First X-ray free-electron laser gets funding

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Plans by the Stanford Linear Accelerator Center (SLAC) to build a revolutionary new synchrotron X-ray source received a major boost this year thanks to $54 million in funding provided by Congress in the fiscal 2005 budget appropriation.
"The Department of Energy's Office of Basic Energy Sciences—which funds synchrotron programs—has given the project very high priority and got our full request through Congress," said SLAC physicist John Galayda, director of the project, called the Linac Coherent Light Source (LCLS). "I was euphoric. We've been treated very well, which is particularly notable in very tough budget times."

Said Professor Keith Hodgson, director of the Stanford Synchrotron Radiation Laboratory (SSRL) at SLAC: "LCLS will be the world's first X-ray free electron laser and will provide a powerful combination of laser properties delivered at X-ray wavelengths." LCLS X-ray pulses will be 1,000 times shorter and 10 billion times brighter than pulses available at existing synchrotron sources like SSRL's SPEAR3. That will enable breakthrough science such as the creation and study of exotic states of matter, imaging the structures and dynamics of biological and chemical molecules on the atomic scale and probing the fundamental aspects of atomic structure.

Congress began funding project engineering and design work for LCLS in fiscal 2003 with $6 million. Last year, LCLS received $7.5 million for engineering and design, and $2 million for research and development. The big step up to $54 million marks the first phase of construction. Actual groundbreaking and construction of new buildings will begin in

2006. Construction will include 800 meters of tunnel and 100,000 square feet of work space, including underground experimental halls and a central laboratory office support building.

"For this fiscal year, Congress provided the full funding required to accelerate engineering design and buy the first components," Galayda said. "[Progress] requires a big step upward in activity this year."

Thirty million dollars goes to long-lead procurement—buying components that are needed early on to meet the overall schedule. SLAC will transfer some of the funds to Argonne National Laboratory in Illinois to buy raw materials and supervise construction of specialized undulator magnets to induce the electron beam from SLAC's linear accelerator (linac) to emit X-rays. Argonne is a Department of Energy laboratory and collaborator on LCLS, along with Lawrence Livermore National Laboratory in Livermore, Calif., and the University of California-Los Angeles. SLAC will build a magnet measurement facility to test, adjust and align the complex magnet structures.

Another early phase task is building an injector to produce an intense electron beam ready to travel at nearly the speed of light down the last kilometer of SLAC's 3-kilometer linac. The LCLS will not interfere with operation of the B-factory, SLAC's primary high-energy physics experiment.

Project engineering and design will continue this year with $20 million of the funds, with $4 million remaining for research and development, primarily into X-ray optics and diagnostics. The project total is approximately $315 million.

"In parallel with the construction effort, we're also planning the experimental program," Hodgson said. An international scientific advisory committee evaluated and ranked proposals for the initial suite

of instruments. Working in close cooperation with researchers who will use LCLS, the project is beginning research and development and design on the instruments using $1.5 million of additional new funding provided by the Department of Energy.

The main campus, in close cooperation with SLAC and SSRL, is preparing to take advantage of the unique research capabilities of LCLS with a new center for ultrafast science that will share the LCLS facility. The Department of Energy awarded $4.7 million for three years, and the W. M. Keck Foundation in early January awarded Stanford $1 million for developing research programs in the center.

"The LCLS offers a new opportunity for Stanford to build research programs that will strengthen the ties between SLAC and the main campus in very substantial ways," said Professor Arthur Bienenstock, vice provost and dean of research and graduate policy at Stanford.

"LCLS will represent a major investment in scientific infrastructure at [SLAC], making yet another innovative use of the SLAC linac to deliver a scientific tool of unprecedented capabilities," said SLAC Director Jonathan Dorfan. "Together with our SPEAR3 facility, SLAC will be among the premier laboratories in the world for synchrotron science in the coming decades."

Scientists expect LCLS to deliver "first light" to experimenters in 2009. For more information, see www-ssrl.slac.stanford.edu

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