Ramping up CC-IN2P3 for the LSST challenge

fabio hernandez

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CONTENTS

○ IN2P3 computing center overview

○ CC-IN2P3 current and foreseen contributions to LSST

IN2P3 COMPUTING CENTER

IN2P3

A DISTRIBUTED LABORATORY

2500 researchers, engineers and technicians

700 post-docs and PhD students

25 laboratories and research platforms in France, 16 international laboratories

COMPUTING CENTER

IN2P3 COMPUTING CENTER

○ CC-IN2P3

84 people, 80 FTE, 80% permanent positions

~15 M€ overall annual budget
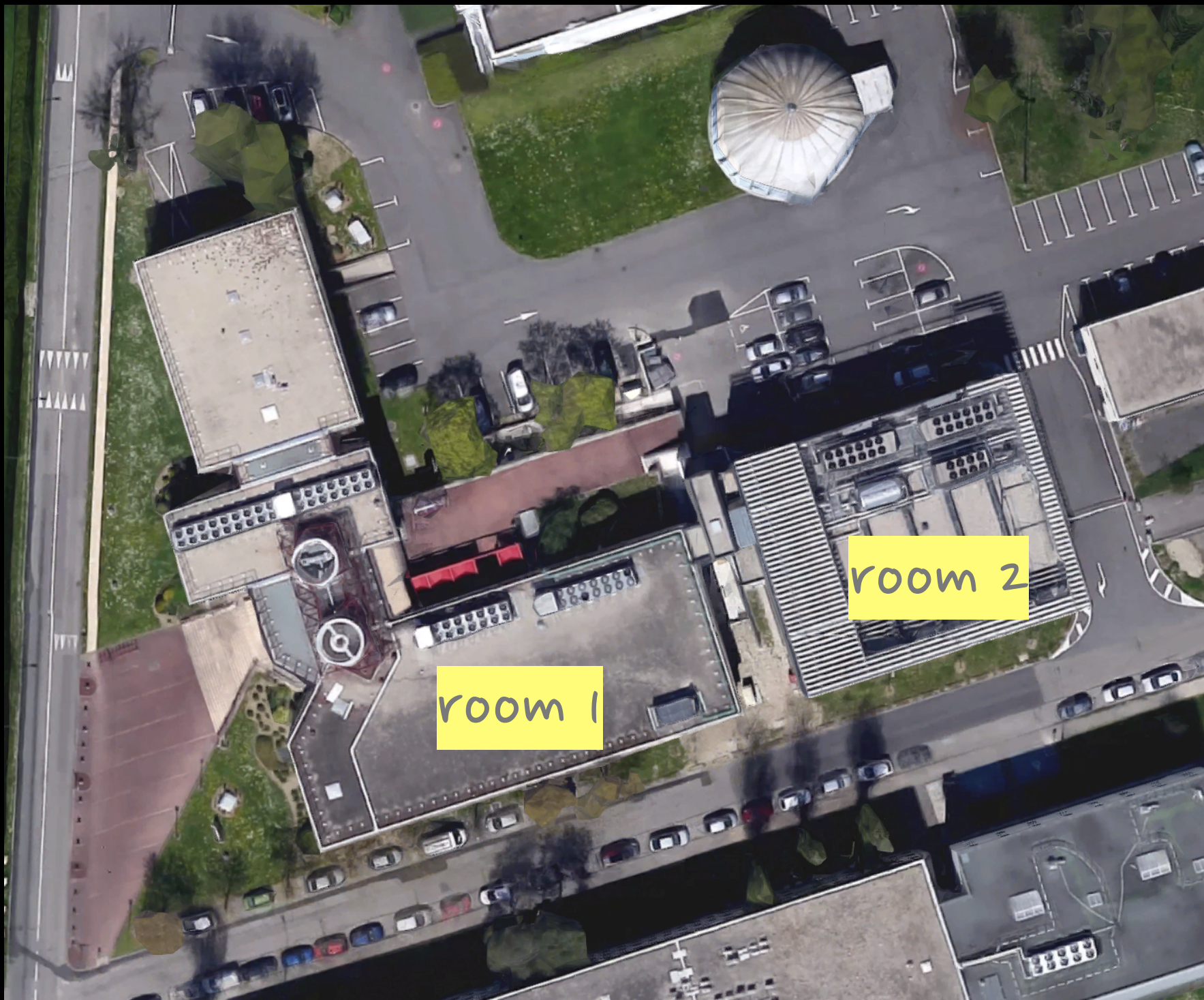
scientific data center, high throughput computing

well connected to national and international networks

○ **Shared computing facility** supporting the institute's research program

~70 projects in high energy physics, nuclear physics and astroparticle physics

○ Operations: 24x7

unattended during nights and weekends

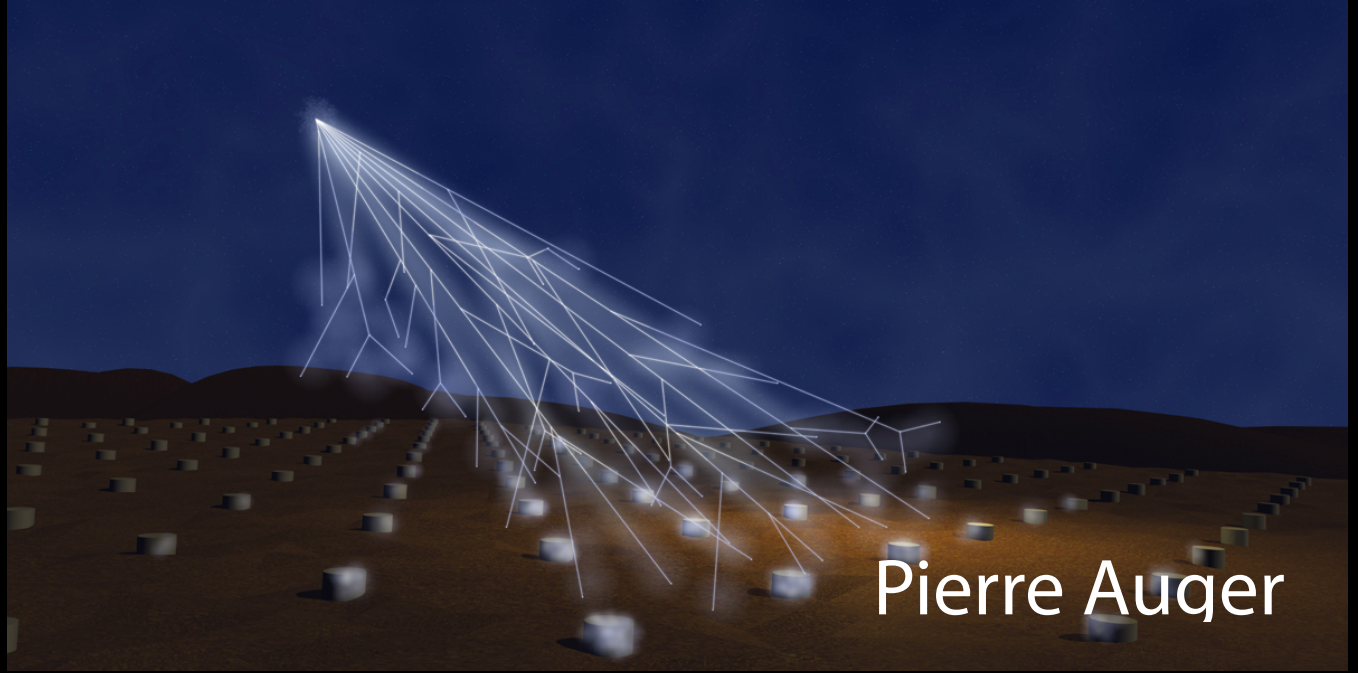*engineer on duty during off-hours*
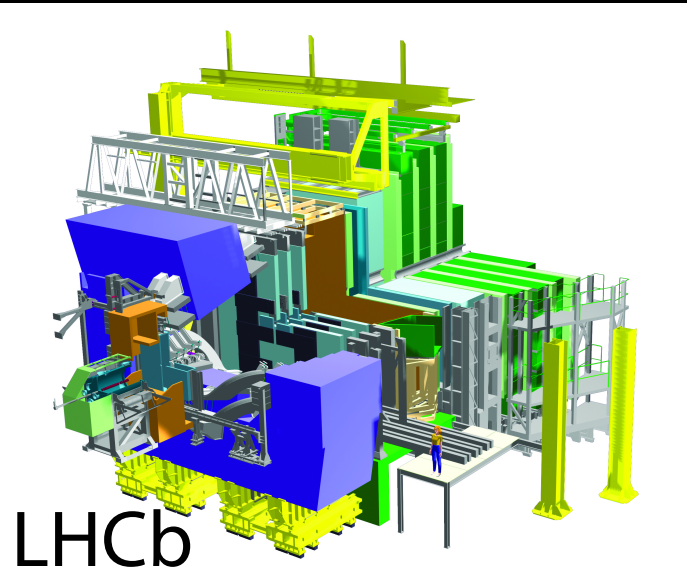
building 2

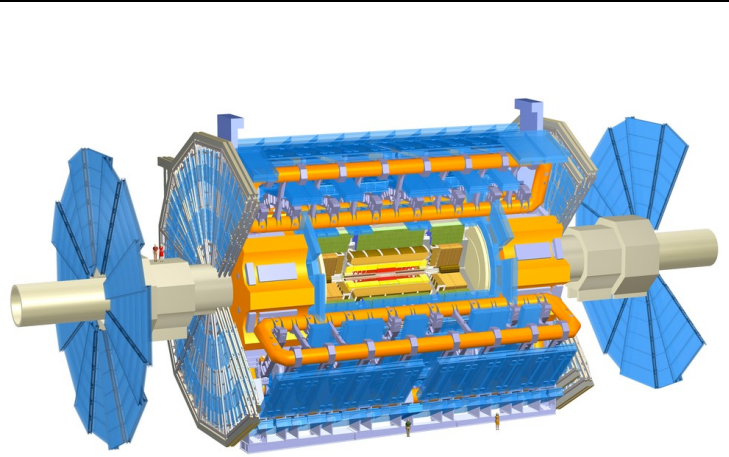machine room 2

room 2

room 1

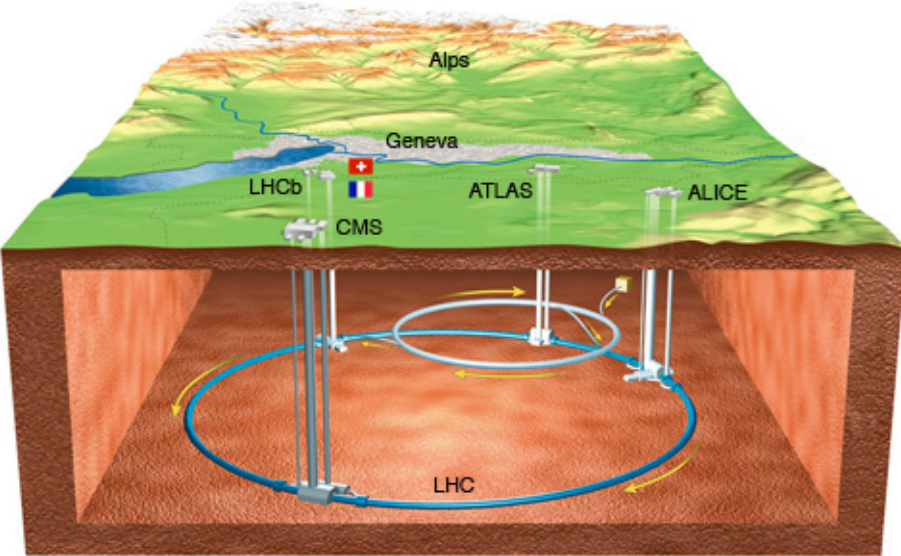aerial view

machine room 1

Planck

Fermi

Pierre Auger

AMS

HESS

LHCb
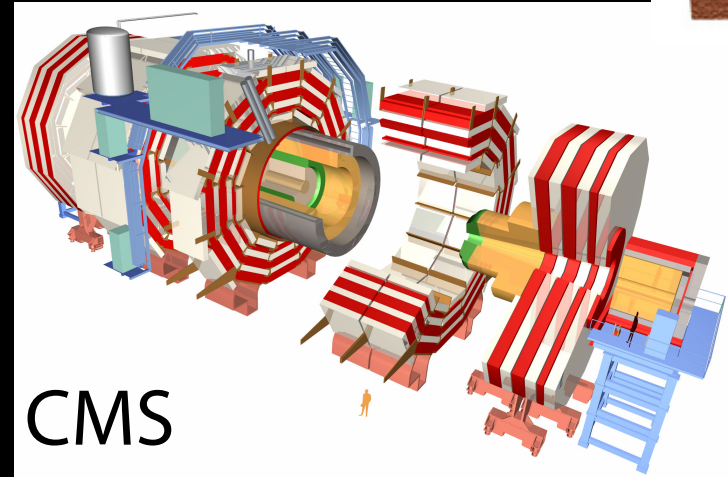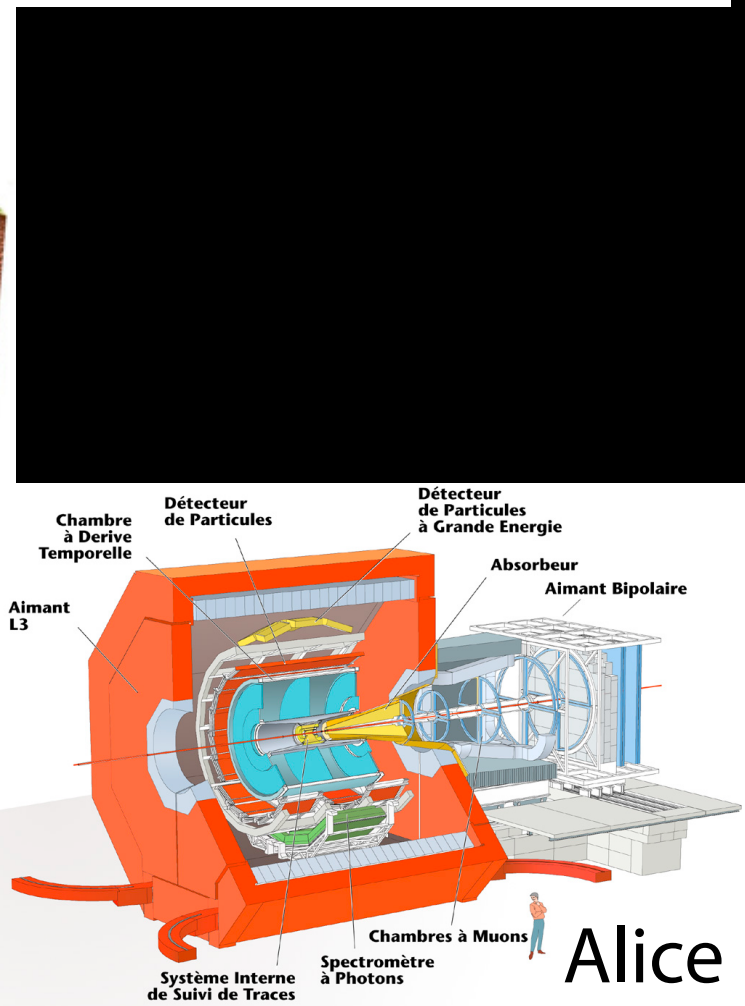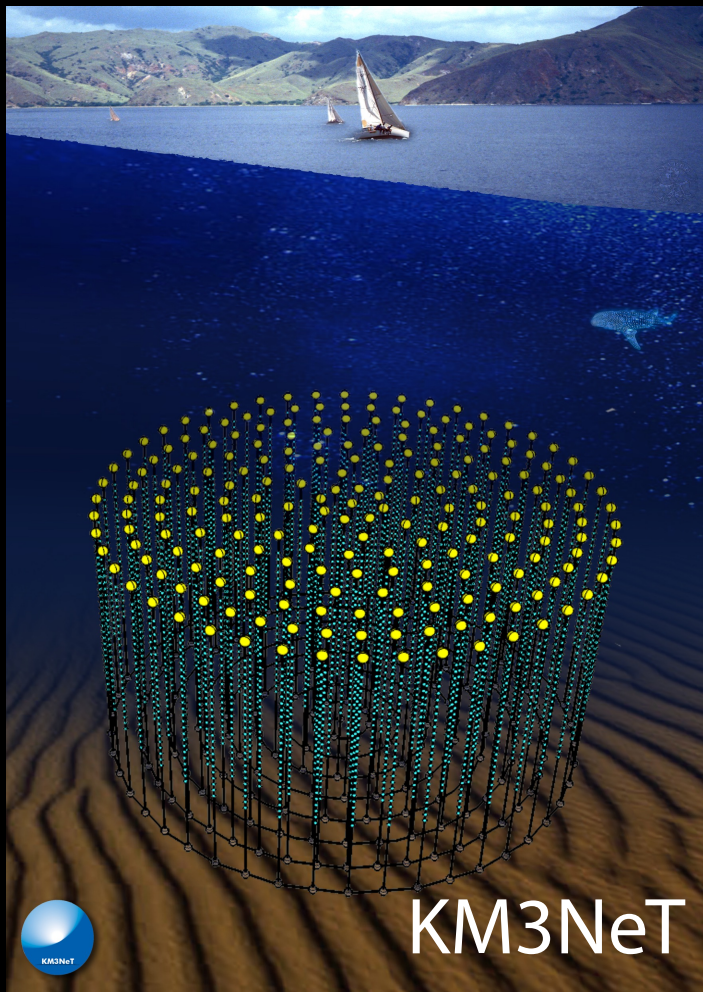
LHC @ CERN

ATLAS

SuperNova Legacy Survey

Virgo

CMS

Alice

KM3NeT

LSST AT CC-IN2P3

○ **CC-IN2P3 preparing to be a satellite data release production center**

under NCSA leadership

formal agreement signed by LSST Corp., NCSA and IN2P3 (2015)

○ Principle of operations

*CC-IN2P3 to **process 50% of the raw data** and **store the full dataset**, both raw and reduced data (images and catalogs)*

both NCSA and CC-IN2P3 to exchange and validate the data produced by the other party

each site to host an entire copy of every annual data release

○ Ongoing work to understand the scope and size of a LSST data access center
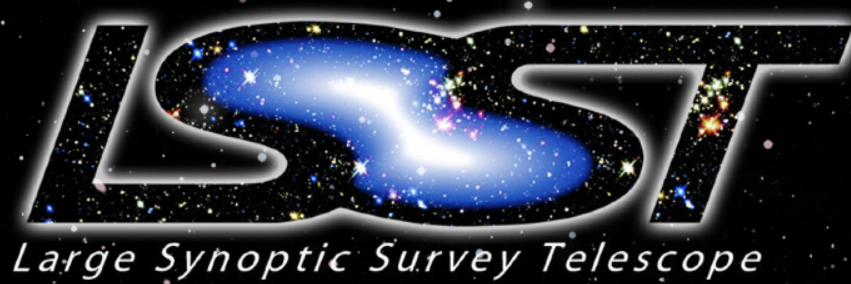
LSST Operations:
Sites & Data Flows

French Site
Satellite Processing Center
Data Release Production
Long-term Storage (copy 3)

Archive Site

Archive Center
Alert Production
Data Release Production
Calibration Products Production
EPO Infrastructure
Long-term Storage (copy 2)

Data Access Center
Data Access and User Services

HQ Site
Science Operations
Observatory Management
Education & Public Outreach

Base Site

Base Center
Long-term storage (copy 1)

Data Access Center
Data Access & User Services

Summit Site
Telescope & Camera
Data Acquisition
Crosstalk Correction

Source: LSST

Imagery ©2017 Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Landsat / Copernicus, IBCAO, U.S. Geological Survey, PGC/NASA, Map data ©2017 Google, INEGI   United States   Terms   Send feedback   200 mi
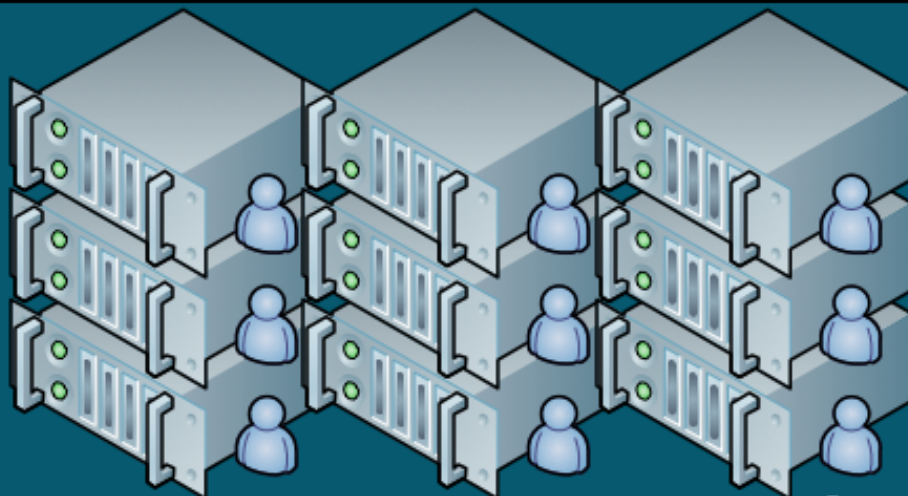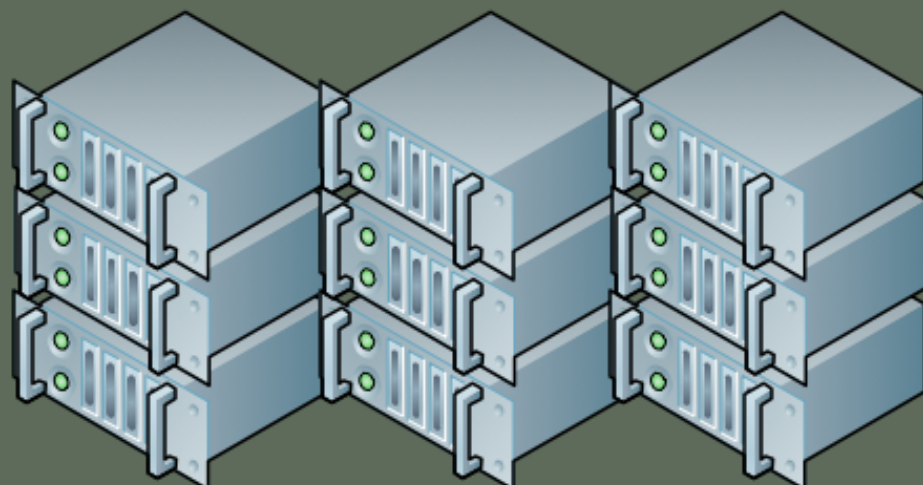
CURRENT STATUS

ENVISIONED ARCHITECTURE

22k → 122k CPU cores

Batch farm

Login farm

Data transfer nodes

Application servers

WAN

LAN
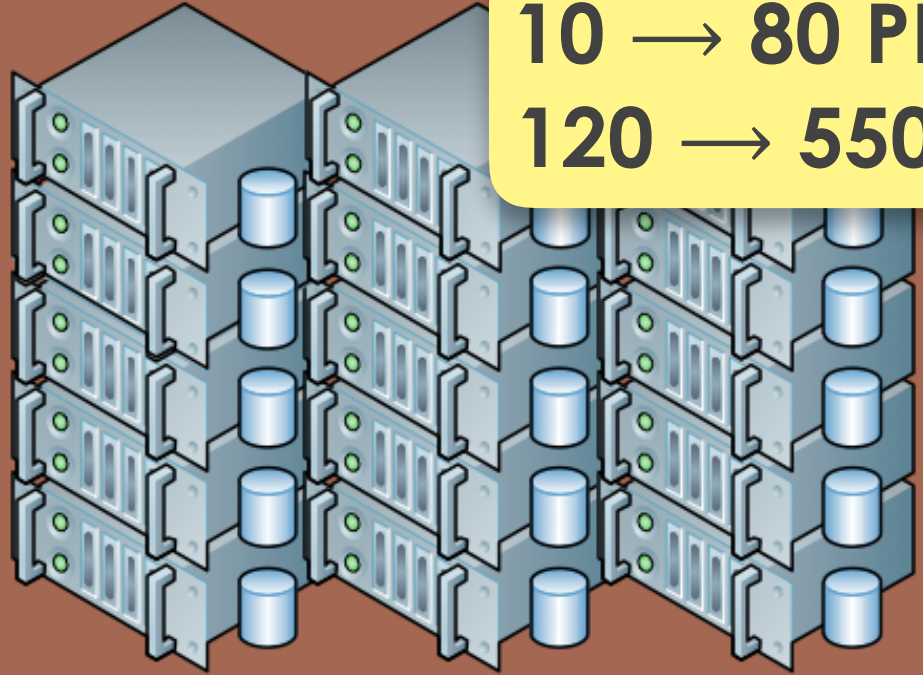
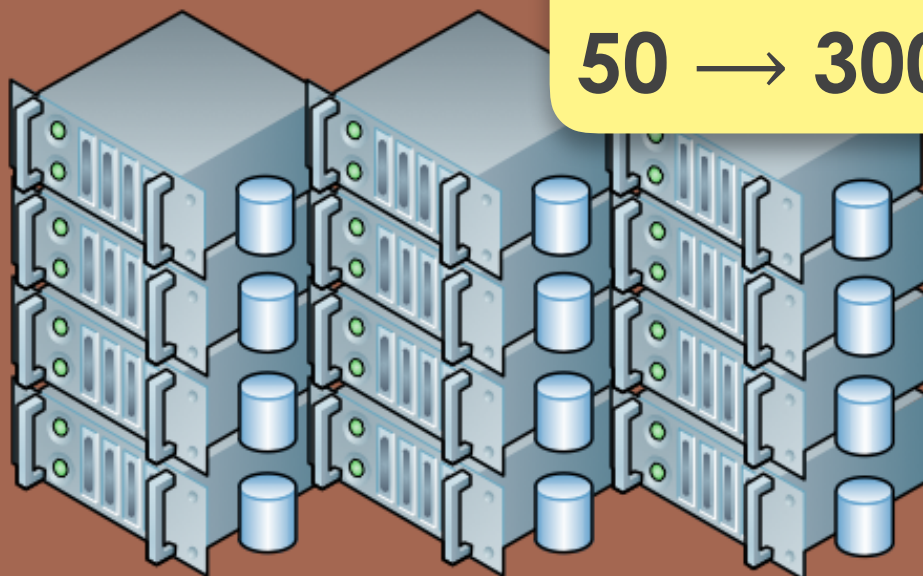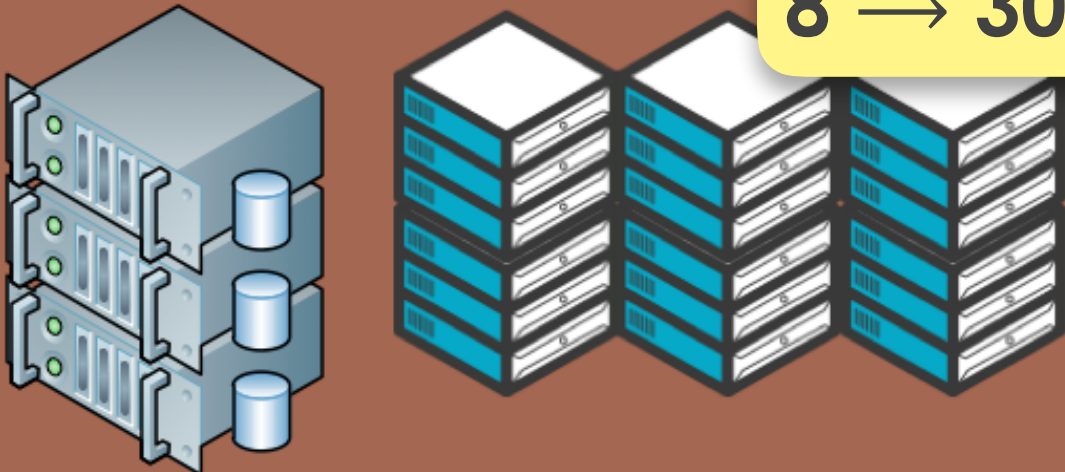10 → 80 PB
120 → 550 GB/s

Catalog database

10 → 55 PB
50 → 300 GB/s

Disk storage

4 → 21 PB
8 → 30 GB/s

Mass storage

2022 → 2032

Machine room infrastructure

Number of racks on the floor
LSST data release processing at CC-IN2P3

Racks
peak 34 racks

Power
peak 1.4 MW

Required Power
LSST data release processing at CC-IN2P3

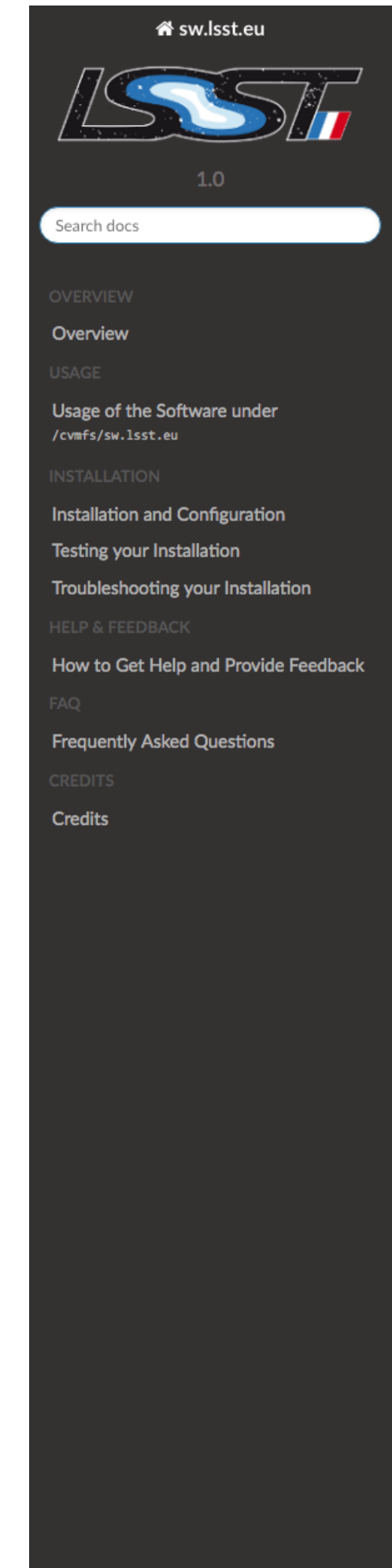Computing Equipment — Total power (including overhead)
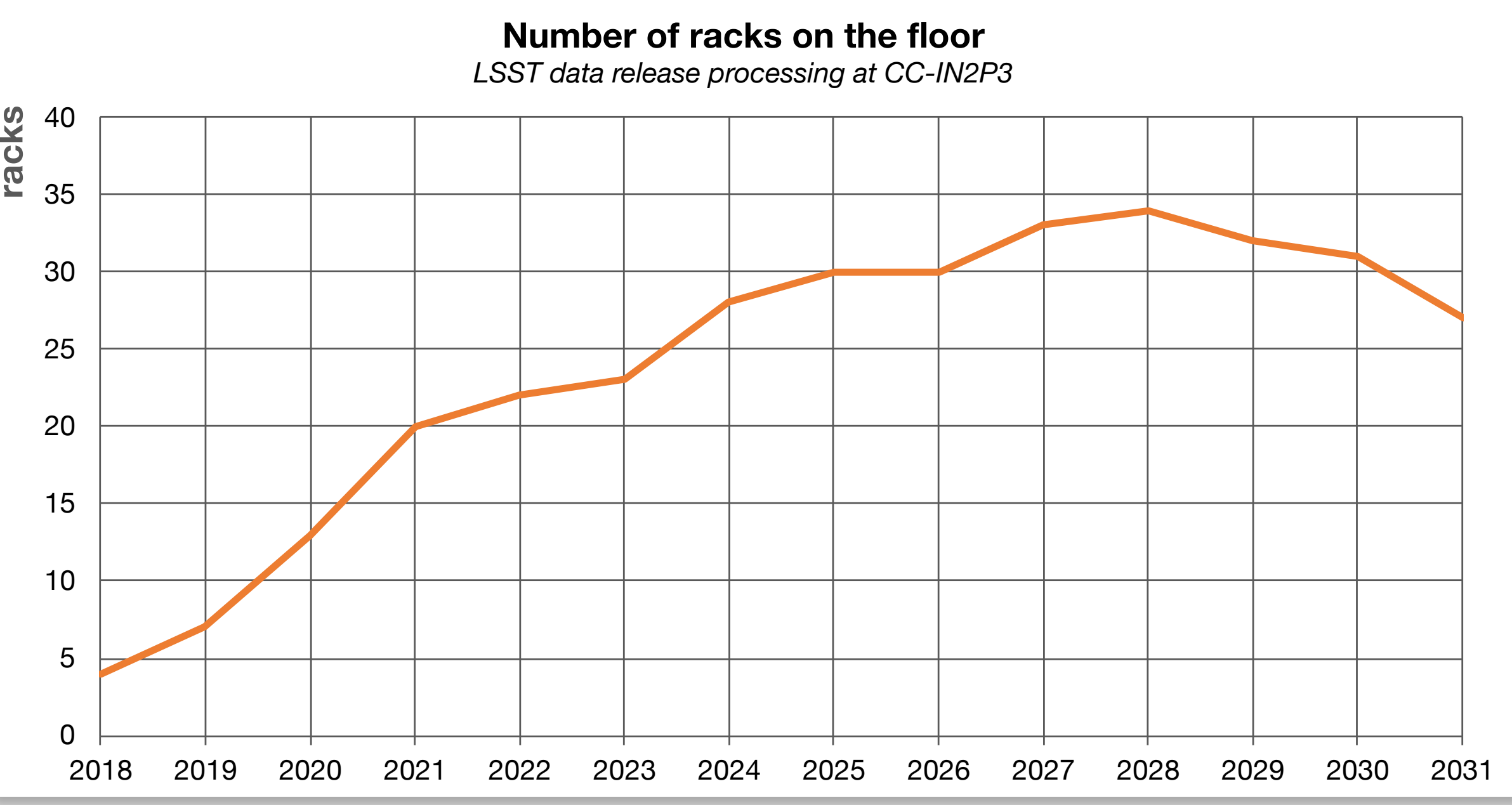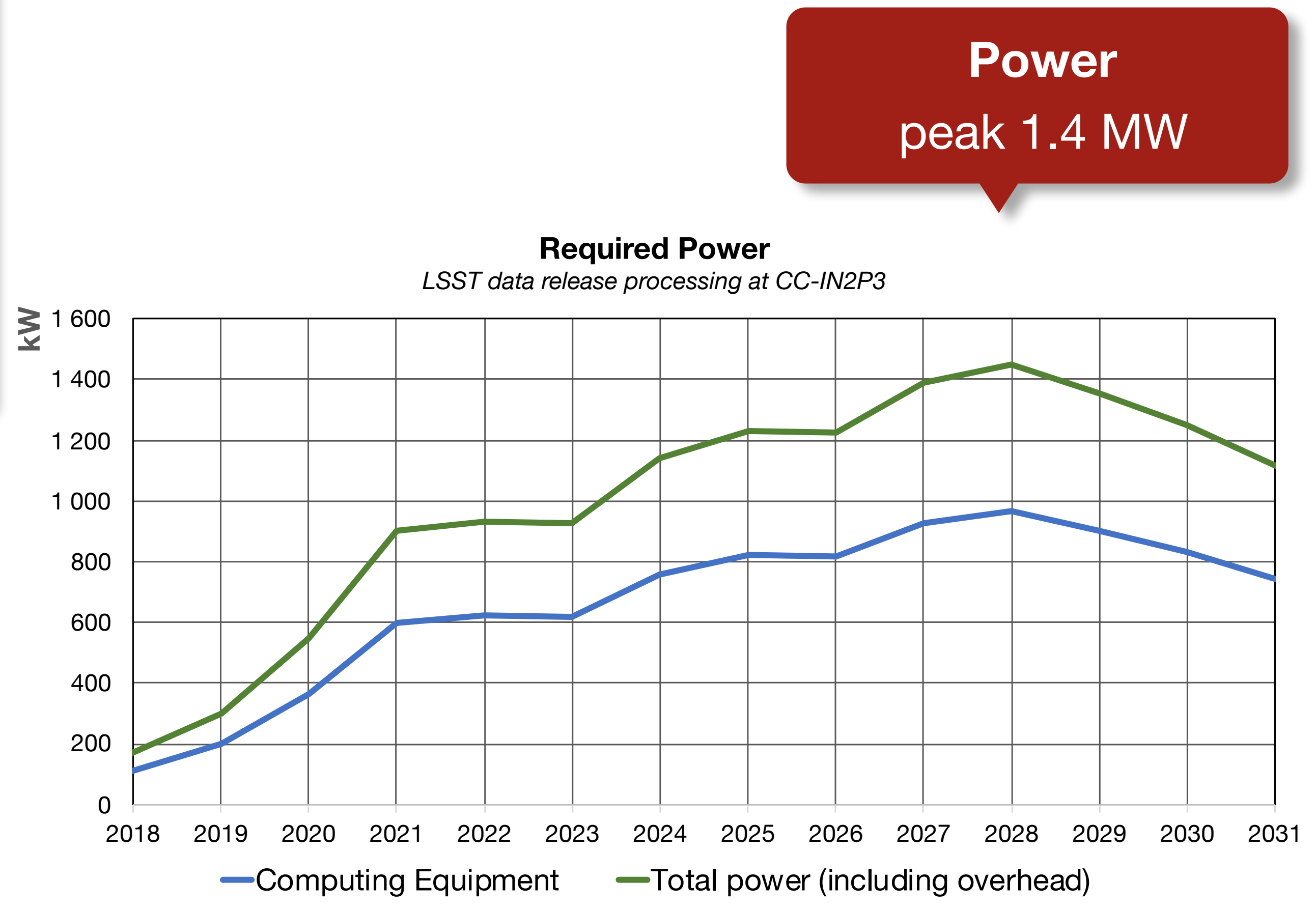
Sizing for Data Release Processing

- Our sizing work is based on requirements as estimated by the project in 2013

  at that time, the LSST software was significantly less developed

- It would be prudent we revisit the project's estimations in the light of the current state of the LSST software

  in particular, we could measure the ability of the LSST software to exploit the computing capacity of modern CPUs

  I expect we will find discrepancies which may have a significant impact on the computing capacity and machine room infrastructure required for DRP

  *e.g. LHC experiments at CERN **measured** their simulation software uses **less than 10% of the FLOPs** theoretically delivered by recent CPUs (source: G. Stewart, slide 5 of this presentation)*

SOFTWARE DISTRIBUTION

sw.lsst.eu

○ LSST software **automatically delivered** to your personal computer

*without your intervention, both **stable** and **weekly** releases just appear as if they were installed on your laptop under* `/cvmfs/sw.lsst.eu`

same mechanism used for delivering the software to computers in both the login and batch farms at CC-IN2P3

*lower the barriers for end users to use the LSST software: the more people use it, the better it gets*

useful also for reproducibility

DESC DATA CHALLENGE 2

○ Use the LSST software pipelines to process simulated LSST images

  valuable for exercising CC-IN2P3's infrastructure for LSST data release processing

  we want to identify the limitations of our infrastructure and tools as early as possible

○ Images produced at NERSC, transferred to CC-IN2P3, batch processed using LSST software

  data products transferred back to NERSC

  currently using SLAC's SRS Pipeline execution engine

○ Preliminary lessons learned

  work needed for making the data products easily available for analysis: DESC task force created

  hoping that Gen3 Butler will enable easier creation of data-driven workflows and give us more flexibility with file-related management tasks

  need to build workflow-aware tools for continuous data exchange with the partner site as soon as data is produced
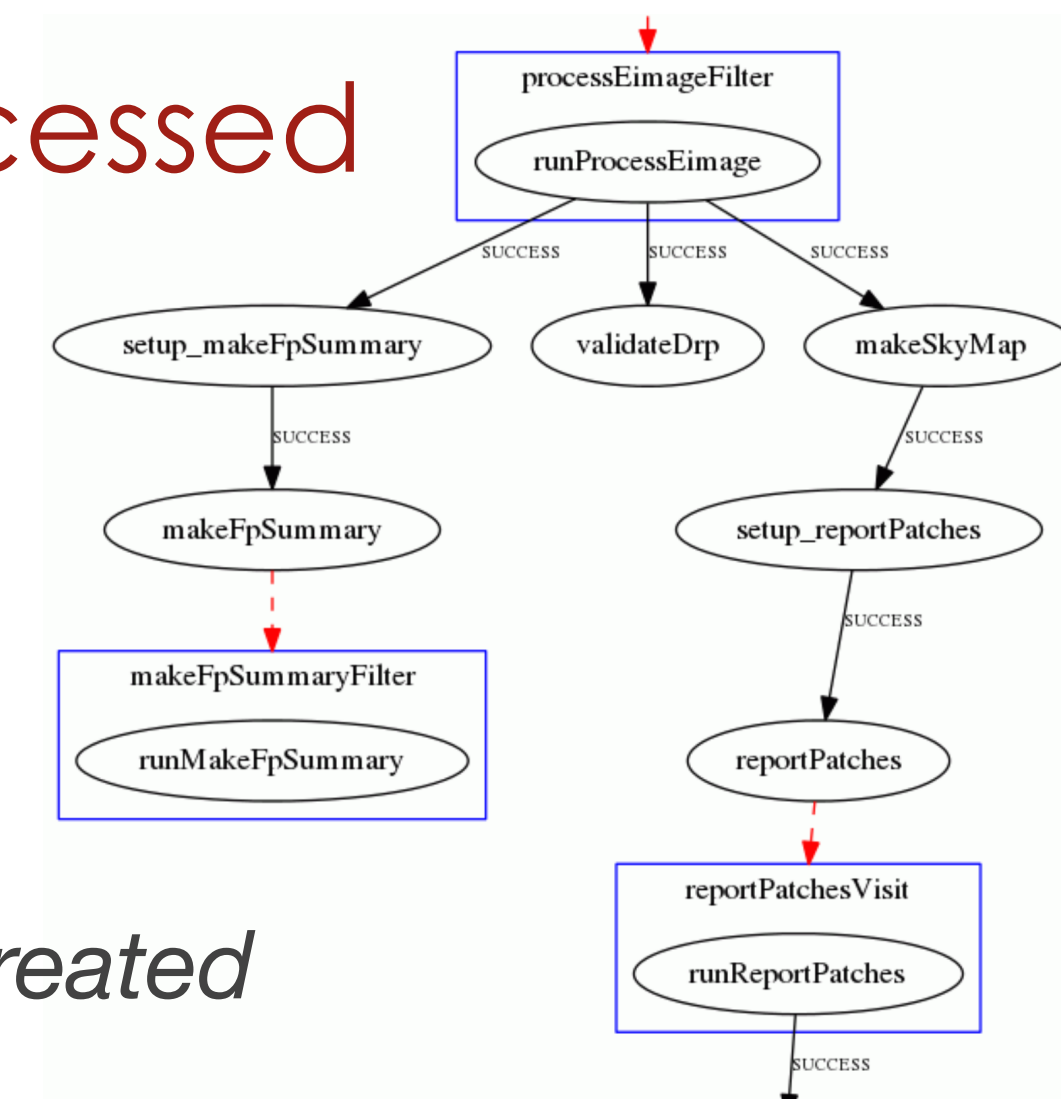
Connectivity & Data exchange

○ **Allocated bandwidth between CC-IN2P3 and NCSA: 20 Gbps**

bottleneck link is currently 10 Gbps

to ask for an increase of this allocation we need to demonstrate that we are limited by the current available capacity

connectivity provided by Renater, the French academic and research network

○ **We need to demonstrate capacity to import 15 TB of raw data per night from NCSA (RTT: 110 ms)**

in addition to capacity to exchange data products with NCSA

currently doing exercises with NERSC, in the framework of the DESC data challenge

CONNECTIVITY & DATA EXCHANGE (CONT.)

Data flow: **NERSC** (GPFS) → **CC-IN2P3** (GPFS) [3 servers, 4 clients]

Aggregated application-level network throughput: **1.5 GB/s (12 Gbps)**

pull model, disk-to-disk transfer, wide area network, 150ms RTT, secure HTTP

International connectivity provided by

LSST SCIENCE PLATFORM PROTOTYPE

LSST-ready Python notebooks, routinely used by scientists in CC-IN2P3's login farm

Currently exploring how to integrate a Firefly server without requiring users to go through a VPN

Sources: D. Boutigny, X. Wu et al.
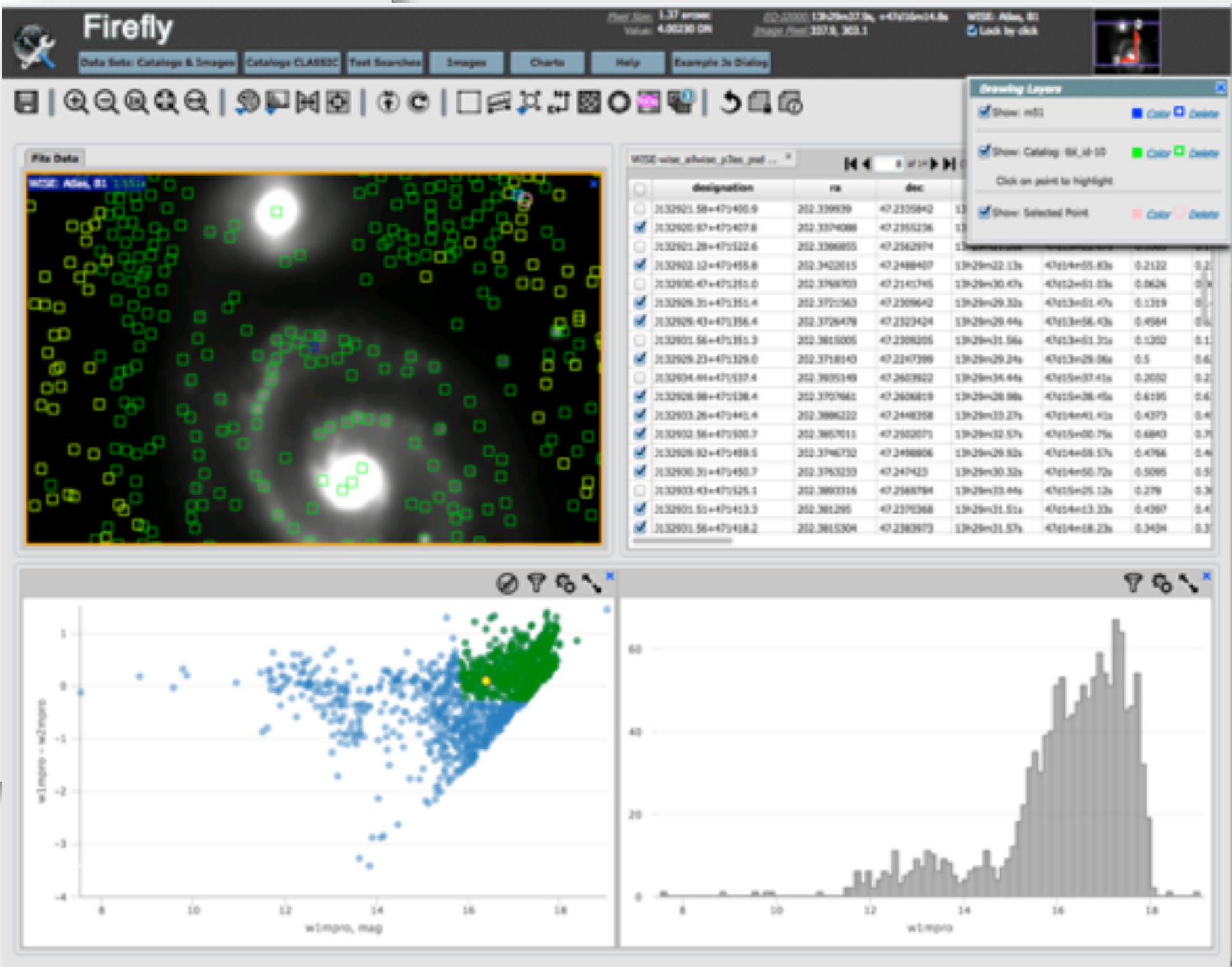
CATALOG DATABASE

○ We continue supporting the Qserv development team by operating a dedicated development cluster

50 hosts, 400 CPU cores, 800 GB RAM, 500 TB raw storage capacity

hardware lent by Dell in the framework of an institutional partnership

○ A fraction of that cluster was recently prepared for ingestion exercises of data products of DESC data challenge

tools for multi-threaded ingestion were developed

work lead by S. Elles (IN2P3 LAPP)

Visit to CC-IN2P3 scheduled on Wednesday afternoon

click here for a virtual visit

QUESTIONS & COMMENTS