SLAC National Accelerator Laboratory

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Director
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SLAC Mission

• Explore the ultimate structure and dynamics of matter in the domains of energy, space and time—at the smallest and largest scales, in the fastest processes, and at the highest energies
Lab at a Glance

Total DOE Funding:
• $298M FY2009

Location: Menlo Park, CA
Type: Multi-program Laboratory
Contract Operator:
Stanford University

Human Capital:
• Employees: 1,490 FTE
• 205 Postdocs + Grad Students
• 3430 Facility Users & Visiting Scientists
SLAC Scientific Objectives

• Internationally leading photon science lab
  – Facilities opening the frontier of atomic scale dynamics
  – Performing science programs including energy

• Premier electron accelerator laboratory
  – FEL research
  – High gradient x-band technology
  – Research in new acceleration mechanisms

• Targeted programs in particle physics, particle astrophysics & cosmology
  – Energy frontier (ATLAS, ILC)
  – Intensity frontier (Super-B, EXO)
  – Cosmic frontier (FGST, LSST, Super-CDMS ..)
Elements of an Internationally leading photon science lab

- Atomic resolution in energy (meV), space (nm) and time (fs)
  - Need both FEL’s & CW ring based machines
  - Science delivery ➔ Experimental tools

- Structure ➔ Dynamics
  - New frontier
  - Observation ➔ Understanding ➔ Control

- Light Sources @ SLAC
  - LCLS/LCLS-II
  - SSRL
  - PEP-X

- Accelerator R&D to Support Light Source Development ➔ Accelerator R&D Initiative

- Performing Science to Drive Light Source Development ➔ Energy Sciences Initiative
  - Drivers/Organizational Structure/People

Annual SLUO Meeting
LCLS Early Operations

- Starts with LCLS performance
  - 4/22/10 12:56 pm -- final technical milestone for LCLS CD-4
  - 4/22/10 2:00 pm -- CD-0 for LCLS II signed
- User demand growing fast!

FEL Available to users: 92.9%

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![Graphs showing growth in proposals and unique users from Oct. 2009 to Oct. 2010]
Conclusions from Nanocrystal Imaging Experiments

• Femtosecond nanocrystallography opens up a new route for small or radiation sensitive single-crystal structure determination

• High-quality diffraction patterns can be collected at the pulse rate of the LCLS

• “Diffraction before destruction” concept validated to sub-nanometer resolution

• Nanocrystallography is immediately extendible to femtosecond time-resolved measurements of photoinduced dynamics

• We are seeing the first ‘killer app’ for LCLS
Future of SLAC x-ray Facilities

- Facilities Vision: LCLS II
  - Improve capability and capacity
  - Use 2\textsuperscript{nd} km of Linac
  - Second injector
    - 2+ independent FELs
    - Independently flexible
  - Seeding

- Facilities Vision: SSRL
  - Exploit psec pump probe
  - Exploit synergies with LCLS

- Longer term
  - Full exploitation of Linac
  - PEP-X

enclosure exists at sector 10

RF gun-1

3-7 GeV \(e^-\) bypass line

new undulators

Sector-20 wall

existing LCLS

3-7 GeV

3-15 GeV

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Growth of Performing Photon Science Program @ SLAC

• Driver for Growth: Performing science drives facilities
  – Fundamental Science underpinnings for long term energy technology

• Build on strengths
  – Materials physics particularly correlated materials
    • Exploit X-ray scattering, imaging, and spectroscopy tools @ SLAC
  – Ultrafast processes
  – Interface/catalysis leading to materials by design
  – People

Annual SLUO Meeting
Accelerator Research

• SLAC Accelerator research key to future of the laboratory
  – Focused on advancing operating facilities and next generation of HEP and BES accelerators
  – Supports all labwide objectives

• Goals of accelerator R&D
  – Maintain world-leading XFEL program with innovation and new concepts
  – Be the world-leader in high power rf systems and high gradient rf linacs
  – Be a world-leader in advanced accelerator R&D with focus on e+/e-

• Associated benefits
  – Support ongoing accelerator-based laboratory program
  – Accelerator education program
Accelerator R&D

• XFEL development program
  – Theory
  – Injectors
  – Seeding
• High Power rf & linacs
  – X-band rf $\Rightarrow$ 100MV/m
• Advanced Accelerator R&D & new concepts
  – FACET (PWA)
  – Direct laser acceleration
Physics opportunities at the LHC

The Future of SLAC Particle Physics and Astrophysics
Particle Astrophysics and Cosmology @ SLAC

- Challenges at the Cosmic Frontier
- Progress requires instruments in space, on the ground and underground
- SLAC programs align with priorities of community
  - Contributions coordinated with partner laboratories
Moving SLAC to the Future

Research Support Building

Science and User Support Building
The Future!

• A new scientific frontier is being opened at LCLS
  – Biggest surprises are yet to come!
• Strategic programs in particle physics and astrophysics
  – Energy frontier
  – Intensity frontier
  – Cosmic frontier
• Accelerator Research
• New Laboratory Infrastructure