

A brief introduction to the Vera C. Rubin Observatory

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LCLS/ECS Delivery/Matter in Extreme Conditions

Co-chair LSST Stars, Milky Way, and Local Volume collaboration



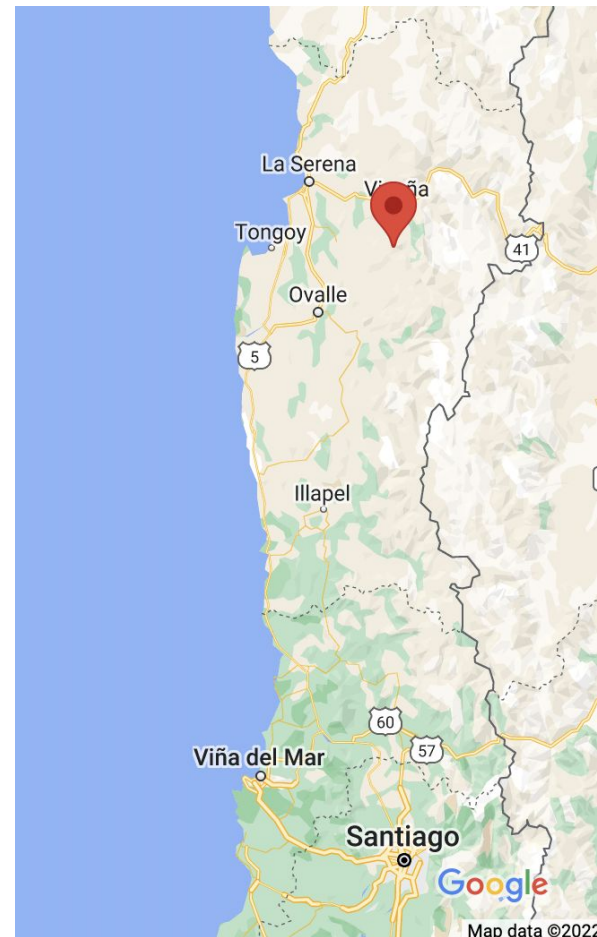
Survey information

Baseline survey:

- Science operations start spring 2024
- 10 year nominal survey

Only one instrument - LSSTCam:

- 1.65m by 3m, 2800 kg
- 3.2 Gigapixels (silicon detectors)
- 3.5 degree FOV
- Imaging surface diameter = 0.64 m
- Six filters (ugrizy) spanning 300 to 1000 nm.

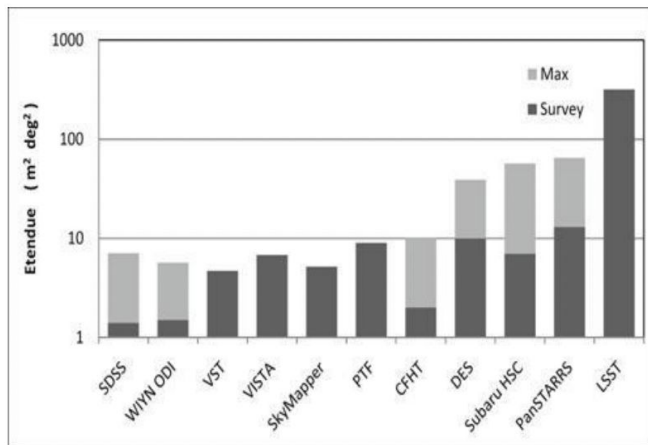


Snow on Cerro Pachon: June 2022



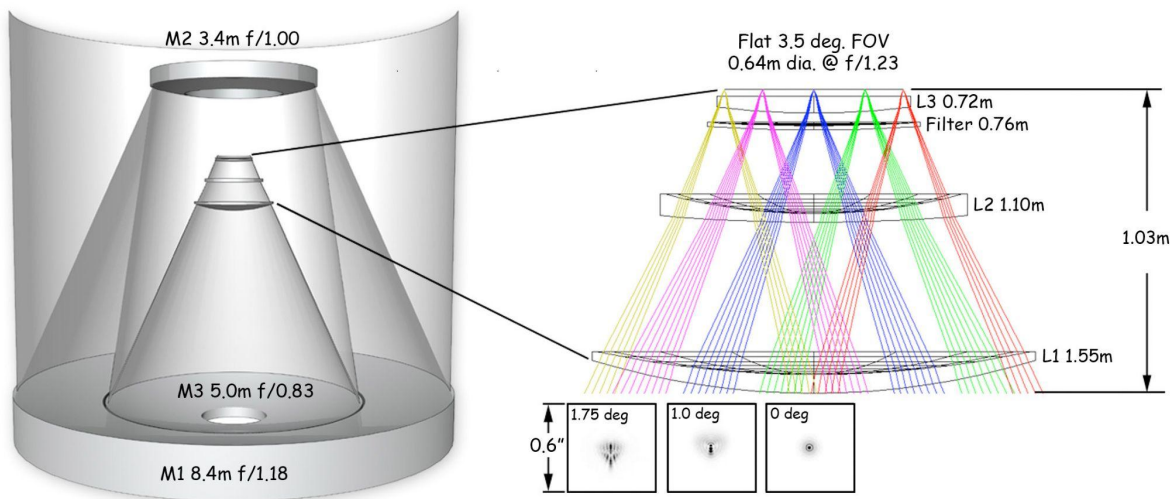
Optical Design - optimized for surveys

Etendue comparison



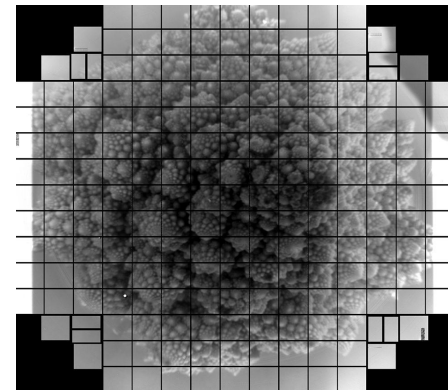
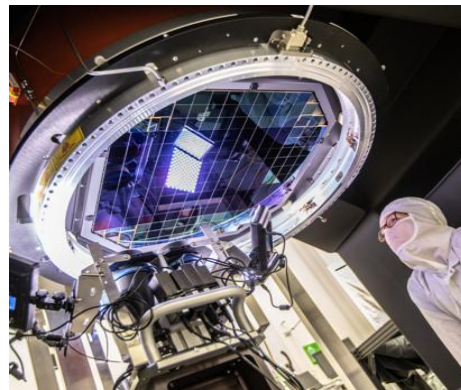
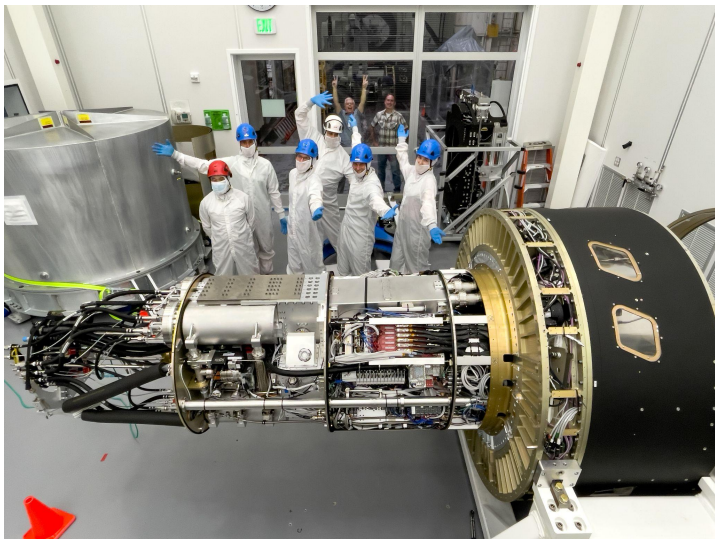
Raw survey efficiency pushed to limits

- large mirror area (6.7m diam effective)
- huge field of view (3.5 deg, 3000X HST)
- Telescope and camera dedicated
- Minimize dead area and time



Somewhere else at SLAC...

8 April 2022: The LSST team successfully completed the lift of the cryostat and installation into the camera body.



Camera - and Mirrors



Inside the
dome



Data Management - 1

Data volume:

- 20 terabytes (TB) of raw data per night.
- The total amount of data collected over the ten years of operation will be about 60 petabytes (PB)
- Processing this data will produce a 20 PB catalog database.
- The total data volume after processing will be several hundred PB, processed using about 150 TFLOPS of computing power for the first Data Release, increasing to 950 TFLOPS by Data Release 11 at the end of the ten-year survey

Data Management - 2

Data processing requirements:

- converting the raw images into a faithful representation of the universe
 - complicated by the advent of StarLink and similar commercial satellite constellations
- implementing automated data quality assessment and automated discovery of moving or transient sources
- archiving the results in useful form for a broad community of users.

The nightly pipelines:

- are based on image subtraction
- rapidly detect interesting transient events in the image stream and **send out alerts to the community within 60 seconds of completing the image readout.**

Science Themes

The Legacy Survey of Space and Time [LSST] is an ambitious program undertaken at the Vera C. Rubin Observatory.

Within the LSST there are four main science themes:

- Understanding Dark Matter and Dark Energy
- Hazardous Asteroids and the Remote Solar System
- The Transient Optical Sky
- The Formation and Structure of the Milky Way

Overall survey concept

At first this seems straightforward - let's create a 10 year digital movie of the sky:

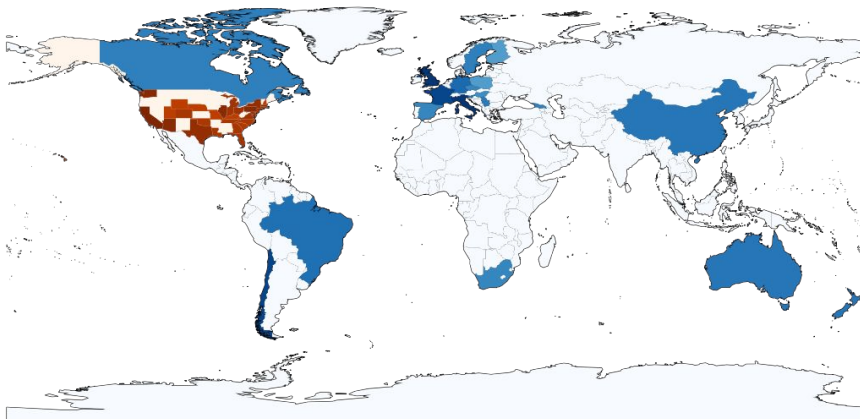
- conduct a deep survey over an enormous area of sky
- do it with a frequency that enables images of every part of the visible sky to be obtained every few nights

However, specific science goals have different requirements on where, when, what filter you use for each exposure:

- Where: extragalactic vs galactic vs solar system studies
- When: best repeat timing to detect/study asteroids or supernovae or quasar variability or your favorite type of variable star
- Filters: only use one filter at a time - so may miss color (multi-band) data

LSST Science Collaborations

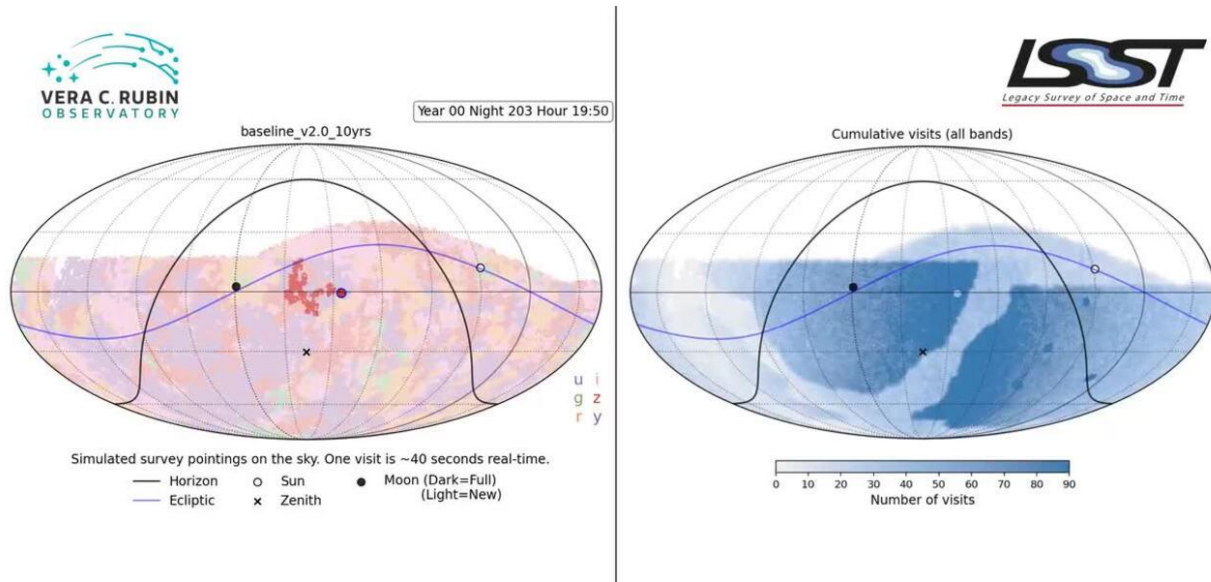
- NSF-DOE Rubin funding extends to construction of Rubin and operation of the LSST
- The self governed science collaborations consist of 1500+ members: physicists, astronomers, data scientists, software engineers



Survey Cadence Optimization

Creation of a survey strategy that benefits the diverse science goals is a complex, lengthy, and heavily debated process!

The project is now using a set of science collaboration created metrics to evaluate different strategies.



Project and Community Workshop: 8-12 August 2022 - Tucson, Arizona

