Laboratory Overview

Steven M. Kahn

Director of Particle Physics & Astrophysics
SLAC-History

* A government-owned facility operated by Stanford University and located on about 430 acres of Stanford land leased to the federal government (originally AEC, now DOE)

* SLAC was conceived by Stanford faculty in the late 1950’s and was approved by the Stanford Trustees in 1962. Construction started in 1963 and the first experiments began in 1966

* SLAC is open to all scientists worldwide on the basis of proposals submitted for peer review. The Laboratory conducts fundamental research, unclassified in nature, and widely published in the open literature

* The laboratory has remained on the frontiers of science through continued upgrades and additions to its initial complement of accelerator facilities

* Six Nobel Prizes have been awarded for work done at SLAC
Two Main Science Programs

* High Energy Physics / Particle Astrophysics
  The study of the fundamental constituents of the universe, and the forces between them. The program entails both accelerator-based and non-accelerator-based experiments, theory, and research on future accelerators.

* Photon Science
  The use of ultra high-intensity x-ray beams for studies in physics, biology, chemistry, medicine, and environmental sciences.

* 3000 scientists from about 30 nations use SLAC facilities to do their research

* Science Program at SLAC generates 800-900 publications / year
Stanford University:
A Crucial Element in SLAC’s Success

* SLAC benefits greatly from being an intimate and integral part of Stanford University

* SLAC is a School of Stanford with two faculties (departments). The PPA faculty comprises 33 active professors, the Photon Sciences faculty comprises 17 active professors

* Very close coupling to both the academic and administrative leadership of Stanford
  
  – The University is a pro-active contract administrator of SLAC – it provides very close, supportive and highly skilled oversight

  – Facilitates recruitment to SLAC of exceptional intellectual capital (Four of the original eight SLAC Group Leaders won Nobel Prizes)

  – Crucial investments by the university have greatly leveraged the Government’s investment
Contract Competition in 2008

United States Department of Energy
Office of Public Affairs
Oak Ridge, Tennessee 37831

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Walter Perry, (865) 576-0885

U. S. DEPARTMENT OF ENERGY TO EXTEND
MANAGEMENT AND OPERATION CONTRACT FOR ITS
STANFORD LINEAR ACCELERATOR CENTER

OAK RIDGE, Tenn. – The U.S. Department of Energy (DOE) today announced that it will extend, for up to two years, the management and operating (M&O) contract for its Stanford Linear Accelerator Center (SLAC) in Menlo Park, California. The Board of Trustees for the Leland Stanford Junior University currently holds SLAC’s M&O contract, set to expire September 30, 2007. The annual estimated value for this performance-based contract is $316 million.

“The researchers at the Stanford Linear Accelerator Center continue to make leading contributions to science,” Under Secretary for Science Raymond L. Orbach said. “Through this contracting process, DOE is seeking the best possible management of this laboratory to sustain our nation’s cutting-edge resources.”
High Level Organization

- Department of Energy
- Stanford Univ Trustees
- Stanford Univ President
- SLAC Policy Committee
- SLAC Director
- LCLS Construction
- Photon Science Directorate
- Operations Directorate
- Particle & Particle Astrophysics Directorate
Stanford University Organization

Organization Chart

President

- Board of Trustees
- President
- Associate Vice President of Strategic Planning
- Senior Assistant to the President and Secretary of the Board of Trustees

VP for Business Affairs & Chief Financial Officer (1)
- Vice President and General Counsel (1)
- VP for Development (1)
- CEO, Stanford Management Company

Director of Hoover Institution (1) (2)
- Vice President for Public Affairs
- Special Counselor to the President for Campus Relations
- President, Stanford Alumni Association (1)

Provost
- Director of Stanford Linear Accelerator Center (1) (2)
- Senior Vice President for University Resources

(1) Organization charts for these officers are shown in Guide Memo series 12
(2) Reports jointly to President and Provost
SPEAR
Synchrotron Radiation Light Source
Linac Coherent Light Source at SLAC: The Next Revolution in X-Ray Science

LCLS Will Be The World’s First X-ray Laser
LCLS Construction -- Beam Transport
LCLS Construction -- Two Tunnels ongoing
LCLS Construction Near Experimental Hall
Laboratory Budget Evolution

In Millions


HEP-NonILC/D HEP-ILC/D Operations-HEP Operations-BES BES/BER Other

SLAC B-Factory D&D Review: August 6-7, 2007
The PPA Program

* The current PPA program involves a mix of experiments in or near to the operations phase (B-Factory, GLAST, ATLAS), R&D for near-term future facilities (ILC, LSST, EXO, SNAP), and R&D for the more distant future (High Gradient, Accelerator Research).

* It is well-matched to the science priorities set by national review committees (EPP2010, P5):
  – Research at the energy frontier (LHC, ILC).
  – Exploring the mysteries of dark matter and dark energy (GLAST, LSST, SNAP).
  – Unraveling the nature of the neutrino (EXO).

* As the field evolves, so does SLAC. But, the transition is not without challenges! When the B-factory shuts down at the end of FY08, it will be the first time that SLAC will not be operating an on-site accelerator-based facility for high energy physics!
“The Wiring Diagram”
B-Factory Physics Program

* Highly constrained and redundant set of precision tests of weak interactions in the Standard Model
  – legacy of fundamental constraints on future New Physics discoveries
* Searches for physics beyond the Standard Model
  – Sensitivity to New Physics at LHC mass scales
* Discovery potential from large data sample across range of heavy quark and lepton flavor, two-photon and ISR physics
B-Factory
**The BABAR Collaboration**

10 Countries  
77 Institutions  
593 Physicists

<table>
<thead>
<tr>
<th>Country</th>
<th>[Count/Total]</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>[38/300]</td>
</tr>
</tbody>
</table>
| California Institute of Technology  
UC, Irvine  
UC, Los Angeles  
UC, Riverside  
UC, San Diego  
UC, Santa Barbara  
UC, Santa Cruz  
U of Cincinnati  
U of Colorado  
Colorado State  
Florida A&M  
Harvard  
U of Iowa  
Iowa State U  
LBNL  
LLNL  
U of Louisville  
U of Maryland  
U of Massachusetts, Amherst  
MIT  
U of Mississippi  
Mount Holyoke College  
SUNY, Albany  
U of Notre Dame  
Ohio State U  
U of Oregon  
U of Pennsylvania  
Prairie View A&M U  
Princeton U  
SLAC  
U of South Carolina  
Stanford U  
U of Tennessee  
U of Texas at Austin  
U of Texas at Dallas  
Vanderbilt  
U of Wisconsin  
Yale  |
| Canada  | [4/20]        |
| U of British Columbia  
McGill U  
U de Montréal  
U of Victoria  |
| China    | [1/5]         |
| Inst. of High Energy Physics, Beijing  |
| France   | [5/51]        |
| LAPP, Annecy  
LAL Orsay  
LPNHE des Universités Paris VI et VII  
Ecole Polytechnique, Laboratoire Leprince-Ringuet  
CEA, DAPNIA, CE-Saclay  |
| Germany  | [4/31]        |
| Ruhr U Bochum  
Technische U Dresden  
Univ Heidelberg  
U Rostock  |
| Italy    | [12/101]      |
| INFN, Bari  
INFN, Ferrara  
Lab. Nazionali di Frascati dell' INFN  
INFN, Genova & Univ  
INFN, Milano & Univ  
INFN, Napoli & Univ  
INFN, Padova & Univ  
INFN, Pisa & Univ & Scuola Normale Superiore  
INFN, Perugia & Univ  
INFN, Roma & Univ "La Sapienza"  
INFN, Torino & Univ  
INFN, Trieste & Univ  |
| The Netherlands | [1/5] |
| NIKHEF, Amsterdam  |
| Norway   | [1/3]         |
| U of Bergen  |
| Russia   | [1/11]        |
| Budker Institute, Novosibirsk  |
| United Kingdom  | [10/66]   |
| U of Birmingham  
U of Bristol  
Brunel U  
U of Edinburgh  
U of Liverpool  
Imperial College  
Queen Mary , U of London  
U of London, Royal Holloway  
U of Manchester  
Rutherford Appleton Laboratory  |

03/22/07  
Visit of Jürgen Mlynek and Albrecht Wagner
Observation of $D^0$ Mixing

![Graph showing observation of $D^0$ mixing](image-url)
Particle Astrophysics

* The establishment of the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) at SLAC in 2003 created a unique environment for forefront research in this emerging field

- KIPAC is a joint institute between SLAC and the Depts of Physics and Applied Physics on the Stanford campus.
- The Fred Kavli building was completed in Spring 2006.
- A second new building, was completed on campus in Sept 2006.
GLAST

* The GLAST experiment will open up a new window on the universe when it is launched early 2008.
  – Factor of 50 improvement in sensitivity over previous experiments for the detection of gamma-ray sources at GeV energies
  – SLAC played the lead role in the construction of the Large Area Telescope (LAT), the main experiment on the mission.

* SLAC scientific focus in three main areas:
  – Indirect detection of dark matter.
  – Particle acceleration in cosmic sources.
  – Relativistic outflows.
GLAST MISSION ELEMENTS

- **GLAST Spacecraft**
- **Large Area Telescope & GBM**
- **DELTA 7920H**
- **GPS**
- **TDRSS SN S & Ku**
- **White Sands**
- **Mission Operations Center (MOC)**
- **GLAST Science Support Center**
- **GBM Instrument Operations Center**
- **LAT Instrument Operations Center**
- **HEASARC GSFC**
- **GRB Coordinates Network**
- **03/22/07**
Dark Energy

* The Large Synoptic Survey Telescope (LSST):
  – A large area, widefield ground-based telescope designed to survey half
    the sky every few nights.
  – LSST will constrain dark energy using a range of complementary
    techniques: weak lensing, Type 1a SNe, baryon acoustic oscillations,
    clusters of galaxies.
  – SLAC is the leading the development of the 3.2 Gigapixel camera for
    this facility.

* The SuperNova Acceleration Probe (SNA):
  – A candidate for the Joint Dark Energy Space Mission (JDEM), SNAP
    will constrain dark energy using supernovae and weak lensing.
  – SLAC is leading the electronics development for the mission and the
    fine guidance system.
  – KIPAC scientists are playing key roles in the strong lensing program.
The Energy Frontier

* SLAC is committed to playing a forefront role at the energy frontier, first through the LHC, and eventually through the ILC.

* ATLAS
  
  – Group now is ~ 10 FTEs. Will grow by a factor of two.
  
  – Junior Faculty search in progress.
  
  – Involved in both the pixel and trigger subsystems.
  
  – Will host Tier 2 facility.
  
  – Hope to play a coordinating role for the US ATLAS community, especially on the West Coast.

  – Exploring possible roles in the ATLAS upgrade.
International Linear Collider

* The highest priority for the international field of particle physics is the full, direct exploration of the TeV energy scale.
  – with high probability, new physics will be there

* SLAC is committed to the ILC
  – SLAC staff are broadly involved in all elements aspects of the ILC effort
  – SLAC has played a key role in all aspects of the ILC design (RF power, operational issues, beam delivery, particle sources).
  – We are lagging behind Europe in detector development due to lack of resources
    • Some hope situation will improve in FY07
The Energy Frontier: Accelerator Research

* Accelerator Research for Future Machines
  – High Gradient Studies for CLIC type machine
  – Development of L-band power sources for ILC

* Proof of Principle Studies of New Acceleration Mechanisms:
  – Plasma Acceleration Experiment
    • FFTB
  – Laser Acceleration
    • NLCTA
L-Band cavity for ILC

>80 GeV e- @ SLAC
From plasma accelerator

SLAC Prototype Collimator Jaw
Summary

* PPA in time of transition
  – Changes from past
  – Exciting opportunities for the future but also significant uncertainty

* The B-Factory remains the highest priority for the current program. We are committed to making its final year of running as successful as possible.

* We are working with the community and the agencies to develop balanced, forward looking, science driven programs