LCLS-II
Boosting the power of SLAC’s premier X-ray laser

A major upgrade to SLAC’s renowned Linac Coherent Light Source significantly boosts its power and capacity, allowing it to deliver X-ray laser beams that are 10,000 times brighter with pulses that arrive up to a million times per second. LCLS-II will transform our view of how nature works at the atomic scale and help advance technologies of the future, including novel electronics, life-saving drugs and innovative energy solutions.

A superior X-ray microscope
Hundreds of scientists use LCLS each year to catch a glimpse of nature’s fundamental processes. The unique X-ray microscope uses the brightest X-ray pulses ever made to provide unprecedented details of the atomic world. LCLS’s ultrafast pulses allow scientists to create:

- Molecular movies that reveal how chemical bonds form and break, which can lead to novel energy production and storage technologies;
- Snapshots that capture the rapid rearrangement of electric charges in materials, which can inform the designs of advanced electronics and materials with revolutionary new properties; and
- Precise 3D dynamics of disease-related proteins with atomic level details that could hold the key for discovering cures.

LCLS-II will allow researchers to capture the full history of chemical processes that underpin sustainability, study real-world materials for clean energy technologies, reveal precise details of how quantum phenomena can be harnessed for next generation microelectronics and gather immense data that will change the nature of how X-ray science is performed.
Superconducting technology
The new X-ray laser will work in parallel with the existing one. Both LCLS and LCLS-II will use electrons accelerated to nearly the speed of light to generate beams of extremely bright X-ray laser light. The electrons fly through a series of magnets, called an undulator, which forces them to travel a zigzag path and give off energy in the form of X-rays. But the way those electrons are accelerated will be quite different and give LCLS-II much different capabilities. With LCLS, electrons are accelerated down a copper pipe that operates at room temperature and allows the generation of 120 X-ray laser pulses per second.

LCLS-II adds a superconducting accelerator, occupying one-third of SLAC’s original 2-mile-long linear accelerator tunnel, which will generate a continuous stream of X-ray laser pulses, up to 1 million per second. In addition to the new accelerator, LCLS-II requires a number of other cutting-edge components, including a new electron source, two powerful cryoplants that produce refrigerant for the accelerator, and two new undulators to generate X-rays.

About LCLS
When LCLS opened in 2009 as a Department of Energy Office of Science User Facility, it was the world’s first light source of its kind, a free-electron laser producing “hard,” or very high-energy X-rays. Since then, more than 3,000 scientists from 37 U.S. states and around the world have conducted experiments at LCLS, and over 30% of experimenters each year are first-time users.

Strong Partnerships in X-ray science
SLAC is proud to partner with experts at four other national labs – Argonne National Laboratory, Lawrence Berkeley National Laboratory, Fermilab National Accelerator Laboratory and Thomas Jefferson National Accelerator Facility – and Cornell University on planning, design and construction for LCLS-II. The DOE’s Office of Science program for Basic Energy Sciences is investing in this groundbreaking light source.