Large Synoptic Survey Telescope:
Science Collaborations

Michael Strauss
*Princeton University*

LSST Science Requirements
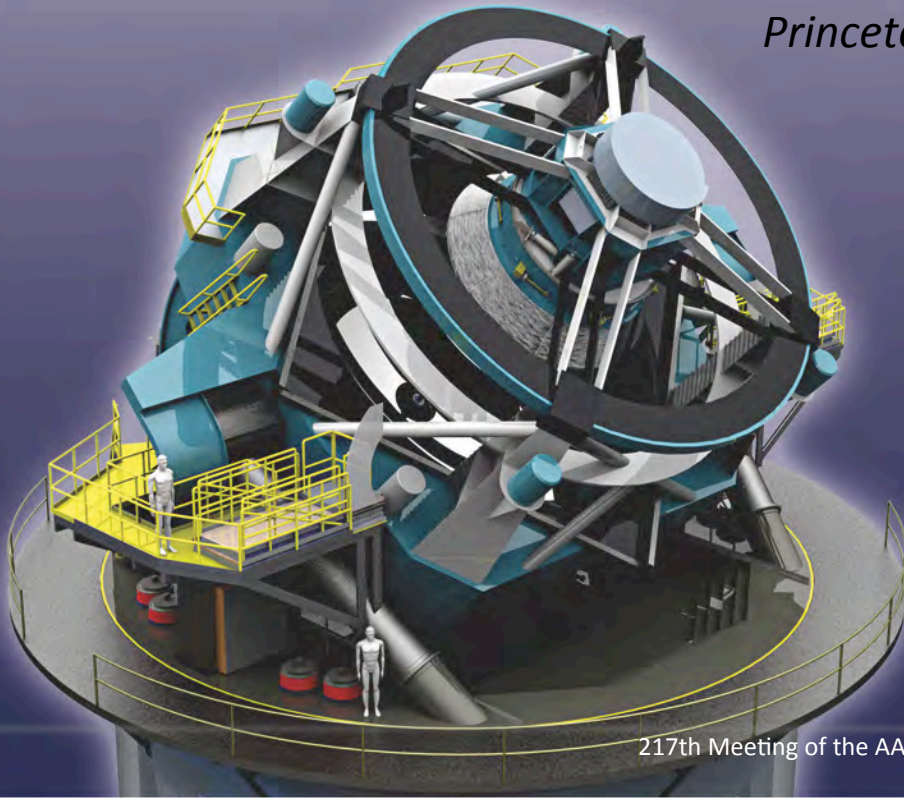
- Based on four science themes that exercise various aspects of the survey:
  - Dark energy and dark matter, especially weak lensing
  - Inventory of the Solar System
  - The transient universe
  - Mapping the Milky Way
- These lead to requirements on depth, seeing, astrometric and photometric precision, cadence, filters, etc.

LSST: A dedicated 10-year survey
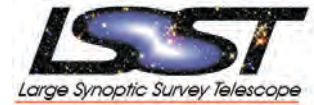
- Main survey will cover 20,000 deg^2, 2000 exposures across 6 filters.

- 5σ point-source depth after two exposures: 23.9 (u), 25.0 (g), 24.7 (r), **24.0** (i), 23.3 (z), 22.1 (y)

- Depth at end of the survey: 26.3 (u), 27.5 (g), 27.7 (r), **27.0** (i), 26.2 (z), 24.9 (y)

- Perhaps 10% of the time will be devoted to 'deep fields' ~1 mag deeper; cadence good for faint Kuiper Belt Objects, good light curves for supernovae, and short-timescale transients.

- ***20 trillion observations of 20 billion objects***

Extremely high-quality data
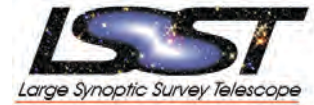
- Median delivered image quality of 0.67".

- Can cover all the available sky in a given filter in roughly 3 nights.

- Probes of variability on timescales from 15 seconds to 10 years.

- Stellar photometric calibration to 1% or better; stellar repeatability to 0.5%.

- Astrometry to 10 mas per visit, allowing proper motions uncertainty of 0.2 mas/year, and parallax uncertainty of 1 mas over the course of the survey. LSST matches Gaia's astrometric precision at r~20, and extends it 4 magnitudes fainter.

A Series of Science Collaborations
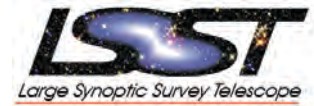
- Weak lensing (*Bhuvnesh Jain and Dave Wittman*)

- Strong lensing (***Phil Marshall***)

- Supernovae (*Michael Wood-Vasey and Richard Kessler*)

- Large-scale structure/BAO (*Hu Zhan and Eric Gawiser*)

- AGN (*Niel Brandt*)

- Galaxies (*Harry Ferguson*)

- Galactic structure (***Beth Willman** and Marla Geha*)

- Stellar populations (*Abi Saha and Kevin Covey*)

- Variability and transients (***Lucianne Walkowicz** and Josh Bloom*)

- Solar system (***Lynne Jones** and Michael Brown*)

- Informatics and Statistics *(Kirk Borne)*

Scientific Input Continues to be Needed at Every Stage of LSST Development

Basic decisions on filter choices, cadence, deep drilling fields, etc.

LSST Data Management
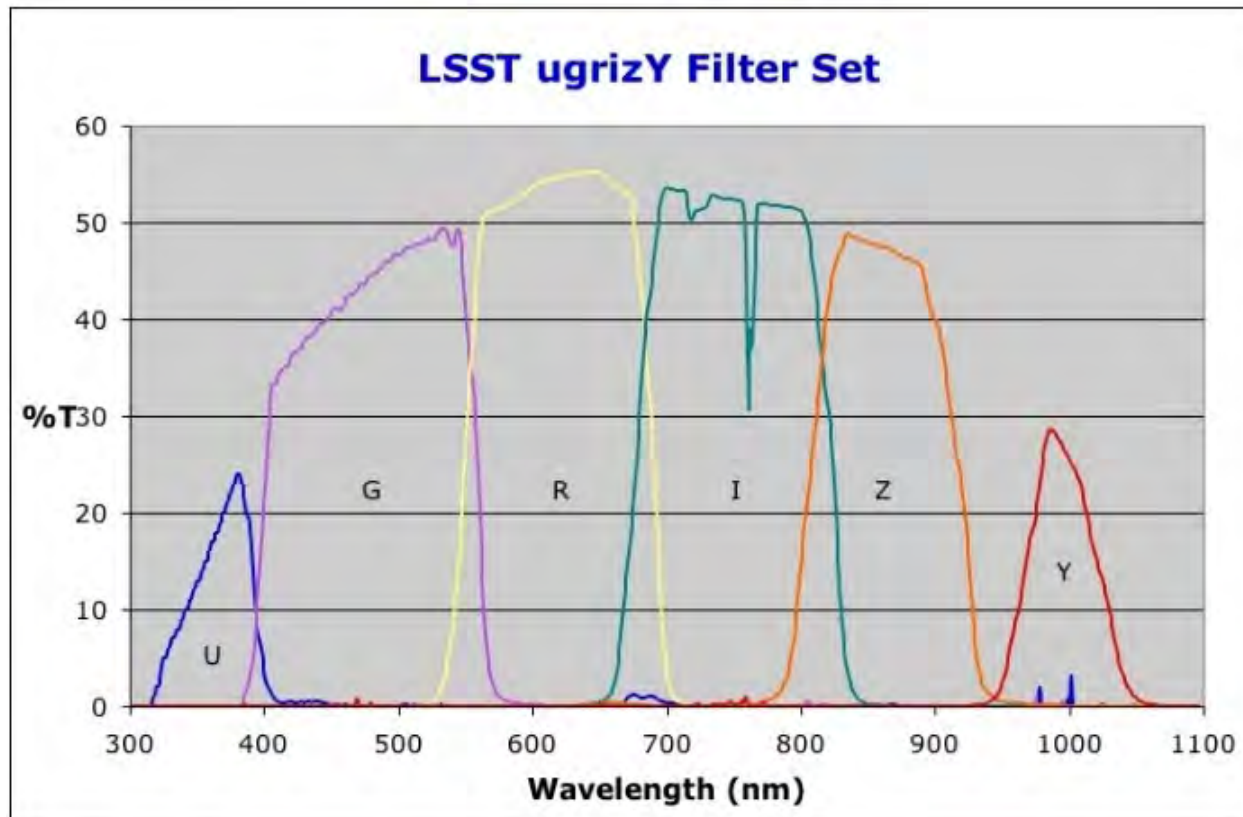
- LSST software effort is underway: development of data processing algorithms, database structures, etc.

- Input from scientists is needed at all stages: algorithm design/development, testing, quantities to be measured, database design, etc.

- Science collaborations will have opportunity to run their own codes on LSST data using LSST infrastructure.

LSST Commissioning

- We have two years from engineering first light to confirm that we meet our science requirements.

- Scientists will be involved in all stages of this commissioning period: planning the observations that will be carried out, analyzing the first data.

- Carrying out scientific analyses with early data will be the best way to reveal possible subtle problems.

Membership of the Science Collaborations

- Currently over 350 people are involved in one of the science collaborations.

- Membership is more than "adding your name to the mailing list"; members are expected to contribute actively to the collaboration.

Membership is drawn from those working on LSST infrastructure and from LSST member institutions.

Adler Planetarium, Arizona, Brookhaven, Caltech, Carnegie Mellon, Cornell, Drexel, George Mason, Google, Harvard-Smithsonian, Illinois, IN2P3 (Paris), Johns Hopkins, Kavli/Stanford, Las Cumbres Observatory, Lawrence Livermore, Los Alamos, Michigan, National Optical Astronomy Observatory, Penn, Penn State, Princeton, Purdue, Research Corporation, Rutgers, SLAC, Space Telescope, Texas A&M, UC Davis, UC Irvine, Vanderbilt, Washington, and the Chilean astronomical community
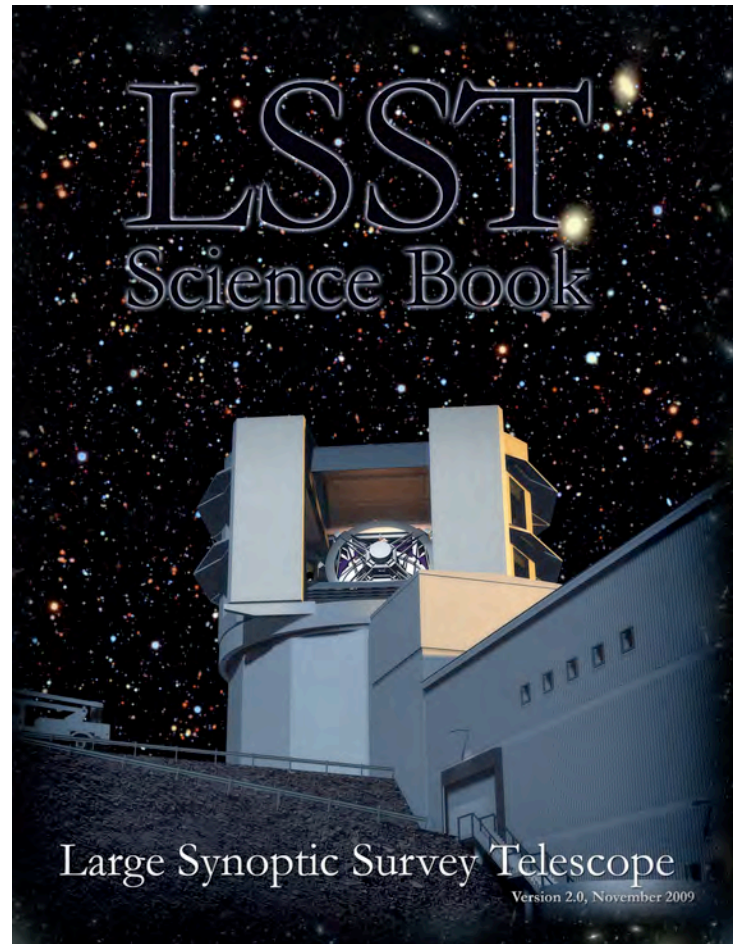
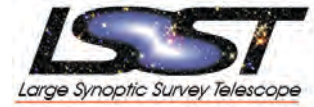# Science Collaborations led the writing of the LSST Science Book
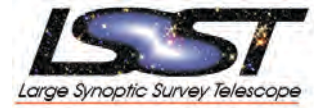
Completed a year ago.
596 pages, 245 authors,
15 chapters and 4
appendices.
Available at:
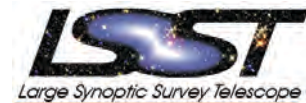http://www.lsst.org/lsst/
scibook

An Annual Call for Proposals to join the Science Collaborations

- Administered by NOAO, those not at LSST institutions can apply for membership.

- Selection is based in part on what one can contribute to the collaboration *now*.

- One can also propose to start new science collaborations.

- Proposals are due in mid-October.

LSST data will not be proprietary: so why join a science collaboration?

- Be in a position to actively influence and contribute to LSST design, including cadence and software. Science Collaborations are advocates for their science needs within the LSST.

- Interact with those developing LSST infrastructure.

- Get a running start on planning to do science once LSST data begin to flow.

- Become fully cognizant of LSST data strengths and quirks, and become familiar with LSST software.

- The survey needs you!