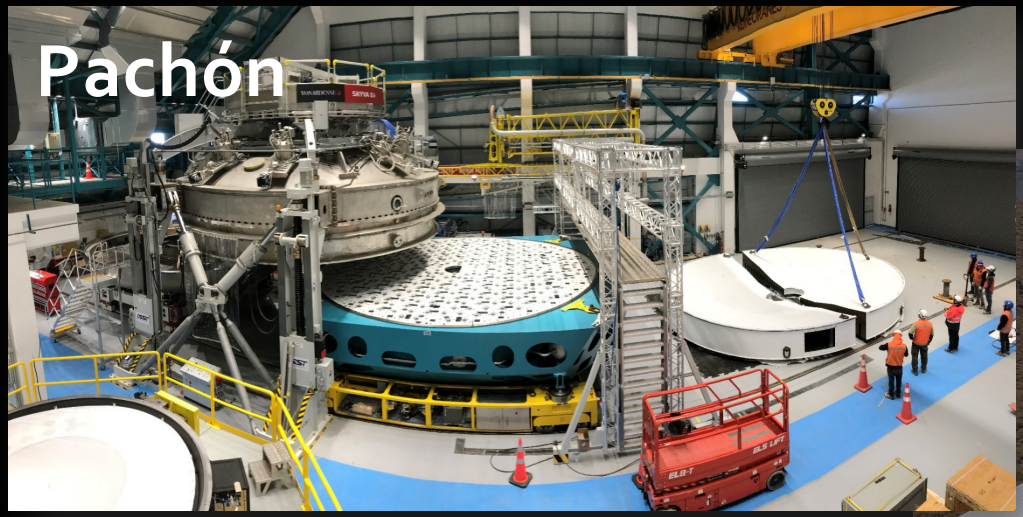
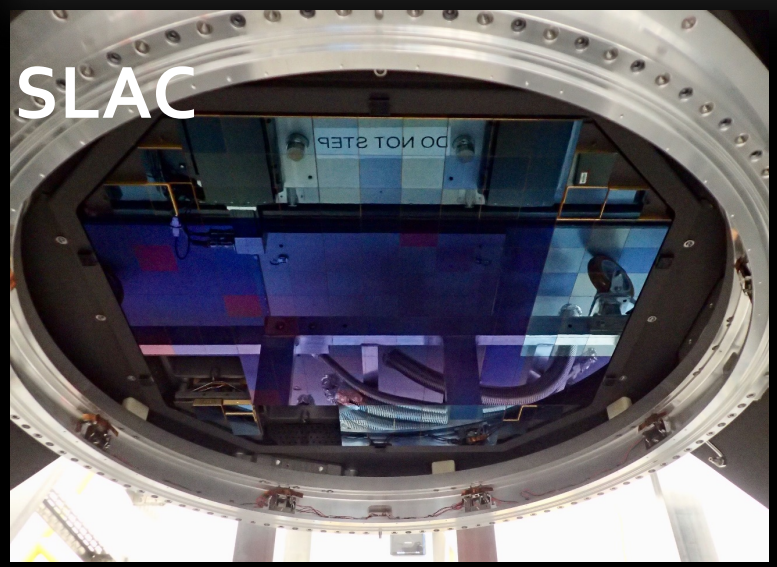
Renaming LSST

- Observatory: Vera C. Rubin Observatory
- Prime program: Legacy Survey of Space and Time (LSST)
- Telescope name: Simonyi Survey Telescope

1965 Georgetown Astronomy Department

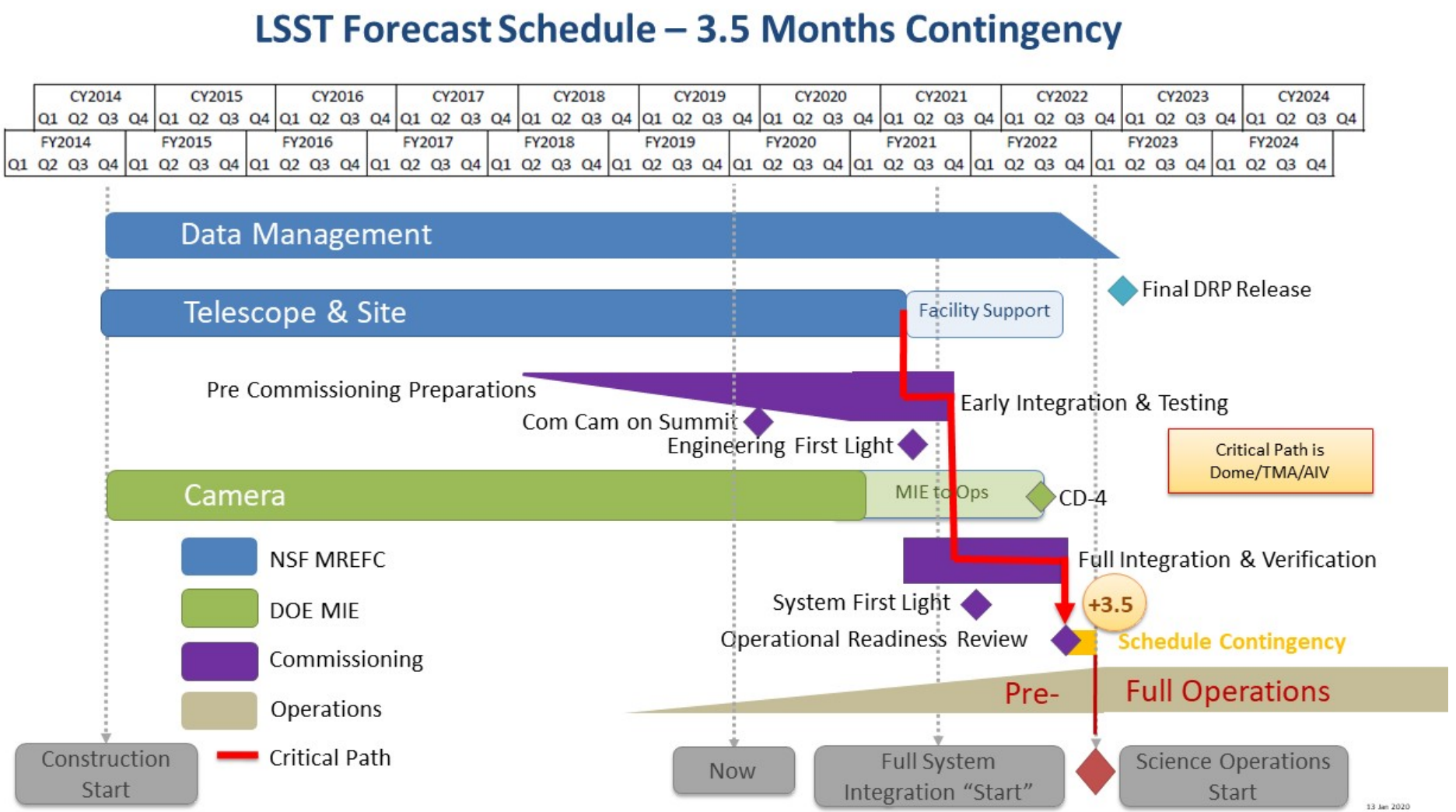




Pics from Steve Kahn's talk at AAS Hawaii, 6th Jan 2020

LSST:UK Consortium

LSST Schedule



Commissioning and 1st Year data plans (latest from AAS Open house 6th Jan 2020)

- System first light : late 2021 (was October 2021) – commissioning time squeezed
- At best ~5 months on-sky data with LSSTCam and 3 months Science Validation Surveys

Survey start October 2022

- Data Release 1 : based on 6 months data, takes 6 months to process. Release : Oct/Nov 2023

Commissioning and 1st Year data plans

- After DR1 : can start "full fidelity" alert generation meaning, every image, difference and alerts
- Commissioning and LOY1 : starting a process to solicit feedback from Science Collaborations (presume SAC too)
  - Area vs Filter
  - Template building
  - What can be done during commissioning ?

"Data Previews"

DP Dataset Cheatsheet

DP0: Simulated/pre-cursor survey data, TBD

- DESC DC2 simulated LSST survey? 300 sq deg WFD, 1 sq deg DDF, 5+ years, ugrizy
- HSC Public DR2? 300 sq deg, grizy, plus Deep and UltraDeep fields
- Something else?
- User choice?

Images (early access): Spring 2021
Catalogues : Fall 2021

DP1: ComCam on-sky test data

- Primarily Active Optics system testing and opportunistic observing
- Small sets of "good images" that result from the successful completion of certain test phases

X will not happen

Fall 2021
Spring 2022

DP2: LSSTCam Science Validation (SV) surveys

- 10 year depth: 300 sq deg, ugrizy, 800 visits per pointing
- Wide: 1600 sq deg, ugrizy, 30 visits (templates then DIA)
- Test Alert Stream (not necessarily live)

Spring 2022
Fall 2022

From Phil Marshall : Project & Community Workshop August 2019, Tuscon

Preferred Options for Alert Production in LOY1

Commissioning-Data Templates Build templates, where possible, from commissioning data before the start of LOY1, and use them to generate alerts during LOY1.

LOY1-Data Templates Build templates progressively from data obtained during LOY1 (e.g., on a monthly timescale), and use them to generate alerts during LOY1, either instead of, or in addition to using commissioning data to build templates.

Option	Scope	Risks	Requirements	Consistency	Science
Commissioning-Data Templates	potential minor expansion	no risk	no violations	somewhat* consistent	enables some** science
LOY1-Data Templates	moderate upscope (no new algorithmic scope)	no risk	no violations	somewhat* consistent	enables more** science

** because templates are built from images obtained in a short time window and because alerts cannot contain, e.g., a 12-month history or matches to nearby DR objects*

*** "some vs. more" is in terms of sky area in which alert generation is possible, the total number of alerts produced, and the filters in which alerts can be produced*

PST Science Collaborations • 2019-11-20 10

- Lasair should aim to be operationally ready for the start of LOY01 : October 2022

LSST Alerts – relevant numbers and policies for Lasair

Prompt products are single visit images and their difference images, which produce :

`DIASource` : S/N>5 sources on difference images

`DIAObject` : astrophysical objects that DIASources are associated with. Clusters of `DIASources` detected on different images are associated with `DIAObjects or SSObjects`

`SSObject` : identified or known SS objects

First detection : DIAObject

DIAObject

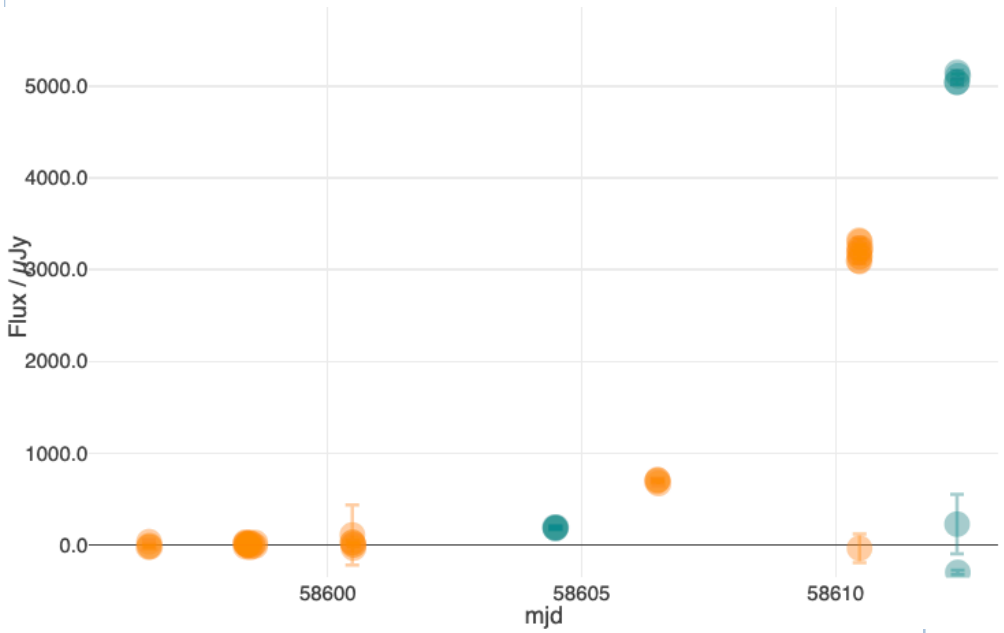
- Each DIASource alert for a DIAObject will include Median noise for last 12 months images (not forced phot)
- 3 nearest stars and 3 nearest galaxies
- Within 24hrs : DIAForcedSource available in the *Prompt Products Database*
- New alert not issued – we must query
- We can make public

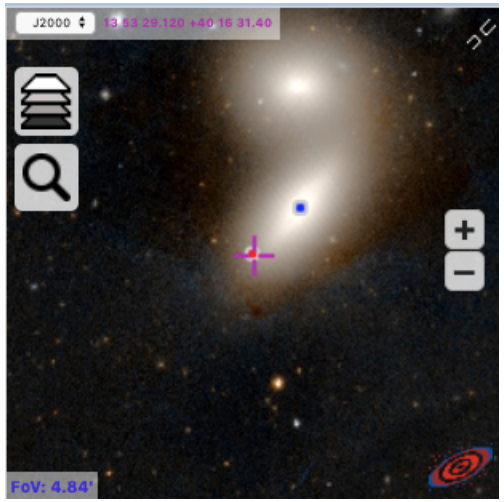
Further alerts of a DIAObject

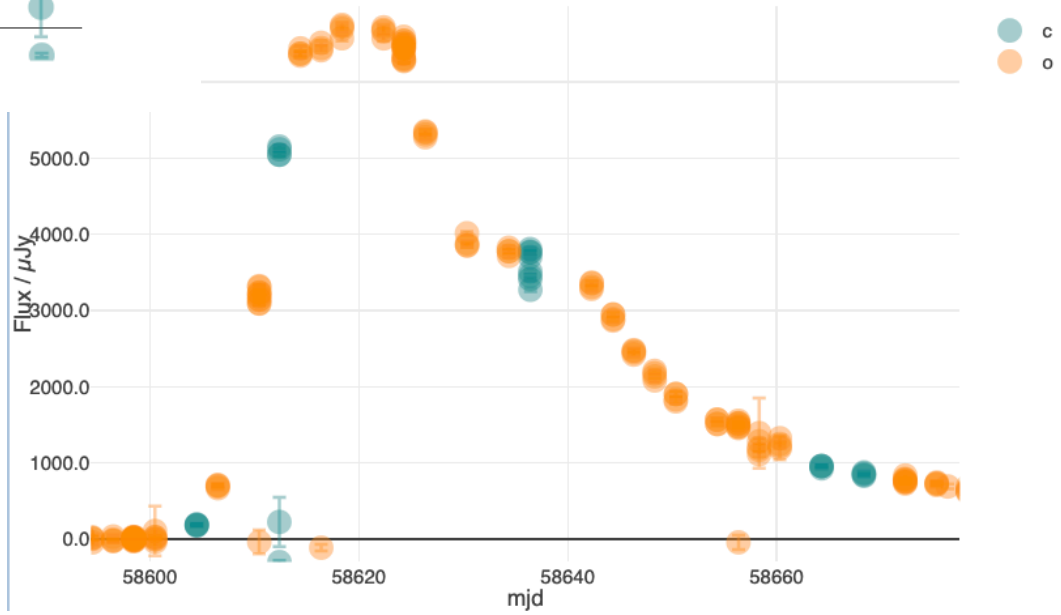
DIAObject

- The second DIASource alert for a DIAObject will include the 30 day DIAForcedSource
- Does not help us a lot – since we will already have this information from our query of the *Prompt Products Database* (going forward it does of course).
- We can make public
- This second DIASource alert will not include the 12 month history
- *Lasair* must cache the 12 month history and the DIAForcedSource information

Forced photometry : the value





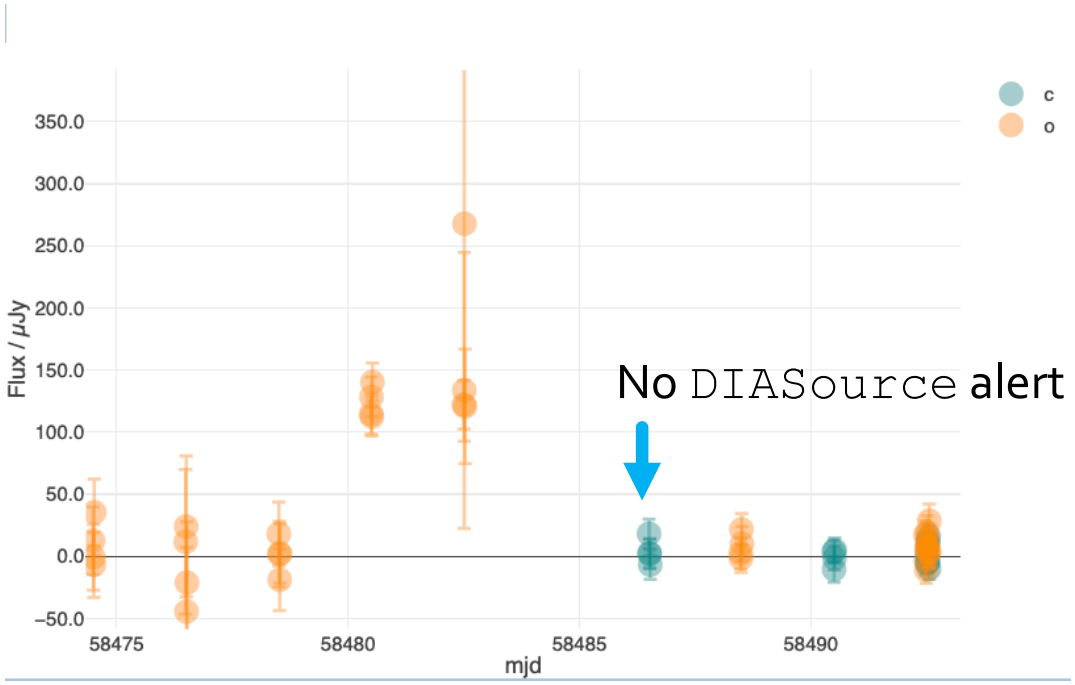


Post-discovery window

- Forced photometry will be run at the positions of every `DIAObject` to give `DIAForcedSource`
- No alerts issued – we need to query the PPD
- We need to be constantly querying the PPD and pulling back these `DIAForcedSource` and matching them in Lasair database
- Essential – but major job
- Not for stars or any `SSObject`

DIAForcedSource : the importance

- We will still ingest `DIAObject` alerts for S/N >5 (still alive) transients
- But essential we do it for dead transients
- Forced phot will run for 30 < t < 50 day after last S/N>5 detection



Alerts - the numbers

Alert numbers : per visit

Type	Extragalactic (80% of sky)	Galactic (20% of sky)
Movers	3000	3000
Stars	1800	30000
AGN	70	70
Supernovae and extragalactic transients	200	200

Hence only 1 in 25 (4%) of `DIASource` are relevant for the *Lasair* transient processing for most of the sky (80% which is outside the plane).

The time-averaged data rate is 200 Mb per seconds - potentially with bursts up to 5.4 Gb per second.

Are we getting a transfer rate of 200 Mb per second to the Edinburgh DAC from the ZTF ***Lasair*** stream ?

Number of extragalactic alerts per visit ≈ 300
Trivial ?

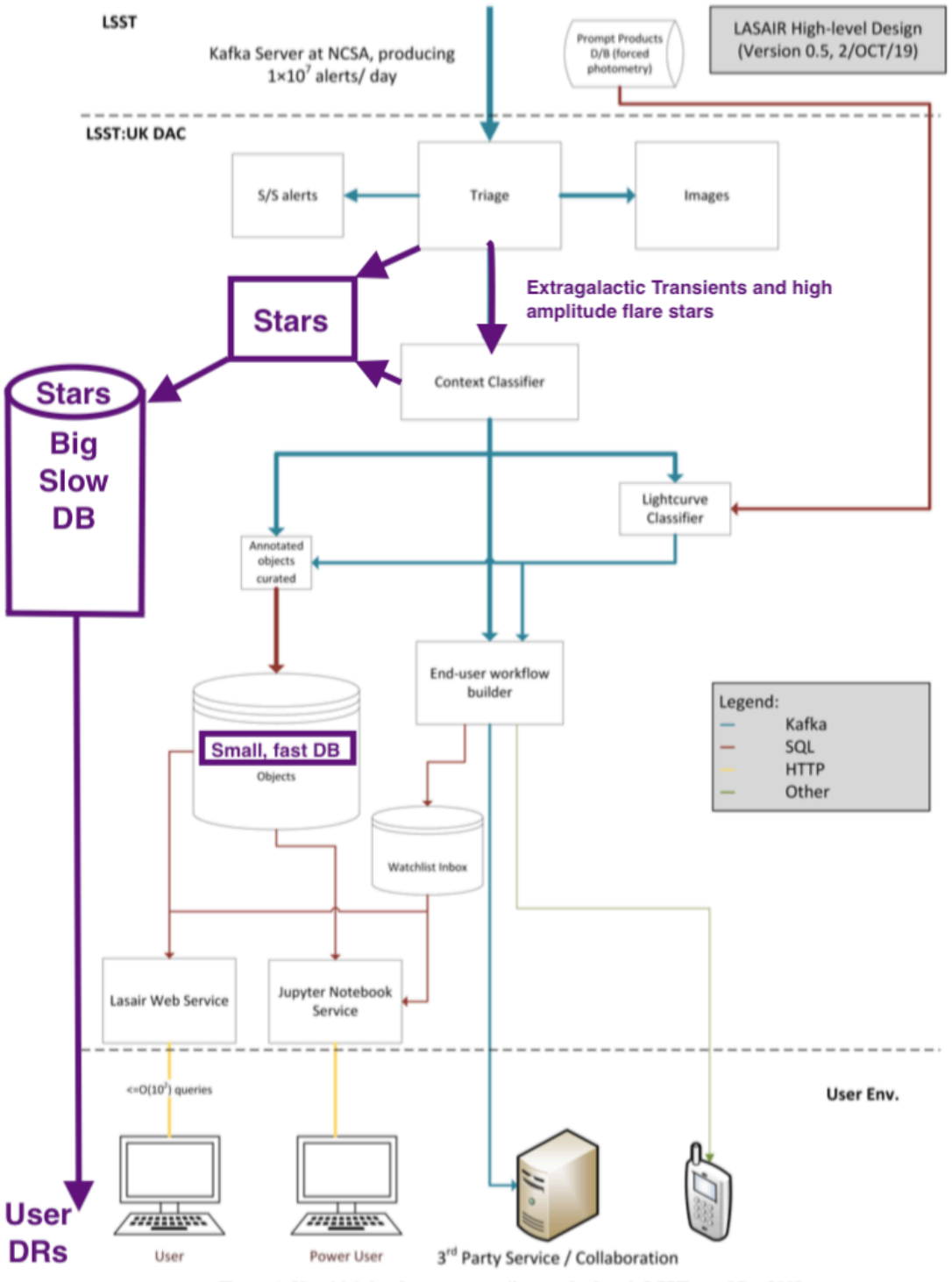
Lasair database size

Estimates of database size

We are also concerned about the size of a relational database. The following numbers are estimated by Roy Williams, by scaling the current ZTF rate by 50, and taking the number of attributes for each Source or Object from LSE-163 (Data Products Definition Document , Juric et al). The final columns just divides that by 25, assuming the breakdown as above.

Type	Number (in units of 10^6 yr^{-1})	Number of Attributes	Size in TB per yr	Size in Tb per without stars and SS
`DIASources`	2450	111	3.3	0.13
`DIAForcedSource`	19,700	8	6.0	0.24
`DIAObjects`	500	396	2	0.08
`DIAObjects ncand>=3`	100	396	0.5	0.02

Compare the numbers in the green cells : Two ways that we consider are viable for reducing the size of the database - either storing the lightcurve data outside the database in a blob store. Or running a database with the stars and the solar system objects removed. The database sizes are comparable in either case.


LSST
Kafka Server at NCSA, producing
1×10^7 alerts/ day
Prompt Products D/B (forced photometry)
LASAIR High-level Design (Version 0.5, 2/OCT/19)
LSST:UK DAC
S/S alerts
Triage
Images
Stars
Extragalactic Transients and high amplitude flare stars
Stars
Big Slow DB
Context Classifier
Lightcurve Classifier
Annotated objects curated
End-user workflow builder
Small, fast DB
Objects
Watchlist Inbox
Legend:
Kafka
SQL
HTTP
Other
Lasair Web Service
Jupyter Notebook Service
<=O(10^2) queries
User Env.
User DRs
User
Power User
3rd Party Service / Collaboration