SLAC National Accelerator Laboratory

General Information

SLAC operates "user facilities" that are open to scientists from all over the world, and about 3,400 of them take us up on the invitation every year. They compete for a chance to use our sophisticated, often one-of-a-kind equipment, which no single company or university could afford to build or operate.

The lab's **Stanford Synchrotron Radiation Lightsource** started the tradition in 1973. It was the first large X-ray facility to open its doors to outside researchers, and upgrades keep it on the cutting edge of science. Then came the **Linac Coherent Light Source**, the world's first hard X-ray free-electron laser, which opened for experiments in 2009. At SLAC's newest user facility, called **FACET**, scientists come to test technologies for the next generation of particle accelerators.

SLAC by Numbers

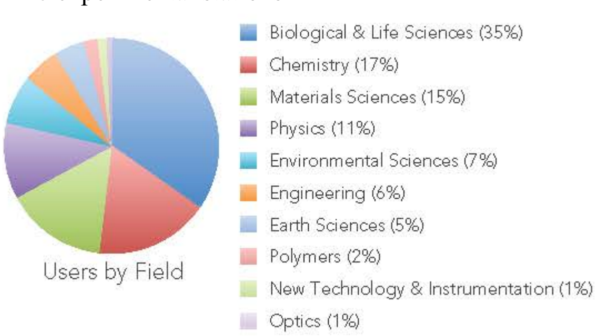
- 3,400 scientists from around the world use our cutting-edge facilities each year.
- 1,000-plus scientific papers are published each year based on research at SLAC.
- 6 scientists have been awarded Nobel prizes for research at SLAC that discovered 2 fundamental particles, proved protons are made of quarks and showed how DNA directs protein manufacturing in cells.
- At 3,073.72 meters (1.9 miles) long, our linear accelerator is one of the longest buildings on Earth.
- Electrons zip down that linear accelerator at 669,600,000 mph – 99.9999999 percent of the speed of light.
- 275 universities make use of our resources, and 55 companies use our X-ray facilities for research aimed at developing medicines and other products.

SSRL-Stanford Synchrotron Radiation Lightsource

SSRL produces extremely bright X-ray light for probing our world at the atomic and molecular level. More than 1,500 scientists from all over the world use it each year for research that benefits every sector of the American economy. Their work spurs advances in energy production, environmental cleanup, nanotechnology, new materials and medicine.

SSRL Facts

- 185 staff members
- 1,515 scientists conducted experiments in 2011
- 10,200+ refereed publications since 1974
- 4,851 operating hours in 2011
- 26 experimental stations



LCLS-The Linac Coherent Light Source

SLAC's two-mile-long linear accelerator (or linac) has begun a new phase of its career, with the creation of the Linac Coherent Light Source (LCLS).

For nearly 50 years, SLAC's linac has produced high-energy electrons for cutting-edge physics experiments. Now, scientists continue this tradition of discovery by using the linac to drive a new kind of laser, creating X-ray pulses of unprecedented brilliance.

LCLS produces pulses of X-rays more than a billion times brighter than the most powerful existing sources, the so-called synchrotron sources which are also based on large electron accelerators.

The ultrafast X-ray pulses are used much like flashes from a high-speed strobe light, enabling scientists to take stop-motion pictures of atoms and molecules in motion, shedding light on the fundamental processes of chemistry, technology, and life itself.

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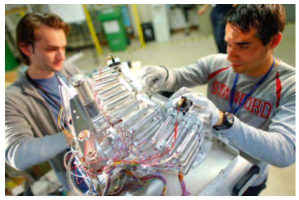
Current Activities

SSRL-Stanford Synchrotron Radiation Lightsource



Mimicking Nature

Making nitrogen fertilizer to nourish crops consumes about 1.5 percent of the world's energy. Scientists at SSRL are working to understand how natural reactions in the soil make plant food from nitrogen. The long-term goal is to develop green manufacturing processes that mimic nature and use much less energy.

Saving Lives

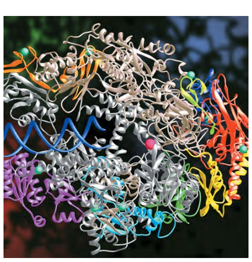
Pharmaceutical companies use the SSRL beam lines to find potential drugs that fit snugly into targets in the cell. Research here contributed to the development of Vemurafenib, a treatment for late-stage or inoperable melanoma, and Osteltamivir, a widely used antiviral drug marketed as Tamiflu, as well as a number of other remedies.

Improving Solar Cells

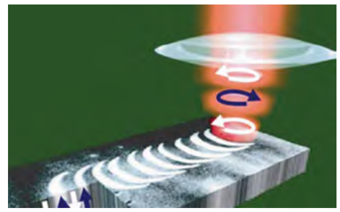
By packing molecules closer together, scientists have developed a semiconductor material that is among the speediest yet. This material—and the innovative process used to manufacture it—may significantly improve the efficiency and cost of organic solar cells used to turn the sun's rays into usable energy.

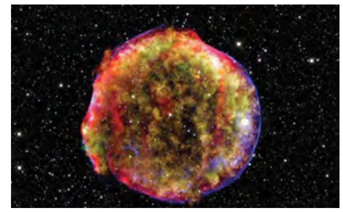
Spurring New Companies

By partnering with start-up companies such as Xradia (imaging products), XIA (detector instrumentation) InSync (custom high-tech mirrors) and Cocrystal Discovery (drug design), SSRL has enabled technical advancements that would otherwise not have been possible. These start-ups create jobs and give advanced technologies a foothold in the commercial market.



LCLS-The Linac Coherent Light Source





Catching Photosynthesis in the Act

Photosynthesis may be one of the most important chemical reactions on Earth, yet most aspects are not fundamentally understood. Using the LCLS, researchers are revealing direct observations of the natural processes that convert the sun's light into useable energy, with promising implications for America's energy future.

Viewing Crystals in Vivo

LCLS is the first light source able to image small crystallized proteins, making "singleshot" images of molecules that resist forming crystals. Now, scientists have taken it one step further and used LCLS to view crystals grown within a cell, opening a brand new field of structural analysis that images biological structures as they exist in nature.

Toward Future Electronics

Experiments at LCLS are exploring new ways to change the magnetic and electronic properties of an important class of electronic materials with ultra-short pulses of light. Such control could ultimately lead to extremely fast, low-energy, non-volatile computer memory chips or data-switching devices.

Matter in Extreme Conditions

For the first time, experimenters have the right tools to investigate high energy density matter in the laboratory. This work is revealing the true properties of matter present in the centers of stars and giant planets—and could help researchers both design new materials with enhanced properties and recreate the nuclear fusion process that powers the sun.

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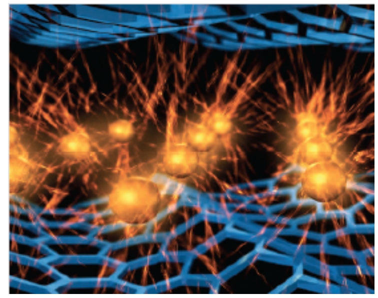
Future Perspective

SLAC is poised to welcome a frontier of discovery unlike any other in our 50-year history.
Our areas of exploration include:

• Designing new materials for alternative energy.

Scientists at SLAC are focusing on the atomic-scale design of materials for energy production and storage. Examples of SLAC research critical to future energy technologies are the use of catalysts to create cleaner fuels and to develop sustainable processes for the production of chemicals and materials, and making materials for better, more efficient batteries for energy storage.

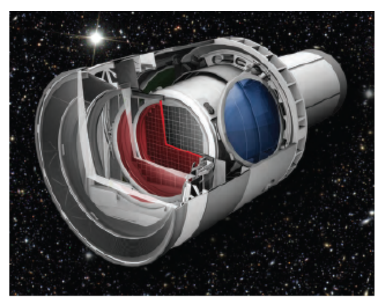


• Developing smaller and more powerful accelerators.

SLAC is at the forefront of experiments aimed at improving the power and efficiency of particle accelerators used in basic research, medicine, industry and other areas important to society. By inducing electrons to "surf " on waves of plasma, researchers have accelerated these particles to 1,000 times greater energies over a given distance than ever before.

• Pursuing dark matter and dark energy.

SLAC is leading the construction of the world's biggest digital camera for the Large Synoptic Survey Telescope, which will undertake the widest and deepest sky survey ever, providing a "movie" of the transient universe and allowing precise probe of dark energy. It will also fabricate the super-cooled crystals at the heart of the next-generation Super Cryogenic Dark Matter Search experiment.



• Making molecular movies.

The ultra-fast, ultra-bright X-rays of SLAC's LCLS are giving researchers an unprecedented view of the atomic world. Advanced instrumentation and expertise at the facility will soon enable the creation of the world's first "molecular movies," revealing chemistry behind the processes of life.