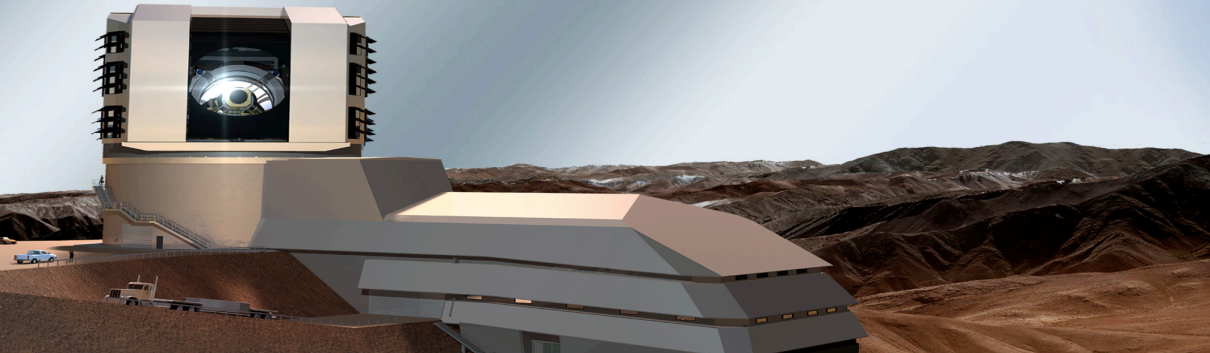
William O'Mullane input from Željko Ivezić
LSST DM Project Manager

LSST DM Overview

Lyon 13th to 16th June 2017



Outline

Introduction

LSST status

Data Management

Conclusion

Introduction

Officially DM project manager since April 3 2017

- So still learning
- some of you may know me from ESA, Gaia, Planck, Integral ..
- but today:
  - LSST Status
  - Overview of data management

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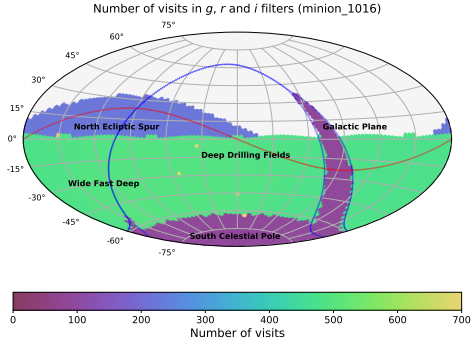
LSST:uniform sky survey

An optical/near-IR survey of half the sky in ugrizy bands to r 27.5 (36 nJy) based on 825 visits over a 10-year period: *deep wide fast*.

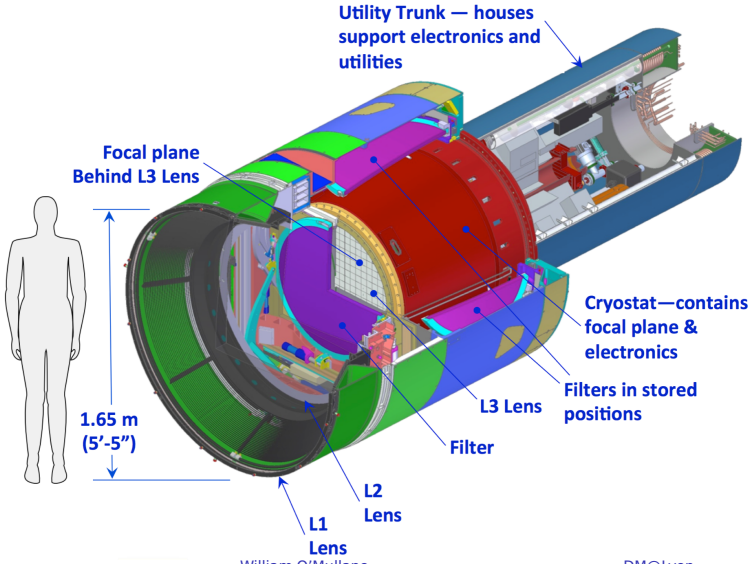
- 90% of time spent on uniform survey: every 3-4 nights, the whole observable sky scanned twice per night
- 100 PB of data: about a billion 16 Mpix images, enabling measurements for 40 billion objects!

see also `http://www.lsst.org` and arXiv:0805.2366



10-year simulation of LSST survey: number of visits in u,g,r band (Aitoff projection of eq. coordinates)

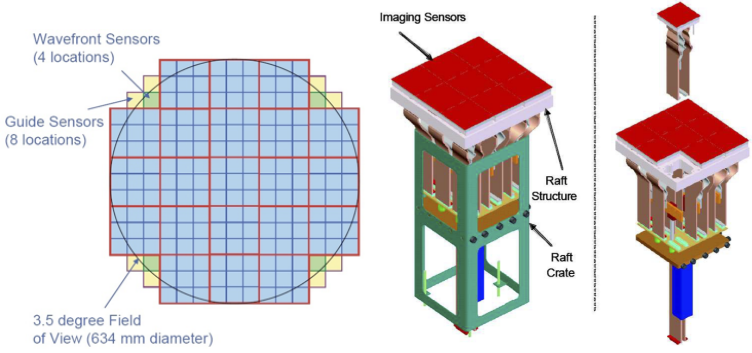
LSST Camera

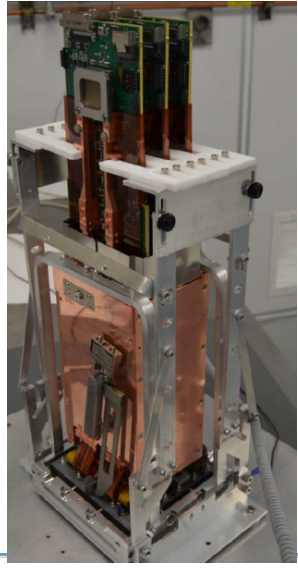


The largest astronomical camera:

- 2800 kg
- 3.2 Gpix

Science rafts





Modular design: 3200 Megapix = 189 x16 Megapix CCD

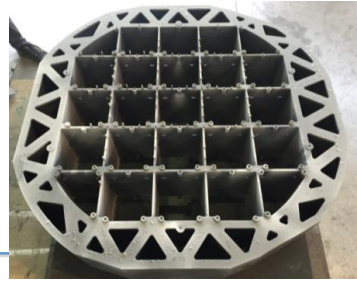
9 CCDs share electronics: raft (=camera 144 Megapix)

First of 21 rafts available ⟶

Hardware arriving

- Fused silica optics
  - contract - Ball Aerospace (With AOS and Vanguard) , TSESO, REOSC and Materion
  - L1 ready to polish - L2 being polished $\Longrightarrow$
  - L3 coming this year
- Cryostat to keep cold CCDs at -100C
  - Grid machining and cell mockup $\Longrightarrow$
  - Awarded Housing & support cylinder fabrication.

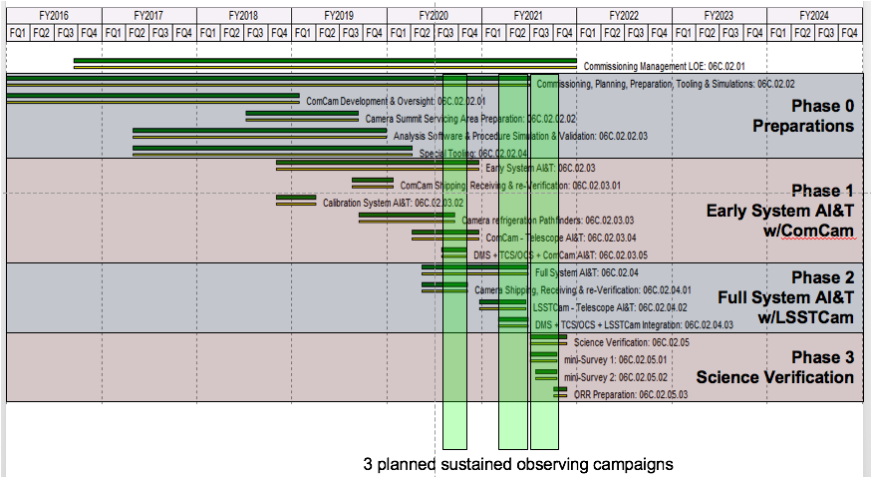
AOS L2 Optic



Site shaping up

- Dome interface and Telescope Mount Assembly (TMA) topple block installed
- But construction is late and its been snowing..

Commissioning preparations



Potentially lots of data for DM

Data Production Milestone	Completion Date
First calibration data from Auxiliary Telescope	02 Aug 2018
First on-sky and calibration images with ComCam	29 Jan 2020
Sustained scheduler driven observing with ComCam	11 May 2020
Images from Camera re-verification at Summit Facility	16 Jun 2020
First on-sky and calibration data from Camera+Telescope	18 Nov 2020
Sustained scheduler driven observing with Camera+Telescope	08 Feb 2021
Start Science Verification mini-Surveys	30 Mar 2021

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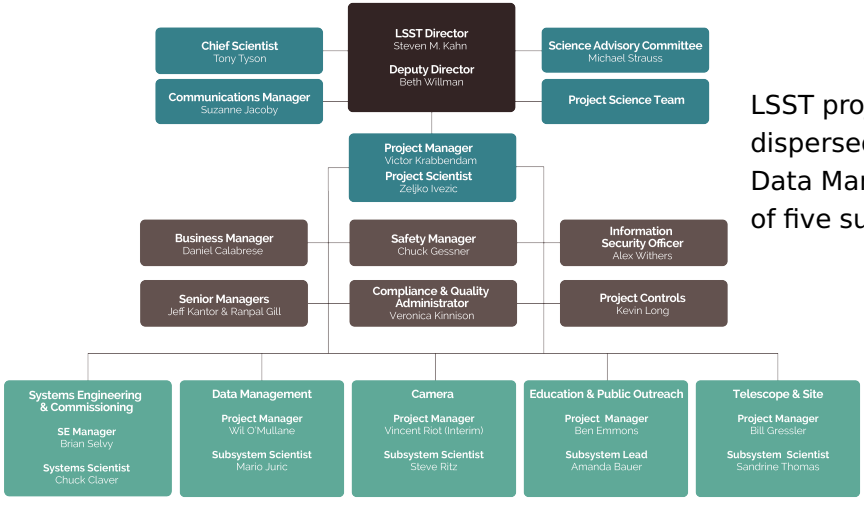
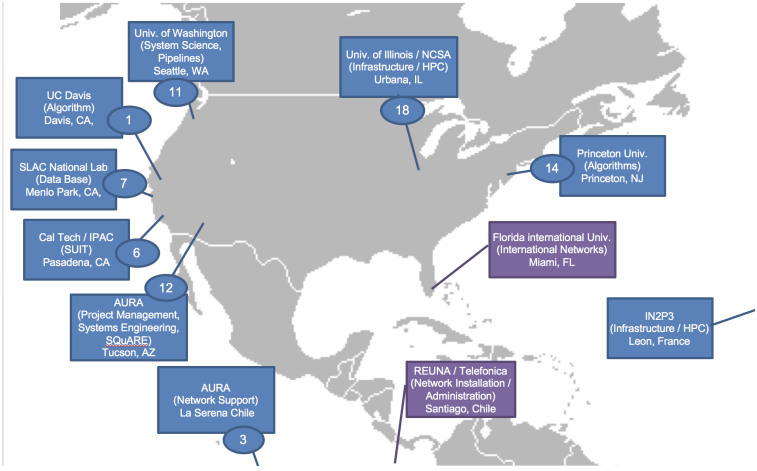
LSST org chart - where DM fits



LSST project is large and dispersed

Data Management is just one of five subsystems.

Data management



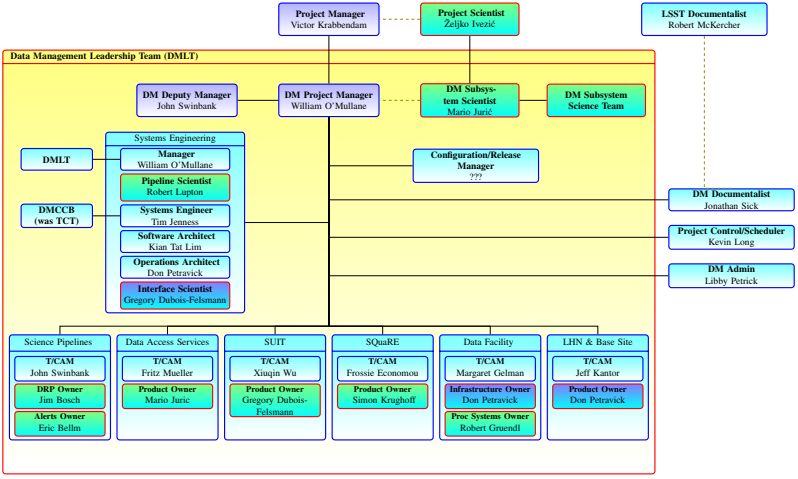
DM Mission :

Stand up operable, maintainable, quality services to deliver high-quality LSST data products for science, all on time and within reasonable cost.

LSST DM development is distributed across the Americas.

Plus we have partners like IN2P3

DM Organization

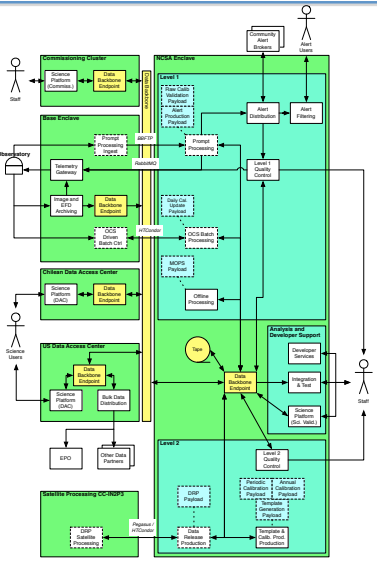


DM leadership meet two times a year and have a weekly telecon.

Technical mangers have a *standup* every Tuesday and Friday.

Toughest thing in any project is communication.

DM build and deploy



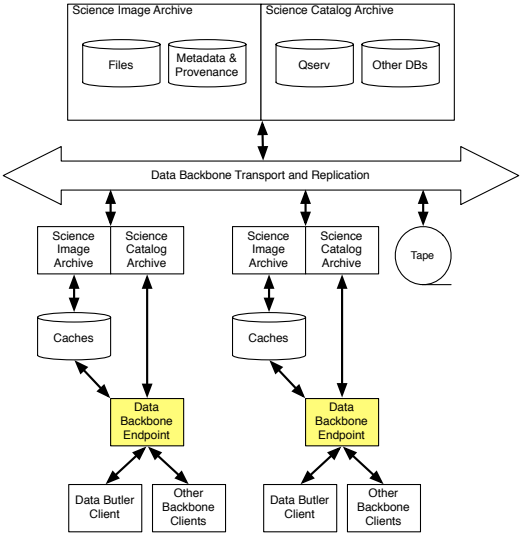
DM must build everything to get LSST products (see `http://ls.st/dpdd`) to the users.

- large data sets (20TB/night)
- complex analysis
- aiming for small systematics
- Science Alerts in under 2 minutes .. (aiming for 1 minute)

About $\frac{1}{2}$ million lines of code (C++/python)

diagram K.T. Lim

Data Backbone

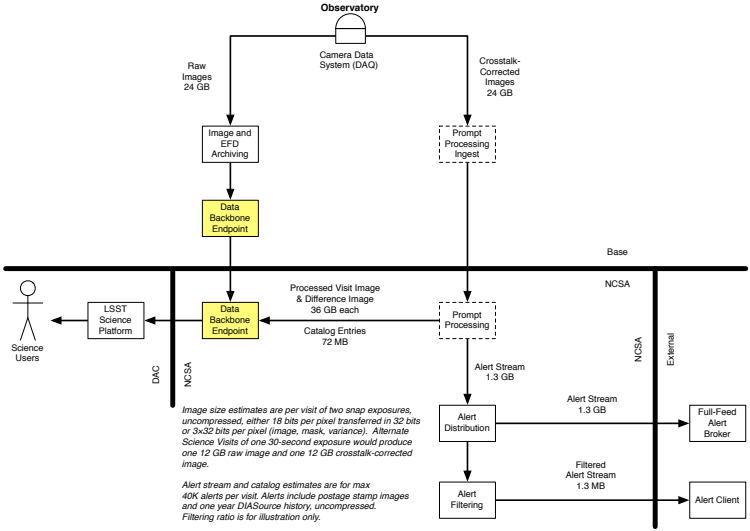


One small box on the previous slide was Data Backbone.
That hides several things

- Qserv - the LSST end user database - Talk from Fritz Mueller coming.
- All the networks : we now have fiber to the mountain and from La Serena to NCSA (two routes)

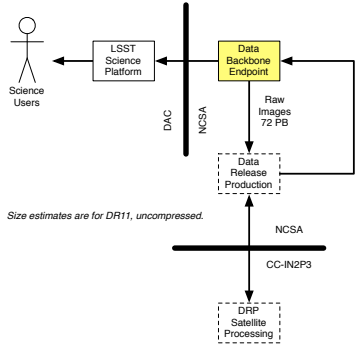
diagram K.T. Lim

Data flow



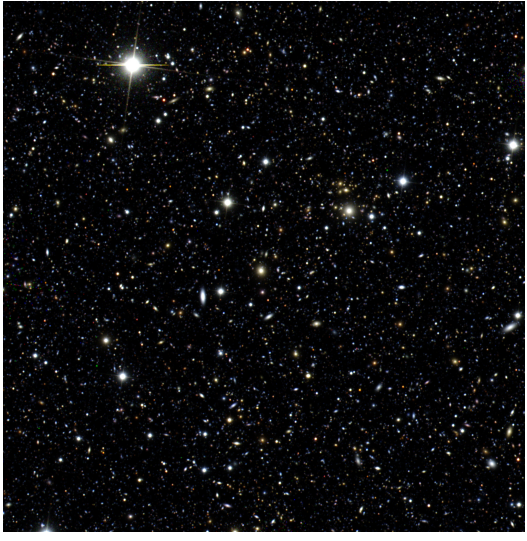
Lots to do every night ..

Plus annually there is a data release



Images from K.T. Lim

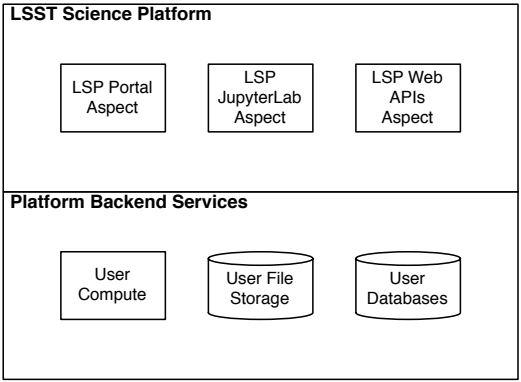
All comes down to images . . .



False color from 3 simulated filter images
From just one of 109 CCDs

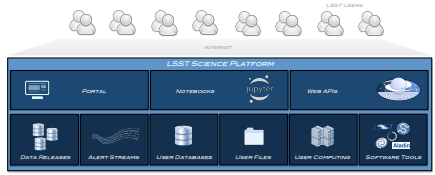
To work with that there is the *LSST Stack*
`https://pipelines.lsst.io/`
Friday some people getting familiar with some of that - starting with a talk from Jim Bosch and we saw some of this from Robert, Dominique and others on Tuesday.

And catalogs and access to all of it. . . .



Most users will be interested in the Science Platform

Mario will say more right after this talk

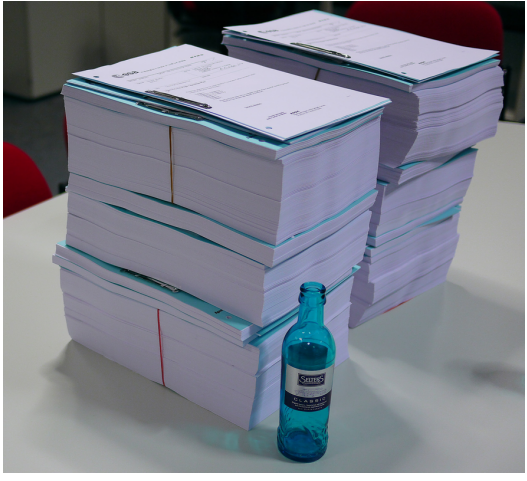


It all sits on machines

Prototype Data Access Center Machines at NCSA

- NCSA
  - GPFS 2 PB
  - Common batch Computing - 2304 cores (48×48)
  - use of common NCSA VSphere infrastructure
  - NCSA tape commons (currently in Blue Waters)
  - Fast (100Gbs) links to ESNET,I2,MREN.
- Supporting :
  - Developer spaces and experimentation (Kubernetes), PDAC, etc.
  - LSST Level one test stand (OCS simulator, WAN Emulator, EFD prototype).
- Currently Amazon for builds .
- IN2P3 - full QSERV at least that I know of and more ..

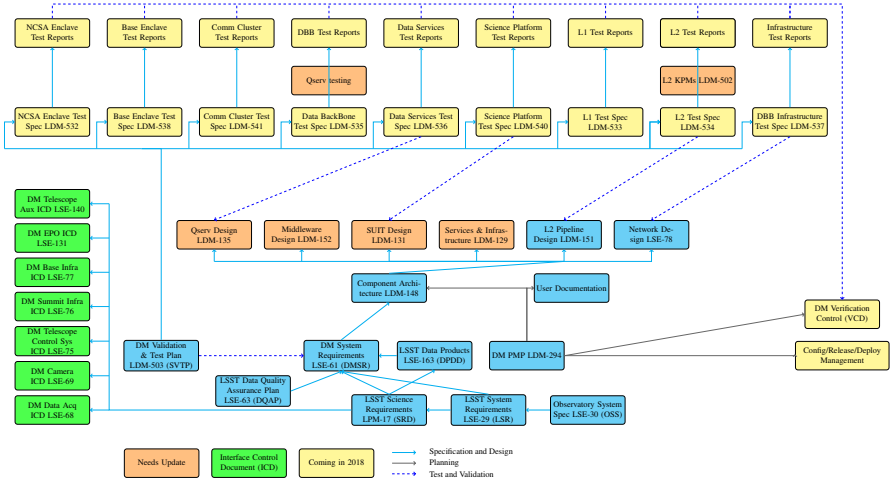
Inevitably we must document ..



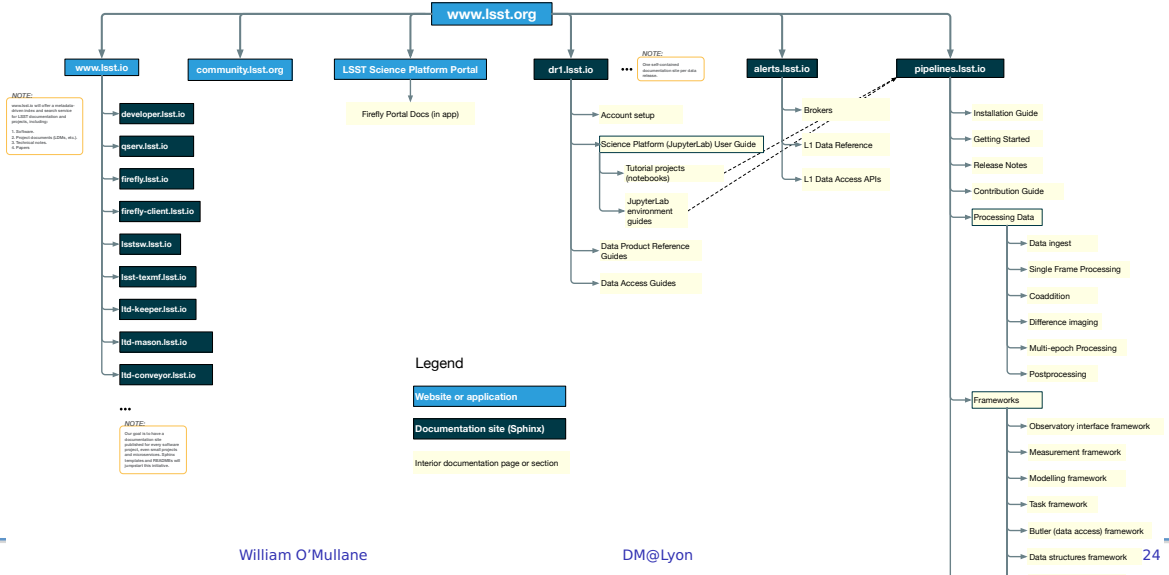
Gaia Flight Operations Procedures (FOP) paper copy in case the computers fail - could be useful!

But we should avoid *write only* documents.

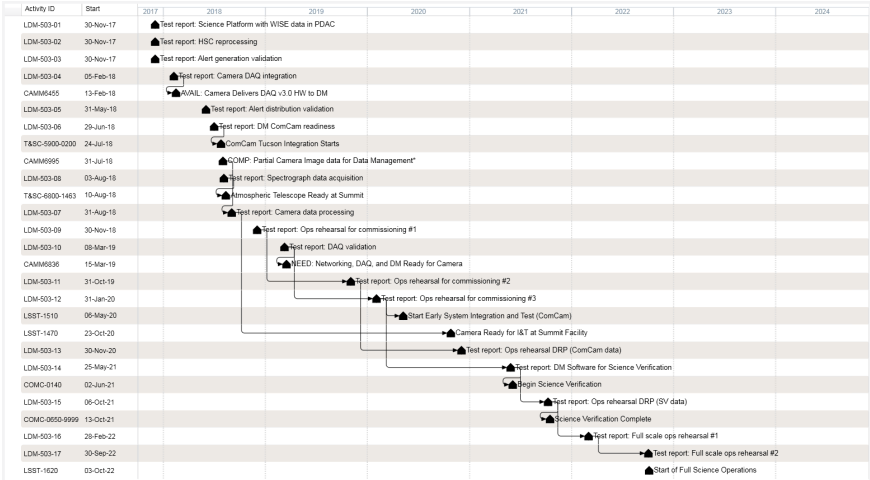
Current DM Doc Tree



Website for users



Big push on verification



Across all of LSST verification is a big topic right now.

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- LSST is on track and data is coming sooner than you might think
- There are plenty of challenges
- Verification and Validation on radar for now
- Looking forward to the first LSST images !

Questions ??

Outline

Reference material

Acronyms I

The following table has been generated from the on-line Gaia acronym list:

Acronym	Description
AOS	Acquisition of Signal
CCD	Charge-Coupled Device
DM	Data Management
EFD	Engineering Facilities Database
ESA	European Space Agency
FOP	Flight Operation Procedure (Plan)
GPFS	General Parallel File System
LSST	Large-aperture Synoptic Survey Telescope
NCSA	National Center for Supercomputing Applications
OCS	Observatory Control System
PB	PetaByte
PDAC	Prototype Data Access Center
REOSC	Optronic Systems Department of SAGEM
TMA	Telescope Mount Assembly
WAN	Wide Area Network