

Linac Coherent Light Source Update



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LCLS Project Director**

**LCLS Technical Advisory Committee
10 December 2001**

Status of LCLS in DOE Approval Process

Change in scope of the LCLS

LCLS Layout

LCLS R&D

Recommendations from last review

Anticipated DOE project review and approval process

- 5/01 DOE approval of mission need (“Critical Decision 0”)
- 4/23/01 DOE “Lehman Review”
- 5/02 Preliminary Baseline Approval (“Critical Decision 1”)
- 6/03 Performance Baseline Approval (“Critical Decision 2”)
- 10/03 Start Construction Approval (“Critical Decision 3”)
- 10/06 Approval of Start of Operations (“Critical Decision 4”)

Three-year construction schedule

This preliminary schedule is based on receiving the following funding levels in thousands of dollars:

Fiscal Year	Total Estimated Cost		Other Project Costs		TPC
	Project Engineering & Design	Construction	Research and Development	Pre-operations	Total
Prior			4,425		4,425
2002			1,500		1,500
2003	6,000		3,000		9,000
2004	15,000	40,000	500		55,500
2005	10,000	55,000		2,000	67,000
2006	2,500	46,500		4,000	53,000
Total	33,500	141,500	9,425	6,000	190,425
	175,000*		15,425		190,425

Prior to CD-2 approval, DOE documents also quote a range rather than a single number for project cost:

\$150M - \$200M TEC, \$165M - \$225M TPC

LCLS Scope Change

US tradition is to fund synchrotron radiation endstations outside the project

- Advanced Photon Source
- National Synchrotron Light Source

US tradition is to fund neutron instruments within the project

- Spallation Neutron Source

Summer of 2000 – LCLS experiments were added to project scope

- Femtochemistry
- Warm Dense Matter
- Nanodynamics
- Atomic Physics
- Biomolecular Imaging

November 2001 – DOE/BES has directed LCLS to remove the experiments from the Project scope

This amounts to ~\$50M change in TEC

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Eric A. Rohlfing, BESAC Meeting February 26, 2001

BES Vision for the LCLS

- ◆ **LCLS is partly an accelerator/FEL R&D project, but it must also be a stand-alone scientific user facility**



DEPARTMENT OF ENERGY
Washington, DC 20585

November 19, 2001

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Audit Report on "Progress of the Spallation
Neutron Source Project"

RESULTS OF AUDIT

We determined that the SNS Project's technical scope was reduced to allow schedule components to be met. ~~Contract commitments in~~ ~~originally~~ ~~in~~ June 2006, the anticipated completion date, the SNS Project will not:

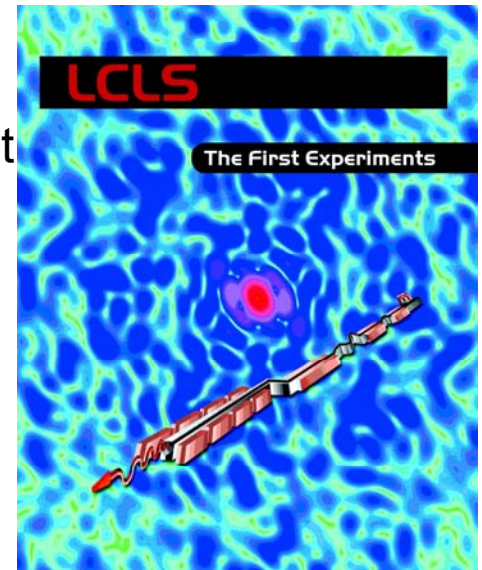
- Have instruments to address all of the initially planned a
- Provide complete user facilities; and,
- Possess critical spare parts and equipment.

Framing a new vision and Scope of Work

We will propose that LCLS include the facilities necessary to characterize the LCLS beam and test our ability to

- filter
- focus
- synchronize with a pump laser
- split/delay the x-ray beam for probe/probe experiments
- monochromatize
- slice

This list is derived from the "First Experiments" document



Sub-Picosecond Photon Source is an opportunity to attack LCLS timing issues
Such as pulse length measurement and laser synchronization

Post commissioning, LCLS research activities will include development of the experimental techniques that will be required for LCLS experiments

An SSRL-led research collaboration will carry out this work

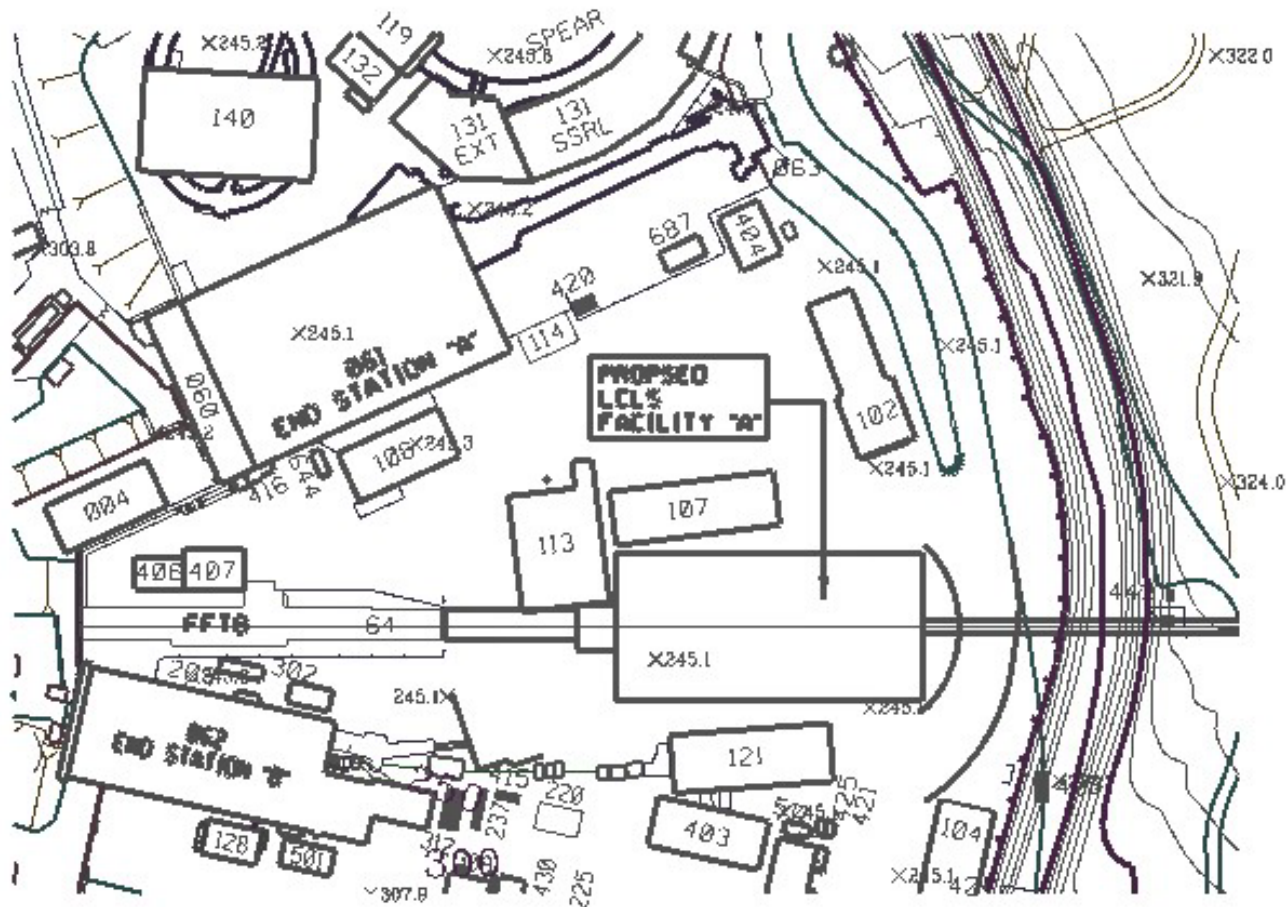
The next LCLS SAC Meeting (2/02) will consider how to best continue developing the experimental program itself in concert with the national and international user community

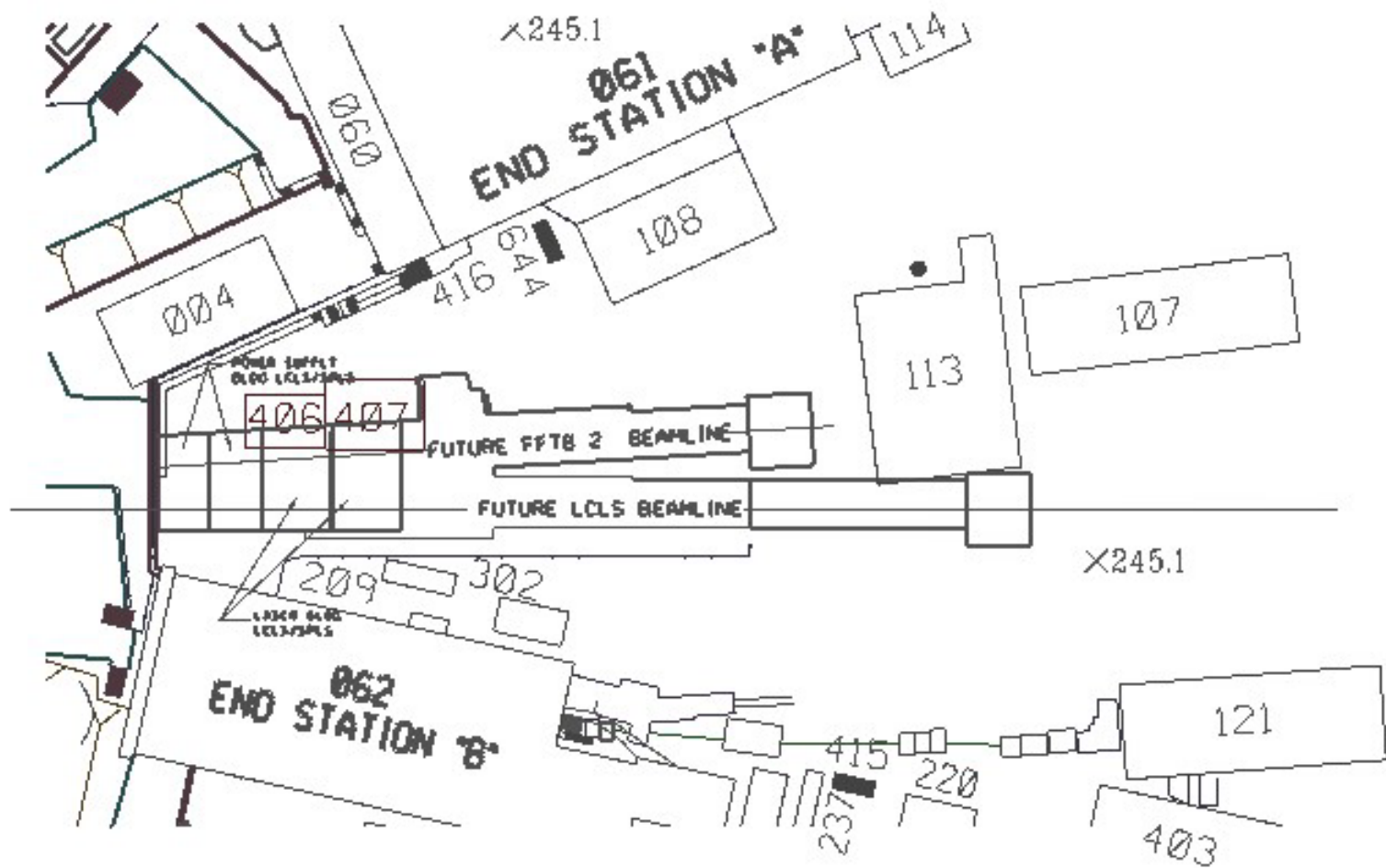
DOE will accept proposals for R&D in support of experiment design at any time

Experiment proposals will be accepted for review after CD-3

LCLS Layout in Research Yard – Proposal to relocate Near Hall to East End

- Adds ~9 months to useful life of FFTB
- Affords greater flexibility in design of FFTB-II
- Provides room for expansion of LCLS undulator sources
- Removal of Bldg 113 is now an option rather than a necessity



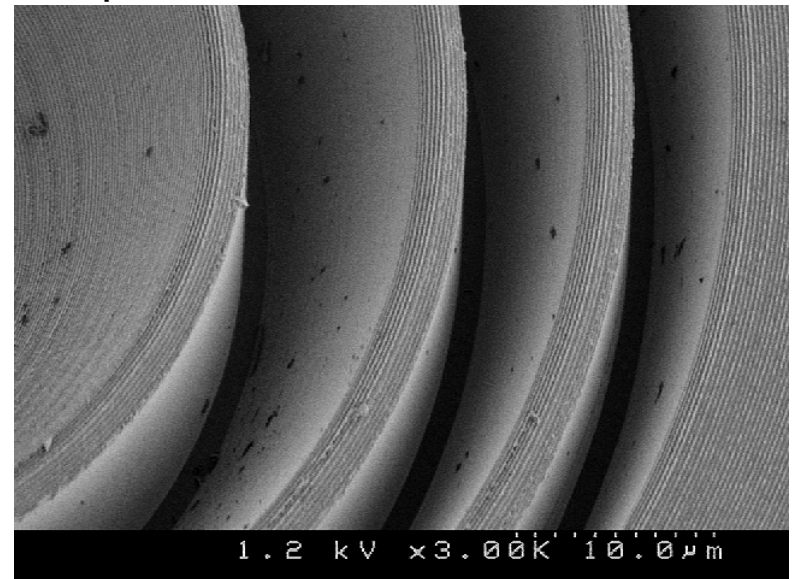
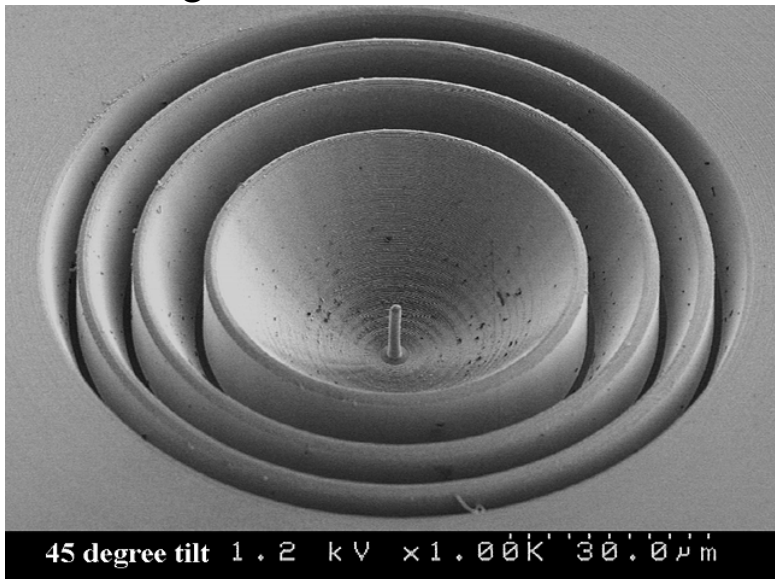


R&D activities

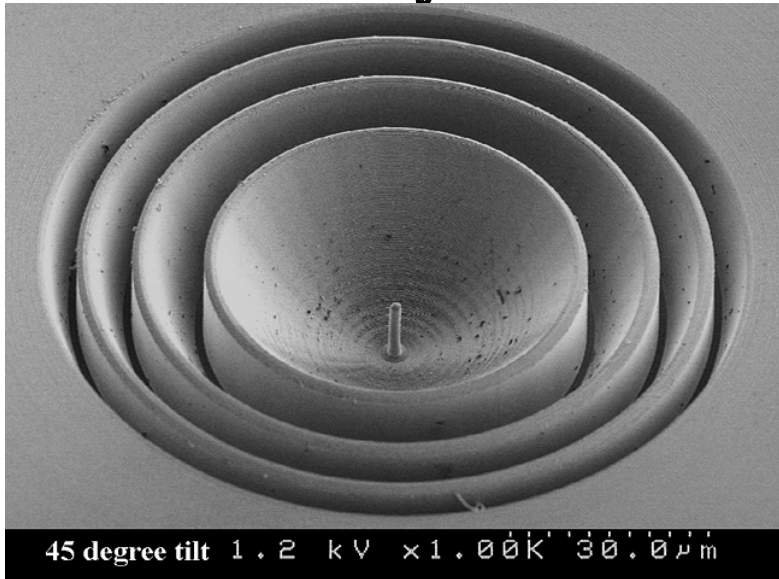
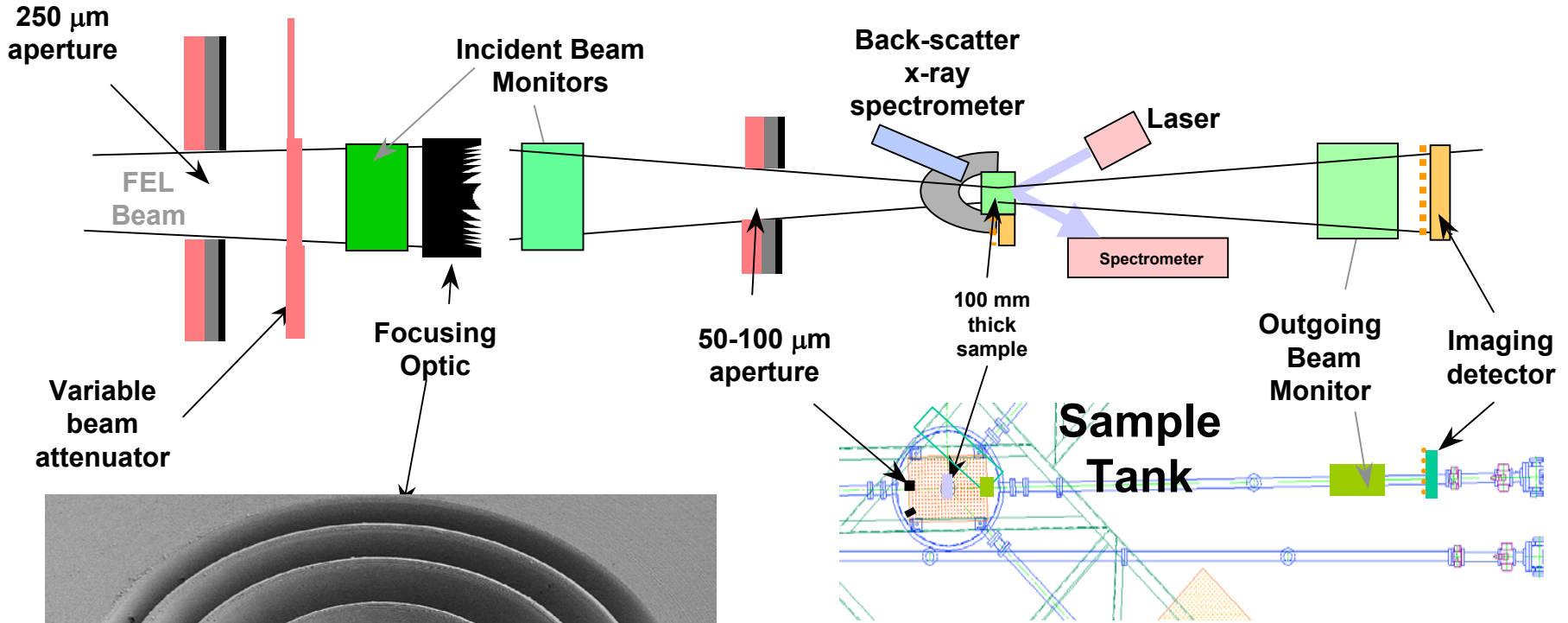
- Gun – More resources, excellent progress
- Bunch compression – CSR causes microbunching
- Undulator Prototype construction near completion
- FEL experiments – VISA achieves saturation

R&D Progress – X-ray optics

- LLNL tests of damage to silicon crystal
 - Exposure to high- power laser with similar energy deposition
 - Threshold for melting 0.16 J/cm^2 , as predicted in model
- Fabrication/test of refractive Fresnel lens
 - Made of aluminum instead of carbon
 - Machined with a diamond point
 - Measurements from SPEAR presently under analysis
- Significant effort to estimate costs of experiments!



Warm Dense Matter Experiment



Last review:

Gun simulation – A lot of excellent work has been done – 3-D simulation has begun

Vacuum chamber wake fields – On the agenda again this review. Resistive wall effects have been studied; assessment of significance is ongoing. There were insufficient resources to perform roughness impedance measurements with GTF.

“Start-to-end” simulations of x-ray optics – a good idea, still in the future.

15 Angstrom simulations – still needs addressing

VISA experiment - has been successfully completed. Beautiful work was done in the data analysis.

Parameters & Performance

FEL Radiation Wavelength	<u>1.5</u>	<u>0.15</u>	nm
Electron Beam Energy	4.54	14.35	GeV
Repetition Rate (1-bunch)	120	120	Hz
Single Bunch Charge	1	1	nC
Normalized rms Emittance	2.0	1.5	mm-mrad
Peak Current	3.4	3.4	kA
Coherent rms Energy Spread	<2	<1	10 ⁻³
Incoherent rms Energy Spread	<0.6	<0.2	10 ⁻³
Undulator Length	100	100	m
Peak Coherent Power	11	9.3	GW
Peak Spontaneous Power	8.1	81	GW
Peak Brightness *	1.2	12	10 ³²
Bunch Length	230	230	fsec

* photons/sec/mm²/mrad²/0.1%-BW

End of Presentation