International Virtual Observatory Alliance

organisation & processes

S. Bertocco, H. Heinl, M. Molinaro

[INAF - OATs]

D. Morris

[UK-SRC SKAO]

Introduction to the VO
Wednesday 25 March 2026 – Internationales Wissenschaftsforum Heidelberg
Astro-CC European Data Provider Forum

Summary: IVOA why and how

- Archive concept

- IVOA:
  - Vision
  - Interoperability
  - Standards
  - Organization
  - Architecture
  - How to participate

Store vs. Archive

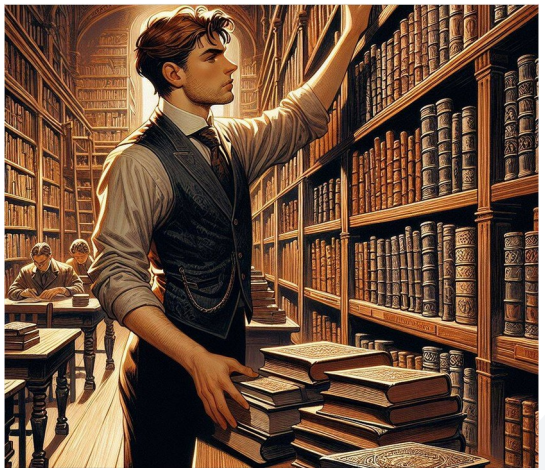
To store:

placing something in a specific location for future use, whether immediate or distant.

To archive:

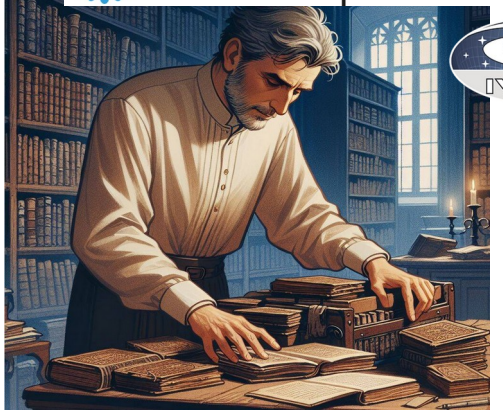
to catalogue, sort, and preserve documents or data in an archive

To archive



"The librarian organized the collection of books."

"The librarian meticulously classifies all the books."



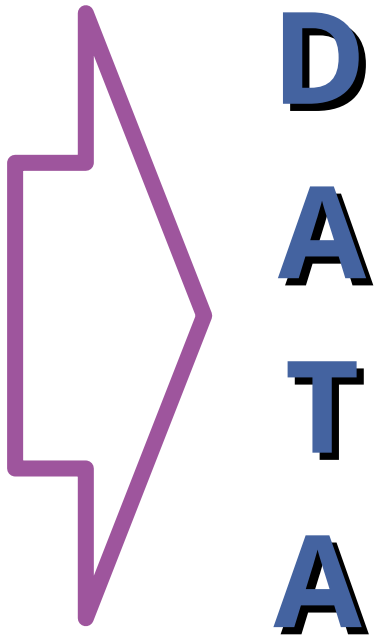
"The librarian organized an exhibition of books."

"The reader found the book he were looking for."

> To archive means
>
> to catalogue, sort, and preserve
>
> documents or data in an archive

Why archives?

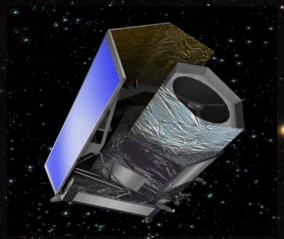
- **Preservation**
  - *“forever”*
- Sharing
  - **Open/Public** accessibility
- **Interoperability**
  - Technical & Semantic

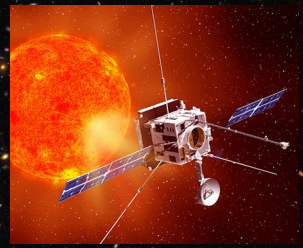


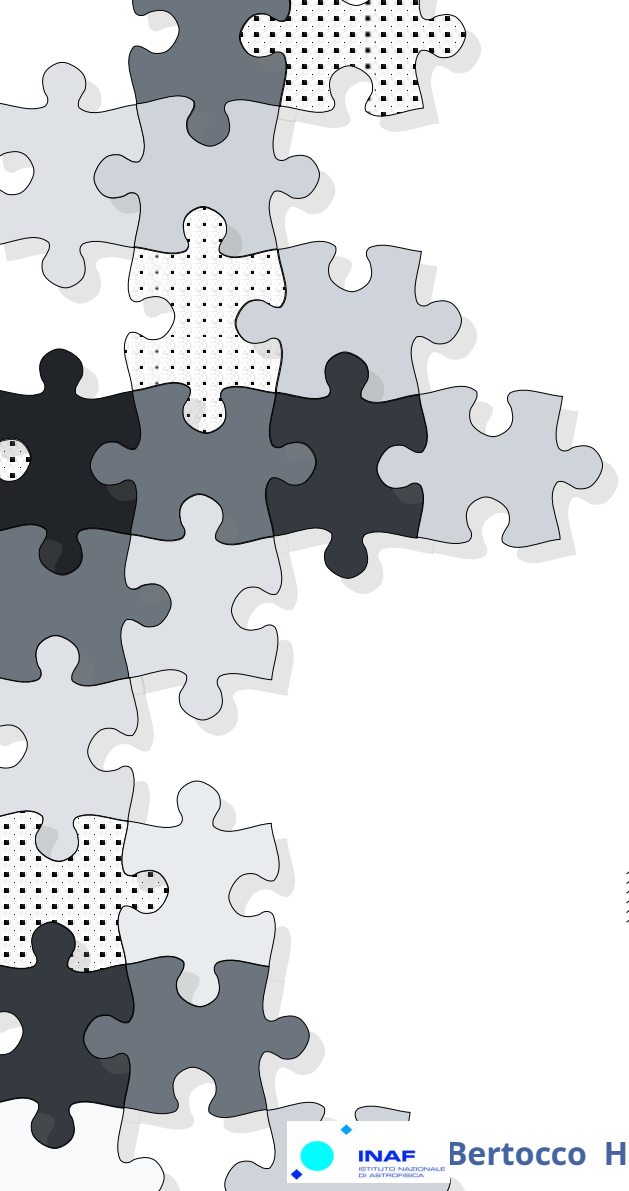
VIRTUAL OBSERVATORY

The Virtual Observatory (VO) is the vision that astronomical datasets and other resources should work as a seamless whole.

VO

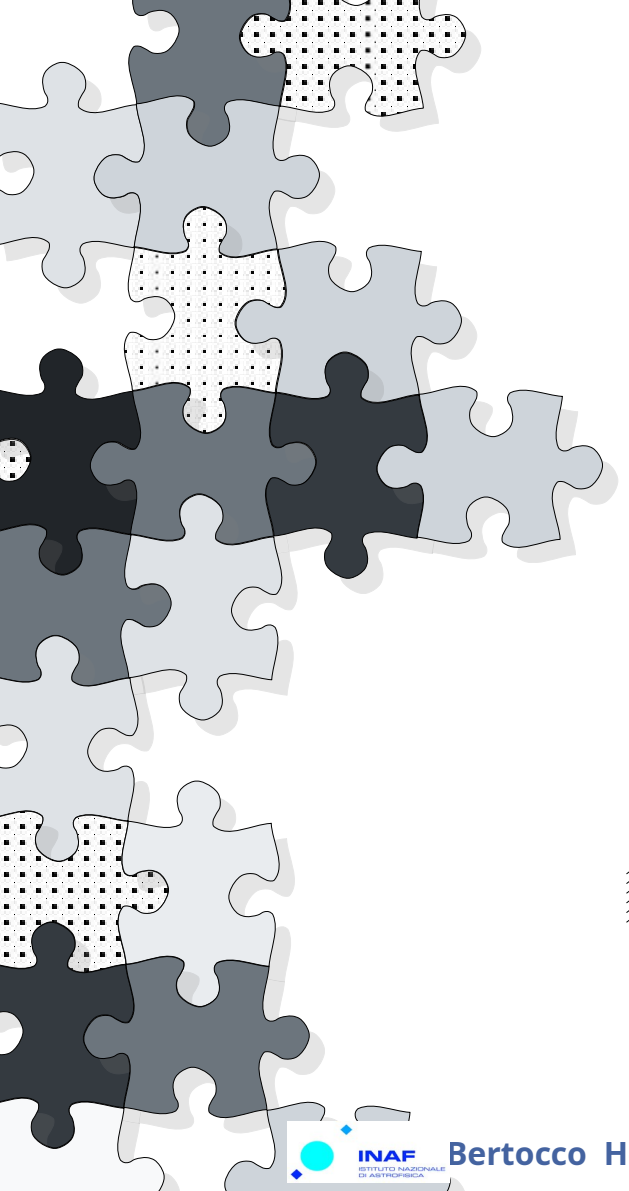






IVOA

> "The International Virtual Observatory Alliance (IVOA) is an organisation that debates and agrees the technical standards that are needed to make the VO possible."



Interoperability

> "Interoperability is the ability of two or more systems to exchange information and to use the information that has been exchanged"

IVOA Standards
The Language of Astronomy

Just like human beings need a shared language to communicate, telescopes and archives need a shared framework to exchange data. This is what the IVOA provides.

Vocabulary (The 'What'): "In a language, we agree on what words mean. In the Virtual Observatory, we use Unified Content Descriptors (UCDs). They ensure that when two different archives talk about 'brightness', they are using the exact same 'word' or tag, avoiding a Tower of Babel scenario."

Grammar (The 'How'): "Grammar gives structure to words. Data Models like ObsCore act as our grammar; they define the mandatory relationship between a metadata field and its observation context."

Syntax: The formal structure and format used to write and read the data. VOTable (XML) is how to describe data to exchange

Dialogue (The 'Action'):

"Finally, we need a way to ask questions. Protocols like TAP (Table Access Protocol) are the format rules of conversation that allow a scientist to query any compliant archive worldwide using the same syntax: ADQL."

Interoperability through Common Rules

Linguistic Element	IVOA Equivalent	Technical Role
Vocabulary	UCDs & Semantics	Assigns unambiguous names to physical concepts (e.g., flux, velocity)
Grammar	Data Models (DM)	Defines how to describe pieces of information
Syntax	VOTable (XML)	The formal structure and format used to write and read the data
Dialogue	Protocols (TAP, SIA)	How a client (you) "talks" to a server to request specific data

FITS: a first (technical?) solution

https://fits.gsfc.nasa.gov/fits_home.html

- Discussion started end of ‘70s
- First formal document in 1981
  - focus: archive & share
- Today it’s FITS v.4.0 (2018)
- Maintained by an IAU Working Group
  - Challenged by a growing number of other formats

What is the IVOA?

IVOA founded in 2002.

23 Member Organizations/Projects

A **group of people** that agrees on **standards** on which to build applications that **interoperate** across data providers

Two **interoperability** meetings per year:

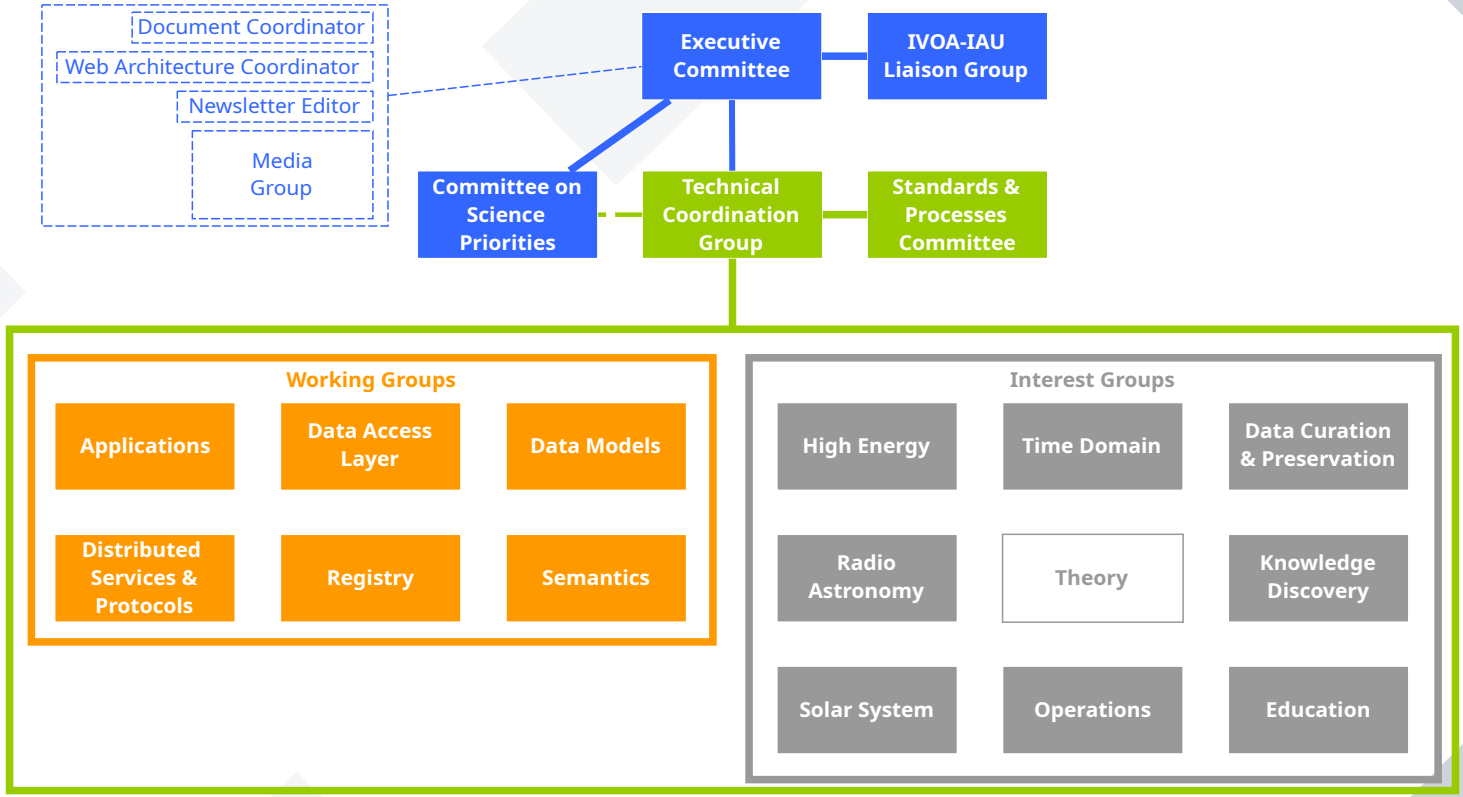
- "Northern Spring"
- "Southern Spring" (typically after ADASS)

JJ Kavelaars
IVOA Chair

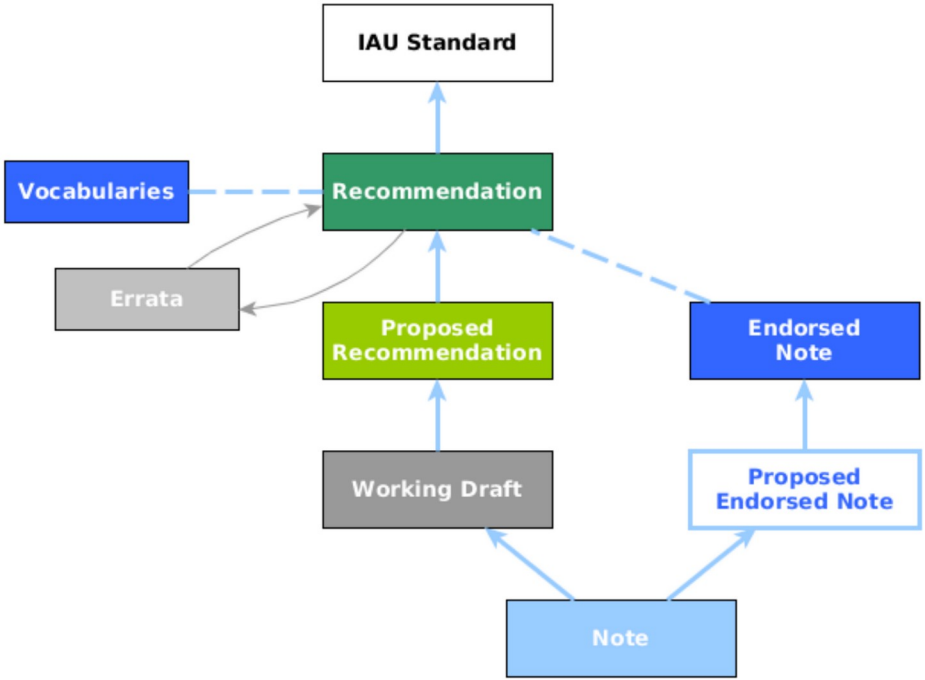
14-16 Nov 2025
Southern Spring Interoperability Meeting
Görlitz, Germany

ivoa.net

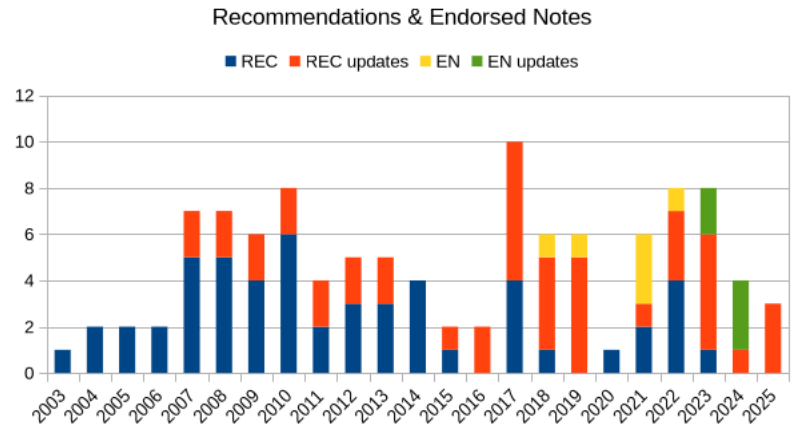
IVOA organisation



IVOA processes



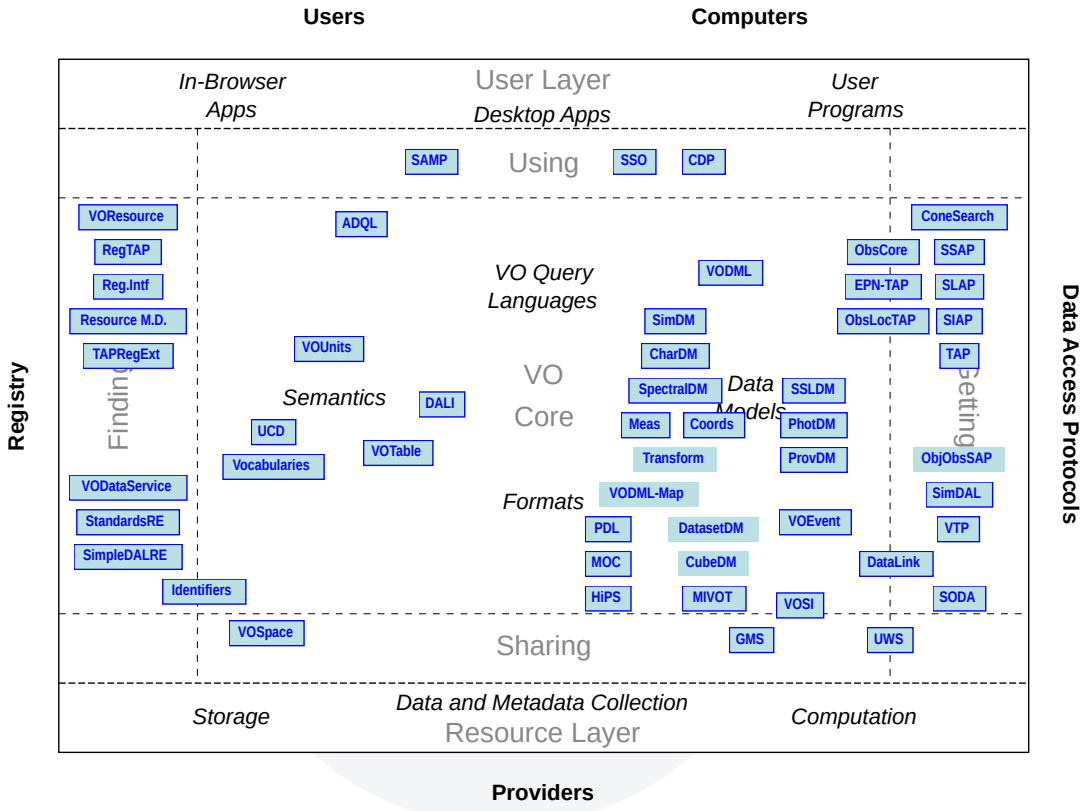
- **IVOA Document Standards 2.0**
  - 10.5479/ADS/bib/2017ivoa.spec.0517G
- **Vocabularies in the VO 2.1**
  - 10.5479/ADS/bib/



recommendations (standards) are **agreed on consensus**

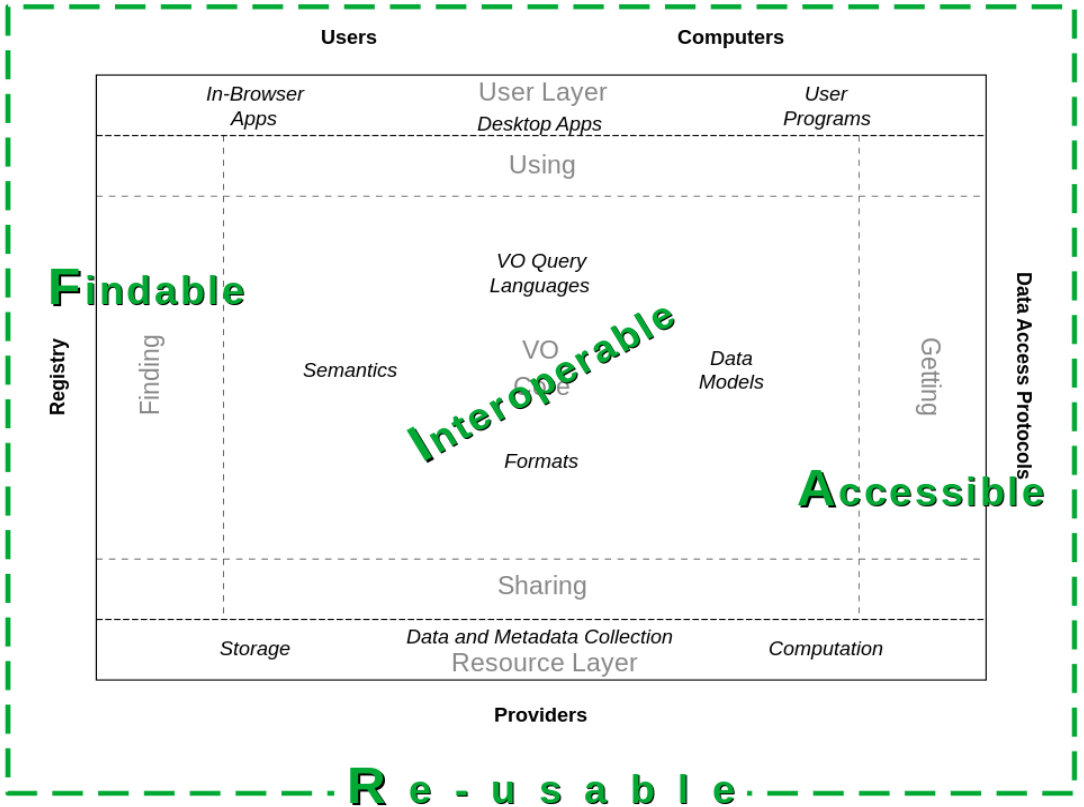
IVOA architecture

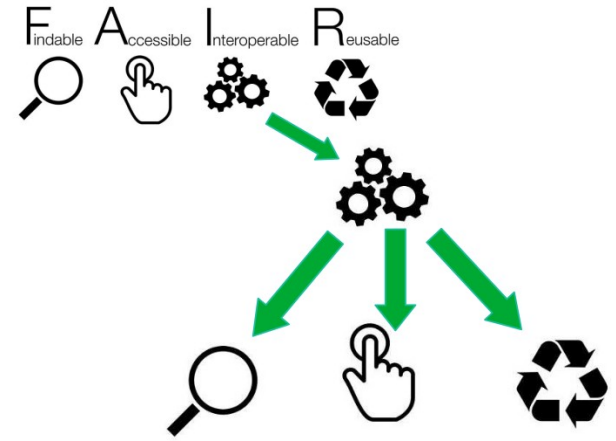
IVOA Architecture 2.1
https://ui.adsabs.harvard.edu/abs/2024ivoa.spec.1114E

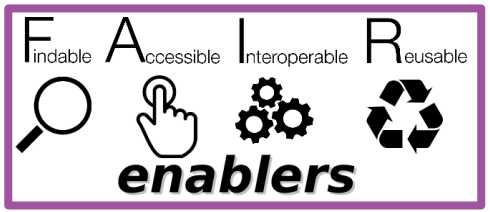


level 2

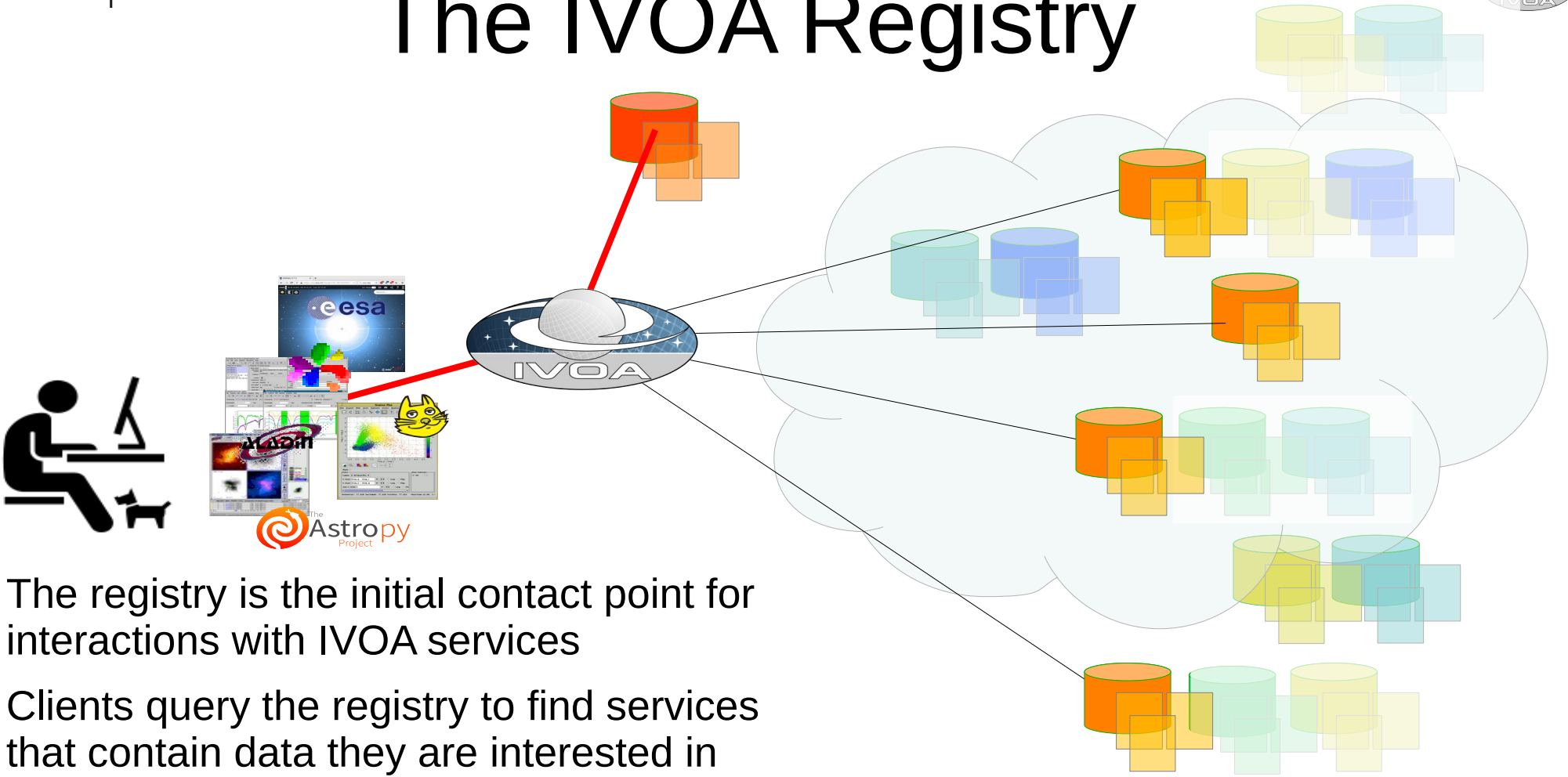
IVOA – FAIR mapping







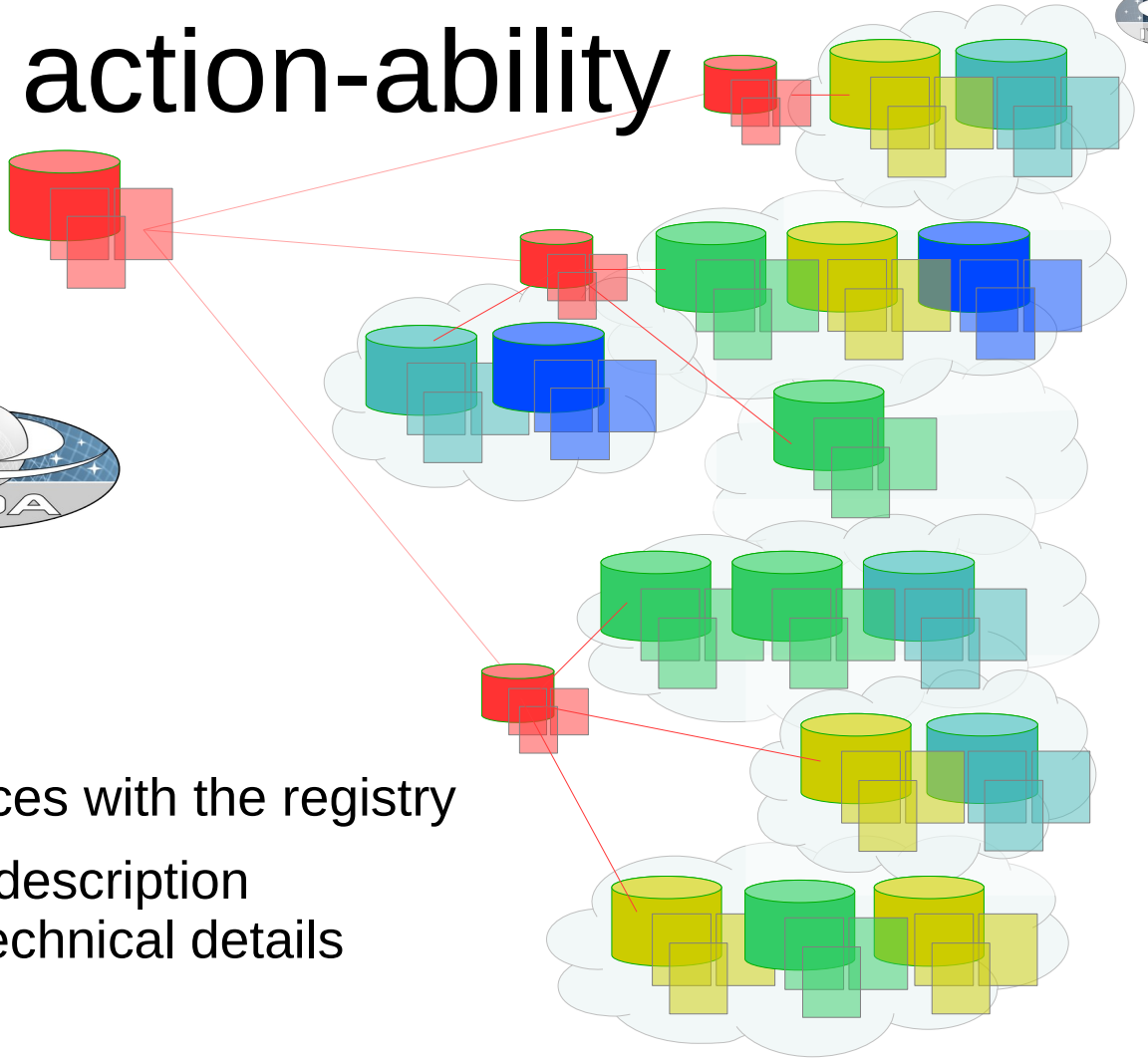
The IVOA Registry



The registry is the initial contact point for interactions with IVOA services

Clients query the registry to find services that contain data they are interested in

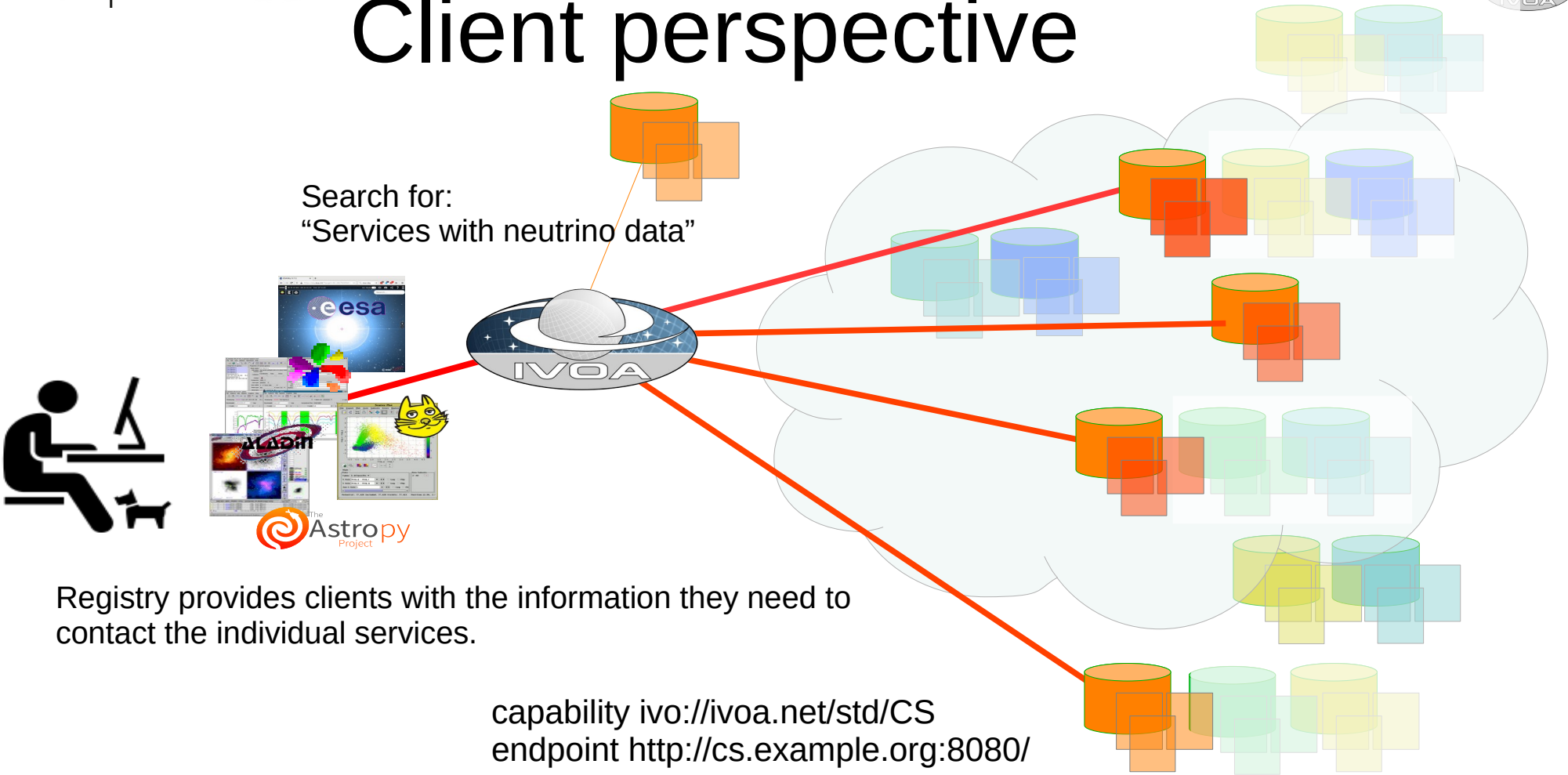
Access action-ability



Data providers register their services with the registry

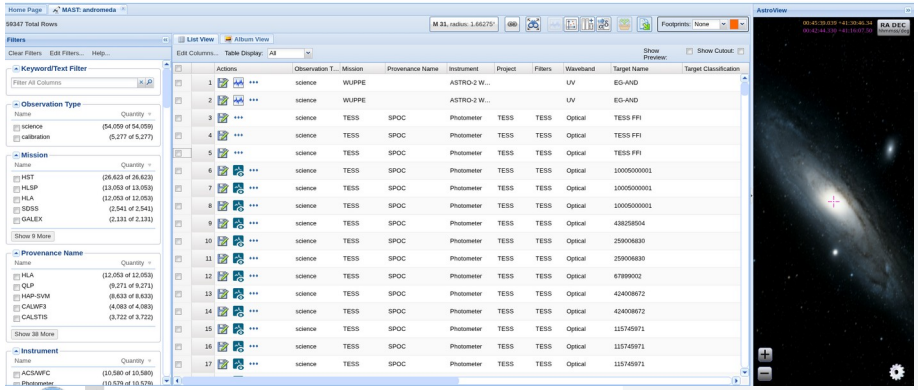
Registration metadata includes a description of the data they provide and the technical details of how to connect

Client perspective



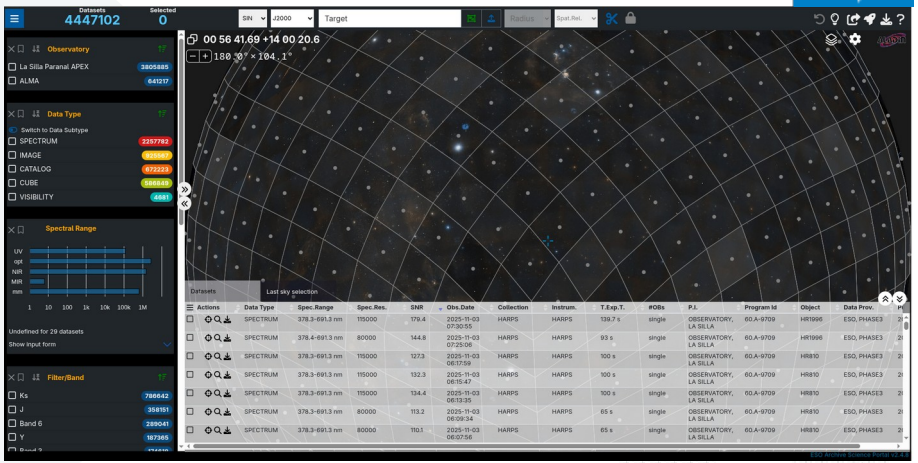
Registry provides clients with the information they need to contact the individual services.

(archives)

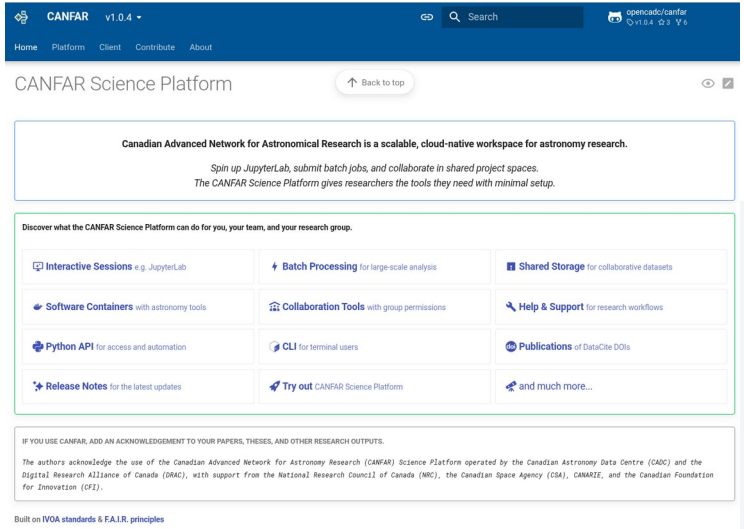


https://archive.stsci.edu/

https://archive.eso.org/

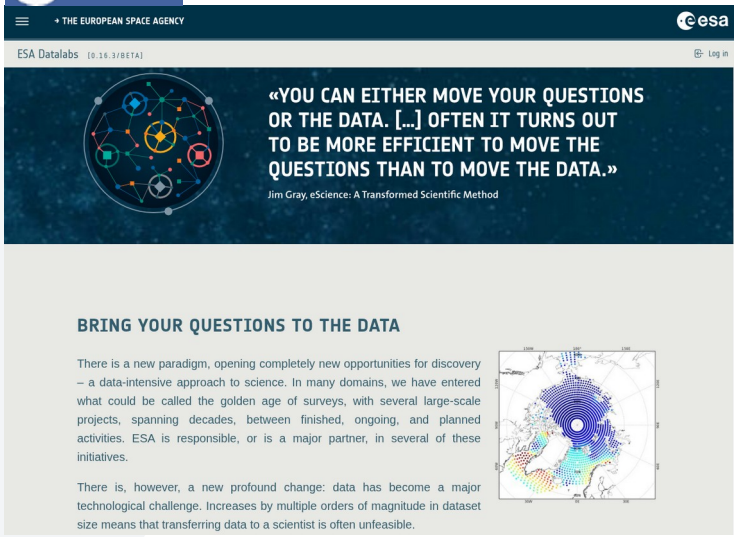


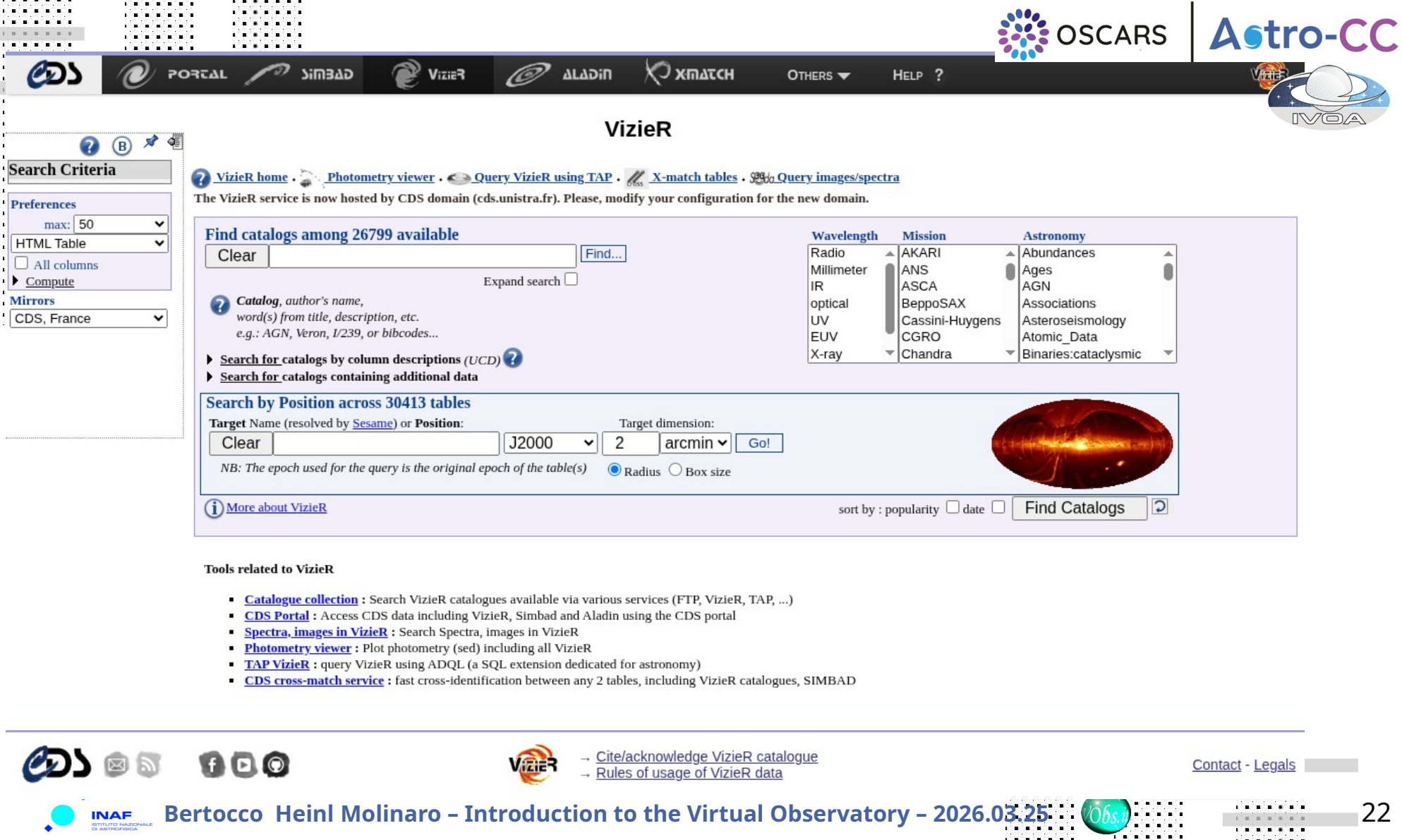
(platforms)

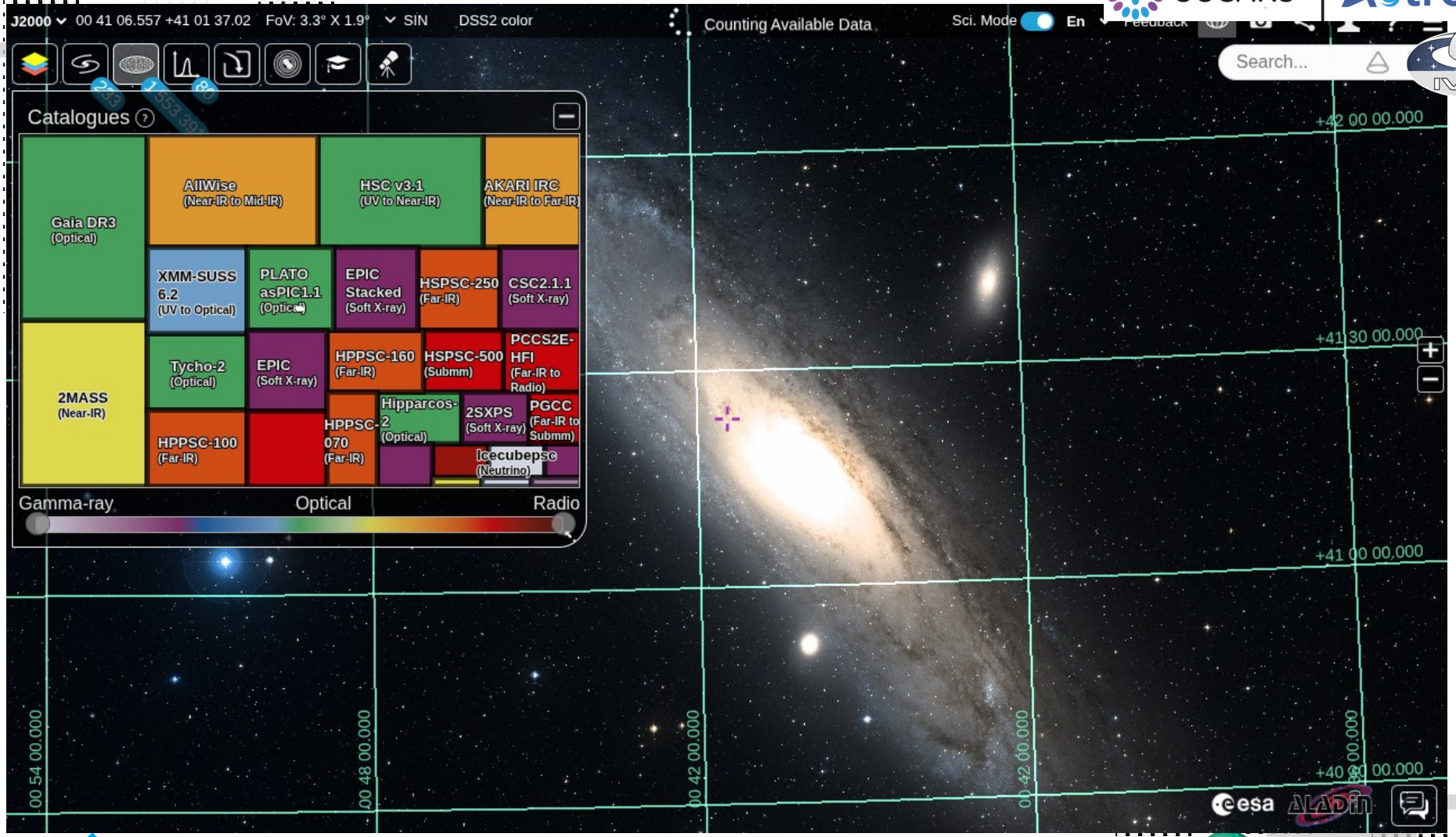


https://www.canfar.net/

https://datalabs.esa.int/




OSCARS
Astro-CC
PORTAL
SIMBAD
VIZIER
ALADIN
XMATCH
OTHERS
HELP ?
IVOA
VizieR
Search Criteria
Preferences
max: 50
HTML Table
All columns
Compute
Mirrors
CDS, France
VizieR home . Photometry viewer . Query VizieR using TAP . X-match tables . Query images/spectra
The VizieR service is now hosted by CDS domain (cds.unistra.fr). Please, modify your configuration for the new domain.
Find catalogs among 26799 available
Clear
Find...
Expand search
Catalog, author's name,
word(s) from title, description, etc.
e.g.: AGN, Veron, I/239, or bibcodes...
Search for catalogs by column descriptions (UCD)
Search for catalogs containing additional data
Wavelength
Radio
Millimeter
IR
optical
UV
EUV
X-ray
Mission
AKARI
ANS
ASCA
BeppoSAX
Cassini-Huygens
CGRO
Chandra
Astronomy
Abundances
Ages
AGN
Associations
Asteroseismology
Atomic_Data
Binaries:cataclysmic
Search by Position across 30413 tables
Target Name (resolved by Sesame) or Position:
Target dimension:
Clear
J2000
2
arcmin
Go!
NB: The epoch used for the query is the original epoch of the table(s)
Radius
Box size
More about VizieR
sort by : popularity
date
Find Catalogs
Tools related to VizieR
Catalogue collection : Search VizieR catalogues available via various services (FTP, VizieR, TAP, ...)
CDS Portal : Access CDS data including VizieR, Simbad and Aladin using the CDS portal
Spectra, images in VizieR : Search Spectra, images in VizieR
Photometry viewer : Plot photometry (sed) including all VizieR
TAP VizieR : query VizieR using ADQL (a SQL extension dedicated for astronomy)
CDS cross-match service : fast cross-identification between any 2 tables, including VizieR catalogues, SIMBAD
→ Cite/acknowledge VizieR catalogue
→ Rules of usage of VizieR data
Contact - Legals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Catalogues
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AllWise (Near-IR to Mid-IR)
HSC v3.1 (UV to Near-IR)
AKARI IRC (Near-IR to Far-IR)
XMM-SUSS 6.2 (UV to Optical)
PLATO asPIC1.1 (Optical)
EPIC Stacked (Soft X-ray)
HSPSC-250 (Far-IR)
CSC2.1.1 (Soft X-ray)
2MASS (Near-IR)
Tycho-2 (Optical)
EPIC (Soft X-ray)
HPPSC-160 (Far-IR)
HSPSC-500 (Submm)
PCCS2E-HFI (Far-IR to Radio)
Hipparcos-2 (Optical)
2SXPS (Soft X-ray)
PGCC (Far-IR to Submm)
HPPSC-100 (Far-IR)
HPPSC-070 (Far-IR)
Icecubepsc (Neutrino)
Gamma-ray
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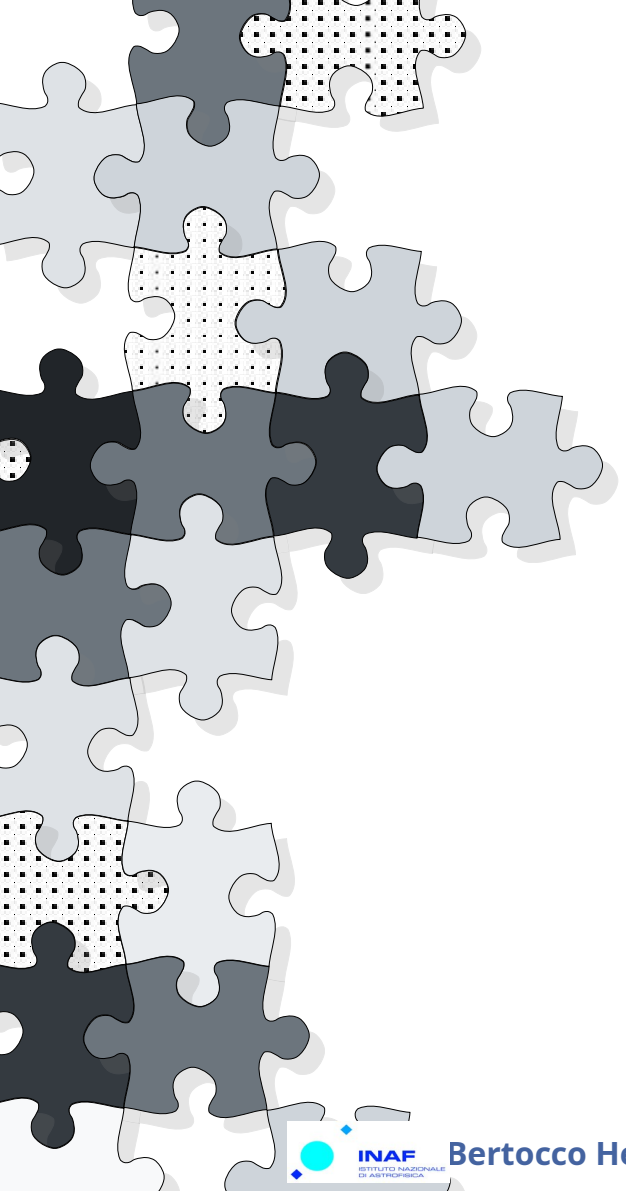

What to do?

> "As a data providers, manager, describe your resources, add them to the Registry, and let the applications connect."

If you want to go fast, go alone.
If you want to go far, go together.

Introduction to the IVOA

Thank you for your attention!

Bertocco, Heinl, Morris,Molinaro

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DI ASTROFISICA