of variable supply and demand. With our partners, NREL has examined how to keep the lights on and the fuel flowing through extreme weather events, cyber threats, and aging infrastructure. Future projects include new business models, regulatory frameworks, and value propositions for consumers.

Research Highlight

NREL Advancing Perovskite Solar Cells to Market

Perovskite solar cells are an important class of photovoltaic (PV) materials with impressive characteristics that include high light absorption and efficiency, as well as low-cost, industry-scalable processing—qualities that make perovskites strong candidates for commercialization to U.S. companies. Scientists at NREL recently developed a method that could push perovskites even further down the path to market—a method that leads to even more efficient, reliable, and reproducible solar cells. In the past year, researchers established a perovskite road map from science to processing/manufacturing; NREL has improved stability and demonstrated efficient mini-modules. NREL continues to build on its perovskite leadership (it's the No. 1-cited U.S. institution) by expanding collaborations with other world leaders in this area.

Technology to Market Highlight

Partnership with Raytheon Strengthens Military, National Security

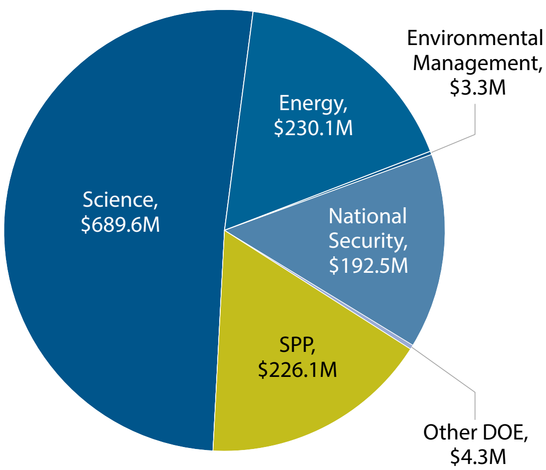
NREL's partnerships enhance U.S. infrastructure and strengthen our national security. Raytheon and NREL validated an advanced microgrid system for installation at U.S. Marine Corps Air Station Miramar. The system maintains power to mission-critical facilities under many adverse conditions—including loss of the local power grid. The NREL team was able to demonstrate the actual performance of the installation and refine its operation prior to it being installed in the field, greatly reducing the risk of investing in the system. Our success earned a 2016 project-of-the-year award from the Department of Defense. NREL also is helping the military develop portable energy technologies that will save lives when American soldiers are deployed in unstable regions.

Oak Ridge National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

ORNL is the largest multiprogram science and energy laboratory in the DOE system. Its mission is to deliver scientific discoveries and technical breakthroughs that accelerate the development and deployment of solutions in clean energy and global security, creating economic opportunity for the nation. Established as part of the Manhattan Project, ORNL pioneered plutonium production and separation, then focused on nuclear energy and later expanded to other energy sources and their impacts. Today, ORNL manages one of the nation's most comprehensive materials programs; two of the world's most powerful neutron science facilities, the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR); unique resources for nuclear science and technology; leadership-class computers including the nation's fastest (Titan) and its successor (Summit); and a diverse set of research and development programs linked by an urgent focus on clean energy and global security.

FY 2016 Funding by Source



Lab operating costs: **$1,345.9M**
DOE/NNSA costs: **$1,100.1M**
SPP costs (non-DOE/non-DHS): **$226.1M**
SPP as % total Lab operating costs: **16.8%**
DHS costs: **$19.6M**

Facts

Location: Oak Ridge, Tennessee
Type: Multiprogram Laboratory
Year Founded: 1943
Director: Thomas E. Mason
Contractor: UT-Battelle, LLC
Responsible Site Office: ORNL Site Office

Physical Assets

4,421 acres and **250** buildings
4.8M GSF in buildings
Replacement plant value: **$6.5B**
1.5M GSF in **67** excess facilities
1M GSF in leased facilities

Human Capital

4,983 full-time equivalent employees (FTEs)
192 joint faculty
305 postdoctoral researchers
294 undergraduate students
317 graduate students
3,131 facility users
1,763 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Advanced Computer Science, Visualization, and Data
- Applied Materials Science and Engineering
- Applied Mathematics
- Biological and Bioprocess Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Computational Science
- Condensed Matter Physics and Materials Science
- Cyber and Information Sciences
- Decision Science and Analysis
- Earth Systems Science and Engineering
- Environmental Subsurface Science
- Large Scale User Facilities/Advanced Instrumentation
- Mechanical Design and Engineering
- Nuclear Engineering
- Nuclear Physics
- Nuclear and Radio Chemistry
- Plasma and Fusion Energy Science
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

Mission Unique Facilities

- Building Technologies Research and Integration Center
- Carbon Fiber Technology Facility
- Center for Nanophase Materials Sciences
- Center for Structural Molecular Biology
- High Flux Isotope Reactor
- Manufacturing Demonstration Facility
- National Transportation Research Center
- Oak Ridge Leadership Computing Facility
- Spallation Neutron Source

OAK RIDGE National Laboratory

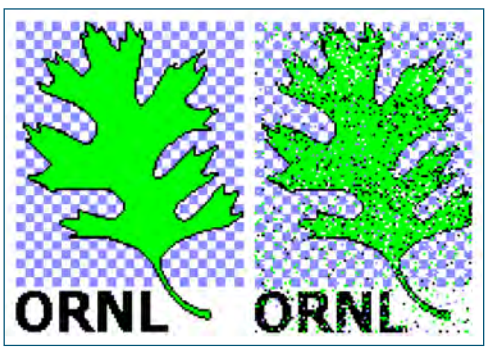
Oak Ridge National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
Spallation Neutron Source Serves Scientists Worldwide

The Spallation Neutron Source (SNS) was completed in 2006 as a third-generation neutron source capable of delivering the world's brightest beams of pulsed neutrons for scientific research and industrial development. Today, SNS is a world leader in particle accelerator science, and it has advanced the state-of-the-art in several areas of accelerator technology. As a user facility, SNS hosts scientists from around the world—11,300 to date—and offers a wide variety of experiment stations that provide research capabilities across a broad range of disciplines including physics, chemistry, materials science, and biology. Conceptual designs for a power upgrade and second target station are moving forward, which will transform SNS into a fourth-generation source capable of addressing gaps in materials research that require the combined use of intense, cold neutrons and instruments optimized for exploration of complex materials.

Research Highlight
Quantum Encoding Sets Information Transfer Record



An ORNL research team set the world record for information transfer via superdense coding, which manipulates particles such as photons, protons, and electrons to store as much information as possible. The team transmitted the ORNL logo at 1.67 bits per quantum bit (the previous record was 1.63) using common fiber-optic cable—itself a major achievement in the quest to adopt quantum communication to networking technology and apply it practically to the Internet and cybersecurity. The physics of the transfer are similar to those employed in quantum computing, which uses quantum mechanics to arrive at solutions to extremely complex problems faster than traditional computers.

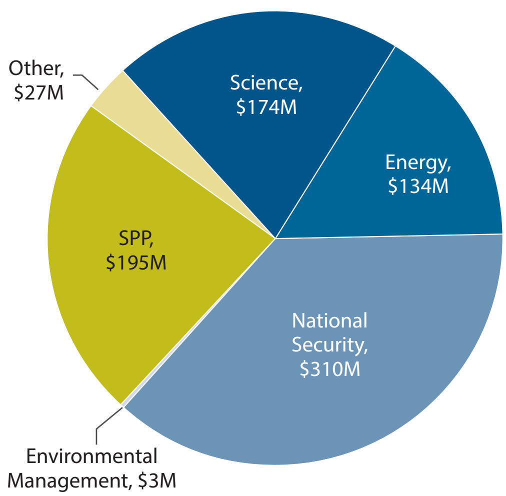
Technology to Market Highlight
Big Area Additive Manufacturing Advances Industry

ORNL worked with Cincinnati Incorporated, one of the oldest machine tool manufacturers in the United States, to develop leap-ahead technologies in large-scale additive manufacturing by developing a platform known as Big Area Additive Manufacturing. BAAM can 3D print components 10 times the size of those that could be produced by previous commercial processes, and it prints them 200 times faster. BAAM is also the first manufacturing system capable of depositing carbon fiber reinforced plastic into printed materials, which yields products with greater strength and four to seven times the material's original stiffness. In addition, BAAM is more energy efficient than traditional manufacturing methods such as stamping and blow molding. Cincinnati commercialized the technology, which is being used in the automotive, aerospace and prototyping industries.

Pacific Northwest National Laboratory
At a Glance

Pacific Northwest National Laboratory (PNNL), as the nation's premier chemistry, earth science and data analytics Laboratory, conducts world-leading research and development to address the nation's most challenging problems in energy resiliency and national security. In particular, our researchers provide national and international leadership in energy storage, grid modernization, nuclear non-proliferation and cyber security – all for the purpose of keeping the U.S. safe, secure and strong. Our deep technical capabilities enable us to make scientific breakthroughs, deliver leading-edge technologies and drive innovations to market that support U.S. prosperity, job creation and economic competitiveness.

FY 2016 Funding by Source



Lab operating costs: **$842M**
DOE/NNSA costs: **$250M**
SPP costs (non-DOE/non-DHS): **$195M**
SPP as % total Lab operating costs: **23%**
DHS costs: **$60M**

Facts

Location: Richland, Washington
Type: Multiprogram Laboratory
Year Founded: 1965
Director: Steven Ashby
Contractor: Battelle Memorial Institute
Responsible Site Office: Pacific Northwest Site Office

Physical Assets

582 acres and **77** buildings
2,309,553 GSF in buildings (total)
Replacement plant value: **$772,028,671**
962,119 GSF in leased facilities

Human Capital

4,183 full-time equivalent employees (FTEs)
55 joint appointments
259 postdoctoral researchers
469 undergraduate students (cumulative)
433 graduate students (cumulative)
1,814 facility users
100 visiting scientists

Core Capabilities

- Advanced Computer Science, Visualization and Data
- Applied Materials Science and Engineering
- Applied Mathematics
- Biological and Bioprocess Engineering
- Biological Systems Science
- Chemical Engineering
- Chemical and Molecular Science
- Climate Change Science and Atmospheric Science
- Computational Sciences
- Condensed Matter Physics and Materials Science
- Cyber and Information Sciences
- Decision Science and Analysis
- Earth Systems Science and Engineering
- Environmental Subsurface Science
- Large Scale User Facilities/Advanced Instrumentation
- Nuclear Engineering
- Nuclear and Radio Chemistry Particle Physics
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

Mission Unique Facilities

- Atmospheric Radiation Measurement (ARM) Climate Research Facility
- Applied Process Engineering Laboratory
- Bioproducts, Sciences and Engineering Laboratory
- Environmental Molecular Sciences Laboratory
- General Purpose Chemistry Laboratory
- Marine Sciences Laboratory (Sequim, Washington)
- Radiochemical Processing Laboratory
- Systems Engineering Building, which includes the Electricity Infrastructure Operations Center

Pacific Northwest NATIONAL LABORATORY

Pacific Northwest National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility
At EMSL, Team is in our DNA

The Environmental Molecular Sciences Laboratory (EMSL) is a national scientific user facility located at PNNL and sponsored by DOE's Office of Biological & Environmental Research. EMSL draws together the global scientific community and assembles the people, instruments and resources for molecular-level discoveries and predictive understanding to accelerate solutions for national energy and environmental challenges. The nearly 800 scientists who use EMSL's 150 experimental instruments and high-performance supercomputer each year are gaining a deeper understanding of molecular-level processes needed to advance predictive, systems-level understanding of climate, biological, environmental and energy systems.

Research Highlight
Creating Tomorrow's Efficient, Affordable Electric Vehicle Batteries

The PNNL-led Battery500 consortium aims to significantly improve the batteries that power today's electric vehicles by nearly tripling the amount of "specific energy" in lithium batteries, that is, the amount of energy packed into a battery based on its weight. Higher specific energy reduces cost and enables electric vehicles to be driven farther without adding battery weight. The multidisciplinary research group includes leaders from DOE national labs, universities and industry. The team is focusing on advancements to lithium-metal batteries in three specific areas: materials and interfaces, architecture of electrodes and improved cell design. The team has already made progress in improving the stability of the electrode materials and has discovered new approaches to protect the lithium metal. The ultimate goal of the consortium is to deliver smaller, lighter and less expensive batteries that can be seamlessly adopted by manufacturers.

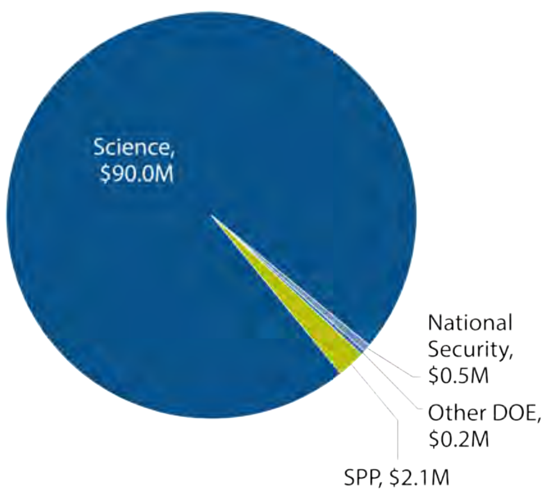
Technology to Market Highlight
Protecting Consumers from Cyber Attacks

Drawing on data analytics and computational modeling capabilities, PNNL developed analytical software to protect consumers and retail companies from cyber attacks in near real time. The innovation addresses a growing need to analyze huge amounts of data efficiently and effectively to spot threats in time to thwart an attack. PNNL licensed the award-winning technology to Champion Technology Company, whose resulting Darklight® software automates the understanding and decision-making processes that are typically performed by a security analyst for cyber defense and information sharing. The artificial intelligence system is customizable and continuously learns based on contextual data from the company it's protecting. The versatile software is also capable of analyzing financial services and health care data.

Princeton Plasma Physics Laboratory
At a Glance

PPPL is an innovative and discovery leader in plasma and fusion science and engineering. It is the only DOE Laboratory devoted to these areas, and it is the lead U.S. institution investigating the science of magnetic fusion energy. For more than six decades PPPL has been a world leader in magnetic confinement experiments and nationally leading programs in plasma theory and computation, and plasma science and technology. PPPL is a partner in the U.S. contributions to the international ITER Project and hosts multi-institutional collaborative work on the National Spherical Torus Experiment–Upgrade facility. The Laboratory also hosts smaller experimental facilities used by multi-institutional research teams and collaborates strongly by sending scientists, engineers and specialized equipment to other research facilities in the U.S. and abroad. PPPL has two coupled missions. First, PPPL develops the scientific understanding of plasmas from nano- to astrophysical scale. Second, PPPL develops the scientific knowledge to enable fusion to power the U.S. and the world. Woven throughout PPPL's approach, as a core part of Princeton University's culture, PPPL educates and inspires future generations for the national interest. This includes outreach programs for science education from elementary school to college, a world-leading graduate education program in plasmas and astrophysical sciences in conjunction with Princeton University, and hosting hundreds of external students and thousands of visitors each year.

FY 2016 Funding by Source



Lab operating costs: **$92.92M**
DOE/NNSA costs: **$90.86M**
SPP costs (non-DOE/non-DHS): **$2.06M**

Facts

Location: Princeton, New Jersey
Type: Single-program laboratory
Year Founded: 1951
Director: Terrence Brog (Interim)
Contractor: Princeton University
Responsible Site Office: Princeton Site Office

Physical Assets

90.7 acres and **30** buildings
765,000 GSF in operating buildings
Replacement plant value: **$660M**

Human Capital

500 full-time equivalent employees (FTEs)
6 joint faculty
22 postdoctoral researchers
40 graduate students
~350 visiting scientists

Core Capabilities

- Large-Scale User Facilities/Advanced Instrumentation
- Mechanical Design and Engineering
- Plasma and Fusion Energy Sciences
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

Mission Unique Facilities

- National Spherical Torus Experiment-Upgrade
- Lithium Tokamak Experiment
- Laboratory for Plasma Nanosynthesis
- Magnetic Reconnection Experiment

Princeton Plasma Physics Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

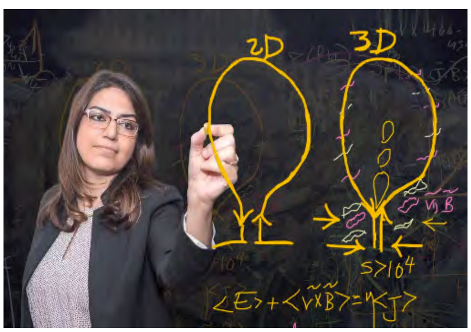
Research Highlight

The Power Behind Solar Storms

Magnetic reconnection, in which the magnetic field lines converge, break apart and violently reconnect, occurs throughout the universe. The process creates massive eruptions of plasma from the sun and triggers brilliant auroras and geomagnetic storms that can disrupt cell phone service and electrical power grids. PPPL research has provided fresh insight into how the stunning transformation of magnetic energy into kinetic energy takes place. Recent findings show that reconnection converts about 50 percent of the magnetic energy in a prototypical conversion layer, with one-third of the conversion heating electrons and two-thirds accelerating the atomic nuclei, or ions, in the plasma. Further findings shed fresh light on why the process occurs much faster than theory says that it should.

Unique Facility

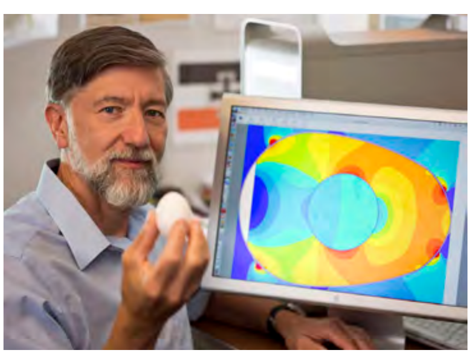
A Powerful Spherical Tokamak



Using powerful magnetic fields to confine a plasma hotter than the core of the sun, the National Spherical Torus Experiment-Upgrade (NSTX-U) is more compact than a typical tokamak device and studies whether this configuration can lead to a smaller, cheaper, and more efficient nuclear fusion energy power plant. When operational, fusion will be a safe, clean and abundant source of energy to generate electricity for humankind. An extensive upgrade to the original NSTX device doubles the heating power, magnetic field strength and plasma current of its predecessor and will narrow or close critical gaps on the path to fusion energy. When running at full strength, experiments on NSTX-U will provide key information for the next major steps in the U.S. fusion program.

Technology to Market Highlight

Pasteurizing eggs in the shell with radio frequency waves



PPPL has long used radio frequency waves to help heat the plasma that fuels fusion reactions. The Laboratory has now applied that knowledge to pasteurizing eggs in the shell in a patented process developed in collaboration with the U.S. Department of Agriculture. The invention uses RF energy to transmit heat into the yolk while the egg rotates. Streams of cool water simultaneously flow over the egg to protect the delicate white. Researchers then bathe the egg in hot water to complete the pasteurization process. The USDA estimates that pasteurizing all U.S.-produced shell eggs could reduce the number of egg-borne salmonella illnesses by up to 85 percent, or more than 110,000 cases a year.

Sandia National Laboratories
At a Glance

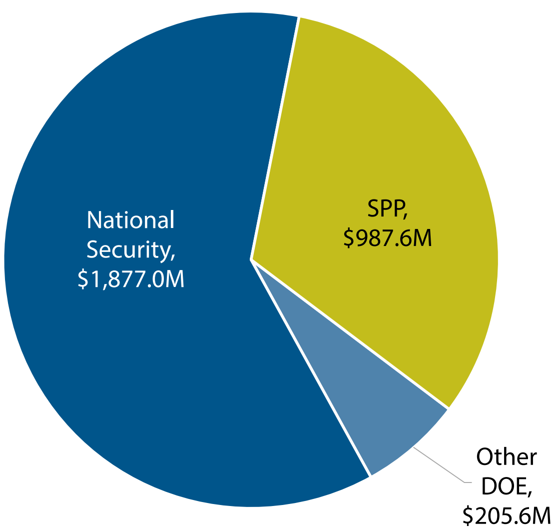
U.S. DEPARTMENT OF ENERGY

SNL grew out of the effort to develop the first atomic bombs. Today, keeping the U.S. nuclear stockpile safe, secure, and effective is a major part of SNL's work as a multi-mission national security, engineering Laboratory. SNL's role has evolved to address the complex threats facing the United States through research and development in the following areas:

- Nuclear Weapons – Supporting U.S. deterrence policy by helping sustain and secure the nuclear arsenal,
- Defense Systems and Assessments – Supplying new capabilities to U.S. defense and national security communities,
- Energy and Climate – Ensuring the stable supply of energy and resources, and protection of infrastructure,
- International, Homeland and Nuclear Security – Protecting nuclear assets and nuclear materials, and addressing nuclear emergency response and nonproliferation worldwide.

SNL's science, technology, and engineering foundations enable its unique mission. The Laboratories' highly specialized research staff is at the forefront of innovation, collaborating with universities and companies and performing multidisciplinary science and engineering research programs with significant impact on U.S. security.

FY 2016 Funding by Source



Lab operating costs: **$3,070.2M**
DOE/NNSA operating costs: **$2,082.6M**
SPP costs (non-DOE/non-NNSA/non-DHS): **$987.6M**
SPP as % total Lab operating costs: **32.2%**

Facts

Location: Albuquerque, NM; Livermore, CA; Tonopah, NV; Amarillo, TX; Carlsbad, NM; Kauai, HI
Type: Multimission National Security Laboratory
Year Founded: 1949
Director: Dr. Stephen Younger
Contractor: National Technology and Engineering Solutions of Sandia, LLC
Responsible Site Office: Sandia Field Office

Physical Assets

193,483 acres and **1,001** buildings/trailers (all sites)
7,200,201 GSF in buildings and trailers
Replacement plant value: $6.6B
13,942 GSF in **45** excess facilities
357,979 GSF in **15** contractor-leased facilities

Human Capital

10,650 full-time equivalent employees (FTEs)
2 joint faculty
223 postdoctoral researchers
738 undergraduate and graduate students

Core Capabilities

- Cyber technology
- High-reliability engineering
- Micro and nano devices and systems
- Modeling and simulation and experiment
- Natural and engineered materials
- Pathfinder engineered systems
- Radiation-hardened and trusted microelectronics development and production
- Reverse engineering
- Safety, risk, and vulnerability analysis
- Sensors and sensing systems

Mission Unique Facilities

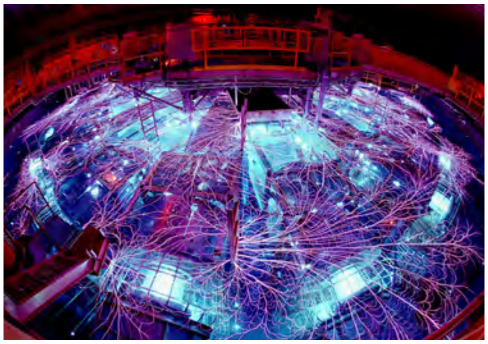
- Z Machine
- Combustion Research Facility
- Microsystems and Engineering Sciences Applications (MESA) Complex

Sandia National Laboratories

Sandia National Laboratories
Accomplishments

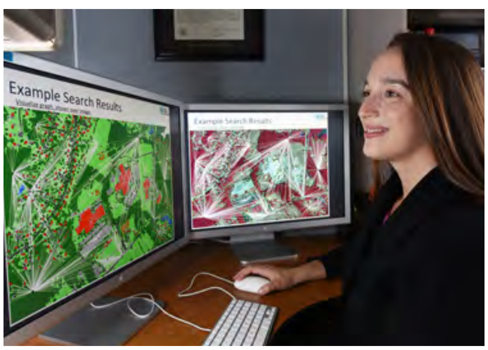
U.S. DEPARTMENT OF ENERGY

Unique Facility
Z Machine Creates Pressures, Temperatures Found Nowhere Else on Earth



SNL's Z machine is the world's most powerful and efficient laboratory radiation source. It uses high magnetic fields associated with high electrical currents to produce high temperatures, high pressures, and powerful x-rays, conditions found nowhere else on earth and crucial to SNL's mission to ensure the reliability and safety of the aging U.S. nuclear stockpile. Z provides the fastest, most accurate, and cheapest method to determine how materials will react under extreme pressures and temperatures, similar to those produced by the detonation of a nuclear weapon. It produces key data used to validate physics models in computer simulations. The Z machine's role in solving the world's energy challenges is directly tied to its potential for fusion.

Research Highlight
PANTHER Aids Analysts Hunting for National Security Needles in Data Haystacks



SNL's Pattern Analytics to Support High-Performance Exploitation and Reasoning (PANTHER) team is developing solutions that will enable national security analysts to work smarter, faster, and more effectively when looking at huge, complex amounts of data in real-time, stressful environments where the consequences might be life or death. Based in research in cognitive science, the team is developing ways to pre-process and analyze huge data sets to make it searchable and more meaningful, and designing software and tools to help those viewing the data glean deeper insights in minutes instead of months. They are rethinking how to compare motion and trajectories and developing software that can represent remote sensor images, couple them with additional information, and make them searchable.

Technology to Market Highlight
Decon Formula Battles Everything from Mold to Meth Labs to Ebola

SNL's Decontamination Technology for Chemical and Biological Agents, which won regional and national Federal Laboratory Consortium awards for Excellence in Technology Transfer, contains surfactants that kill 99.99999 percent of bacteria, viruses, and fungi on a surface. Originally used by military and first responders, SNL has licensed the formula to companies that have further developed it to battle toxic mold and decontaminate meth labs, disinfect healthcare facilities and schools, remove pesticides from agricultural packing plants, and fight the Ebola virus in Africa. Seven licensees are manufacturing and distributing products based on the SNL patents, and research efforts continue to discover applications that could lead to more products and licensees.

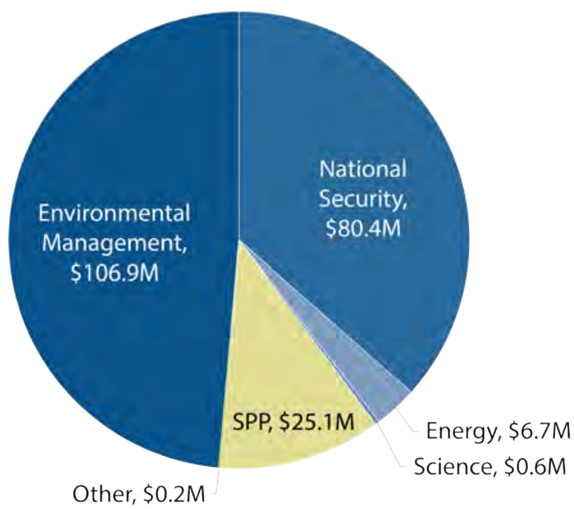
Savannah River National Laboratory
At a Glance

U.S. DEPARTMENT OF ENERGY

Savannah River National Laboratory (SRNL) is a multi-program national laboratory that puts science to work to provide practical, cost-effective solutions for our nation's environmental cleanup, nuclear security and clean energy challenges. SRNL is the national laboratory for DOE's Environmental Management program. In this capacity, SRNL applies its expertise and applied technology capabilities to assist sites across the DOE complex in meeting cleanup requirements.

SRNL's unique facilities include laboratories for the safe study and handling of radioactive materials, a field demonstration site for testing and evaluating environmental cleanup technologies, laboratories for ultra-sensitive measurement and analysis of radioactive materials, and the world's only radiological crime investigation laboratory. Underpinning the laboratory is a world-class culture of safety and security that enables SRNL to tackle some of the nation's most difficult challenges in environmental stewardship, nuclear security and clean energy, as well as to provide nuclear chemical manufacturing leadership for DOE.

FY 2016 Funding by Source



Lab operating costs: **$219.8M**
DOE-EM/NNSA costs: **$187.1M**
SPP costs (non-DOE/non-DHS): **$25.1M**
SPP as % total lab operating costs: **11.4%**
DHS costs: **$7.7M**

Facts

Location: Aiken, South Carolina
Type: Environmental Managment-Multiprogram
Year Founded: 1951
Director: Dr. Terry A. Michalske
Contractor: Savannah River Nuclear Solutions LLC
Responsible Site Office: DOE-Savannah River

Physical Assets

39 acres and **58** buildings
817,010 GSF in buildings
Replacement plant value: **$1.6B**
15,318 GSF in **10** excess facilities
63,285 GSF in leased facilities

Human Capital

972 full-time equivalent employees (FTEs)
12 postdoctoral researchers
60 undergraduate students (summer 2017 projection)
2 visiting scientists (average)

Core Capabilities

- Environmental Remediation and Risk Reduction
- Tritium Processing, Storage and Transfer Systems
- Nuclear Materials Processing and Disposition
- Nuclear Materials Detection, Characterization and Assessment

Mission Unique Facilities

- Shielded Cells Facility
- Ultra-Low-Level Underground Counting Facility
- Outfall Constructed Wetland Cell Facility
- Radiological Testbed Facilities
- FBI Radiological Evidence Examination Facility
- Atmospheric Technology Center

SRNL™ SAVANNAH RIVER NATIONAL LABORATORY

Savannah River National Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Mission Highlight
Immobilization of High Level Waste through Smart Manufacturing

SRNL has optimized the high-level waste vitrification process by employing a "materials-by-design" approach coupled with focused laboratory experiments, as shown at left. Tailoring the glass-forming chemicals (frit) to the composition of each waste batch has significantly reduced the canister fill time (melt rate) and increased the waste loading—the ratio of waste to glass—by 40%. Fewer canisters are filled more quickly and contain more waste, ultimately shaving five years off the life of the defense waste processing mission and reducing the cost by $1.5B.

Technology to Market Highlight
SRNL Innovation Used to Harvest Medical Isotopes

SRNL's Thermal Cycling Adsorption Process (TCAP) is the world's best hydrogen isotope separation process. With flexible modularization and process intensification, the hydrogen isotope separation process has evolved from a 23-ft tall distillation column to a two-square-foot mini-TCAP. This doubles the throughput with 1/10 the footprint, saving hundreds of millions of dollars in tritium separation costs alone. SRNL has licensed this technology to SHINE Medical Technologies, Inc. With their patented application of SRNL's TCAP technology, SHINE anticipates production of enough Mo-99 every year to serve more than two-thirds of the U.S. patient population, ensuring a stable supply of radioisotopes for a wide variety of nuclear-medical diagnostic procedures. Another TCAP technology, the micro-TCAP (at left) is being used in the OMEGA laser at the DOE Laboratory for Laser Energetics.

Mission and Partnership Highlight
Putting Science to Work Securing our Nation's Electric Grid

The electrical transmission infrastructure in the United States needs to be updated to improve efficiency, reliability and security. Central to that update is the development and certification of new technologies that can be added into the existing electrical grid to meet this challenge. SRNL and Clemson University have joined forces in the creation of an electrical grid simulator (at left) for testing multi-megawatt power systems. The system is capable of testing, certifying, and simulating the full-scale effects of new technology under stressed or hypothetical operating conditions. The 20 MW grid simulator is the highest power experimental utility-scale facility in the world. The Grid Simulator will be an invaluable tool in developing cyber security approaches for ensuring the sanctity of power systems.

SLAC National Accelerator Laboratory
At a Glance

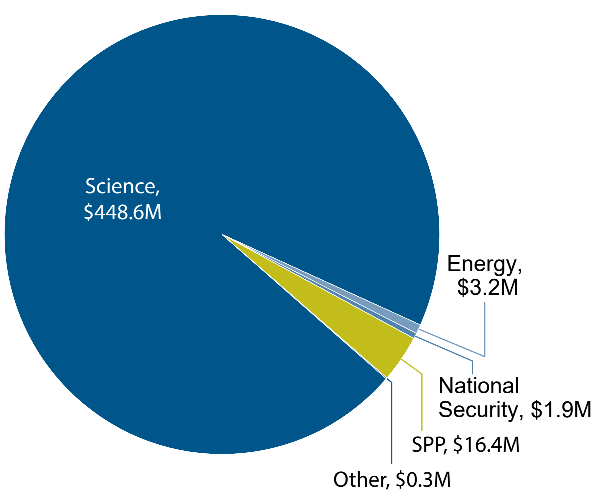
U.S. DEPARTMENT OF ENERGY

SLAC's mission is to be the world-leading laboratory for X-ray and ultrafast science, based on its leadership in electron accelerator physics and it's distinguished history in applications of X-ray science to materials, chemical, and biological sciences. We also play a primary role in elementary particle physics in areas of theory, simulation, instrumentation, high-repetition-rate, fast-readout-detector technology, and massive-scale data acquisition and analysis.

SLAC hosts more than 4,000 researchers each year at its facilities and in laboratory-hosted science programs. We also lead DOE efforts toward the construction and operation of the Large Synoptic Survey Telescope (LSST) and actively participate in the ATLAS detector at the Large Hadron Collider (LHC) in two dark matter searches and in experiments probing the fundamental nature of the neutrino.

SLAC's success depends on a robust partnership with Stanford University, which manages the Laboratory for the DOE. Stanford attracts and supports some of the world's best and most innovative scientists. In addition, SLAC jointly operates three institutes and a research center with Stanford: the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC); the Stanford Institute for Materials and Energy Sciences (SIMES); the Stanford PULSE Institute; and the SUNCAT Center for Interface Science and Catalysis.

FY 2016 Funding by Source



Lab operating costs: **$470.4M**
DOE costs: **$454M**
SPP costs (non-DOE/non-DHS): **$16.4M**
SPP as % total Lab operating costs: **3.5%**

Facts

Location: Menlo Park, California
Type: Multipurpose Laboratory
Year Founded: 1962
Director: Chi-Chang Kao
Contractor: Stanford University
Responsible Site Office: SLAC Site Office

Physical Assets

426 acres and **148** buildings and **39** trailers
1.689 million GSF in buildings
Replacement plant value: **$1.684B**

Human Capital

1,524 full-time equivalent employees (FTEs)
56 faculty
205 postdoctoral researchers
208 graduate students
2,789 facility users
35 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Large Scale User Facilities/ Advanced Instrumentation
- Condensed Matter Physics and Material Sciences
- Chemical and Molecular Science
- Plasma and Fusion Energy Science
- Particle Physics

Mission Unique Facilities

- Linac Coherent Light Source (LCLS)
- Stanford Synchrotron Radiation Lightsource (SSRL)
- Facility for Advanced Accelerator Experimental Tests (FACET)
- Instrument Science and Operations Center for the Fermi Gamma-ray Space Telescope (FGST)
- Leading the DOE contributions to the construction and operation of the Large Synoptic Survey Telescope (LSST)
- Leading the joint DOE-NSF construction of the next-generation dark matter experiment Super CDMS
- Enriched Xenon Observatory (EXO) at the Waste Isolation Pilot Plant (WIPP)

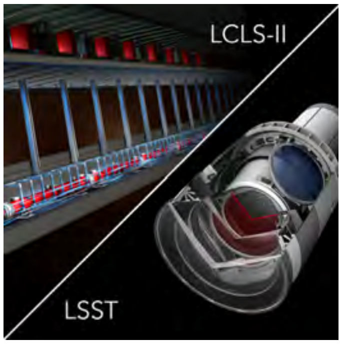
SLAC NATIONAL ACCELERATOR LABORATORY

SLAC National Accelerator Laboratory
Accomplishments

U.S. DEPARTMENT OF ENERGY

Unique Facility

SLAC Leads Major Next-generation Projects for Ultrafast X-ray Science and Cosmology



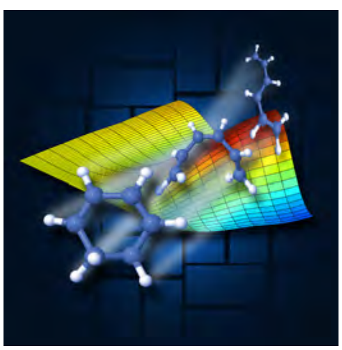
Construction has begun on a major upgrade to the world's brightest x-ray laser, the LCLS. LCLS-II will add a second x-ray laser beam that is 10,000 times brighter and fires 8,000 times faster. The project will greatly increase the power and capacity of the x-ray laser for experiments that sharpen our view of how nature works on the atomic level and on ultrafast timescales. SLAC is also leading construction of the 3.2-gigapixel digital camera (the largest digital camera ever built for ground-based optical astronomy) for the LSST in Chile. LSST will provide a definitive wide-field, ultradeep survey of galaxies for precision measurement of dark energy properties.

Research Highlights

GISMo: Partnering With Industry to Develop the 21st Century Electric Grid

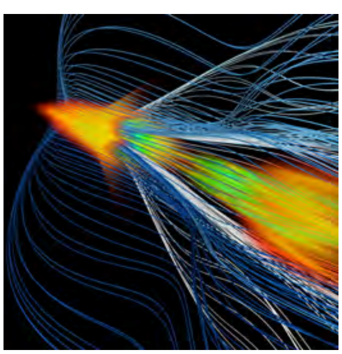
SLAC's new Grid Integration, Systems and Mobility lab, GISMo, is developing ways to collect data from power systems and grid-connected devices and use that data to better manage the electrical grid as it incorporates more sources of renewable energy. As an unbiased, highly technical partner, GISMo can test, benchmark and evaluate emerging technologies and help industry solve numerous other problems.

New 'Molecular Movie' Reveals Ultrafast Chemistry in Motion



Scientists for the first time tracked ultrafast structural changes, captured in quadrillionths-of-a-second steps, as ring-shaped gas molecules burst open and unraveled. Researchers using SLAC's x-ray laser compiled the full sequence of steps in this basic ring-opening reaction into computerized animations that provide a "molecular movie" of the structural changes. Ring-shaped molecules are abundant in biochemistry and also form the basis for many drug compounds. The pioneering study marks an important milestone in precisely tracking how gas-phase molecules transform during chemical reactions on the scale of femtoseconds.

Antimatter Catches a Wave at SLAC



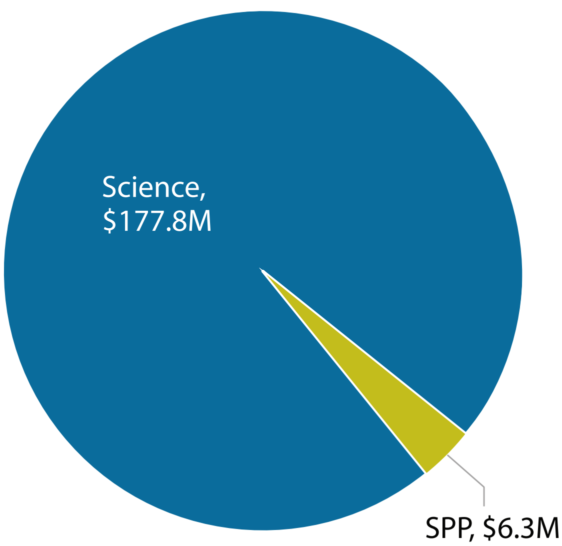
Studies at SLAC's FACET (Facility for Advanced Accelerator Experimental Tests) demonstrated a new, efficient way to accelerate positrons, the antimatter opposites of electrons, by having them "surf" waves of hot, ionized gas in a technique known as plasma wakefield acceleration. The method may help boost the energy and shrink the size of future linear particle colliders that probe nature's fundamental building blocks.

Thomas Jefferson National Accelerator Facility
At a Glance

U.S. DEPARTMENT OF ENERGY

The Thomas Jefferson National Accelerator Facility (TJNAF), located in Newport News, Virginia, is a laboratory operated by Jefferson Science Associates, LLC, for the Department of Energy's (DOE) Office of Science (SC). The primary mission of the laboratory is to explore the fundamental nature of confined states of quarks and gluons, including the nucleons that comprise the mass of the visible universe. TJNAF also is a world-leader in the development of the superconducting radio-frequency (SRF) technology utilized for the Continuous Electron Beam Accelerator Facility (CEBAF). This technology is the basis for an increasing array of applications at TJNAF, other DOE labs, and in the international scientific community. The expertise developed in building and operating CEBAF and its experimental equipment has facilitated an upgrade that doubled the maximum beam energy (to 12 GeV (12 billion electron volts)) and provided a unique facility for nuclear physics research that will ensure continued world leadership in this field for several decades. The upgraded facility has completed commissioning runs to each of the four experimental halls and is poised to begin the experimental program.

FY 2016 Costs by Funding Source



Lab operating costs **$184.1M million**
DOE costs: **$177.8 million**
SPP costs (non-DOE/non-DHS): **$6.3 million**
SPP as % total lab operating costs: **3.4%**
SPP **$6.3M**

Facts

Location: Newport News, Virginia
Type: Single-program laboratory
Year Founded: 1984
Director: Stuart Henderson
Contractor: Jefferson Science Associates, LLC
Responsible Site Office:
Thomas Jefferson Site Office

Physical Assets

169 acres and **68** buildings
880,269 GSF in buildings
Replacement plant value: **$415M**
0 GSF in Excess Facilities
83,542 GSF in leased facilities

Human Capital

699 full-time equivalent employees (FTEs)
26 joint faculty
28 postdoctoral researchers
39 graduate students
9 undergraduate students
1,530 facility users
1,368 visiting scientists

Core Capabilities

- Accelerator Science and Technology
- Large-Scale User Facilities/Advanced Instrumentation
- Nuclear Physics

Mission Unique Facilities

- Continuous Electron Beam Accelerator Facility (CEBAF)

Jefferson Lab

Thomas Jefferson National Accelerator Facility
Accomplishments

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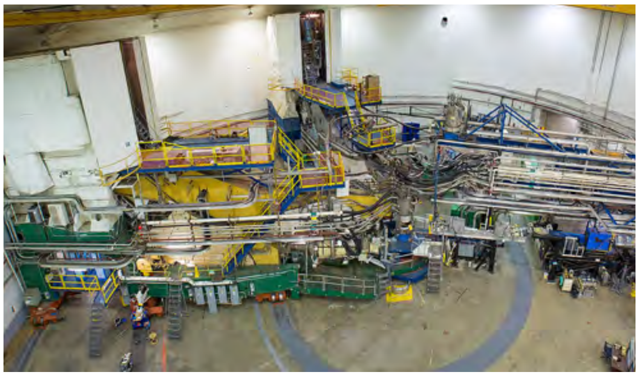
Research Highlight
Elucidating the Internal Structure of the Proton

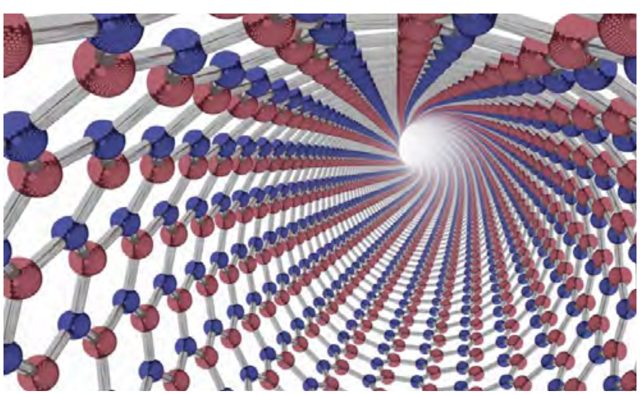


A robust description of the internal structure and dynamics of protons and neutrons is a fundamental goal of nuclear physics. Key ingredients of this characterization are the elastic electric and magnetic form factors of the proton, which are directly related to the charge and current distributions inside the nucleon. Jefferson Lab experiments discovered that the spatial extension of charge in the proton is surprisingly larger than that of magnetization.

Unique Facility
Newly Upgraded Electron Accelerator Facility

In operation at Jefferson Lab since 1995, the Continuous Electron Beam Accelerator Facility (CEBAF) has been upgraded to double the beam energy to 12 GeV and outfitted with new experimental equipment. The research program at CEBAF is a unique and essential part of the national and global program in nuclear physics, spanning the study of hadronic physics, the physics of complex nuclei, the hadronization of colored constituents, and precision tests of the standard model of particle physics. The original 6 GeV machine has been upgraded to deliver 12 GeV maximum beam energy and is poised to begin a scientific program that will allow breakthroughs in hadronic physics including searching for an answer to the question "Why are quarks never found alone?"

Technology To Market Highlight
Boron Nitride Nanotubes (BNNT)



In 2009, researchers developed a now-patented process to synthesize high-quality BNNTs at DOE's Jefferson Lab in collaboration with NASA Langley Research Center and the National Institute of Aerospace. BNNTs are resistant to high temperatures, efficiently conduct heat but not electricity, and can be useful in a wide range of applications, including heat and electrical insulation and - in the biomedical realm - for drug delivery. Patents regarding the material developed at Jefferson Lab have been licensed to a small start-up company, BNNT, LLC. The company has scaled up production and is now manufacturing and offering for sale high-quality BNNTs for scientific investigation, application R&D and commercial products.