Commissioning plans and opportunities

Adapted from December 2018 and March 2019
presentations to Science Collaboration Chairs
by Chuck Claver, Leanne Guy, Bob Blum

Full presentations and further details available on Confluence, via this page:
https://lsst-uk.atlassian.net/wiki/spaces/LUSCSWG/overview

Graham P. Smith, University of Birmingham
LSST:UK All-hands Meeting, Cardiff, May 14, 2019

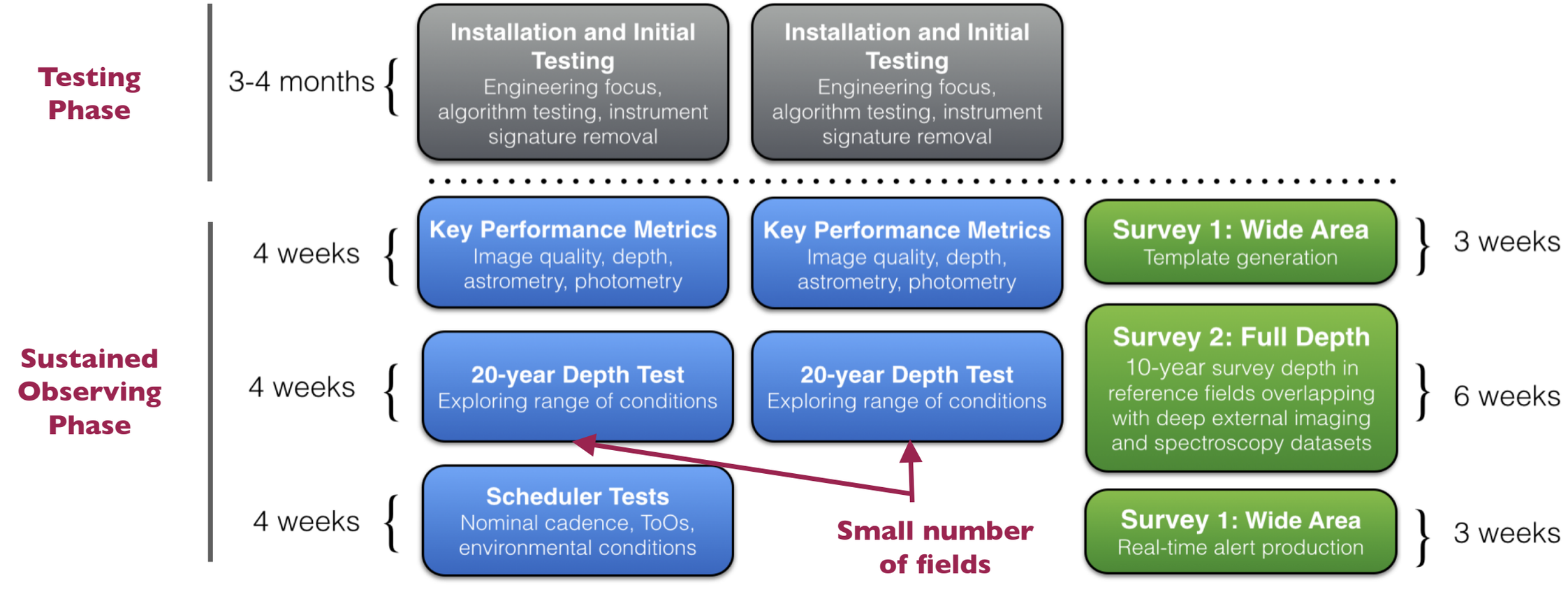
Overview

- Current forecast for commissioning:
  - choice of fields: ongoing, in consultation with SCs
  - observations: Feb. 2021 to Mar. 2022
  - data releases (pixels+catalogues): Mar. 2022 to Sept. 2022
  - alert stream may be available from Aug. 2021
  - moving object pipeline may be run Jul. 2022 to Sep. 2022
- How to participate in / influence commissioning:
  - engage with your Science Collaboration(s)
  - coordinate input to SCs across UK science interests
  - identify and agree value added projects with LSST Commissioning Team (Phase B includes £40k travel funds to support such projects)

https://forms.gle/KoEGYGVbcUX2tfGDA

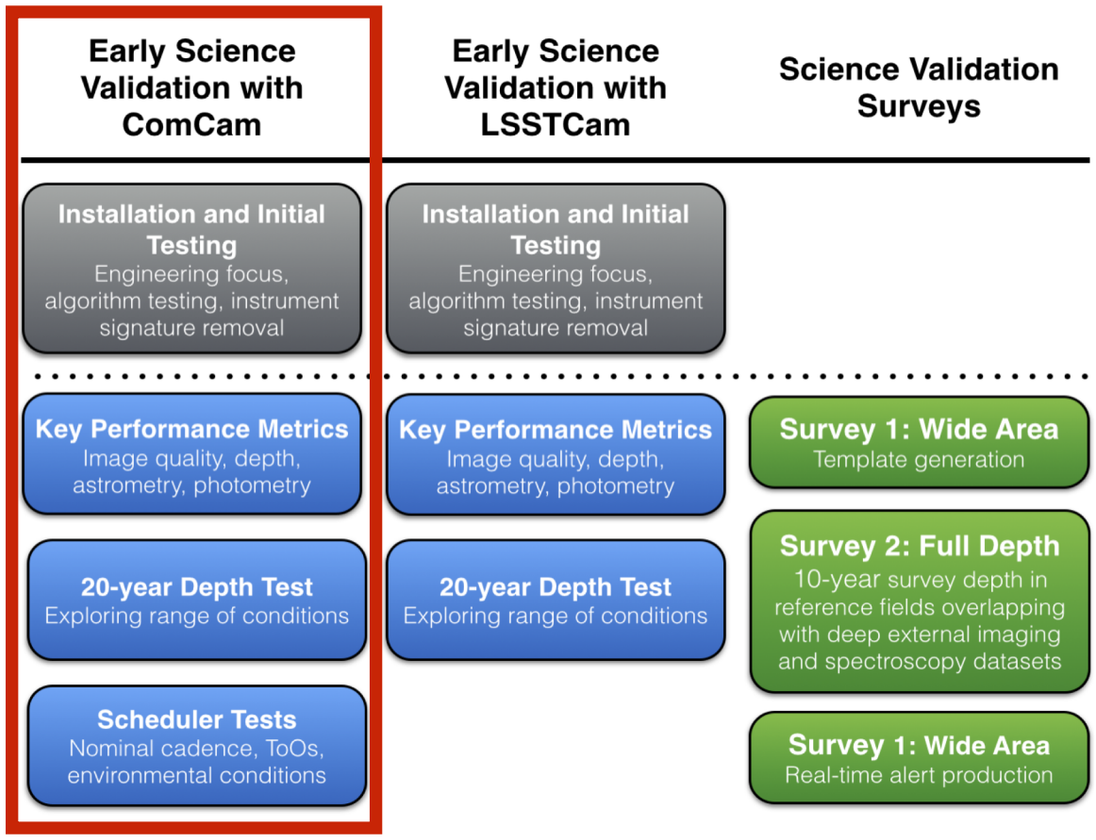
Overview

	Phase 1	Phase 2	Phase 3
Observations	02/21 — 06/21	10/21 — 12/21	12/21 — 03/22
Full data release	03/22	06/22	09/22
	Early Science Validation with ComCam	**Early Science Validation with LSSTCam**	**Science Validation Surveys**



Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

What is ComCam?



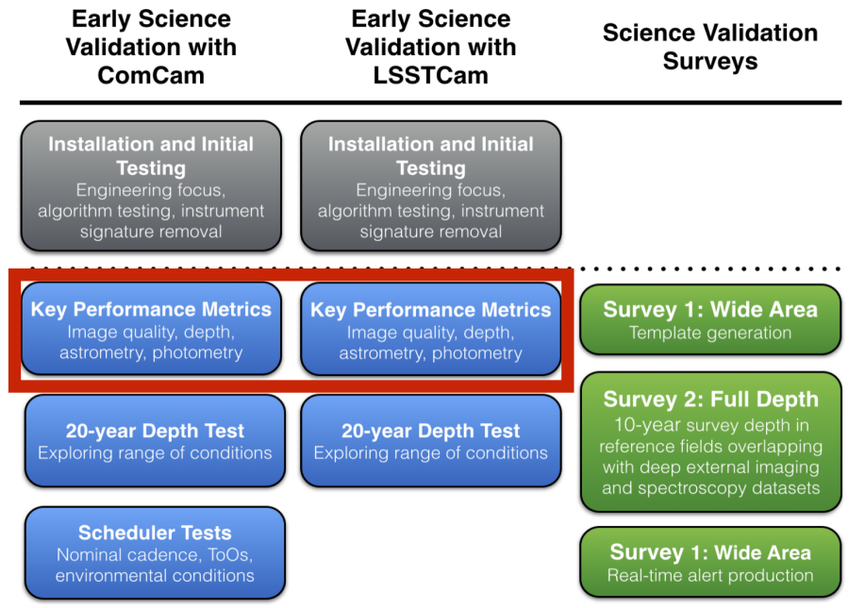
ComCam Technical Summary

- Single Raft - 3x3 CCDs – 144Mpix – engineering grade, possibly low end science grade
- 40 arcmin FOV
- 6 filters ugrizy - 3 LSST filters available at anytime
- Pixel format same as LSSTCam
- Same mass properties as LSSTCam

- Limitations:
  - No Anti-Reflection coating on leses
  - Guiding not available when in imaging mode
  - Closed loop wave-front sensing not available in imaging mode – observing will be paused to tune AOS

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Key Performance Metric (KPM) testing with ComCam and LSSTCam



Objectives

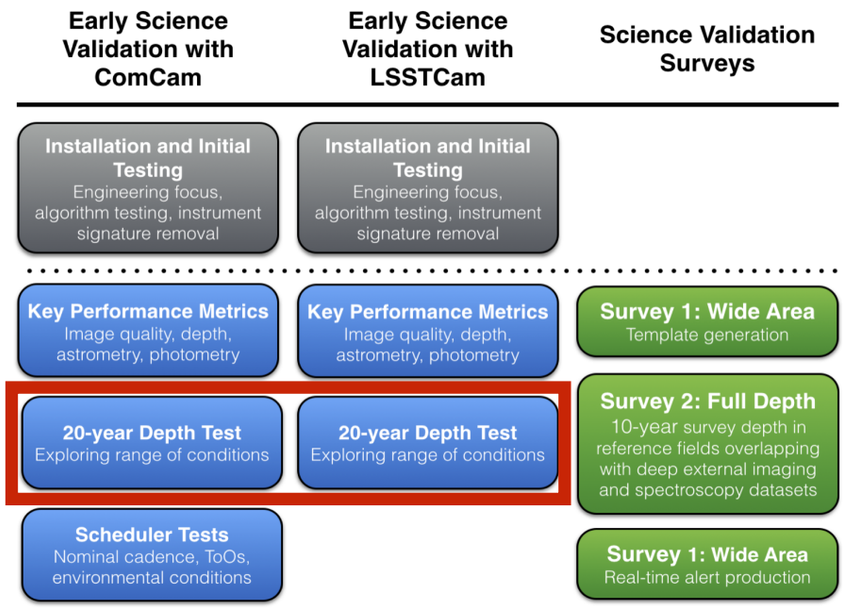
- Evaluate Key Performance Metrics (KPMs) for single-visit performance (e.g., relative + absolute photometry and astrometry, image quality, throughput)
- Measure residual PSF ellipticity distribution; test transient and moving object detection + linkage

Observations

- 20 fields x 5 epochs x 5 visits x 6 filters = 3K visits (~4 nights)
- Several fields contain absolute photometric calibration standards
- Range of airmass, source densities
- 3 fields x 3 (dither allowance) x 200 visits x 2 filters (r, i) = 3.6K visits (~5 nights)
- Sample range of source densities, at least one along ecliptic

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Twenty-year depth testing with ComCam and LSSTCam



e.g. 10-12 fields that are truly unique, with sampling that will never happen during normal ops there will be scince in this data

Objectives

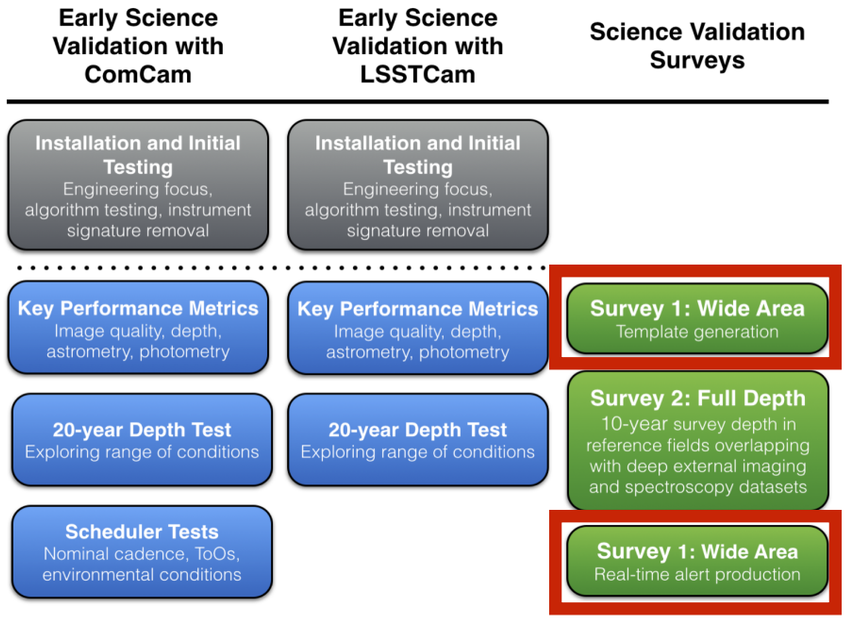
- Focus on image stack performance, sampling range of conditions
- Identify subsets of the data for Data Release Processing (e.g., best/worst seeing, lowest/highest airmass)
- Repeated observations of the same fields are useful for testing template generation algorithms and Alert Processing pipelines (can be offline)

Observations

- Observe 10 fields to depth equivalent to 20 years of Wide-Fast-Deep survey in 6 filters (~1700 visits per field, ~20 nights)
- Where possible, fields should overlap external reference datasets
- Explore a range of environmental conditions to examine various potential systematics — observations driven by needs to test pipeline algorithms
- Dither pointings in each field to approximate Wide-Fast-Deep pattern

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Science Validation Survey 1: Wide Area



Objectives

- Validate template building with Data Release Processing pipeline
- Alert Processing, real-time alert generation
- Monitor survey progress over wide area to test observation simulations

Observations (location and distribution on the sky TBD)

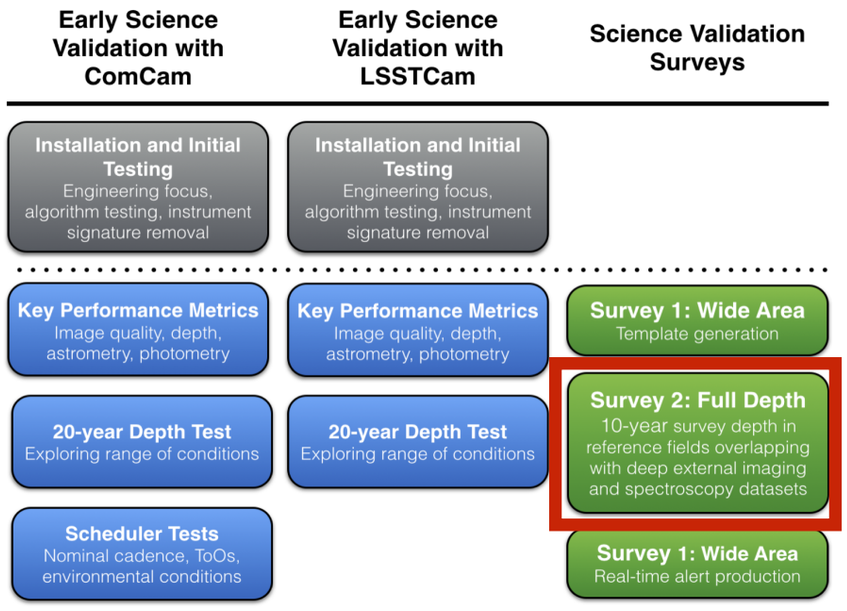
- ~1600 deg^2 x 15 visits x 6 filters x 2 phases (~30K visits, ~40 nights)
- Phase 1: observations for template generation (3 weeks)
- Phase 2: observations of same area for alert production (3 weeks)
- Phases separated by 6 weeks to allow for astrophysical evolution and template processing (Science Validation Survey 2 scheduled between phases)

Additional Considerations

- Use dithered pointings to match Wide-Fast-Deep pattern
- Use large sky area to explore edge cases (bright stars, high source densities, etc.)

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Science Validation Survey 2: Ten-year depth test



Objectives

- Focus on Data Release Products at full survey depth
- Data quality characterization beyond the SRD
- Template generation and real-time alert production (more rapid cadence may enable unique tests)

Observations (location and distribution on the sky TBD)

- ~300 deg^2 x 825 visits across 6 filters (~30K visits, ~40 nights)
- Select fields to overlap with external reference fields
- Scheduler used to optimize data quality across fields

Additional Considerations

- Use dithered pointings to match Wide-Fast-Deep pattern
- Option to select adjoining fields to form larger contiguous full-depth regions
- Alert Processing studies would benefit from early template generation

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

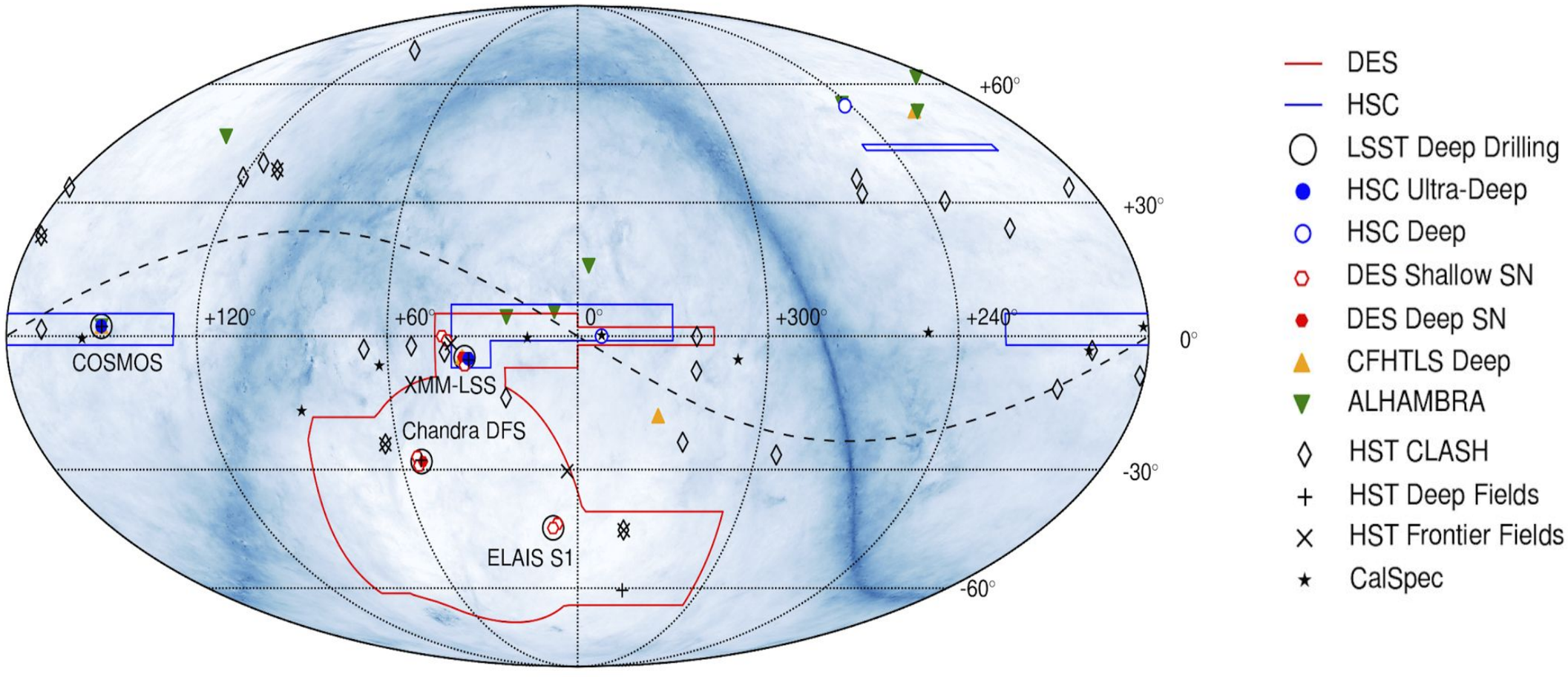
Commissioning field selection

- Quoting Chuck Claver: “ongoing but not done”
- Google form on which to propose fields is being developed (not clear if input is requested only via Science Collaborations)

- Phase 1 and 2 commissioning fields (all 6-filters):
  - KPM testing in Phase 1: 20+ fields
  - 20-year depth testing: 10 fields
- Phase 3 commissioning fields (all 6-filters):
  - Wide area survey: 1600 degree^2
  - 10-year depth test: 300 degree^2

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Commissioning field selection



- Overlap of commissioning fields with deep drilling fields and so-called “pre-cursor” surveys (HSC, DES, et al.) seems inevitable and sensible
- Overlap of commissioning fields with infrared (VISTA, Euclid, Spitzer, AllWISE) and X-ray (XXL) survey footprints is strategically important to UK

Adapted from: PST Briefing to Science Collaboration - Chairs December 18, 2018

Commissioning targets

File Edit View Insert Format Data Tools Add-ons Help

Share

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fx WG

	A	B	C	D	E	F	G	H	I	J
1	**WG**	**Field Name**	**Field Type**	**Time of Year**	**RA**	**Dec**	**Filter(s)**	**Depth**	**Cadence**	**HST imaging**
2			(e.g. "cluster")		degrees	degrees				# pointings; filter
3	PZ	COSMOS	spec-z confirmation	Feb-April	150.1191667	2.20583333	ugrizy	10 year	doesn't matter	lots of existing
4	PZ	SXDS / UKIDSS UDS	External imaging/spectroscopy	Oct-Dec	34.5	-5	ugrizy	10 year	doesn't matter	Candels
5	PZ	VVDS Deep	External spectroscopy	Oct-Dec	43	-4.5	ugrizy	10 year	doesn't matter	
6	PZ	GOODS-S / ECDFS	External spectroscopy	Nov-Jan	53.11667	-27.808333	ugrizy	10 year	doesn't matter	z850,i775,V606,I
7	PZ	DEEP2 field 3	External spectroscopy	Aug-Oct	352.5	0	ugrizy	10 year	doesn't matter	
8	PZ	DEEP2 field 4	External spectroscopy	Oct-Dec	37.5	0	ugrizy	10 year	doesn't matter	
9	PZ	DES SN S1	External spectroscopy	Oct-Dec	42.82	0	ugrizy	10 year	doesn't matter	
10	PZ	DES SN S2	External spectroscopy	Oct-Dec	41.194	-0.9883	ugrizy	10 year	doesn't matter	
11	PZ	HSC wide Fall equator	External spectroscopy(wide)	Fall (southern)	330<ra<40	-1<dec<7	ugrizy	10 year*	doesn't matter	
12	PZ	HSC wide Fall equator	External spectroscopy(wide)	Fall (southern)	27.5<ra<40	-7<dec<-1	ugrizy	10 year*	doesn't matter	
13	PZ	HSC wide Spring equa	External spectroscopy(wide)	Spring (southern)	127.5<ra<225.0	-2<dec<5	ugrizy	10 year*	doesn't matter	
14	PZ	early DESI fields	External spectroscopy (wide)		overlaping with Stripe 82		ugrizy	10 year*	doesn't matter	
15	PZ	PFS pointings	External spectroscopy (deep)					*shallower data also useful		
16										
17		C3R2 fields (already on list, consists of VVDS, SXDS, COSMOS, and EGS[too far north])								
18		HSC deep fields (same as CLAUDS + SXDS)								
19		XMM-LSS (superset of VVDS/SXDS)								
20		CLAUDS fields (HSC fields: XMM-LSS, COSMOS, DEEP2-F3, ELAIS-N1[too far north])								
21										
22										

LSST DESC Dark Energy Science Collaboration

LSST Commissioning Input

form to propose commissioning observations

* Required

Email address *

Your email

Science Collaboration *

Leading Science Collaboration (if mutiople choose other and specify in text box)

- AGN
- Galaxies
- ISSC
- SMWLV
- SL

https://forms.gle/KoEGYGVbcUX2tfGDA

Synthesis of current commissioning plans with input fom LSST:UK Commissioning Workshop, May 2017:

Phases 1+2
20-year depth test

- LSST Deep Drilling Fields
- HST Frontier Fields Clusters
- Well resolved galaxies within 5Mpc
- Local clusters, e.g. Virgo or Centaurus

Phase 3
10yr depth: 300degree^2

- Equatorial field preferred
- Overlap with Stripe 82
- Overlap with Euclid deep fields and Euclid calibration fields
- Overlap with existing near-IR data
- Contiguous area preferred by cosmologists
- Include a star-forming region of MW

Phase 3
Wide area: 1600deg^2

- Overlap with Stripe 82
- LMC as test bed for crowding and saturation
- Euclid quick look field (70degree^2)
- Overlap with VVV and VST for Galactic plane studies

Adapted from from reports from break-out groups, available via:
https://lsst-uk.atlassian.net/wiki/spaces/COL/pages/52268392/Commissioning+Workshop+2017-05-11

Transient alerts will be distributed with significant latency during commissioning

Alerts

- Early alert stream data will also be distributed, possibly with substantial latency, to familiarize the community with the planned format and content of the alert stream.
- A best-effort alert stream may be distributed around Aug 2021.
  - ComCam +3 months: Produce sample commissioning alerts
  - LSSTCam M/S +1 month: Produce sample commissioning alerts
- Distribution Mechanism: Kafka/AVRO based system
  - Currently being tested on ZTF (and ingested by ANTARES and Lasair).
- See LDM-612 for more information on alerts and brokers

Moving object alerts will also be distributed with significant latency…

Moving Objects Pipeline

- Expect to run MOPs in the Mini Surveys Q4 2022
- Validate the the Solar System products pipeline
  - Test the linking software works
  - Test the interface to the Minor Planets Center
- Prompt Data Products -> SSObject Table, see DPDD
  - Possibly only for known asteroids
- Should not expect operations-era latencies of 24h for solar system data products in commissioning
- Any discoveries can be released as a byproduct of this activity

Adding value to LSST Commissioning Team's capabilities

- *"The Project welcomes external groups to add value and complement the existing LSST Commissioning Team's capabilities."*
- "*The Project will not rely on the contributions of external groups to fulfill the core commissioning requirements to the Operations Readiness Review"*
  - External group contributions will involve:
    - signing an MOU that commits to delivering specific tasks under direction of the LSST Commissioning Team
    - spending time at an LSST site before and during commissioning
  - External group contributions will give those involved:
    - *"open access to everything we learn during commissioning"*
    - *"deep understanding of LSST data before the survey starts"*
  - *"No scientific publication on the commissioning data shall be made prior to the data going public. Technical publications will be allowed."*
  - LSST:UK Phase B includes £40k travel funds to support such projects

Quoting from: "PST/Science Collaboration Chairs, Tucson, March 2019"

Adding value to LSST Commissioning Team's capabilities

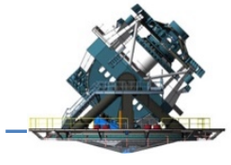
Example Areas of Participation

Conduct anomaly analysis of the Engineering Facility Database. This analysis package is meant to apply Machine Learning/Deep Learner and other AI or similar algorithms to search for otherwise undetected anomalies in the system performance and correlate these with properties of the image data and catalog parameters.

Extended analysis to characterize system performance at the margins of operational parameter space. Over the course of commissioning the LSST Telescope and Camera will be operated over a wide range of environmental conditions. This analysis package is meant to characterize the multiple performance metrics, of both scientific and technical kinds, and explore performance correlations with respect to environmental parameters.

Evaluate operational configurations of the observatory to determine optimum performance. The LSST Observatory has been design with many degrees of freedom built in to optimize system performance to respond to different observing conditions. This analysis package is meant to analyze where optimal operational parameters, configurations and procedures lie for the as built system.

Adding value to LSST Commissioning Team's capabilities



Characterize Other SRD-Motivated Metrics

Between the normative SRD data quality metrics and high-level science analyses there exists a set of intermediate data characteristics that represent important benchmarks of scientific capability:

- Object detection completeness
- Star-galaxy separation
- Galaxy photometry (e.g., for photometric redshifts)
- Difference image analysis photometry (e.g., for statistical variability metrics)
- Low surface brightness features
- Weak-lensing null tests
- Crowded fields / deblending
- ….

Several of the metrics above are directly related to data products included in the **Data Products Definition Document** (LSE-163). Optimization of the algorithms that generate these quantities is beyond the scope of the Commissioning Team. However, baseline characterization of these quantities is a goal of Science Validation.

… and therefore might represent opportunities for external contributions to the LSST Commissioning Team?

Adapted from: "PST/Science Collaboration Chairs, Tucson, March 2019"

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Discussion

- Which commissioning fields will optimize LSST science in general and UK interests in particular?

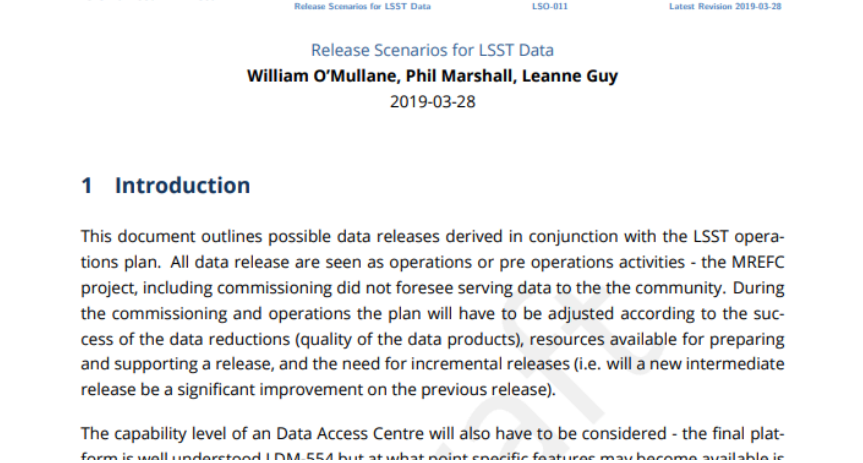
- What value-added projects can potentially benefit LSST Project, Science Collaborations, and the UK community?

- What other opportunities exist to coordinate UK input to LSST commissioning?

Fine Print

- Commissioning team reserve the right to release comm data as they see fit (*not all data will be released*)
- Expect continuous changes over comm period (*requires flexibility, shared-risk approach*)
- DAC interface/platforms will be evolving (*not all functionalities will be available*)
- Data release **scenarios** not strategies (*necessary to allow flexibility and contingency*)

Scenarios


LSST LARGE SYNOPTIC SURVEY TELESCOPE

Release Scenarios for LSST Data LSO-011 Latest Revision 2019-03-28

Release Scenarios for LSST Data

William O'Mullane, Phil Marshall, Leanne Guy

2019-03-28

1 Introduction

This document outlines possible data releases derived in conjunction with the LSST operations plan. All data release are seen as operations or pre operations activities - the MREFC project, including commissioning did not foresee serving data to the the community. During the commissioning and operations the plan will have to be adjusted according to the success of the data reductions (quality of the data products), resources available for preparing and supporting a release, and the need for incremental releases (i.e. will a new intermediate release be a significant improvement on the previous release).

The capability level of an Data Access Centre will also have to be considered - the final platform is well understood LDM-554 but at what point specific features may become available is

- https://lso-011.lsst.io/
- ComCam: IFF ends Aug 2020
  - ~6 mo end of 2020 (flat fits files, tables)
  - ~3 mo Alerts
- Full Camera release IFF ends Mar 2021
  - Comm data ~6 mo, Sep 2021
  - Mini comm surveys end 2021
- DR1
  - 1 yr after start of normal survey ops

- Services
  - Will evolve but stable state Oct 22

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- Other…