LSST All Hands Meeting at NCSA
29 Institutional Members of LSST

- Brookhaven National Laboratory
- California Institute of Technology
- Carnegie Mellon University
- Chile
- Columbia University
- Drexel University
- Google Inc.
- Harvard-Smithsonian Center for Astrophysics
- Johns Hopkins University
- Kavli Institute for Particle Astrophysics and Cosmology at Stanford University
- Las Cumbres Observatory Global Telescope Network, Inc.
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- National Optical Astronomy Observatory
- Princeton University
- Purdue University
- Research Corporation for Science Advancement
- Rutgers University
- Space Telescope Science Institute
- SLAC National Accelerator Laboratory
- The Pennsylvania State University
- The University of Arizona
- University of California, Davis
- University of California, Irvine
- University of Illinois at Urbana-Champaign
- University of Pennsylvania
- University of Pittsburgh
- University of Washington
- Vanderbilt University
3200 megapixel camera
The LSST CCD Sensor

16 segments/CCD
200 CCDs total
3200 Total Outputs
The LSST site
DSS: digitized photographic plates

7.5 arcminutes
Sloan Digital Sky Survey
LSST -- almost

2800 galaxies $i < 25 \text{ mag}$
LSST survey

- 4 billion galaxies with redshifts
- Time domain:
  - 1 million supernovae
  - 1 million galaxy lenses
  - new phenomena
3-D Mass Tomography

2x2 degree mass map from Deep Lens Survey
LSST will measure total neutrino mass
models of dark energy

**Expansion of the Universe**

- Dark Matter + Dark Energy affect the expansion of the universe

<table>
<thead>
<tr>
<th>$\Omega_m$</th>
<th>$\Omega_v$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- Relative size of the universe
- Billions of Years
- Now
Testing models of dark energy

Fractional Errors

\[ \sigma(\ln G_i) \]

\[ \sigma(\ln D_i) \]

With systematics

LSST WL + BAO + Planck
LSST Survey

- Begin operations in 2015, with 3-Gigapixel camera
- One 6-Gigabyte image every 17 seconds
- 30 Terabytes every night for 10 years
- 200-Petabyte final image data archive anticipated
- 20-Petabyte final database catalog anticipated
- Real-Time Event Mining: ~100,000 events per night, every night, for 10 yrs
- Repeat images of the entire night sky every 3 nights
Data volume

- 100+ PB - pixel data
  - including 55 PB raw images

- ~20 PB - catalogs
  - Single largest table $3 \times 10^{12}$ rows
Proposed DOE-OHEP Role in LSST

- Design, development, fabrication, and testing of the camera.

- Lead role in the construction on the data access system within data management, and key role in data management systems engineering.

- Leadership in the analysis of LSST for the purpose of constraining the nature of dark energy.

  - For NSF, LSST is a “facility” enabling a broad-range of user-initiated science investigations.

  - For DOE, LSST is an “experiment” that will probe dark energy through a suite of analyses performed by one or more collaborations (e.g. weak lensing, strong lensing, large-scale structure, supernovae).
SLAC Scientific Staff Working on LSST

- Steve Kahn (Program Lead)
- Kirk Gilmore (Camera Scientist)
- Rafe Schindler (Cryostat Subsystem Manager)
- Dave Burke (Calibration Scientist)
- Andy Rasmussen (Focal Plane Metrology)
- Stewart Marshall (Camera Controls)
- Walt Innes (Controls-Hardware Interfaces)
- Gregory Dubois-Felsmann (Data Management)
- Mike Huffer (Data Acquisition)
- Jack Singal (Contamination) - postdoc
- Debbie Bard (Weak Lensing Methodology) - postdoc
Major Camera Institutional Roles

- **SLAC** - Overall project management, cryostat, camera body and mechanisms, thermal system, data acquisition and controls, integration and test, calibration.

- **BNL** - Development and assembly of science rafts, including science sensors, front-end and back-end electronics, and raft structures.

- **LLNL** - Design and development of the optical elements of the camera, including the refractive lenses and the optical blocking filters. Leadership of the corner raft development.

- **Harvard** - Design and testing of electronics.

- **Penn** - Design and testing of electronics. Electronics system engineering.

- **UCSC** - Leadership of camera controls and data acquisition.

- **Purdue** - Corner raft assembly and testing.

- **UIUC** - Camera controls and data acquisition.

- **UC Davis** - Sensor testing in f/1 beam.

- **Arizona** - Camera utilities.

- **IN2P3 (France)** - Sensor testing, front-end electronics, filter design and testing, camera calibration, camera control software.
Dark Energy Science Facility

- We envision that the major dark energy science investigations (weak lensing, baryon oscillations, supernovae) will be supported by a “science analysis facility”.

- This facility would ensure that the computing resources required to carry out the primary dark energy analyses (weak lensing, baryon oscillations, supernovae) are properly sized and supported. It would be part of the “DOE LSST Program”, but not part of the “LSST Project”, which, in general, does not support science investigations beyond production of the pipeline data products and maintenance of the data access centers.

- It would make sense to base computation for such a facility at SLAC, benefiting from the extensive infrastructure created for BaBar and ATLAS.

- The scientific leadership would come from universities, particularly UC Davis and U. of Pennsylvania, which are leading the weak lensing efforts, and U. of Washington and Purdue, which are leading the simulations.

- SLUO can play an important role in helping to enable this to work. The dark energy science facility would benefit significantly from the presence of a vibrant on-site user community.