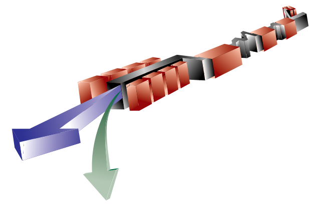
1 Executive Summary



1.1 Introduction

The Stanford Linear Accelerator Center, in collaboration with Argonne National Laboratory, Brookhaven National Laboratory, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and the University of California at Los Angeles, have collaborated to create a conceptual design for a Free-Electron-Laser (FEL) R&D facility operating in the wavelength range 1.5–15 Å. This FEL, called the "Linac Coherent Light Source" (LCLS), utilizes the SLAC linac and produces sub-picosecond pulses of short wavelength x-rays with very high peak brightness and full transverse coherence.

The first two-thirds of the SLAC linac are used for injection into the PEP-II storage rings. The last one-third will be converted to a source of electrons for the LCLS. The electrons will be transported to the SLAC Final Focus Test Beam (FFTB) Facility, which will be extended to house a 122-m undulator system. In passing through the undulators, the electrons will be bunched by the force of their own synchrotron radiation to produce an intense, spatially coherent beam of x-rays, tunable in energy from 0.8 keV to 8 keV. The LCLS will include two experiment halls as well as x-ray optics and infrastructure necessary to make use of this x-ray beam for research in a variety of disciplines such as atomic physics, materials science, plasma physics and biosciences. This Conceptual Design Report, the authors believe, confirms the feasibility of constructing an x-ray FEL based on the SLAC linac.

1.2 Facilities

The facility is comprised of the following main elements:

1. A photoinjector and a short linac, where a bright electron beam is generated and accelerated to 150 MeV.

2. The main linear accelerator, consisting of the last one-third of the SLAC 3 km linac, where the electron bunch is compressed and accelerated to 14.3 GeV.

3. The transport system to the undulator.

4. The undulator, where the electrons emit FEL and spontaneous radiation .

5. The undulator-to-experimental area transport line.

6. Two experiment halls

7. X-ray optics for control of focus, intensity and spectral bandwidth

8. Basic infrastructure for future experiments

1.3 Capabilities

The LCLS is an x-ray source with unprecedented brightness and peak power. It will provide pulses of x-rays of duration 230 fs or less, in an energy range 0.8-8 keV.

Table 1.1 Main performance characteristics of the Linac Coherent Light Source

X-ray beam energy	**0.8 keV**	**8 keV**
FWHM x-ray pulse duration	230 fs	
X-ray peak power	10 GW	8 GW
Max. pulse repetition rate	120 Hz max.	

In average brightness it will match or exceed existing storage ring-based sources. In peak brightness, it will surpass existing sources by a factor 10^{10}.

1.4 Cost & Schedule

The Total Estimated Cost of the LCLS is in the range $165M-$225M. The Total Project Cost is in the range $185M-$245M. A three-year construction schedule is proposed.

1.5 Acquisition Strategy

The lead contractor for acquisition of the Linac Coherent Light Source is Stanford University, which operates the Stanford Linear Accelerator Center. SLAC will collaborate with two national laboratories (Argonne National Laboratory and Lawrence Livermore National Laboratory) to construct the LCLS.