

# The Large Synoptic Survey Telescope: A Challenge and an Opportunity

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# Some Observations

- Many interesting ambitious projects are under way/being planned.
- Recognition that software is a major area of concern/risk
- The astronomical community is wrestling with proprietary data issue

# Multiple Ambitious Surveys!

Mostly Static: 2MASS, SDSS,  
UKIDSS, multiple NOAO survey  
programs, Dark Energy Survey...

Variability: Microlensing surveys,  
GRB monitoring, QUESTs, TAOS,  
SN surveys, Pan-STARRS...

*Some are funded, some are not*

*Varying data release policies*

# LSST era will be different...

- Qualitative change in A? product, dense time domain coverage:
  - deep time lapse multiband image of the sky.
- What's now rare will become common
  - Many tens of thousands of SNe
  - Microlensing events across entire local group
  - ...
- New classes of rare events
  - Microlensing of a supernova in an arc galaxy

# LSST will be different...

- Science accomplished through:
  - Database queries on LSST catalogs
  - Project-specific pipelines for LSST images
- We need to achieve a consensus on observing strategy, as science evolves
- We need to establish a mechanism to arbitrate access to bottleneck resources
  - Bandwidth
  - Scratch space on disk
  - Computing power
  - Database transactions
  - .....?

# We need to adjust our thinking

- Data volume is truly enormous
- Big challenge, but also big opportunity!
- New *type* of resource for both research and education

# Two Approaches:

“How could my current science goals be advanced with LSST data?”

“What *new* opportunities does LSST offer?”

We saw more of the former than the latter....

# LSST will have no proprietary data period

Those who are best prepared will be the beneficiaries of this....

## Implications:

*Users:* Training and education of both practicing scientists and students.

*LSST Project:* Clarity on data products, access mechanisms, user education.

# Scientific Computing is Changing

- Computing has changed science, and science is driving changes in computing:

The Web has changed the world.....

Virtual Observatory approach is moving forward

GRID-based computing may take off (or not!)

*LSST challenge is to design an architecture and access model that will (at least!) survive and (at best!) exploit the inevitable evolution of the nature of computing.*

# Data Processing

- For our present data reduction tools, cluster computing provides adequate processing power
- After crosstalk correction, becomes an “embarrassingly parallel” computing problem
  - Hand each amplifier to a dedicated CPU
- Looks like turnaround in 10’s of sec is achievable.

# Data Storage

- If disk capacity and pricing continue on current trends, storage of large data sets appears quite tractable.

# Data Transport

- “Moving tens of Terabytes/day over continental distances, is likely to be routine.”

(T.S. Axelrod, Sept 2004)

# Information Access

- While reduction hardware and storage capacity look OK, database technology has lagged behind our needs...
  - 1990 MACHO appraisal: immature
  - 2004 SDSS experience: awkward
  - 2010(?) LSST decision point: ?

# The Ideal LSST User Interface



Paper Title:

Paper Authors:

Submit to ApJ

Submit to AJ

# Precursor projects can help immensely

We don't need to wait for LSST first light to address the hard problems:

- Optimal algorithms
- Middleware/scaling issues
- Variability classification
- Information representation
- Data pedigree/provenance issues
- Dialog with user community
- Multiwavelength coordination

# Color/cadence/coverage

- For a fixed amount of telescope time, the observing strategy determines coverage in
  - Wavelength
  - Time domain sampling
  - Depth
  - Area surveyed

A? ??? is our currency, we need to spend it wisely.

Requires high-fidelity simulator.

# The “followup” issue

- Augmenting LSST observations with
  - Complementary wavelengths
  - Denser temporal coverage
  - Spectroscopy

will surely be a good thing!

Should we include, for example, a 2m narrow field multiband (OIR) followup imager?

# Bucking the trend

- US Astronomy has invested in a succession of ever-larger aperture facilities: partial access to Gemini
- Collected photons per source increased
- Number of telescope nights has fallen
- Access to cutting edge facilities limited
  
- LSST will open up scientific/educational opportunity to a broad community
- Multiplex advantage!

# LSST is a Community Project

- This meeting has initiated a conversation
- We need to develop structured science teams, with close ties to LSST project management
- The educational aspects are important!
- Broader impact of LSST:
  - Medical imaging community faces similar challenges
  - Likely to be the world's largest non-proprietary database

# The LSST project needs your input

- Example: Shakedown data products

5 band static image of the accessible sky  
to  $\sim 25^{\text{th}}$  magnitude

Question: Do we want to invest in getting  
U band, B band (as opposed to grizy)?

# LSST contacts:

- *Web site:* [www.lsst.org](http://www.lsst.org)
  - *Project Director:* [tyson@physics.ucdavis.edu](mailto:tyson@physics.ucdavis.edu)
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