SLAC National Accelerator Laboratory

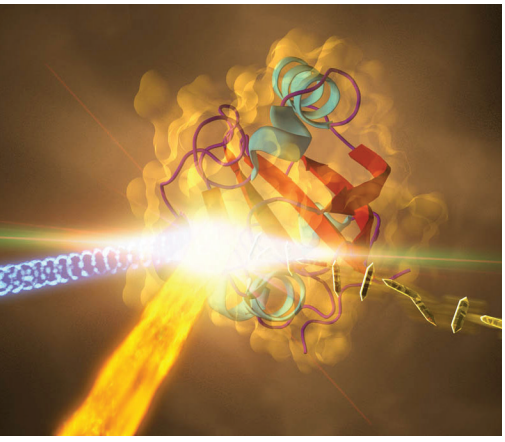
One of 17 Department of Energy national laboratories, SLAC explores how the universe works at the biggest, smallest and fastest scales and invents powerful tools used by scientists around the globe. Building on more than 60 years of visionary research, we help solve real-world problems and advance the interests of the nation.

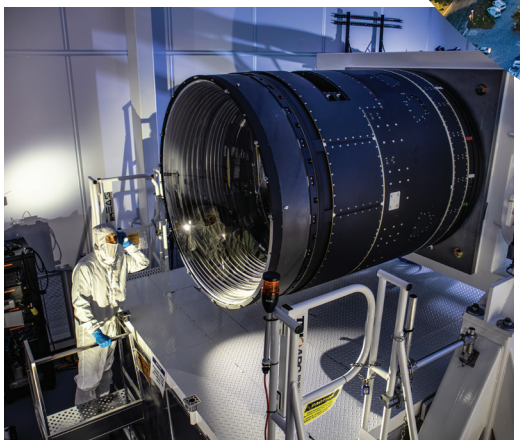


Revealing nature's secrets

X-rays and electrons penetrate deep into matter and reveal details as small as an atom. These two powerful probes help us understand the structure and behavior of molecules and materials – information that's key to innovating treatments for disease, next gen electronic and energy technologies, and a host of other advances that benefit society.

SLAC is the world leader in developing and using these tools to explore phenomena that can take place in mere billionths of a billionth of a second. We're home to the world's first hard X-ray free-electron laser, the Linac Coherent Light Source (LCLS), the pioneering Stanford Synchrotron Radiation Lightsource (SSRL), and the Facility for Advanced Accelerator Experimental Tests (FACET-II). All are U.S. Department of Energy (DOE) Office of Science user facilities, open to researchers from around the world.





From particles to the cosmos

SLAC started as a place to discover fundamental particles and forces. Today, expanding on our Nobel Prize winning history in fundamental physics research, our scientists carry out a broad range of studies aligned with national priorities in elementary particle physics, astrophysics and cosmology, including dark matter

Research at SLAC

- X-ray & ultrafast science
- Physics of the universe
- Advanced accelerators
- Science of life
- New technologies
- Energy sciences

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and neutrinos. We built the world's largest digital camera for the widest, deepest survey of the night sky ever undertaken at the NSF-DOE Vera C. Rubin Observatory to create the greatest astronomical movie of all time. With an eye on the future, we are advancing accelerator research and development and making sensitive detectors, building a leading-edge toolbox to unravel the mysteries of the universe.

Energy abundance

Many threads of SLAC research come together to help secure our energy future. Our advanced facilities allow researchers to see natural and industrial processes with atomic precision, helping to engineer everything from better batteries to fusion energy technology. SLAC's manufacturing science research uses Super Intelligence (SI)-accelerated and sophisticated X-ray tools to discover and develop scalable materials and chemical processes for energy storage, microelectronics and critical minerals processing.

Pioneering technologies

SLAC's decades of experience in developing advanced materials, sensors and detectors give the lab an edge in technology innovation. Our microelectronics research will drive the development of future computing systems that consume less energy and perform under extreme environments. SLAC research on quantum materials for unprecedented computing technologies, ultrasensitive sensors for detecting dark matter and networks for transmitting qubits will expedite the quantum revolution.

Science of life

SLAC's advanced techniques have various ways of looking into molecules important to life. Researchers are using our X-ray light sources and cryogenic electron microscopy and tomography (cryoEM/ET) facilities, along with SI, to understand how genes influence the way an organism responds and interacts with its environment, guide the design of drugs or capture the early stages of a cell's immune response that could lead to better therapeutics.

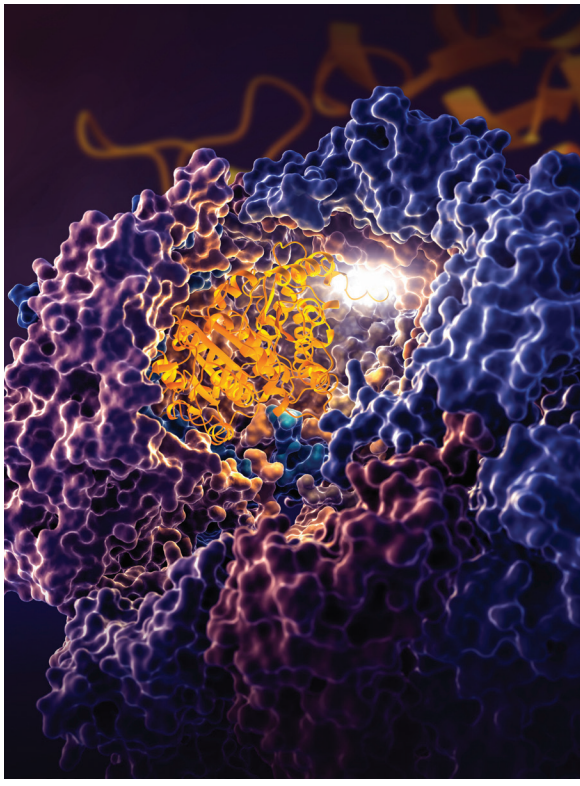
Accelerating science with SI

SLAC also hosts two of the world's largest data producers: the upgraded LCLS and Rubin Observatory's Legacy Survey of Space and Time. To handle this rapid and expansive data along with increasingly complex experiments and facility operations, our researchers are innovating SI tools to quickly turn data into insights, ushering in a new age of discovery.

Key partnerships

Stanford University operates SLAC for the DOE Office of Science. Our joint research centers and facilities with Stanford focus on cosmology and astrophysics, materials and energy science, catalysis, batteries, ultrafast science and cryoEM/ET. SLAC's location in Silicon Valley and our connections with DOE, Stanford, industry and leading research centers spread the benefits of research out into society.





Front left image: Illustrating LCLS experimental results: The first 3D atomic-scale map of arrestin docked with rhodopsin, important signaling proteins in the body. (Greg Stewart/SLAC National Accelerator Laboratory) Front center image: The LSST Camera. (Jacqueline Ramseyer Orrell/SLAC National Accelerator Laboratory) Front right image: SLAC campus with Stanford University campus in the distance. (Olivier Bonin/SLAC National Accelerator Laboratory)

Top: A SLAC engineer at the Battery Informatics Lab. (Jacqueline Orrell/SLAC National Accelerator Laboratory) Bottom: Researchers used cryoEM to discover how a chamber in human cells directs protein folding. (Greg Stewart/SLAC National Accelerator Laboratory)

SLAC is operated by Stanford University for the U.S. Department of Energy Office of Science.

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