Science Opportunities with LSST

M. A. Strauss (Princeton) and the LSST Collaboration

The Large Synoptic Survey Telescope (LSST) will have a scientific impact on fields ranging from studies of asteroids in the Solar System to the nature of dark energy. The LSST has defined a series of Science Collaborations, semi-autonomous groups of scientists drawn from the astronomy and high-energy physics communities, which will lay the detailed groundwork to carry out scientific investigations once the LSST sees first light data in 2013. These collaborations will work with the LSST team on various aspects of survey design, cadence and depth, software pipelines, and database design. They will take the lead in carrying out science investigations with early data from the LSST, to commission the system and ferret out subtle problems in the data. They will develop code and other analysis techniques to allow them to take full advantage of the data once it starts to flow, and will plan precursor or follow-up observations using other facilities needed to meet their scientific goals.

The LSST will be a resource for the entire US scientific community, with broad access to the data and no proprietary data period. The combination of depth, sky coverage, and cadence of the LSST are unprecedented, and the project actively seeks input from the community on innovative scientific applications for the deep multi-wavelength data.

The LSST Key science drivers all utilize the same wide-field multi-band imaging data and are representative of LSST's system capabilities:

- *Precision Characterization of Dark Energy and Dark Matter*
- *Mapping the Milky Way*
- *Taking an Inventory of the Solar System*
- *Exploring the Transient Optical Sky*

The LSST will make it possible to pursue many other research programs, and the public nature of the data will allow both the astronomical and high-energy physics community to carry out this science.

A series of *LSST Science Collaborations* will:

- Develop the detailed science case within each scientific area, and develop analysis software to accomplish this science;
- Obtain necessary precursor and auxiliary data needed for scientific goals, such as calibration data for photometric redshifts.
- Work with the LSST infrastructure teams to refine plans for image processing, database management, observing strategy/cadence, calibration, and other aspects of LSST.
- Play a crucial role in the scientific commissioning of LSST once data begin to flow.
- Write many of the core LSST science papers!

LSST Science Collaborations and their chairs

1. **Supernovae: M. Wood-Vasey (CfA)**
2. **Weak lensing: D. Wittman (UCD) and B. Jain (Penn)**
3. **Stellar Populations: Abi Saha (NOAO)**
4. **Active Galactic Nuclei: Niel Brandt (Penn State)**
5. **Solar System: Steve Chesley (JPL)**
6. **Galaxies: Harry Ferguson (STScI)**
7. **Transients/variable stars: Shri Kulkarni (Caltech)**
8. **Large-scale Structure/BAO: Andrew Hamilton (Colorado)**
9. **Milky Way Structure: Connie Rockosi (UCSC)**
10. **Strong gravitational lensing: Phil Marshall (UCSB)**

171 signed on already, from member institutions and LSST project team. Additional applications from the community will be solicited in the next few months. Ideas for additional science collaborations actively welcomed.

6-band Survey: *ugrizY* 320–1050 nm

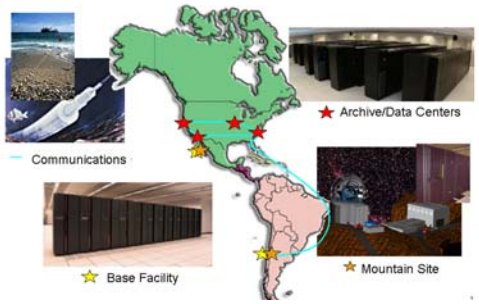
Sky area covered:	**20,000 deg² 0.2 arcsec / pixel**
	+10,000 deg² in North for full ecliptic plane coverage
Each 9.6 sq.deg FOV revisited	**150-200 times/band in *rizY***
Coadded limiting magnitude:	**26.2-27.6 AB magnitude @5σ (24.8 in Y)**
	23-25 AB mag in 30 second visit
Photometric calibration:	**0.01 mag requirement, 0.005 mag goal**
Astrometric calibration:	**10 mas/visit; proper motions to 0.2 mas/year**
Galaxy density:	**50 galaxies/arcmin²**
	3 billion galaxies with color redshifts
Time domain:	**Log sampling, seconds – years**

Full system simulations

We have developed an end-to-end simulation of the LSST system, including the effects of atmospheric propagation, optical transfer function, detector properties, and science signals of interest (in particular weak gravitational lensing).

Data on Disk:

Processed images:	**30 PB / yr**
Raw images:	**5 PB / yr**
Time-Photometry Catalog:	**300 TB / yr**

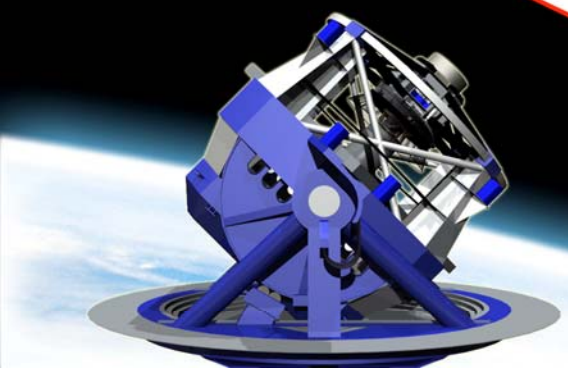


LSST Data Management

Fusion of astronomical algorithm and high performance computing communities

http://www.lsst.org

Data access: The LSST is open-source open-data. The LSST project has begun supplying source code to others. LSST is a community collaboration and data will be promptly provided to the community, with *no proprietary data period.*



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