LCLS Control System Status

EPICS Collaboration Meeting

October 6-7, 2005

- **Outline**
  - Project Overview
  - Control System Goals
  - Resources
  - Design Slides for Global Systems
  - Tools/ Standards to adopt from the community for LCLS
  - Status
  - Conclusions

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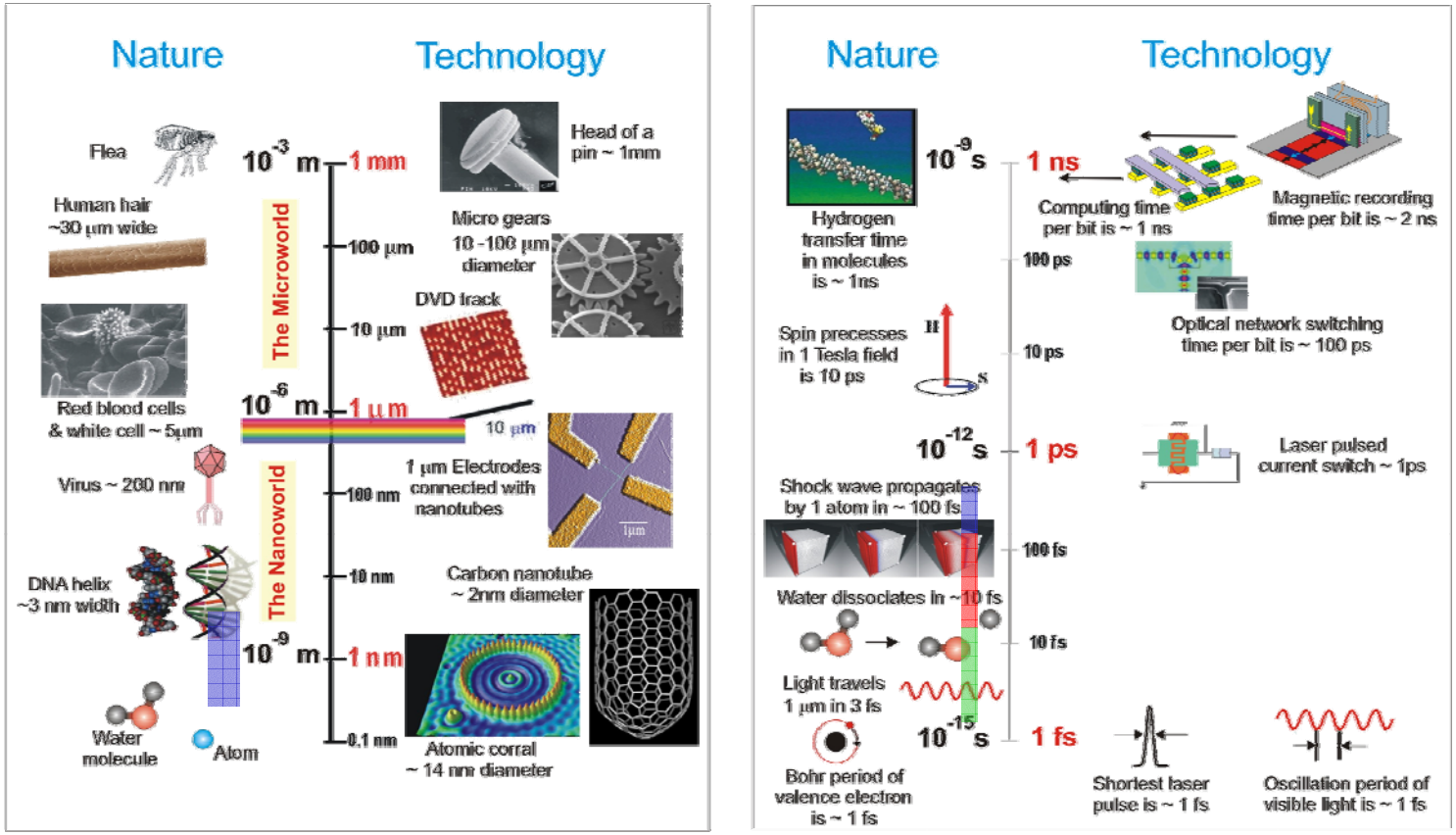
The World's First Hard X-ray Laser

X-FELs open the Ultra-Small and Ultra-Fast Worlds



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Capabilities

Spectral coverage: 0.15-1.5 nm

To 0.5 Å in 3rd harmonic

Peak Brightness: 10^{33}

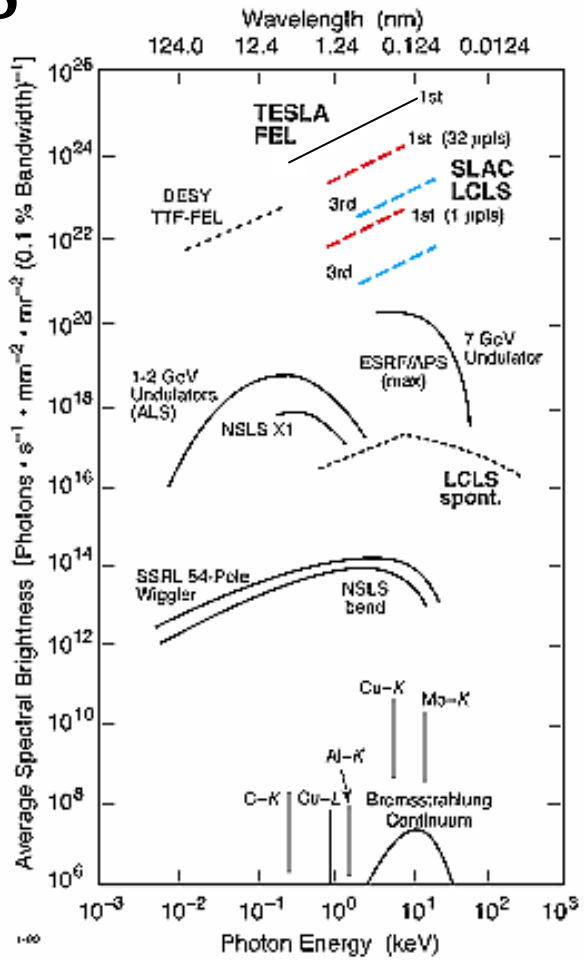
Photons/pulse: 10^{12}

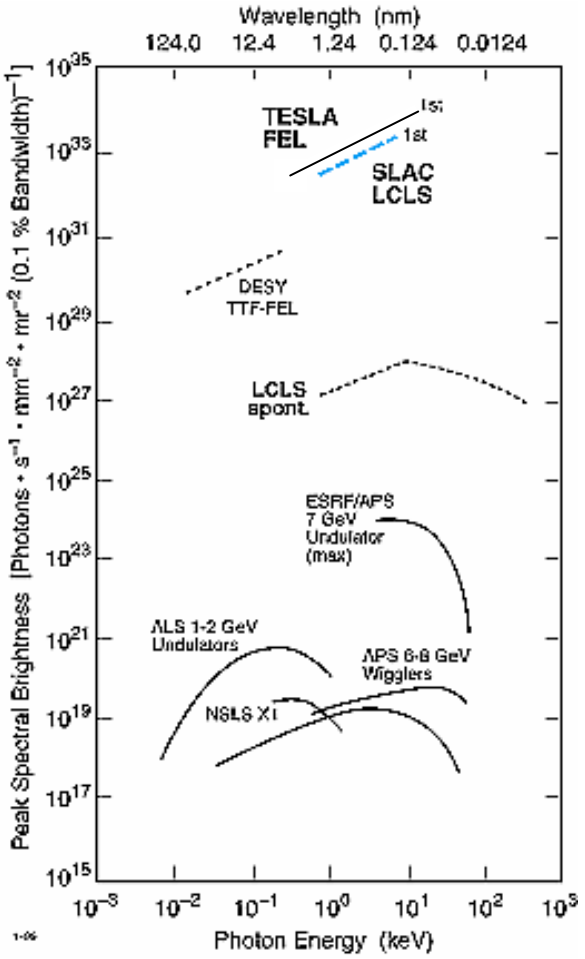
Average Brightness: 3 x 10^{22}

Pulse duration: <230 fs

Pulse repetition rate: 120 Hz

Upgrade – more bunches/pulse





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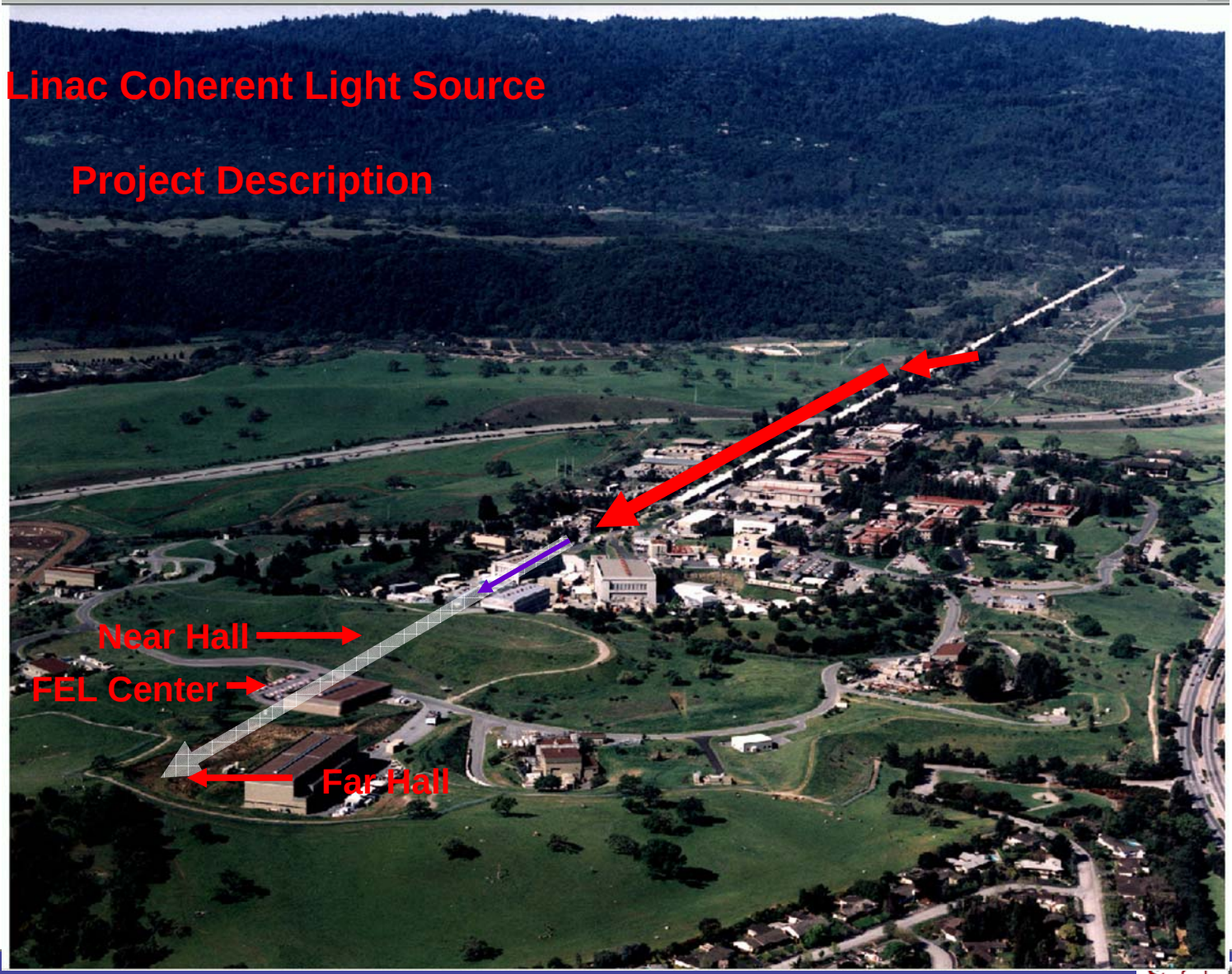
Linac Coherent Light Source

Project Description



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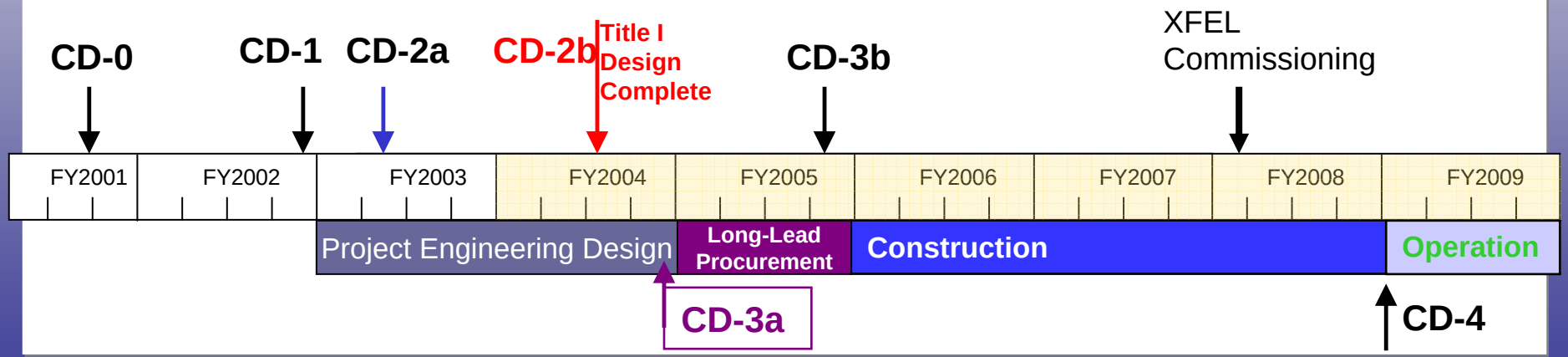
LCLS - Estimated Cost, Schedule

- *$379M Total Project Cost*
  - **FY2005** Long-lead purchases for injector, undulator
  - **FY2006** Construction begins
  - **FY2007** FEL Commissioning begins
  - ***September 2008*** Construction complete – operations begins



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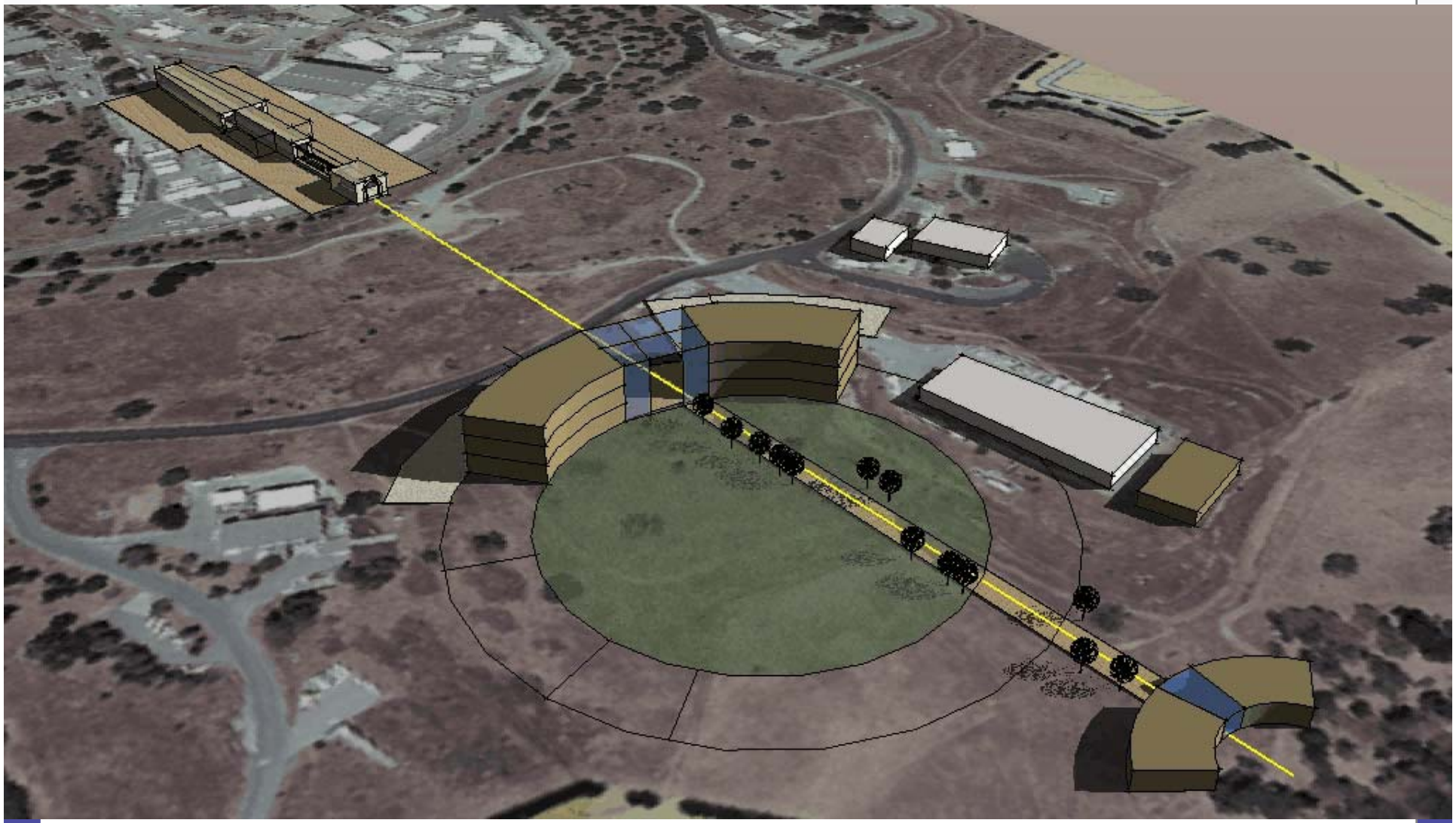

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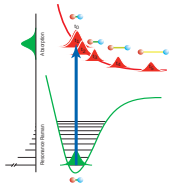
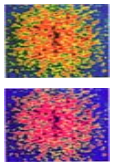
•SLAC-PUB-611

Program developed by international team of scientists working with accelerator and laser physics communities

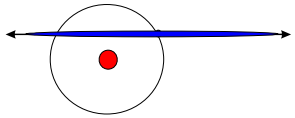
"the beginning.... not the end"



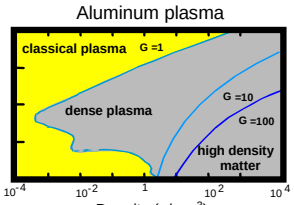
Femtochemistry



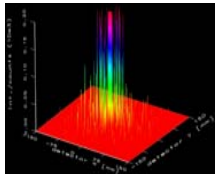
Nanoscale Dynamics in Condensed matter



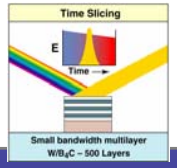
Atomic Physics



Plasma and Warm Dense Matter



Structural Studies on Single Particles and Biomolecules



FEL Science/Technology

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LCLS Control System Goals

- Provide a fully integrated control system to support the construction, test, installation, integration, operation and automation of the LCLS Accelerator
- Standardize all devices and components across all subsystems.
- Identify all data either by pulse id, beam pulse related time stamp, or 500 msec rough time stamp.
- Full integration with the SLC – timing, use of LCLS data in SLC high level applications, and use of SLC data in LCLS

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Personnel – Resources FY 2005

	Q1	Q2	Q3	Q4	06 Q1
Ctl. Elec. Engineer	0.75	4.35	735	7.35	7.35
Ctl. Sr. Elec. Tech.		1.11	3.35	3.35	3.35
Ctl. Elec Tech.		0.56	0.56	0.73	1.96
Pwr. Elec. Engineer		1.32	1.32	1.32	1.32
Pwr. Sr. Elec. Tech.		0.35	0.61	0.62	.62
Control Prog.	3.50	7.14	10.63	10.63	10.63

Dayle Koturri
Mario Ortega
Sheng Peng
Kristi Luchini
Stephen Norum
Sergei Chevstov
Doug Murray
Artura Alacron
Stephen Schuh
Michael Cecere

Stephanie Allison (SSRL)
Tilll Strauman (SSRL)
Debbie ROgind (ESD)
Diane Failrey (ESD)
Paul Bellermo (ESD)
Tom Porter (ESD)
Bob Fuller (EsD)
Antonio Delira (ESD)
Dave Manair (ESD)
Support from others as needed

Fully staffed

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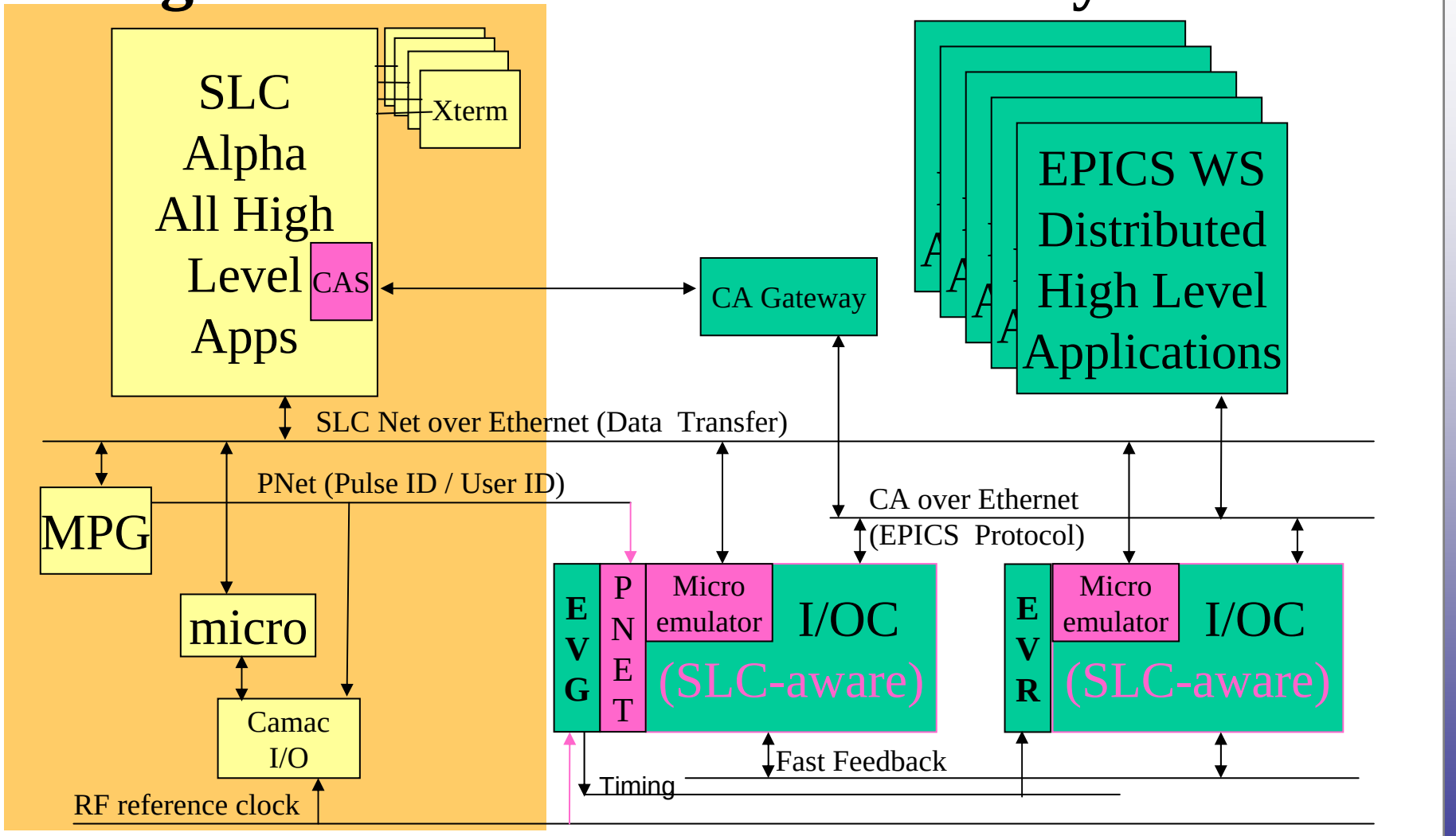
Integration with the SLC Control System



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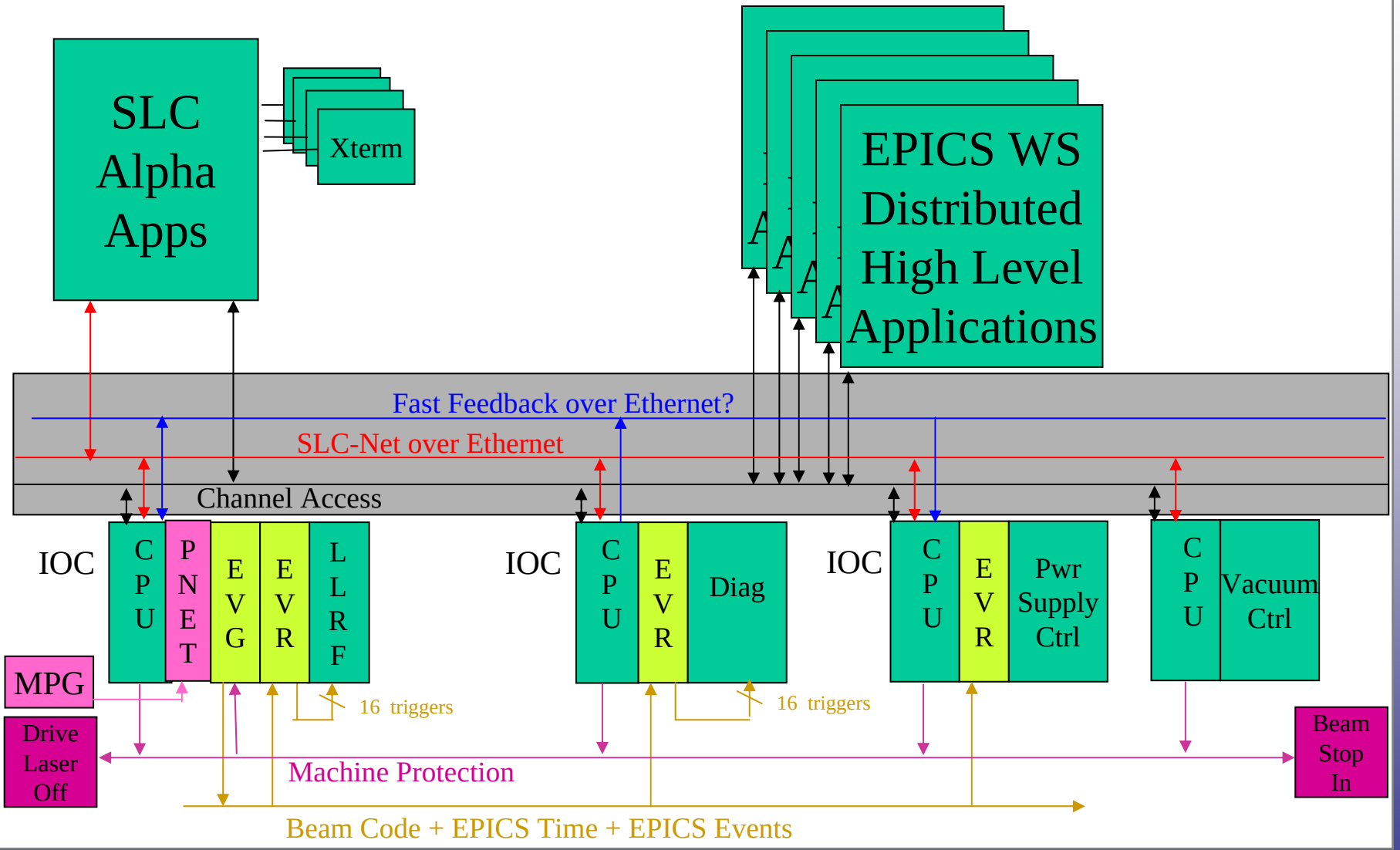
Global Communication Buses



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Environment

EPICS Release	3.14.n
R/T OS	RTEMS
Workstation OS	LINUX
EPICS ADE (CVS)	Simple??
Compilers	GNU
Bug Report / Tracking	Artemis
Naming Standard	PEP II
Name Service	Name Server JLAB
Documentation	Web Area
Test stations	Lab / FFTB? / SLC

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Client Tools

Display Manager	EDM
Archiver	Channel Archiver
Alarm Handler	ALH
Message Logger	CMLog
Electronic Log Book	DESY, Babar, JLAB?
Stripchart	StripTool
Web based viewing	EPICS Office??
Image Analysis	Matlab format?
Save / Restore	?
RDB	PEP derivative
Gateway	3.14.6 Gateway

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High Level Applications

- Matlab — Available for Physicists
- Python — Available for Physicists
- High Level Apps
  - SLC — Available in existing system
  - XAL — New direction
  - Matlab based — Growing group of users
- Top priorities to move into EPICS
  - Which ones make the SLC-aware IOC easier
  - Which are the most useful
  - Which are the easiest to pick off

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Hardware Direction – Buy/Steal/Make

In-House	VME version of the PNET
Commercial	BPM - Echotek digitizer / analog f/e
Community	Timing System (Diamond)
Community	Power Supply Controller (uIOC)
Commercial	LLRF – Digitizers / analog f/e (uIOC)
Community	Machine Protection System (uIOC) 8msec Shut off
Commercial	Video – evaluate several options (30 Hz)
Commercial	Conventional Facilities through ALC
Community	Motion Control using Newport Motors
Commercial	Fast feedback: Shared Mem / 2nd Ethernet?

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Status

- Complete SLC-aware IOC (100% Complete)
- Complete PNET Prototype (100% Complete)
- Complete Timing Prototype (75% Complete)
- Complete BPM Prototype (20% Complete)
- Complete Power Supply Prototype (10% Complete)
- Complete Video Prototype (25% Complete)
- Design Document for Machine Protection System – determine if there is something that we can evaluate (45% Complete)
- Integrate Facility Controls, XRay Transport (75% Complete)
- High Level Applications now have a team starting

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Next 6 Months

- Complete BPM Prototype
- Complete Timing Prototype
- Complete Power Supply Prototype
- Complete Video Prototype
- Design Document for Machine Protection System
- High Level Applications
  - XAL Orbit Display
  - Emittance Measurement

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Installation Schedule

Laser	5/1/2006 –05/31/2006
Injector, Injector Spectrometer	9/1/2006 - 11/02/2006
Linac L1 and Bunch Compressor 1	9/1/2006 - 11/02/2006
Linac L2, Bunch Comp. 2, and L3	8/1/2007 - 10/31/2007
Linac to Undulator	11/1/2007- 1/31/2008
E-Dump	11/1/2007- 1/31/2008

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Conclusions

- We have a great team in place.
- Integration with the existing SLC system is a critical step to allow SLAC operators to use the existing tools while we are adopting and modifying replacements.
- Standard EPICS tools for core development and engineering interfaces are in use.
- Most of our hardware is based on developments from the community or those commercially available.
- Embedded controllers are being evaluated for Power Supply, LLRF, MPS, Vacuum and Video Control.
- Effort to expand high level applications is started.

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