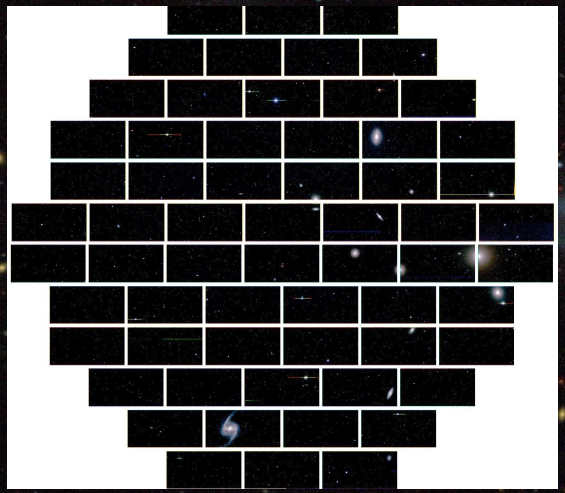
Containerized Solutions for astronomical surveys

A brief overview from DES/LSST

Matias Carrasco Kind (NCSA)

NDS Container Workshop, August 14th 2017, @ NCSA

Photometric Surveys

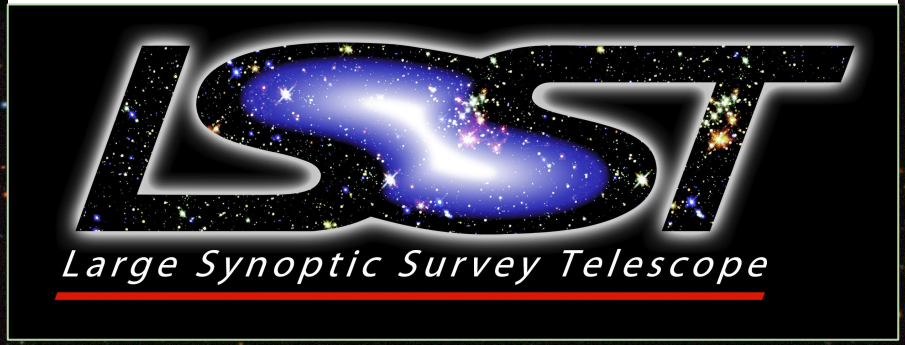


IDX	RA	DEC	MAG_AUTO_G	
0	9.55367	-52.858189	99	
1	9.999752	-52.754332	22.4878	
2	9.114992	-52.555158	25.3244	
3	8.994403	-52.899365	24.9927	
4	9.427335	-52.595066	23.6036	
5	10.008397	-42.256504	24.9008	
6	10.084474	-47.183702	24.6363	
7	10.556631	-47.180639	23.4764	
8	10.197952	-47.10095	26.3588	
9	10.863236	-46.987299	21.7274	
10	10.673803	-47.056676	23.6435	
11	10.250745	-47.011011	24.6457	
12	9.145812	-41.983799	22.9988	
13	9.156004	-41.756442	20.9553	

Telescope → Images → Catalogs

Collection of thousands of images in different filters. Raw Images are processed and combined and large catalogs are created with position and information of millions of astronomical sources.

Photometric Surveys

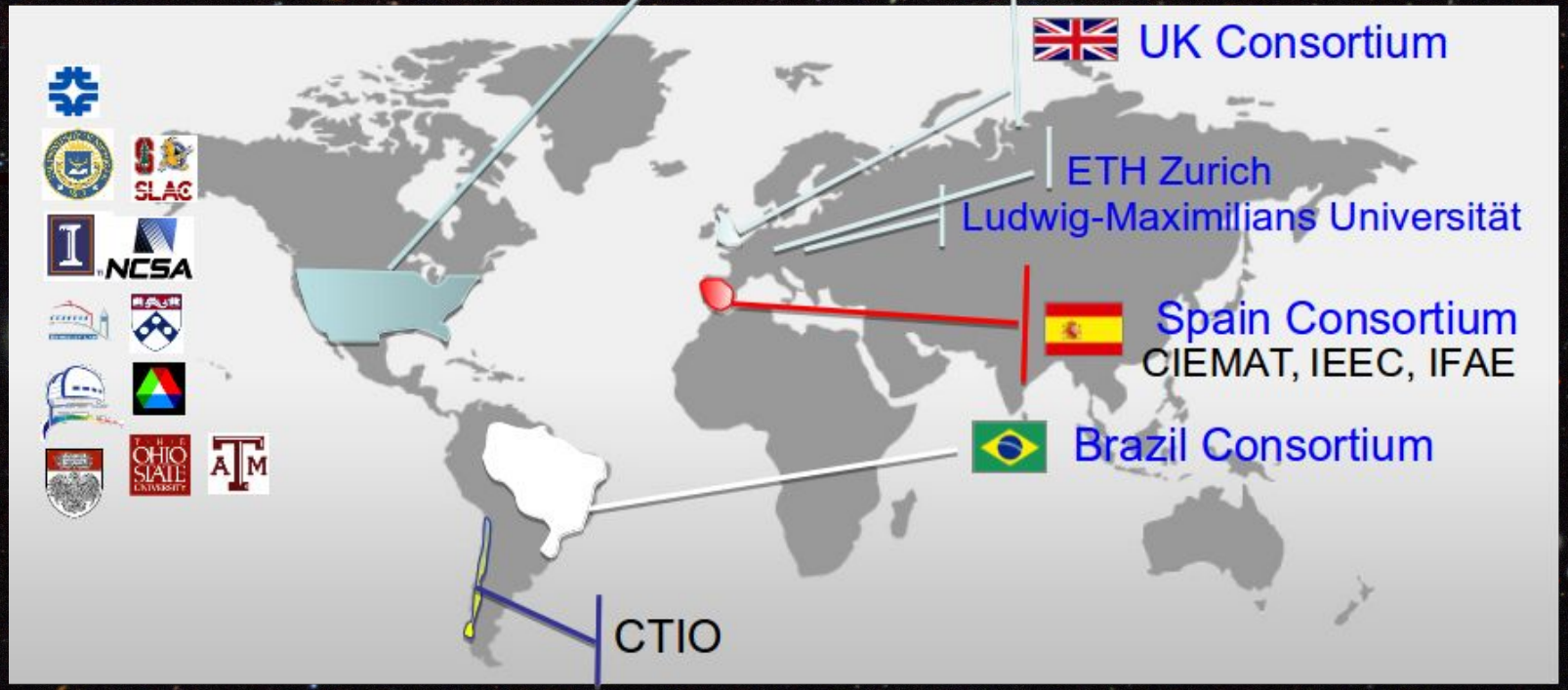


NCSA does Data Management for these 2

Dark Energy Survey (DES)

Started in 2003, DES is now an international collaboration of ~500 scientists from around the world

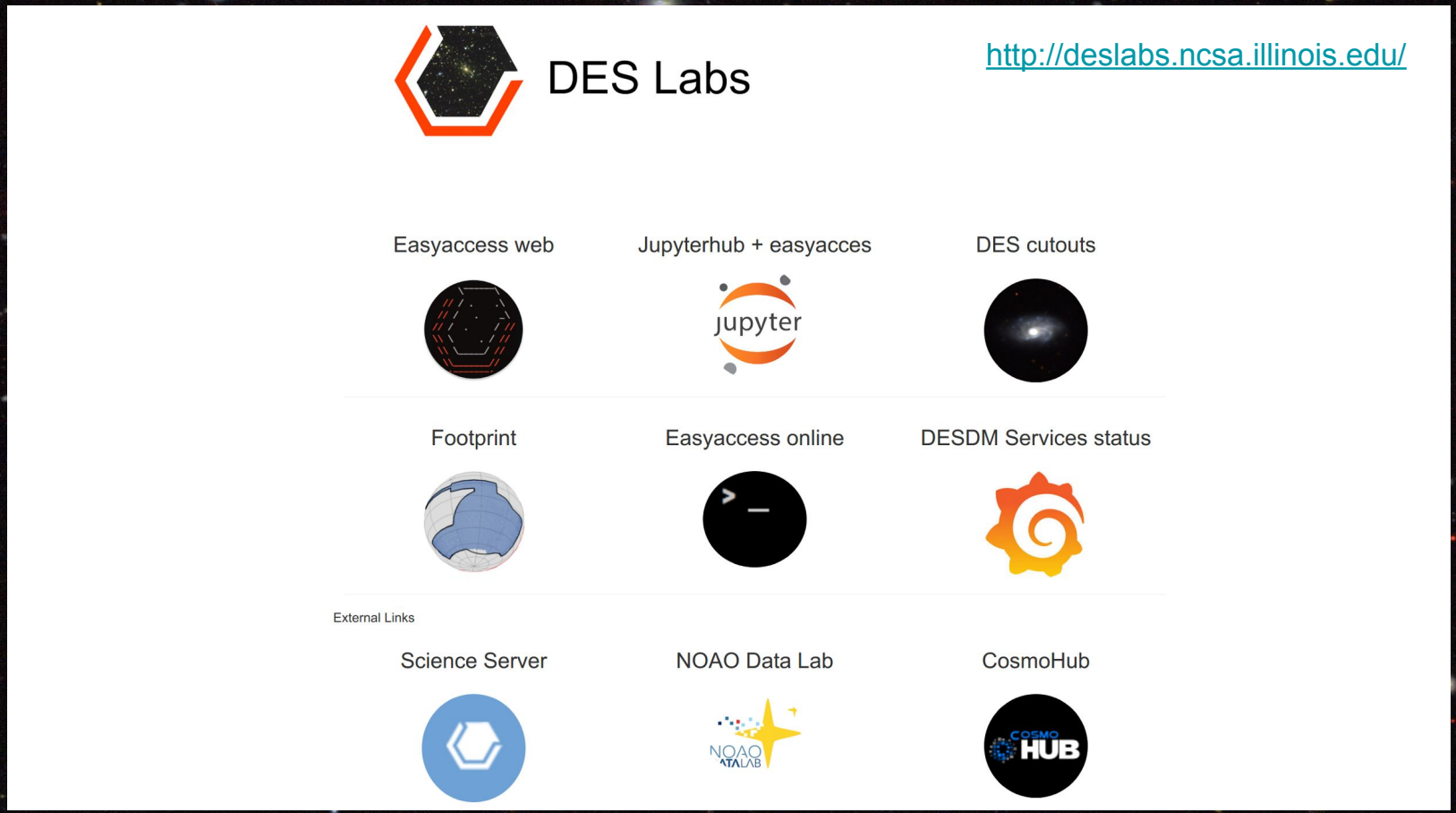
Fermilab, UIUC/NCSA, University of Chicago, LBNL, NOAO, University of Michigan, University of Pennsylvania, Argonne National Laboratory, Ohio State University, Santa-Cruz/SLAC/Stanford Consortium, Texas A&M



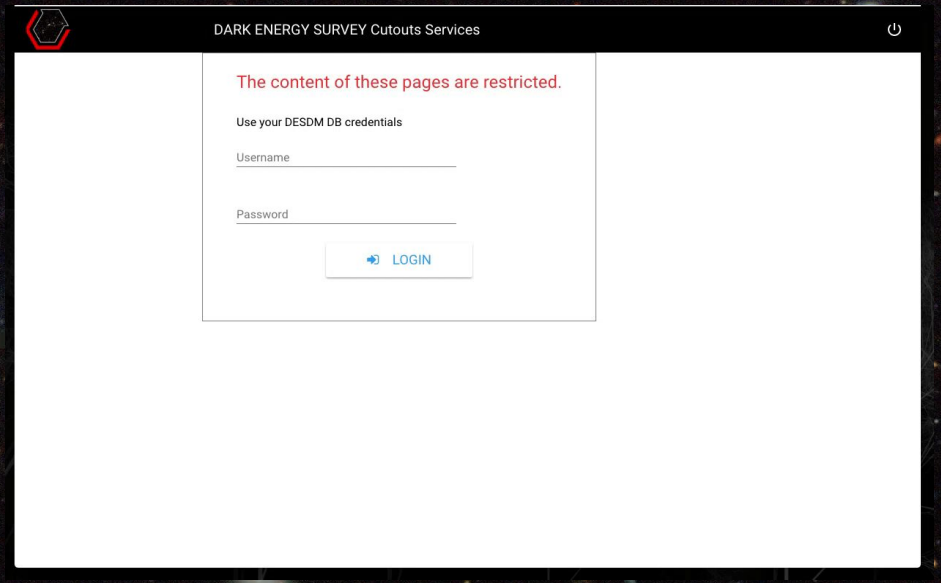
Dark Energy Survey facts

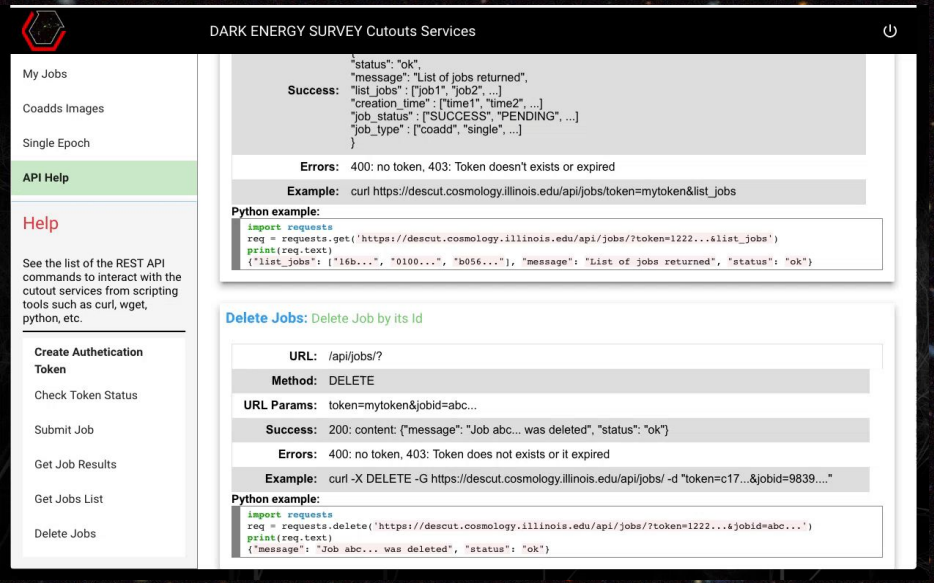
- 4 meters telescope, 520 Mpx camera
- 5 year survey, ⅛ of the sky, Telescope in Chile, data @ NCSA, about to start 4th season
- Main Goal: To constrain the models of the Universe regarding Dark Energy and Dark Matter. Check Recent News!
- Many other Science Cases! (New dwarf planet, New galaxy satellites, Supernovae, etc)
- 1 - 3 TB of data per night, 1 PB of data
- Processing done at FermiGrid, Campus Cluster and Blue Waters
- Thousands of images and billions of rows, ~500 millions objects
- December to announce 1st Public Data Release
- NCSA provide means to access and interact with data → Containers

DES Labs : Collection of containerized tools for DES



DES Labs : Cutout Service

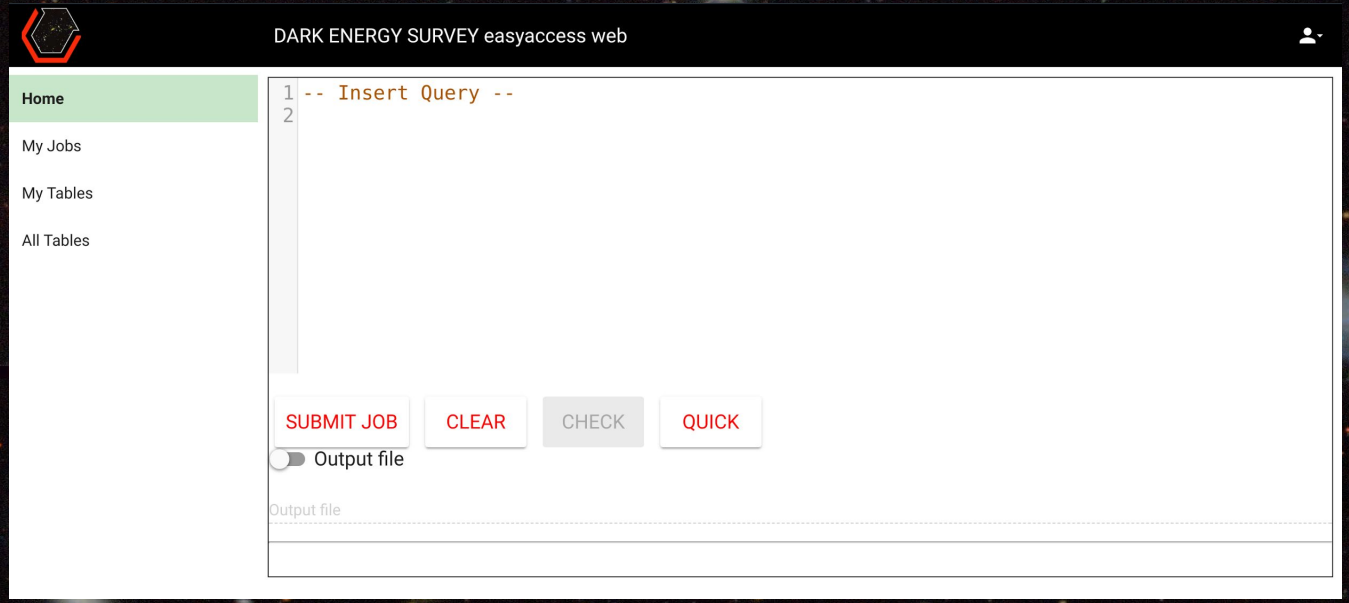




Input a position or a list of positions and return a cutout (all filters, all exposures) around that position for further analysis, direct access to FS

Uses: MongoDB, Redis, Celery and Web Framework on different containers. Prototype version for Kubernetes

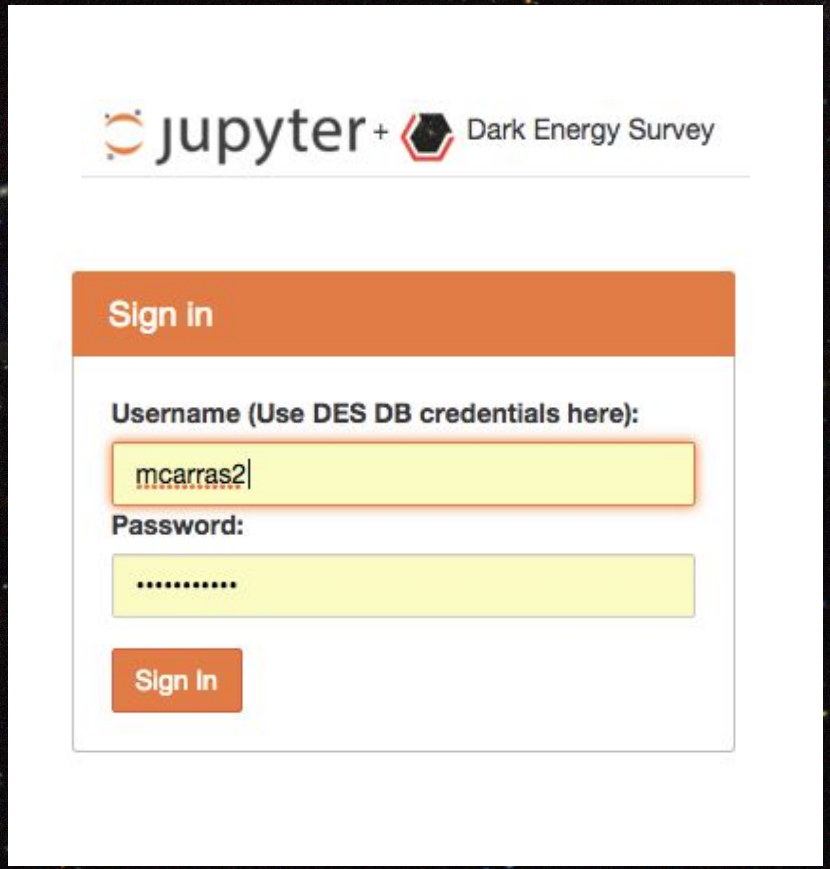
DES Labs : easyaccess Web client



SQL client that runs easyaccess in the backend. Allows to submit Jobs, Table Schema and soon to be linked to the cutout Server

Managed by Kubernetes, uses MySQL, Redis, Celery, and others

DES Labs : jupyterHub + easyaccess



- Managed by Kubernetes, Persistent storage through NFS
- Multi-user jupyter notebook sessions
- Access with DB credentials
- Easyaccess and other tools installed
- Spark Cluster and Batch Submission in alpha stage
- Local JS9 (Next gen. DS9)
- Open to DES collaborators

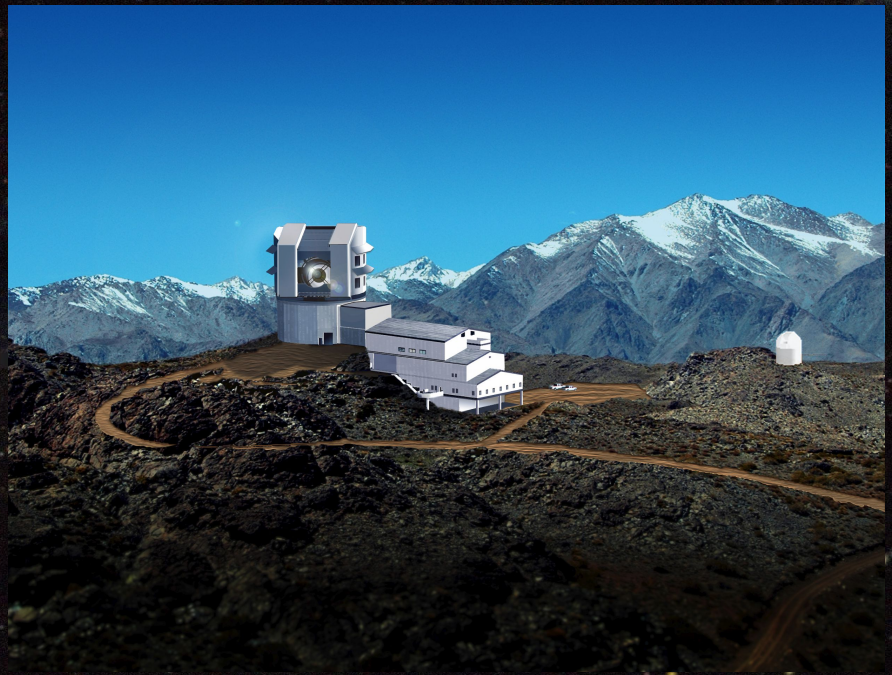
DES Labs

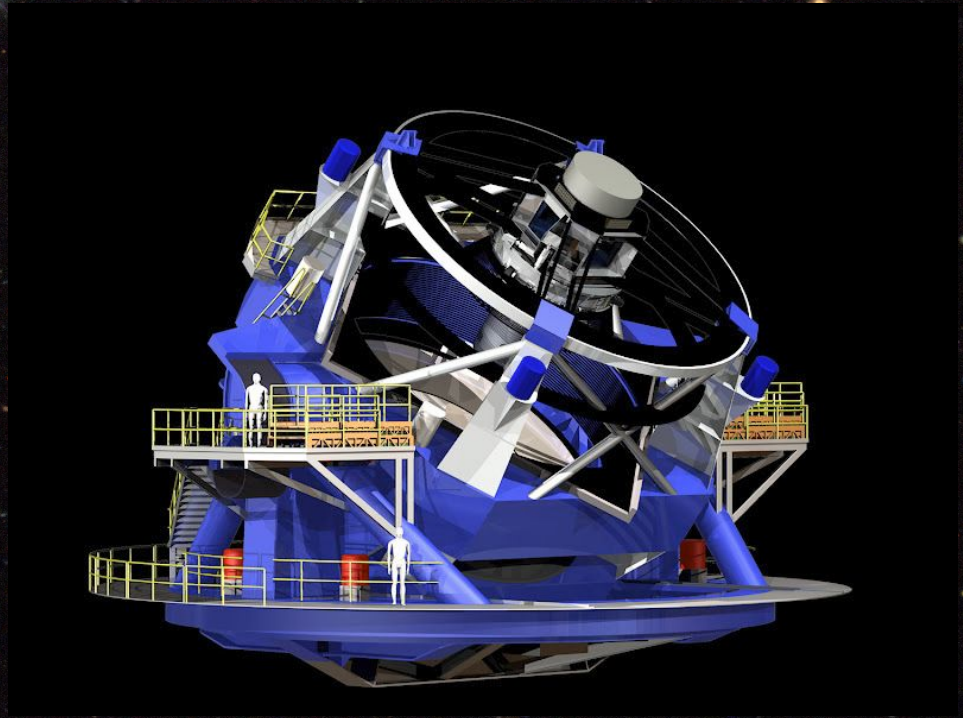
- Footprint exploration and Image Archive
- DESDM Service Status Managed with Kubernetes, uses InfluxDB and Grafana
- DES Release Pages
- Others…



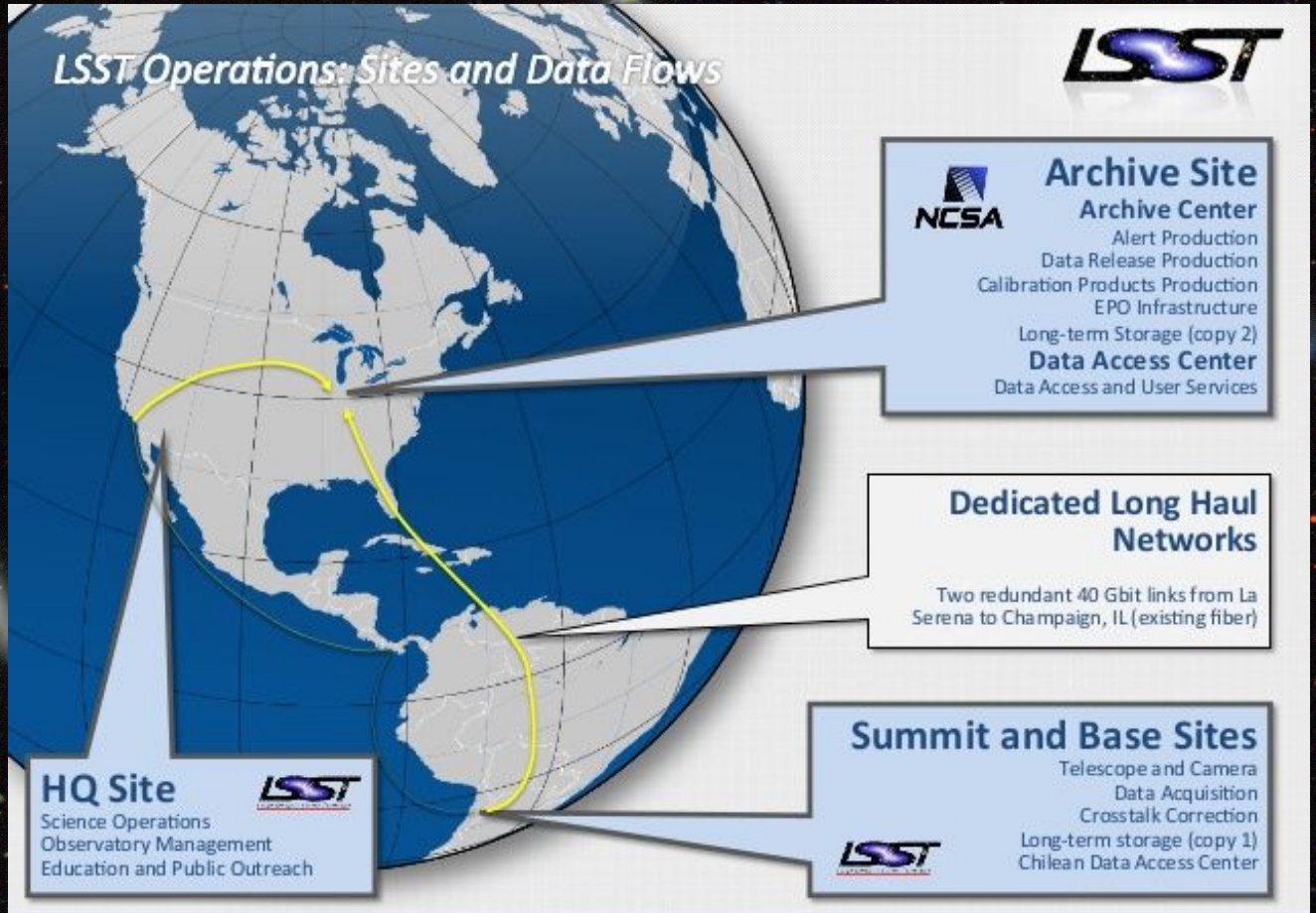


Large Synoptic Survey Telescope (LSST)





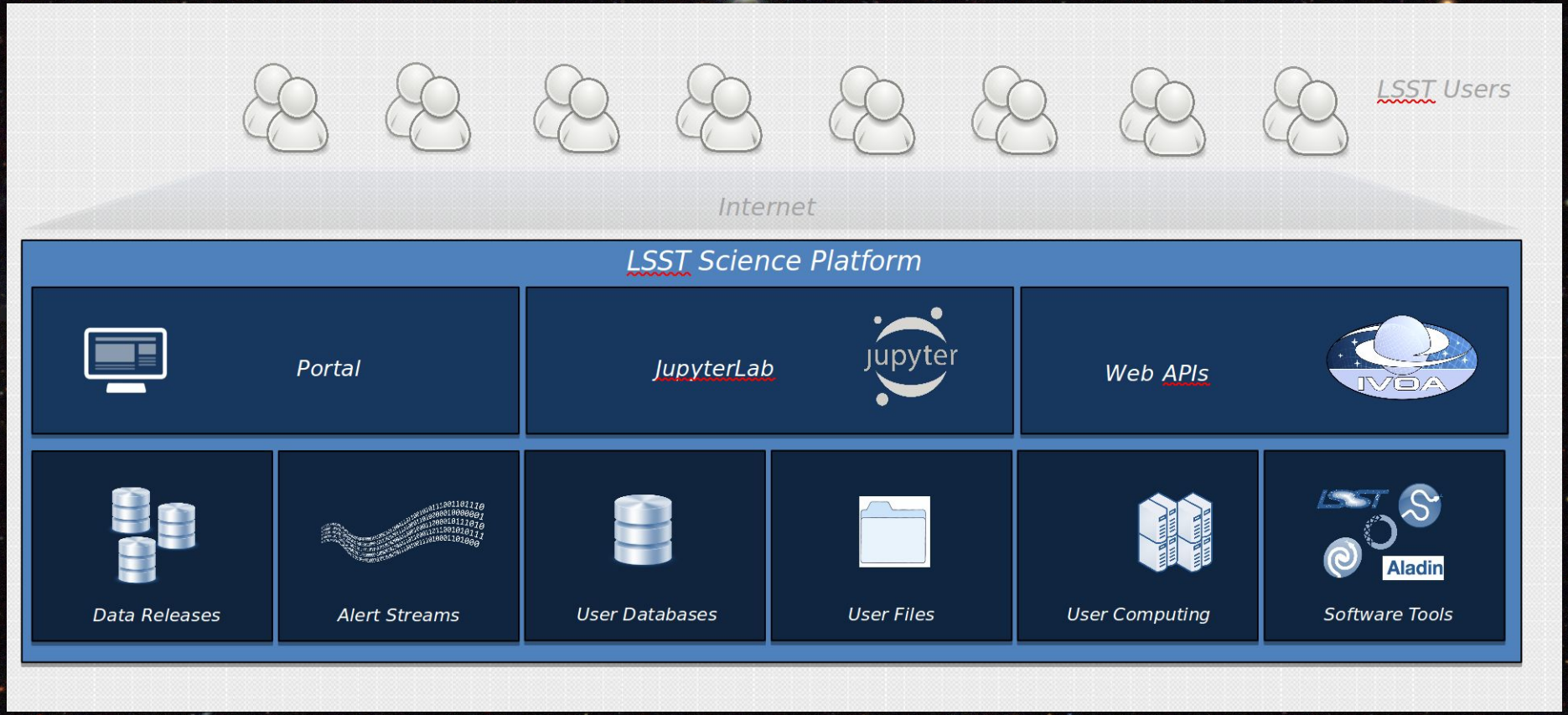
Large Synoptic Survey Telescope facts



Large Synoptic Survey Telescope facts

- 8.4 Meters Telescope, 3.2 Gpx camera
- 10 year survey, ½ of the sky, Telescope in Chile, data @ NCSA, starts 2020
- Several Goals: Dark Energy/Matter, Transients (Bright/positions), Milky Way
- Public Access since the beginning
- 15 TB per night, 0.5 Exabytes in images, 15 PB in Database
- 37 Billions objects, 5.5 Million 6.4 GB images
- Processing done at NCSA LSST Cluster
- DAC in Chile and NCSA
- Planned to containerized scientific pipelines, DB, Interfaces

LSST Container Solutions

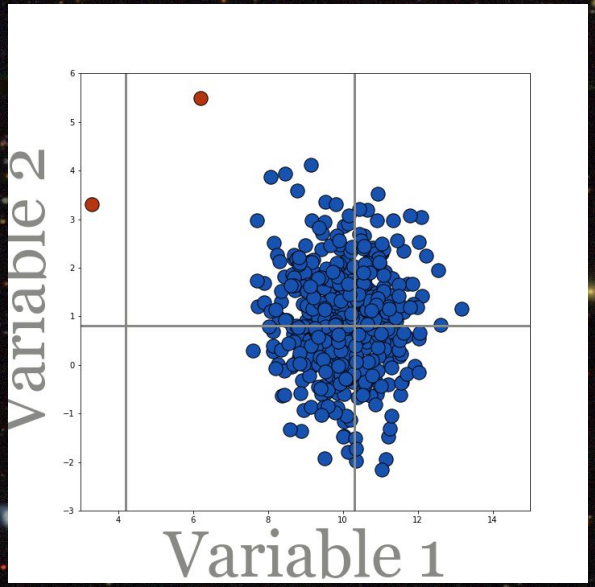


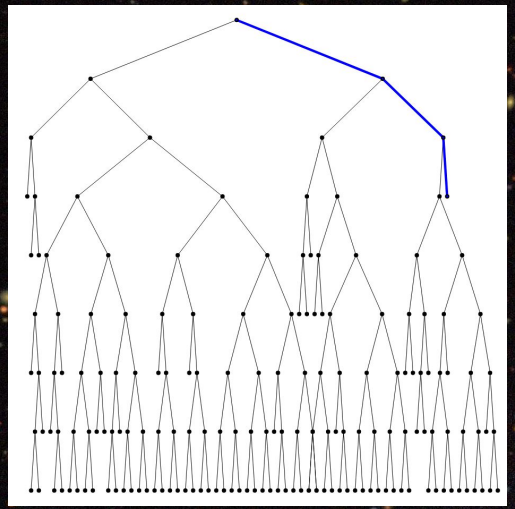
LSST Container Solutions (+ Kubernetes)

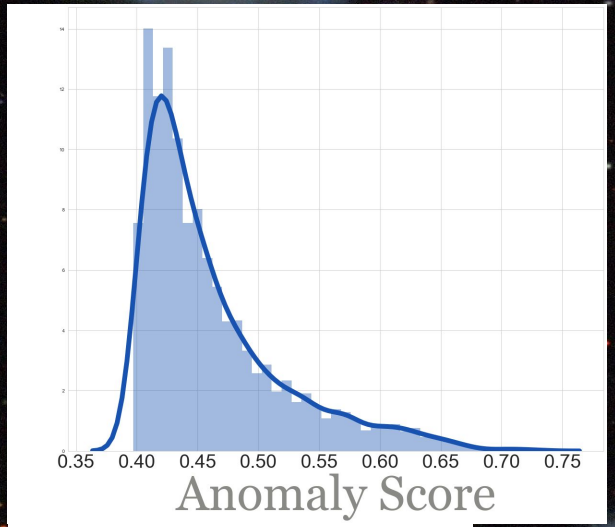
- Running Scientific Processing Pipelines (Being tested, IN_2P_3)
- QA Framework and System (Under Development)
- HTCondor and Spark Cluster (Being tested at bare metal K8S install)
- User interfaces (Under Development)
- JupyerHub (Currently on GKE, moving to Nebula)
- LSST Documentation and Forum (Currently on AWS, eventually NCSA)
- Other Services
- Security, GPFS and Developer/Production current issues
- Local Docker Registry

Isolation Forest (Anomaly Detection)

- Used for anomaly detection in static and stream mode
- Managed by Kubernetes, Front-end, Spark back, Accesible from Jupyter notebook
- Elastic Computing







Credit: Sahand Hariri

Conclusions

- Moving forward for containerized applications
- DES mostly uses containers for data access and user interfaces via cluster and container management
- LSST will go beyond that and will do processing, production, user interfaces, HPC in a multiple DAC schema
- Common needs, solutions and synergy @ NCSA

Thanks!

Questions?

Matias Carrasco Kind
mcarras2@illinois.edu
github.com/mgckind
matias-ck.com