LSST Commissioning & Science Verification

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Stars, Milky Way & Local Volume Telecon
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Commissioning & Science Verification

- The following describes what commissioning looks like from the project's PoV, focusing on planned observation strategies and technical goals.

- There are also many ways in which Project-Community cooperation would be very valuable in commissioning. This interaction requires some high level policy, which is still a work-in-progress. Will defer that topic until a formal plan can be arranged.
- Second formal review of commissioning plan will take place Summer 2018.

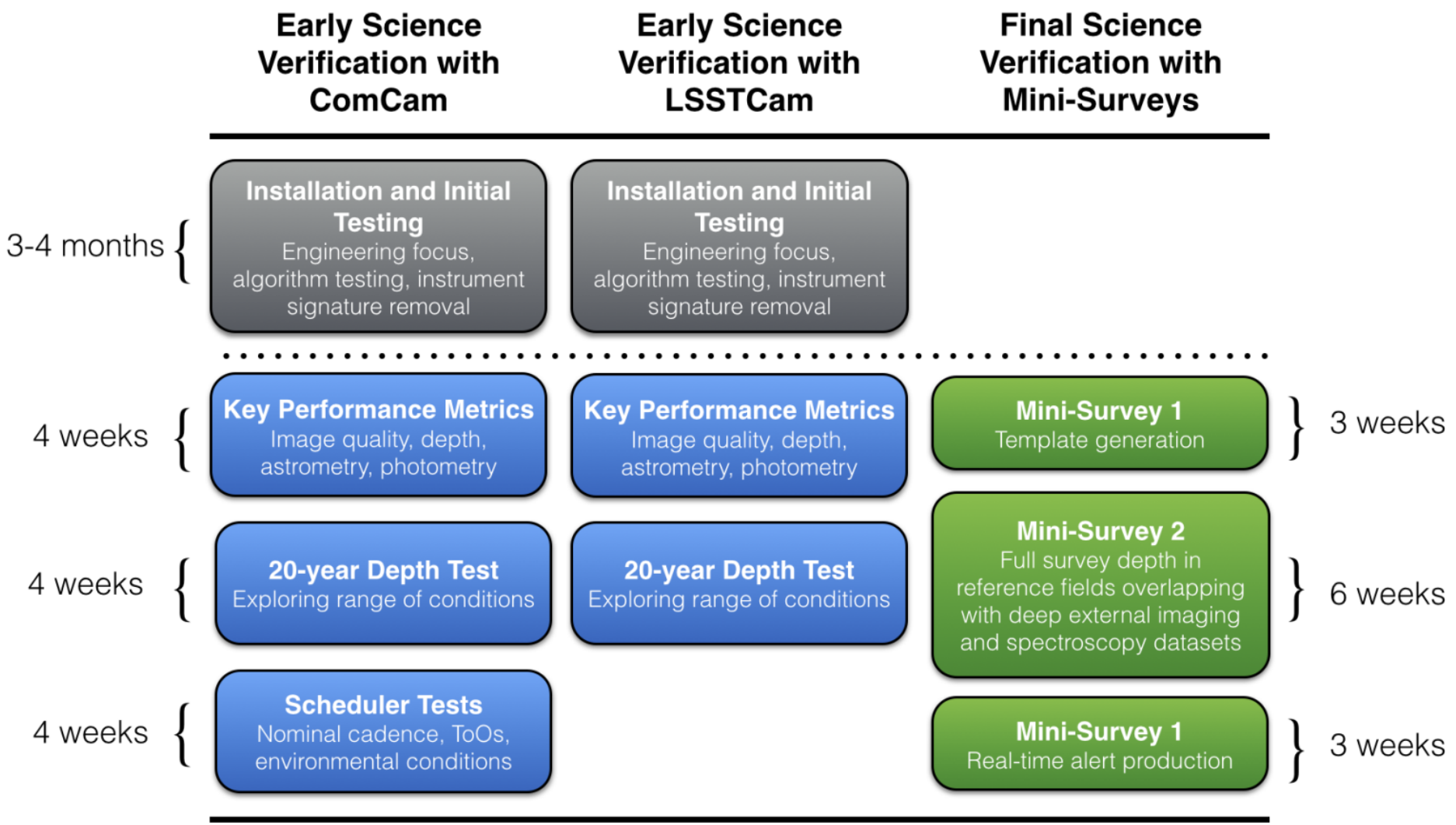
Construction Timeline

Data Production Milestone	Start Date
First on-sky and calibration images with ComCam	May 2020
Sustained observing with ComCam	August 2020
First on-sky and calibration data from Camera+Telescope	February 2021
Sustained scheduler driven observing with Camera+Telescope	April 2021
Start Science Verification mini-Surveys	June 2021

The Goals of Science Verification

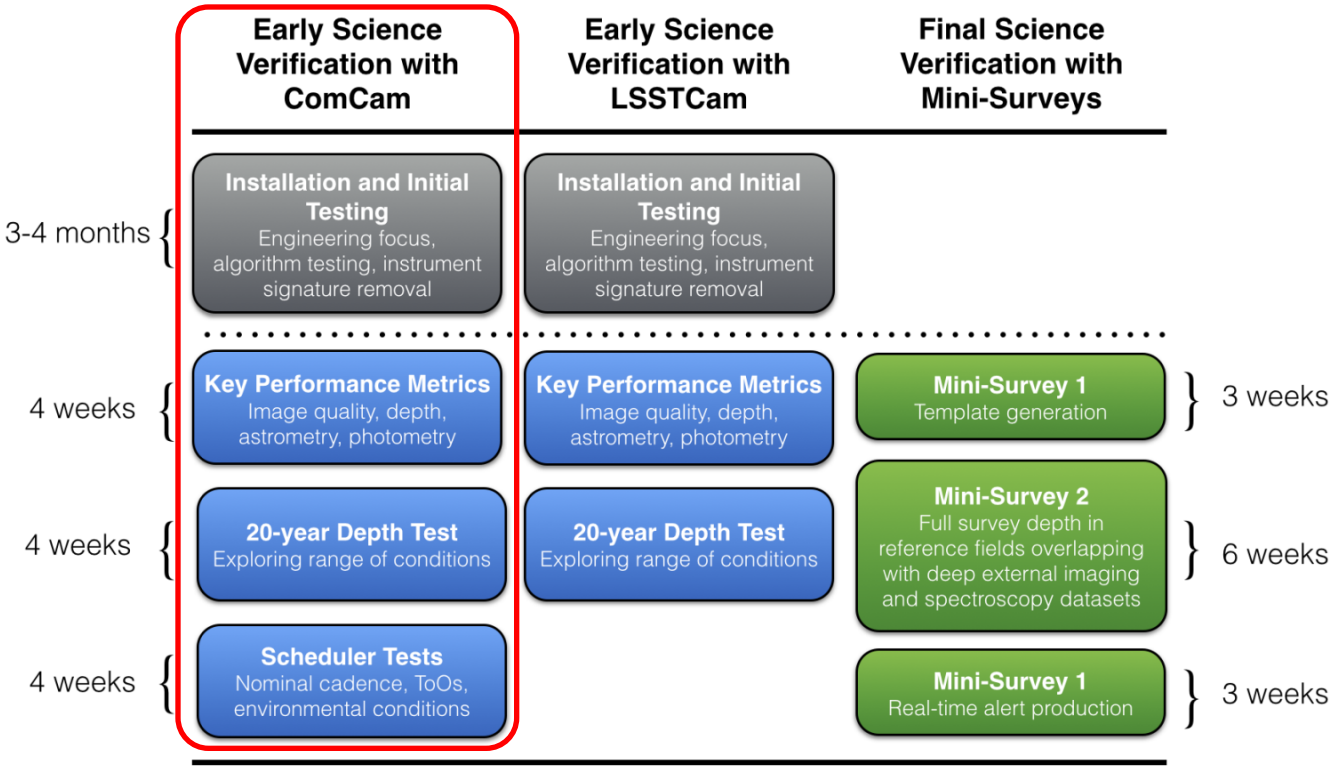
1. Determining whether the specifications defined in the **Science Requirements Document** and **LSST System Requirements** can be met over the full survey
2. Characterizing **other system performance metrics** in the context of the four primary science drivers
3. Studying **environmental dependencies** and **technical optimization** that inform early operations
4. **Documenting** system performance and verifying mechanisms to **monitor** system performance during operations
5. Validating **data delivery**, derived **data products**, and **data access** tools that will be used by the science community

Sustained Observing Periods during Commissioning



Early Science Verification with ComCam

- Science images with ComCam provide a first opportunity to test DM software with on-sky LSST images
- Gradual transition from engineering focus to periods of sustained observing

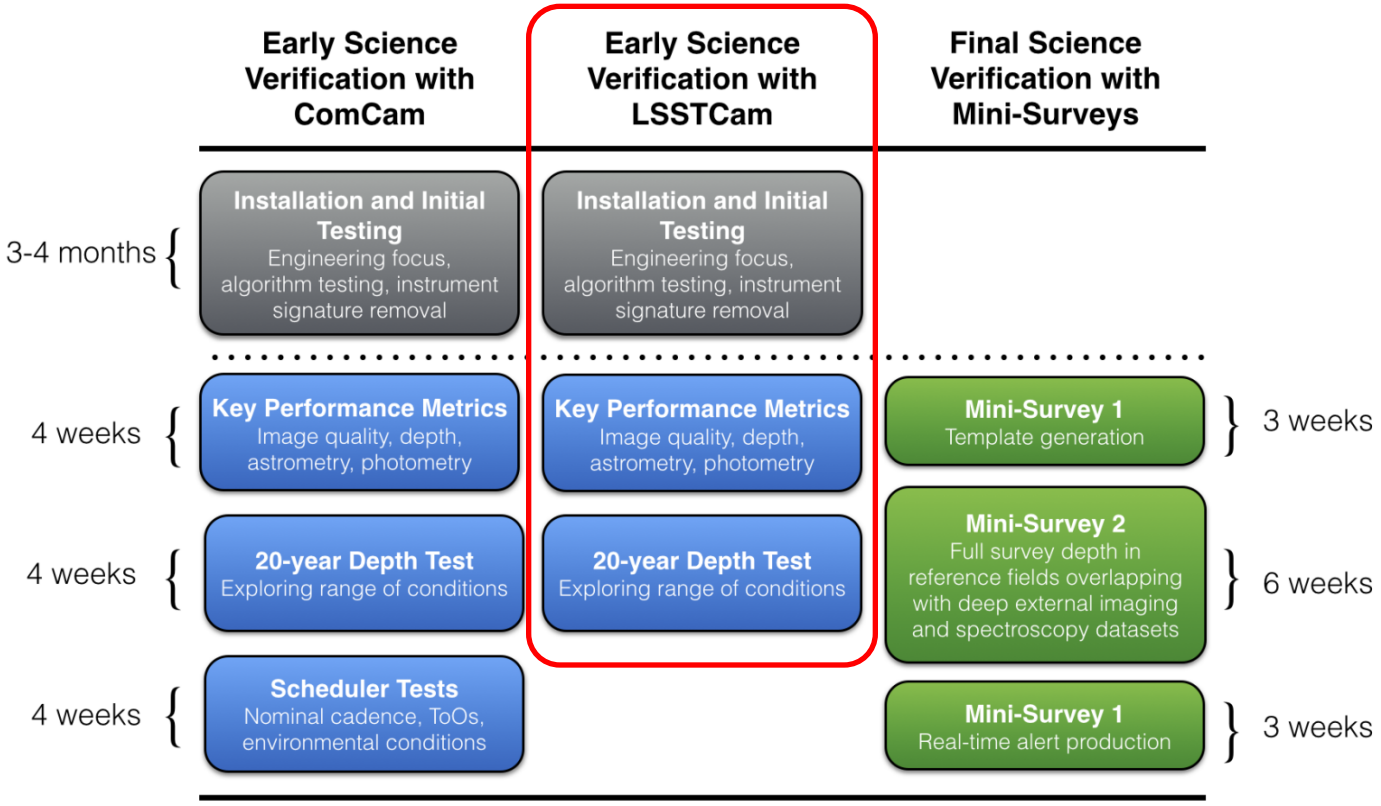


Early Science Verification with ComCam

- Designed to test quantifiable metrics that we have formal requirements on, via the Science Requirements Document and its subsidiaries.
- E.g. photometric & astrometric repeatability, spatial uniformity, PSF ellipticity, differential chromatic refraction.
- Dataset #1 – 20 widely-distributed fields, all filters, ~ 25 exposures per filter. Photometric.
- Dataset #2 – 3 fields at 10 year depth in r and i. ~600 visits per filter. Photometric
- Dataset #3 – 10 fields, 20 year depth, all filters. ~1700 visits. Range of airmass, sky brightness, cloud cover.

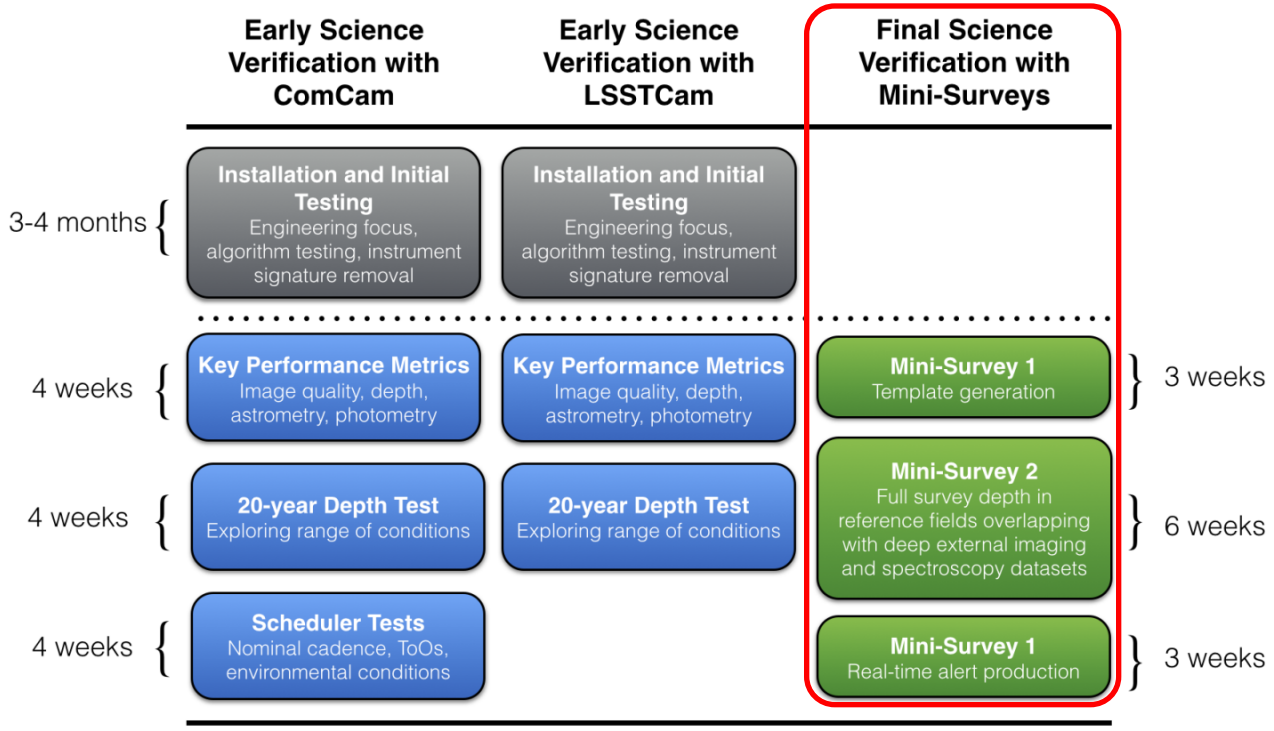
Early Science Verification with LSSTCam

- Repeat sequence of early science verification observations and analysis from ComCam with LSSTCam, making use of experience and analysis tools gained with ComCam
- Focus on range of delivered performance over larger FOV



Final Science Verification with Mini-Surveys

- Two 6-week continuous scheduler-driven mini-surveys exercising the Level-1 and Level-2 data production systems
- Comprehensive characterization of bulk data acquired under nominal observing conditions
- Identifying corner cases with the aid of a larger statistical sample of observations



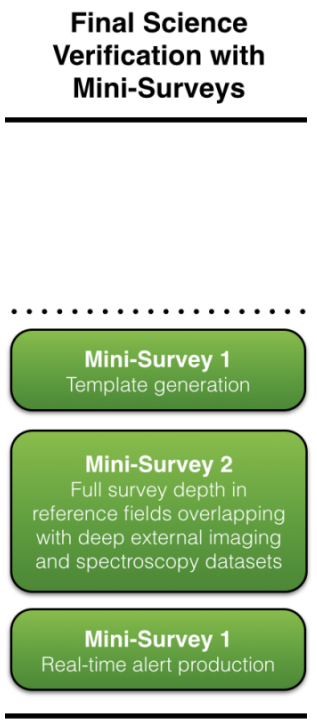
Mini-Survey 1: Wide-Area Alert Production

Objectives:

- Template building with DRP pipeline
- Level-1 processing, real-time alert generation
- Testing survey progress over wide area, validating observation simulations

Observations:

- ~1600 deg^2 x 15 visits x 6 filters x 2 phases (~30,000 visits, ~40 nights)
  - In each phase, cover ~10% of footprint with exposure equivalent to 1 year of Wide-Fast-Deep survey
- Phase 1: Observations for template generation (3 weeks)
- Phase 2: Re-observing area for alert production (3 weeks)
- Phases separated by 6 weeks to allow for astrophysical evolution and template processing (mini-survey 2 scheduled in-between phases)



Mini-Survey 2: 10-year Depth Survey

Objectives:

- Focus on Level-2 data products at full survey depth
- Data quality characterization beyond the SRD through analyses that are closely tied to main science themes
  - e.g., source detection completeness, star-galaxy separation, photo-z, weak-lensing null tests, cluster weak lensing
- Template generation and real-time alert production; these high-cadence observations will form an exceptional dataset for detailed characterization of transient, variable, and moving object alerts

Observations:

- ~30 fields x 825 visits in 6 filters (~25,000 visits, ~30 nights)
  - ~300 deg^2 to full depth of Wide-Fast-Deep survey (~1% of footprint)
- Select fields to overlap with external reference datasets
- Will request community input on planning fields and cadence for both Mini-Surveys

Summary

- Fast cadence of LSST means commissioning can explore wide range of parameter space very quickly.
- “Wedding cake” set of observations to give statistical power, both at depth and across area.
- Mini-surveys will demonstrate the significant capabilities of LSST:
  - 10% of LSST area gets 1-year depth, including image differencing
  - 1% of LSST area gets 10-year depth