Virtual Observatory and Science Platforms in Astronomy

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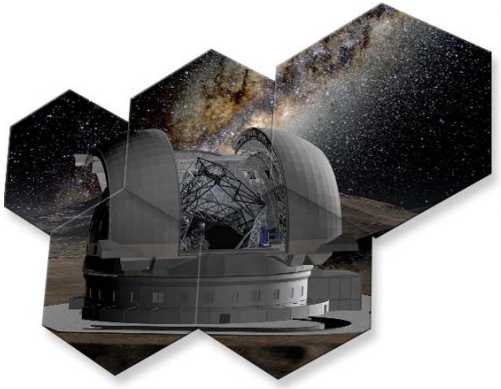
NAOC, CAS

With contributions from the IVOA

Big Data Astronomy and Its Heroes





The Idea of Virtual Observatory

Vision of the VO:

- The Web is *transparent*. The goal of the Virtual Observatory is to achieve the same feeling for astronomical data - that it is all available to explore in a single transparent system.
- Astronomical datasets, tools, services should work seamlessly together.
- The VO allows astronomers to interrogate multiple data centers in a seamless and transparent way, provides new powerful analysis and visualization tools within that system, and gives data centers a standard framework for publishing and delivering services using their data.
- Like the World Wide Web, the VO is not a fixed system, but rather a *way of doing things.*

Virtual Observatory (VO) is a data-intensively online astronomical research and education environment, taking advantages of advanced information technologies to achieve seamless, global access to astronomical information.

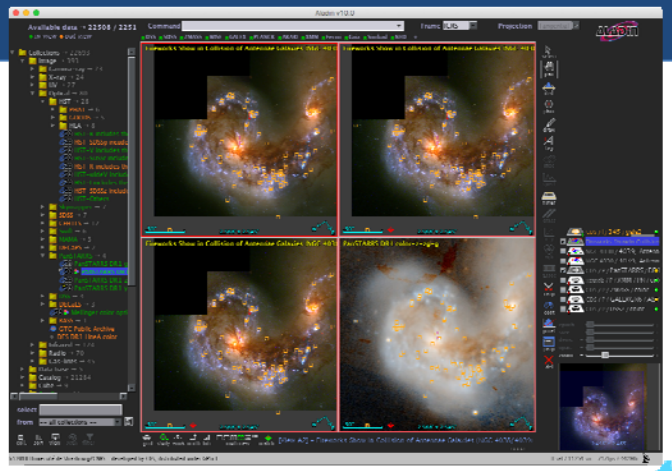
-- my words

International Virtual Observatory Alliance

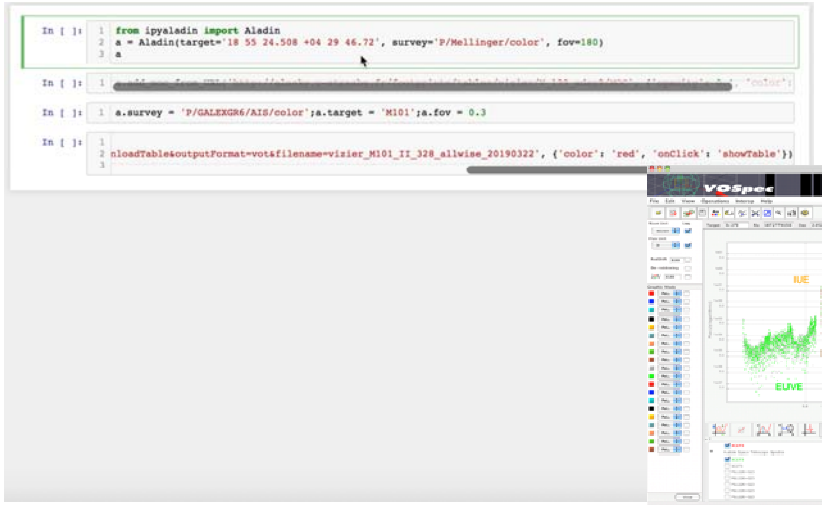
- An organisation that debates and agrees the technical standards that are needed to make the VO possible, A focal point for VO aspirations, a framework for discussing and sharing VO ideas and technology.

- Created in 2002
- 21 member VO projects
  - Netherlands shows strong interests
  - Thailand-VO is under preparation
- 6 Working Groups, 8 Interest Groups
- 2 Interoperability meetings per year
  - May
  - Oct/Nov with ADASS
- *~ 46 interoperability standards*

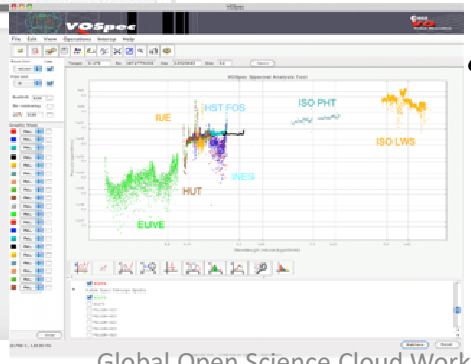
Interoperable applications and services



Aladin

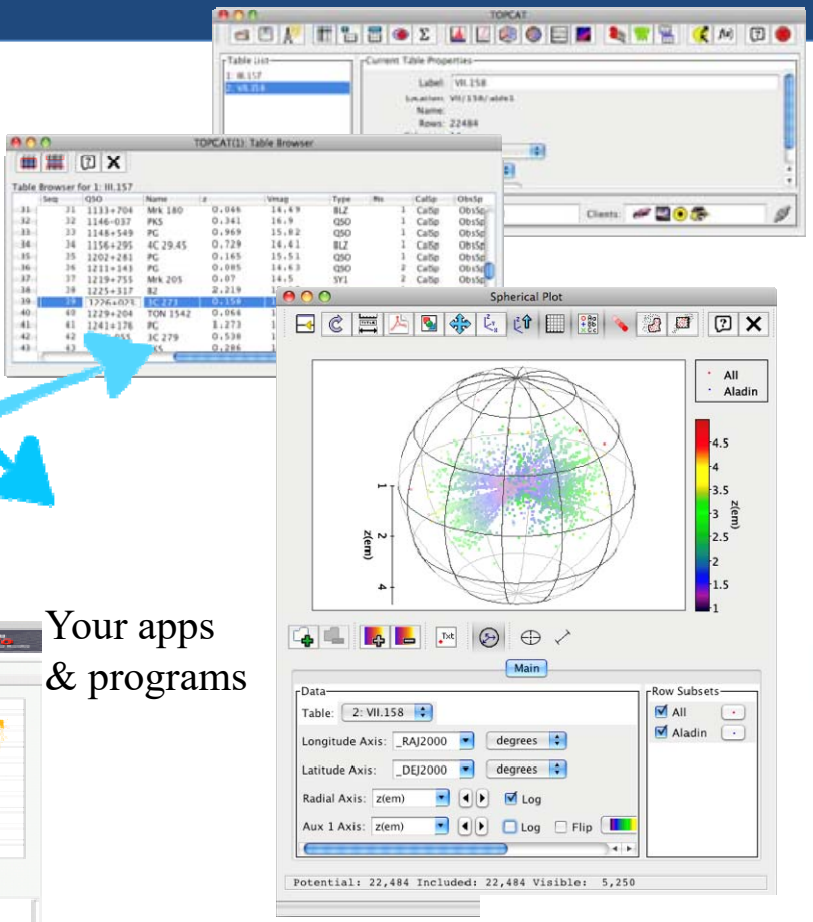


Notebooks



Spectral tools

Your apps & programs

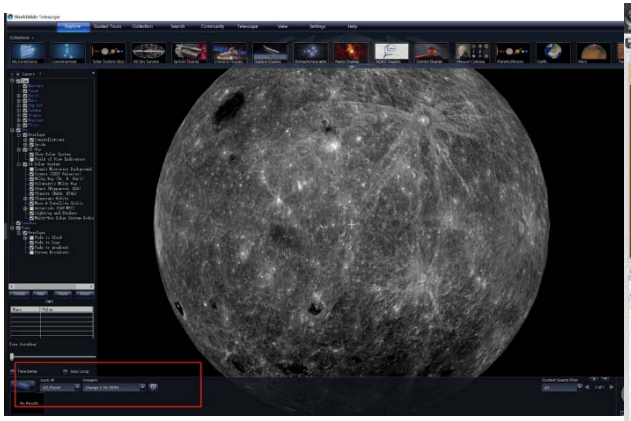


TOPCAT

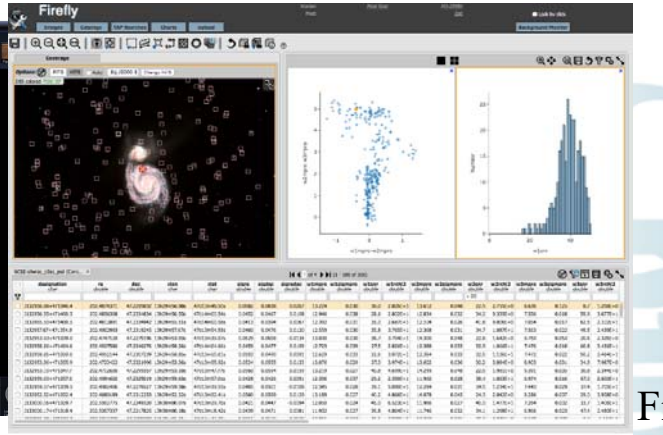
Broadcast

VO embedded in astronomy services

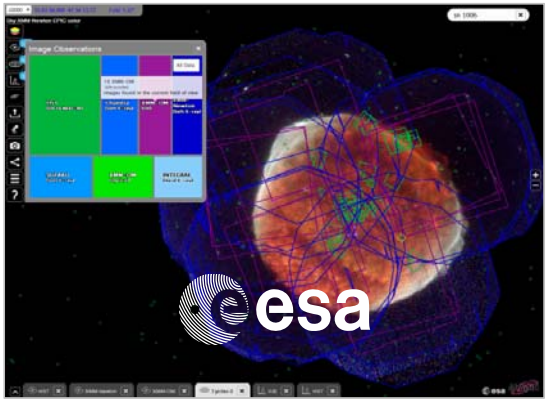
ESO Science Portal



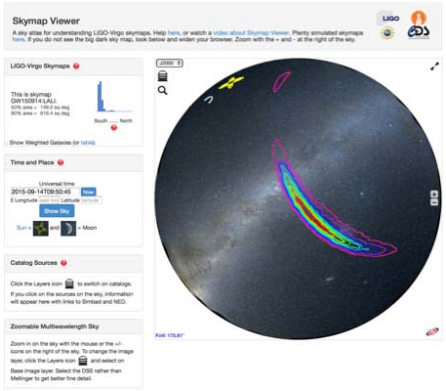
WWT



Firefly
Caltech-IPAC



ESA Sky



Grav. waves

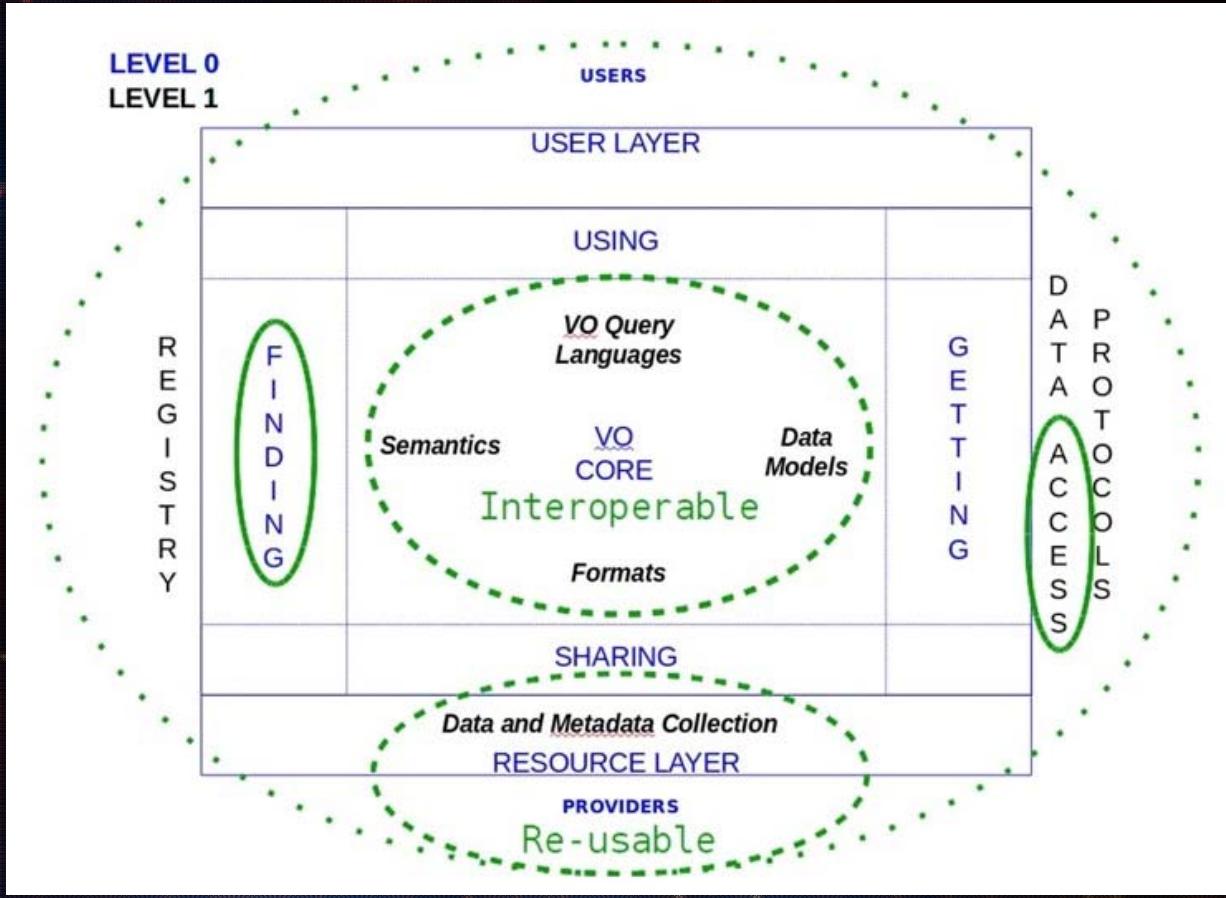
CDS reference data service

SVO Filter Profile service

VO is FAIR

Making data:

Findable
Accessible
Interoperable
Reusable



Credit: X-ray: NASA/CXC/CfA/R. Tullmann et al.; Optical: NASA/AURA/STScI

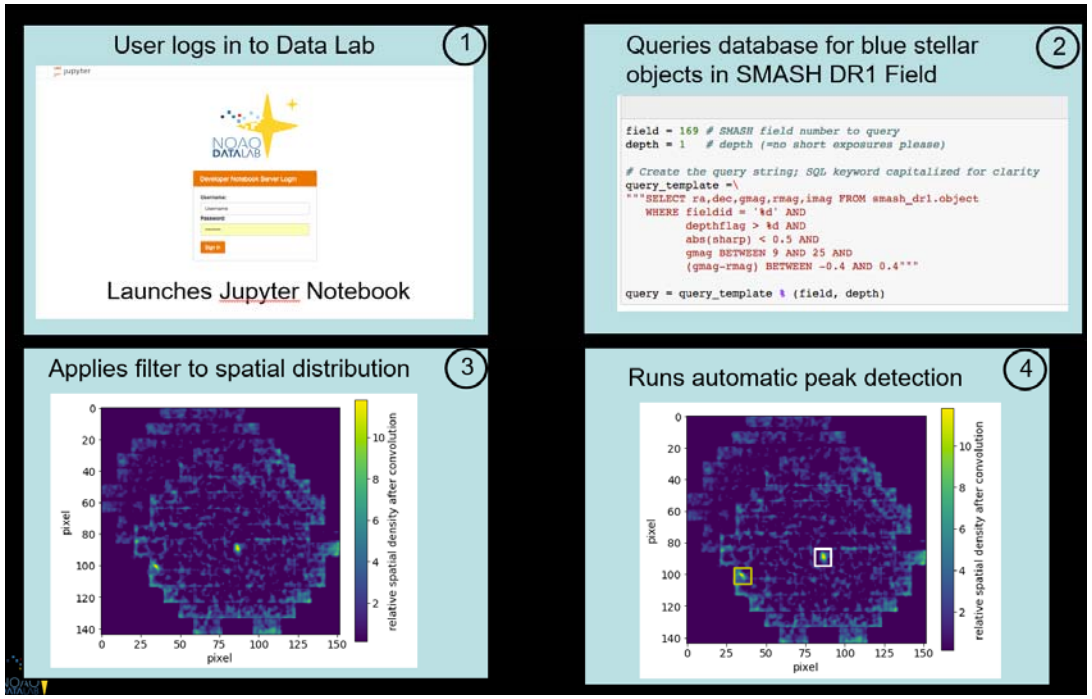
Science Platforms in Astronomy

- The amount of astronomy data will increase greatly in the near future. Science platforms are being developed to allow researchers to efficiently analyze big data sets. These science platforms enable analysis close to the data, support online data mining and machine learning.
- Most science platforms in astronomy employ a similar architecture and technologies to provide an interactive data analysis environment. Basing on a Cloud computing platform, JupyterHub with JupyterLab are used as an interface for exploratory data mining and analysis. The interactive environment is generally deployed using container techniques (e.g., docker).

NOAO Data Lab

The Astro **Data Lab** is operated by the National Optical Astronomy Observatory, the national center for ground-based nighttime astronomy in the United States operated by the Association of Universities for Research in Astronomy (AURA)

- Large Catalogs – TB-scale databases
- Pixel Data – images & spectra in NOAO Science Archive
- Virtual Storage – 1 TB per user to minimize data transfer
- Visualization – data exploration
- Compute Processing – workflows run close to the data
- ++ Access to published datasets, data publication, exportable workflows, distributable software



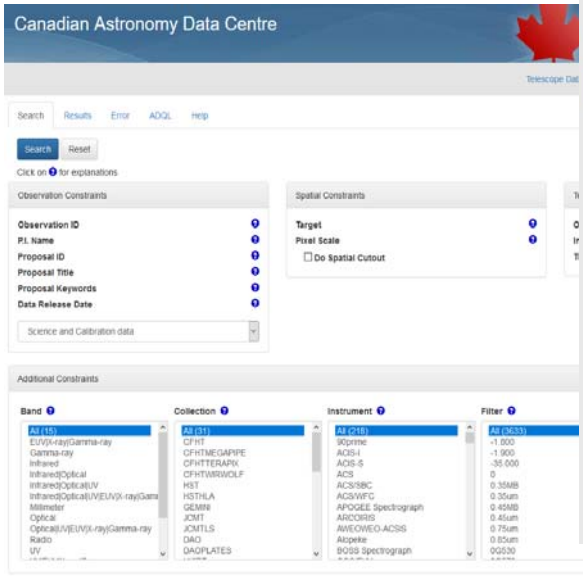
https://datalab.noao.edu/

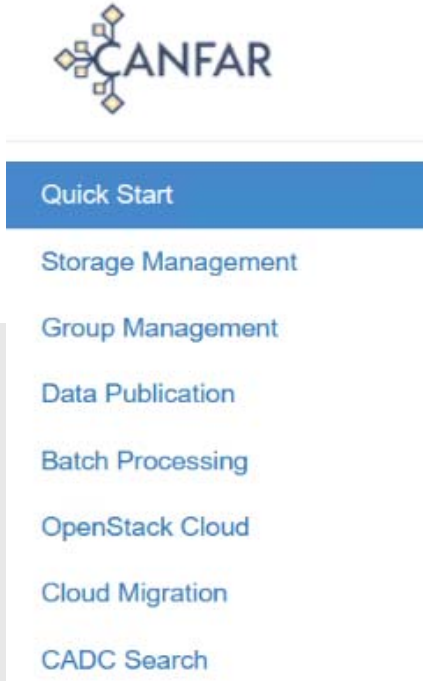
CANFAR

Canadian Advanced Network for Astronomical Research

How to create a basic source detection pipeline on a CANFAR Virtual Machine (VM). It will go over:

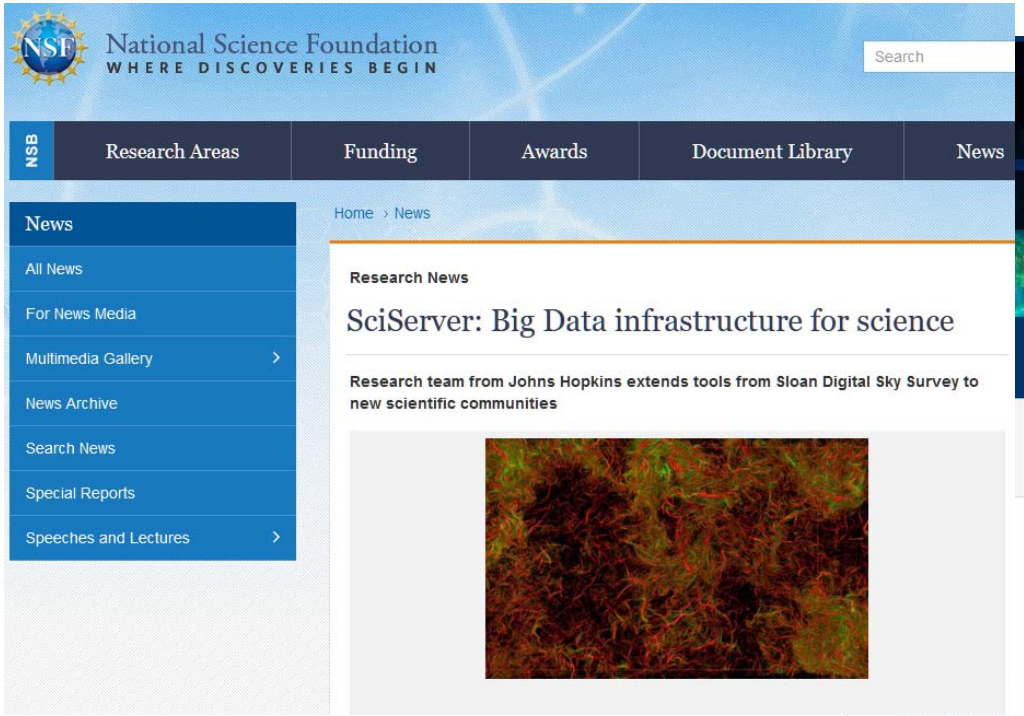
- create, configure, and interact with OpenStack cloud and CANFAR VMs
- access CADC VOSpace storage
- launch batch jobs running the pipeline installed on the VM

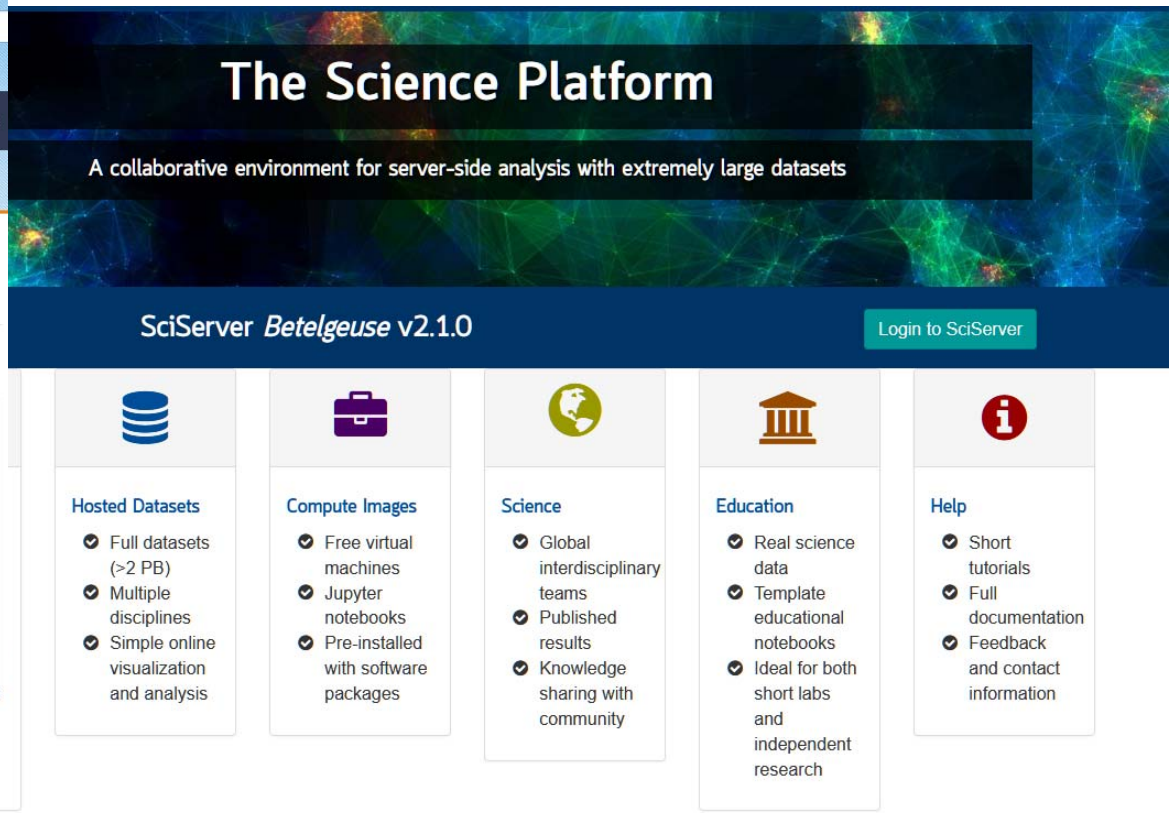




https://www.canfar.net/en/

SciServer





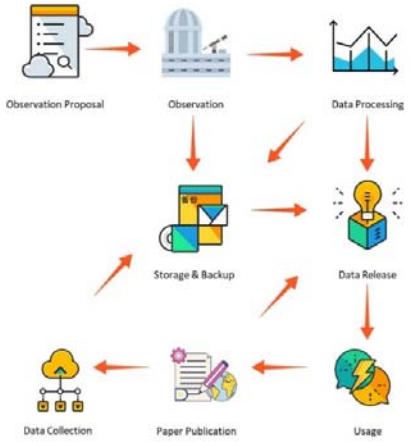
Principle Investigator: Alex Szalay

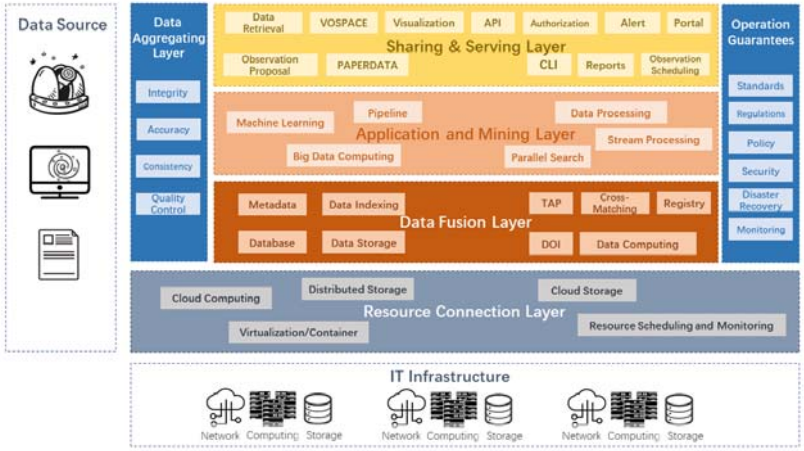
https://www.sciserver.org/

National Astronomical Data Center (China-VO)

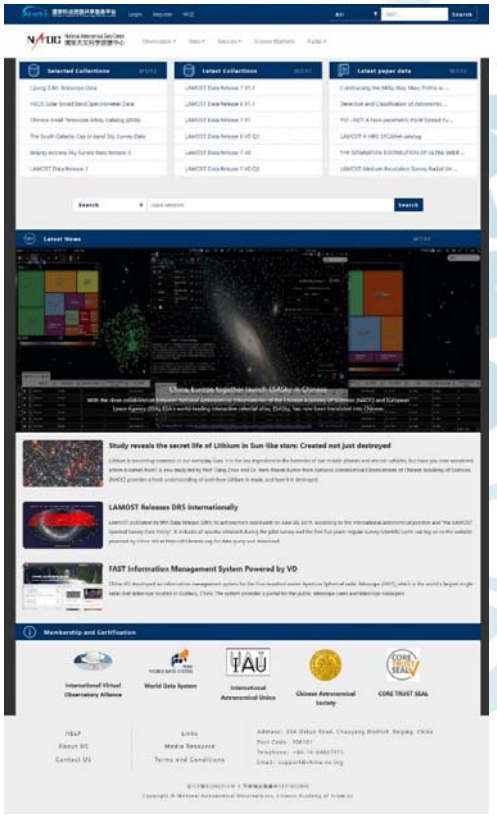
The NADC was announced by Chinese government in June 2019 as one of the first 20 national scientific data centers.

- WDC-Astronomy, 1989





NADC technical architecture



VO-based Science Platform from Idea to Research Mode

- Challenges and requirements are common
- Technical solutions have been (partly) implemented and tested
- As a global science infrastructure, GOSC needs strong financial and community supports

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NADC
National Astronomical Data Center
国家天文科学数据中心