EOSC Activities in the High Energy Physics community

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Physics projects with relation to EOSC

- **ESCAPE**: Establish a single collaborative cluster of next generation European Strategy Forum on Research Infrastructures (ESFRI) facilities in the area of astronomy- and accelerator-based particle physics in order to implement a functional link between the concerned ESFRI projects and European Open Science Cloud (EOSC)
- **ExPANDS**: collaboration between 10 national Photon and Neutron Research Infrastructures and EGI. The aims to deliver standardised, interoperable, and integrated data sources and data analysis services for Photon and Neutron facilities
- **PANOSC**: Photon and Neutron Open Science Cloud, joins six European research infrastructures (ESRF, CERIC-ERIC, ELI Delivery Consortium, the European Spallation Source, European XFEL, ILL, and the e-infrastructures EGI and GEANT
- **interTwin**: interdisciplinary Digital Twin Engine for modelling and simulation includes fast simulation solution to complement the Monte Carlo approach at the LHC and Lattice QCD simulations to develop a theoretical understanding of matter in the plasma phase (started last September)
- **ARCHIVER**: Pre-Commercial Procurement (PCP) approach to competitively procure R&D services for archiving and digital preservation, lead by CERN
- **EOSC-Future**: Implementing the European Open Science Cloud (EOSC), CERN participates with the consolidation of data lake activities and enabling open access to data
- **FAIR4FUSION**: make European funded data more widely available to the fusion community (finished in May 2022)

ESCAPE partners

ESCAPE

- 31 Partners
- 7 ESFRIs & flagship projects
- 2 EIROs (CERN, ESO)
- Budget 15.98M€
- Feb 2019 - Jan 2023

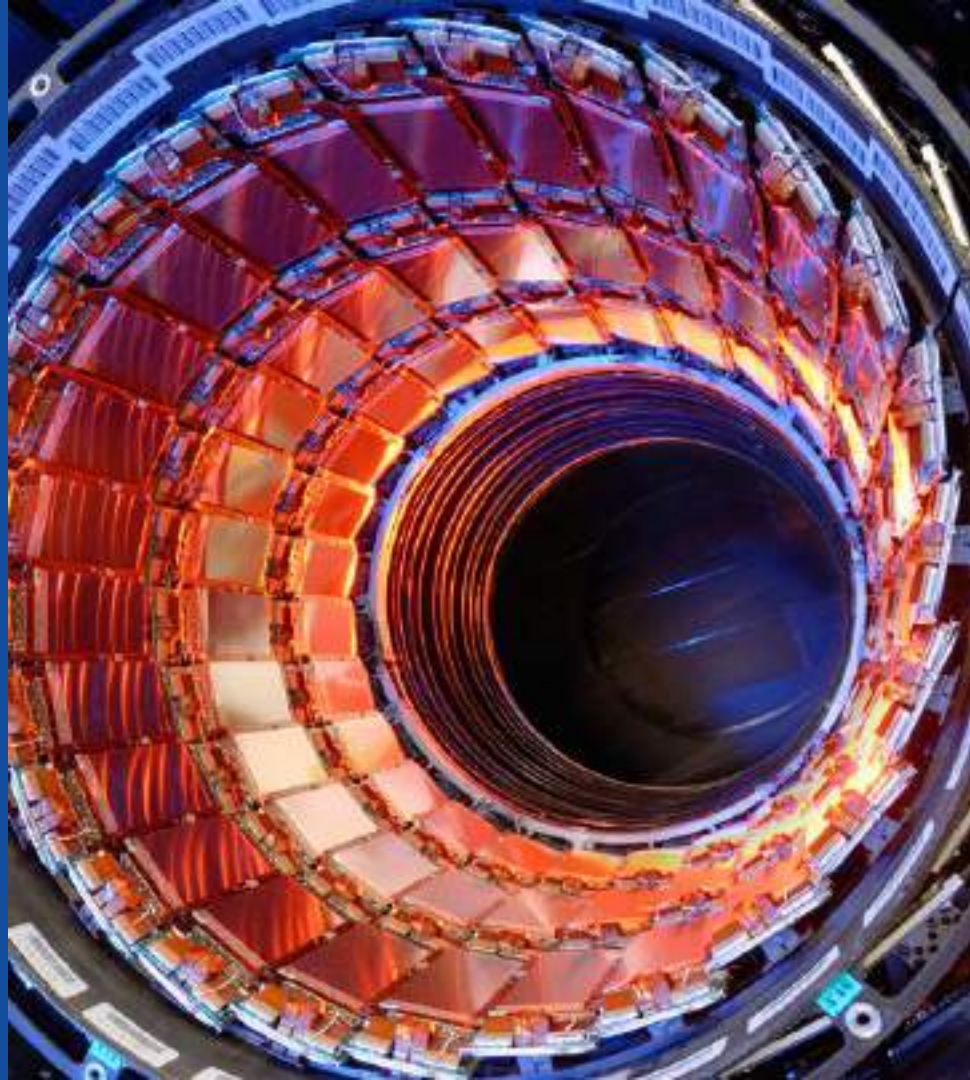
- High Energy Physics
  - HL-LHC
    - High Energy Particle Physics
  - FAIR
    - High Density Exotic Matter Physics

- Multi Messenger Astronomy
  - Not a topic of this presentation

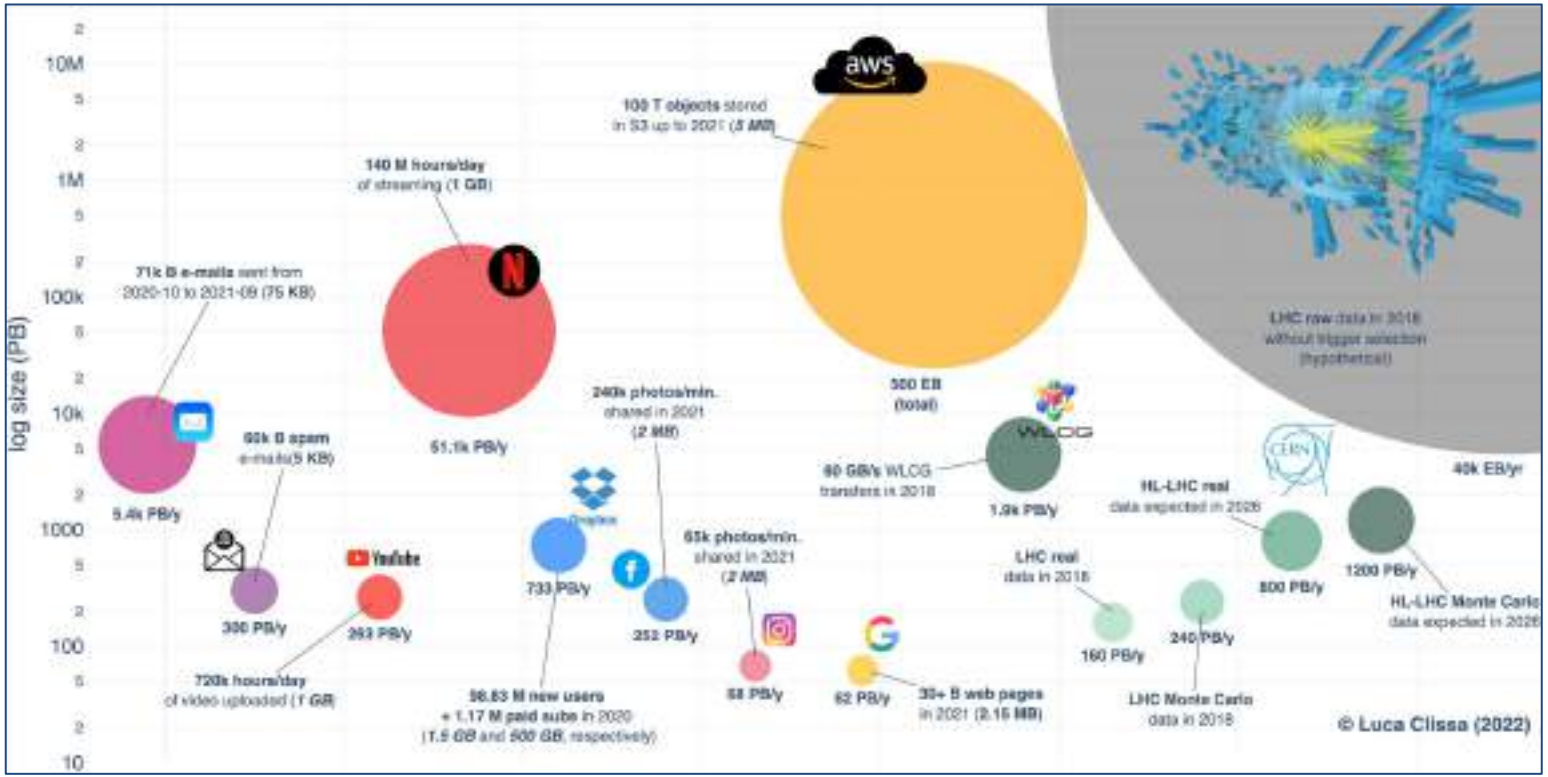
Computing in High Energy Physics

- Particle physics accelerators and detectors are amongst the most complex devices built by the humankind

- Being on the edge of the technology is required
  - Big Data
  - Advanced computing

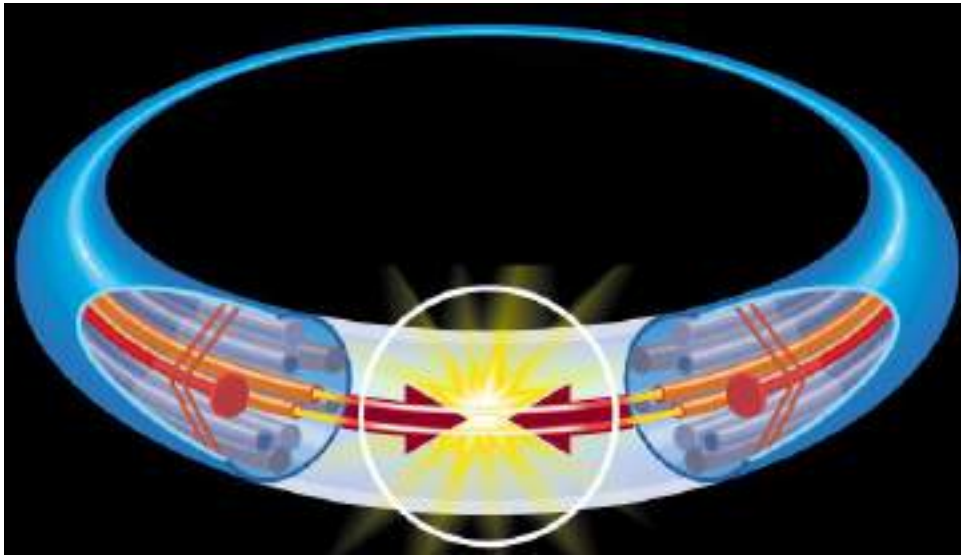


Big Data - High Energy Physics in context



https://cloud.datapane.com/reports/dkjK28A/big-data-2021

from data to physics at the Large Hadron Collider
a long and complex path



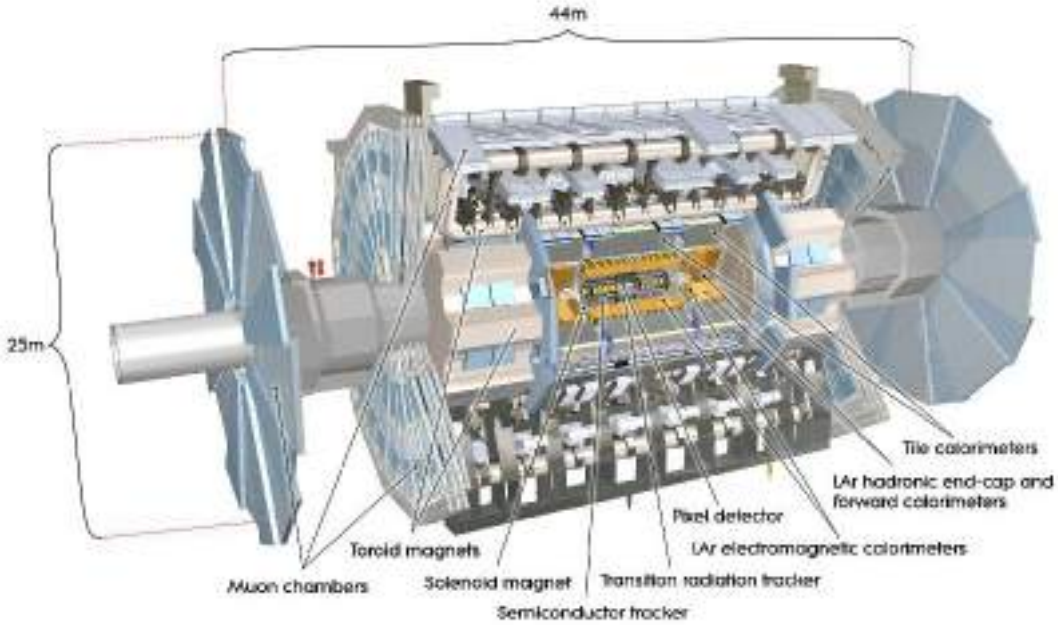
- 40 million proton-proton collisions per second

from data to physics at the Large Hadron Collider
a long and complex path

- O(100 million) readout channels
- assuming 1 channel = 1 byte

  40×10^6 ev/s * $100 * 10^6$ byte/ev

  = 4 PB/s



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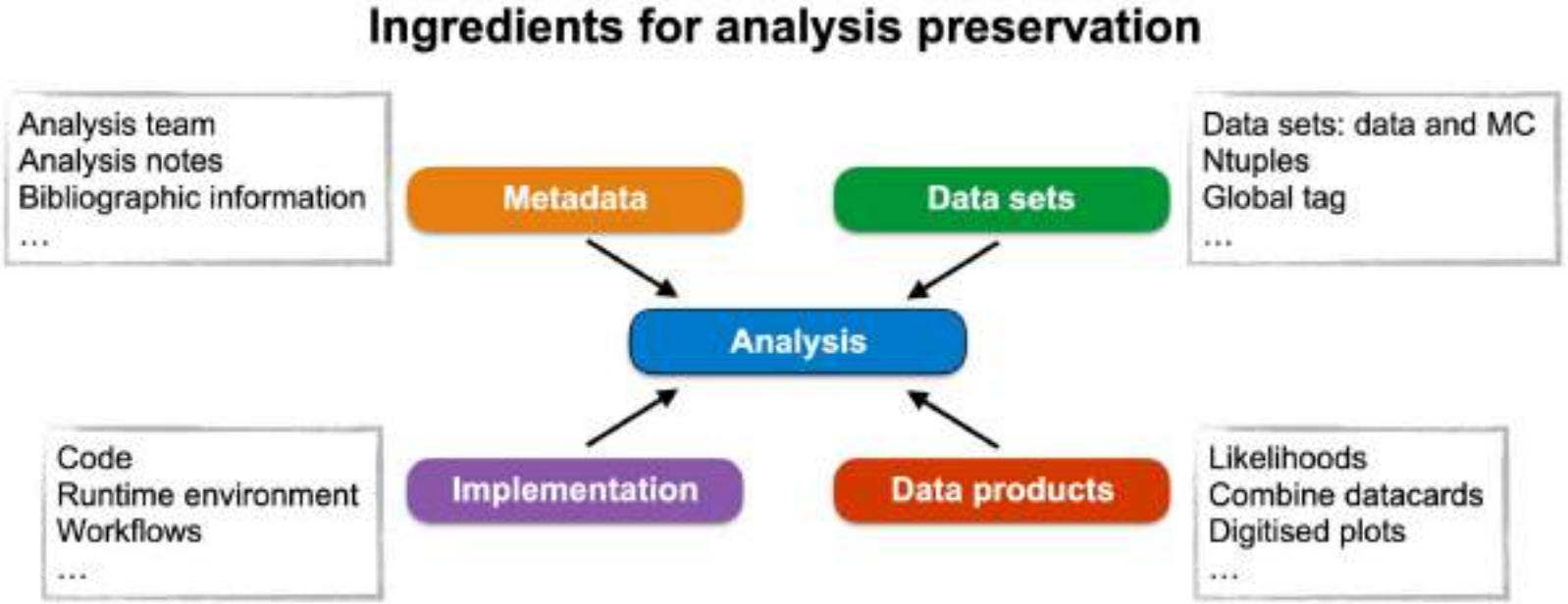


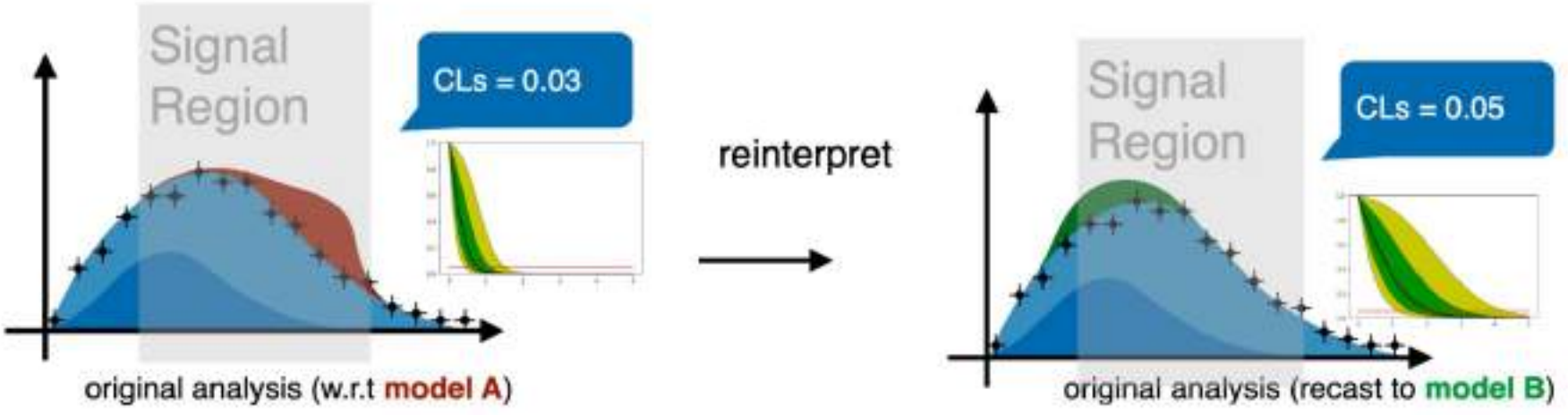
[credit: Clemens Lange]

Software preservation

- LHC experiments are investing in reuseable / reproducible analysis
- Technology Choice for software archival:
  - Git
  - Linux Containers

Software preservation - reinterpretation of results

- Analysis Preservation as part of the workflow
- Allow future theories to be tested against current analysis (reinterpretation)



[credit: Lukas Heinrich]

Preservation of Code, Scripts, Workflows

https://reanahub.io

Data repositories
zenodo

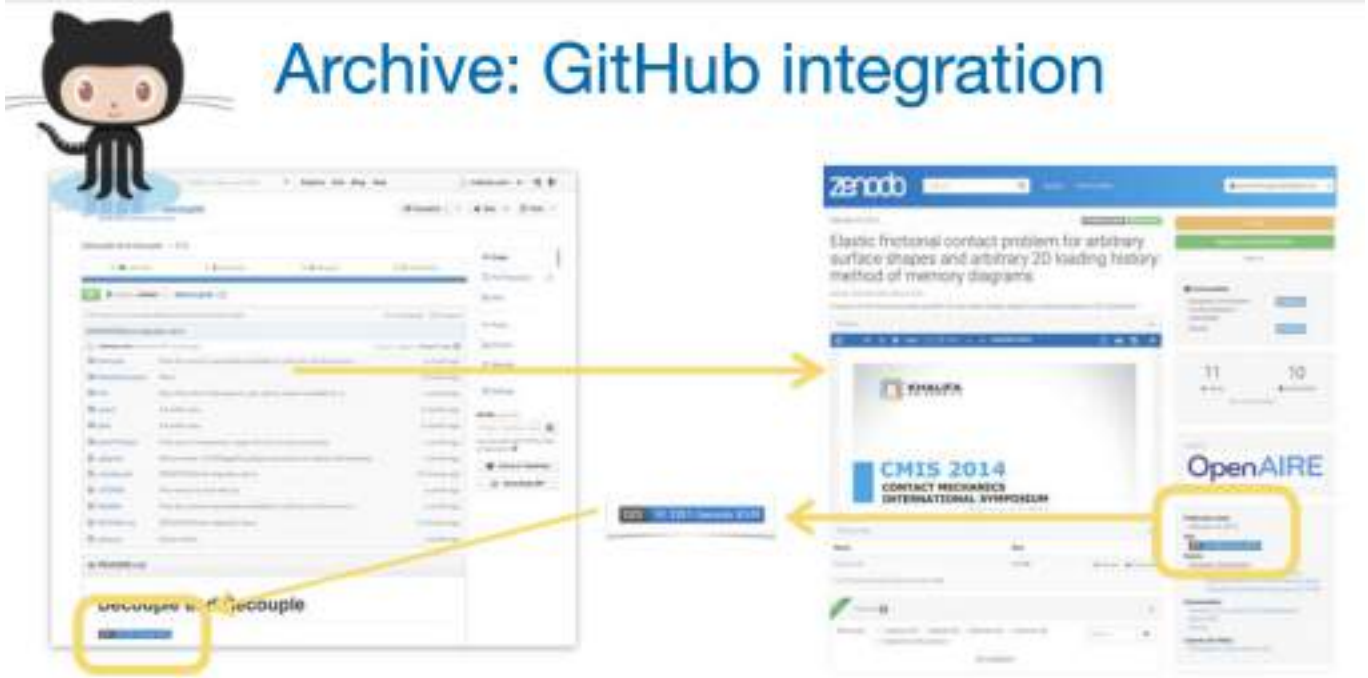
https://zenodo.org

Data repositories

zenodo

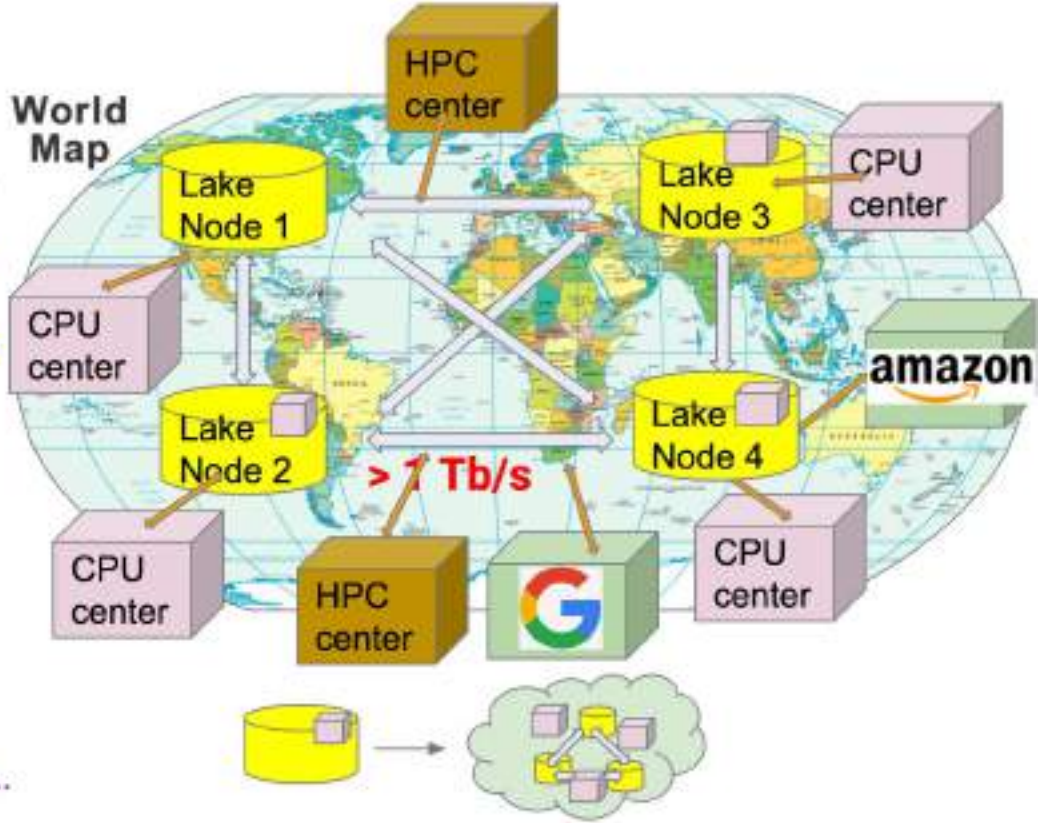
GitHub + zenodo

= Citable Code



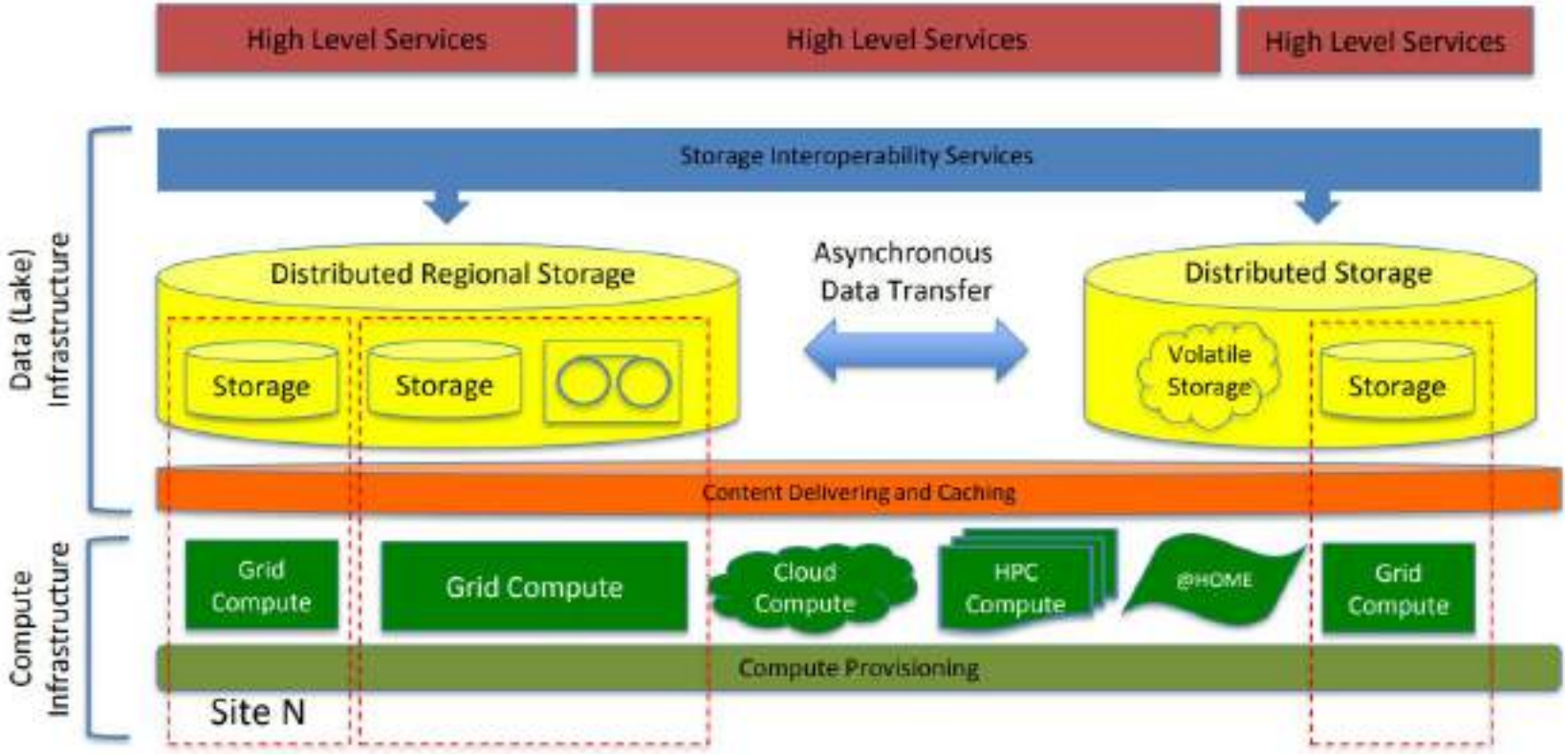
Data lake model

- ⇨ Keep the real value from the experiments safe
  - (RAW) **data** and a solid baseline of **CPU** in owned and stable sites
  - Allow for multiple CPU resources to join, even temporarily
    - Eventually choosing the cheapest at any moment
  - Solid networking: use caches / streaming to access data
- ⇨ Reduce requirements for Computing resources
  - Commercial Clouds
  - Other sciences' resources
    - SKA, CTA, Dune, Genomics, ...
  - HPC systems



[credit: Tommaso Bocali]

Data lake model



[credit: Simone Campana]

Thanks!

any questions?

you can also find me at nuno.castro@fisica.uminho.pt

https://labs.openai.com/s/aUBB7NIMAjxThBOpuYwoboml