



# Wivona et l'Observatoire Virtuel

Un Projet PRO/AM  
soutenu par OBSPM



Basé sur une présentation de  
Renaud Savalle - PADC/Observatoire de Paris-PSL

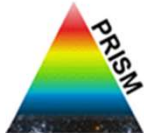
# Plan

- Le projet et l'équipe WIVONA
- L'Observatoire Virtuel (OV)
- Télécharger un catalogue entier de Vizier avec TOPCAT
- Les protocoles Simples d'accès aux données de l'OV
- Accéder à des images avec Aladin
- Tutoriel IVOA
- Tutoriel Python: [t.ly/ugxOR](https://t.ly/ugxOR)

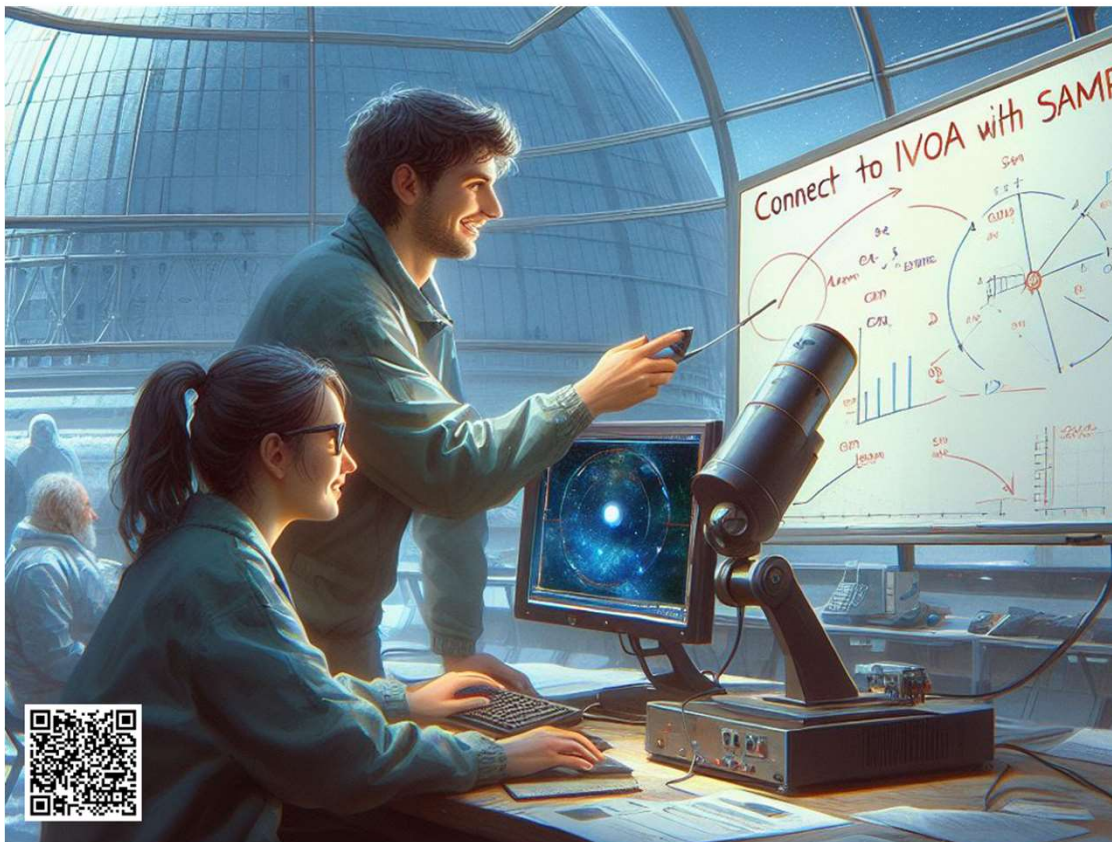


# WIVONA

We Implement  
Virtual Observatory  
Needs of Astrams



*A Pro/Am collaboration for the Observers Community*



- **PI: Jean-Paul GODARD**,  
Astronome amateur  
(Dev PRISM: SAMP, Astro-Colibri)
- **Renaud SAVALLE**,  
PADC/Observatoire de Paris,  
Ingénieur de recherche CNRS, (Dev  
SharpCap: SAMP, Scripts Python)
- **Cyril CAVADORE**, ALCOR  
SYSTEM, PhD (Dev PRISM)
- **David VALLS-GABAUD**,  
LERMA/Observatoire de Paris,  
Directeur de Recherche CNRS

# L'Observatoire Virtuel

- Ce n'est pas:
  - un site web, ni un ensemble de sites
  - un programme
- Mais plutôt:
  - des protocoles standards de l'IVOA pour trouver, accéder, utiliser les données
  - ~50 centres de données (CDS, ESA, ESO, NASA...) dans ~20 pays
  - des opérateurs pour les services et l'infrastructure centrale (le Registre)
  - des développeurs de clients (TOPCAT, Aladin...)

“Un **observatoire virtuel** (OV) est une collection d'archives de données interactives et d'outils logiciels qui utilisent l'[Internet](#) pour bâtir un environnement de [recherche scientifique](#) dans lequel les programmes de recherche en [astronomie](#) pourront être conduits. De la même façon qu'un [observatoire astronomique](#) réel est un ensemble de [téléscopes](#), chacun avec une collection unique d'instruments astronomiques, l'observatoire virtuel consiste en un ensemble de [centres de données](#), chacun avec une collection unique de [données](#) astronomiques, logiciels et capacités de calcul.” [Wikipedia]

# Les données de l'OV

Images

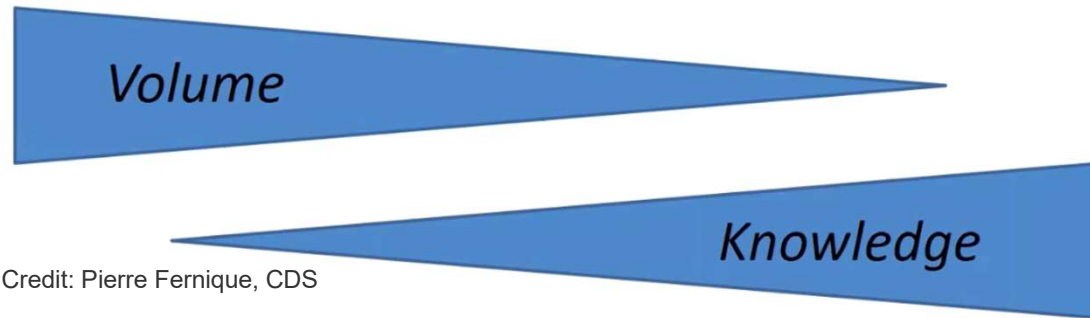


catalogs

objects

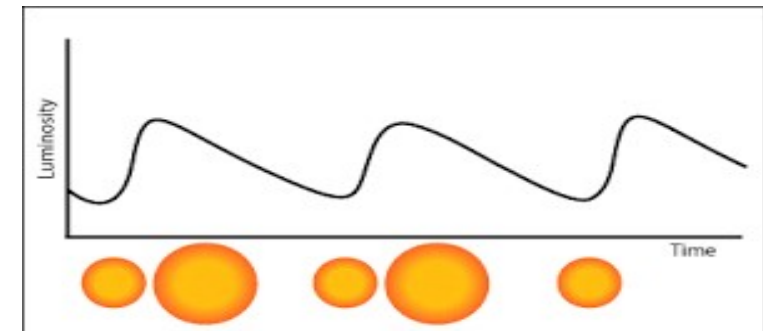
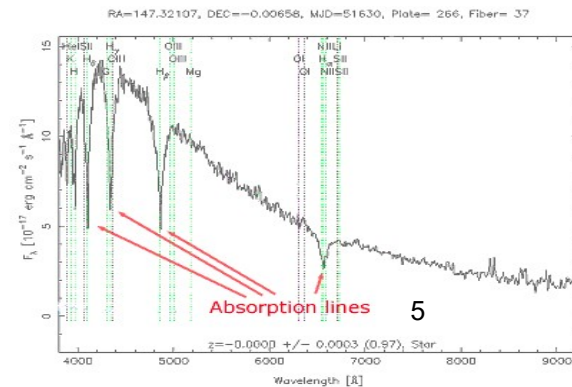
Observation data (J2000 epoch)	
Constellation	Ursa Major
Right ascension	14 <sup>h</sup> 03 <sup>m</sup> 12 <sup>s</sup> .6
Declination	+54° 20' 57"
Redshift	0.000804
Helio radial velocity	241 ± 2 km/s
Distance	20.9 ± 1.8 Mly (6.4 ± 0.5 Mpc)
Apparent magnitude (V)	7.86
Characteristics	
Type	SAB(rs)cd
Number of stars	1 billion (10 <sup>9</sup> )
Size	~170,000 ly in diameter?
Apparent size (v)	28" x 26" x 9"
Other designations	
Messier 101, M101, NGC 5457, UGC 8981, PGC 50063, Aip 26	
References	(2114)(8)(8)(7)

- Images
- Catalogues
- Données physiques
- Séries temporelles



Credit: Pierre Fernique, CDS

- Spectres
- Séries temporelles
- Cubes spectraux
- ...



# L'Alliance Internationale de l'Observatoire Virtuel (IVOA)

- <https://www.ivoa.net/>
- Membres: centres de diffusion de données, développeurs, auteurs de standards, utilisateurs...
- Regroupe plusieurs organismes nationaux dans ~20 pays:



- Argentine Virtual Observatory
- Armenian Virtual Observatory
- AstroGrid, United Kingdom
- Australian All-Sky Virtual Observatory
- Brazilian Virtual Observatory
- Chinese Virtual Observatory
- Canadian Virtual Observatory
- Chilean Virtual Observatory
- European Space Agency
- European Virtual Observatory
- German Astrophysical Virtual Observatory
- Hungarian Virtual Observatory
- Japanese Virtual Observatory
- Netherlands Virtual Observatory
- Observatoire Virtuel France
- Russian Virtual Observatory
- South African Astroinformatics Alliance
- Spanish Virtual Observatory
- Italian Virtual Observatory
- Ukrainian Virtual Observatory
- US Virtual Observatory Alliance
- Virtual Observatory India

# IVOA Contacts (1/2)

## IVOA Working Group Links

Working Group Page	Previous Messages	Subscribe	Send Mail	Chair	Vice Chair
Applications	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:apps@ivoa.net">apps@ivoa.net</a>	TBD	Adrian Damian
Data Access Layer	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:dal@ivoa.net">dal@ivoa.net</a>	James Dempsey	Grégory Mantelet
Data Model	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:dm@ivoa.net">dm@ivoa.net</a>	Laurent Michel	Jesus Salgado
Grid & Web Services	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:grid@ivoa.net">grid@ivoa.net</a>	Giuliano Taffoni	Dave Morris
Registry	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:registry@ivoa.net">registry@ivoa.net</a>	<b>Renaud Savalle</b>	Tess Jaffe
Semantics	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:semantics@ivoa.net">semantics@ivoa.net</a>	Markus Demleitner	Carlo Maria Zwölf

## Interest Groups

Interest Group Page	Previous Messages	Subscribe	Mailing List	Chair	Vice Chair
Data Curation & Preservation	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:datacp@ivoa.net">datacp@ivoa.net</a>	Gilles Landais	Tim Jenness
Education	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:edu@ivoa.net">edu@ivoa.net</a>	Hendrik Heini	Shanshan Li
Knowledge Discovery in Databases	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:kdd@ivoa.net">kdd@ivoa.net</a>	Raffaele d'Abrusco	Yihan Tao
Operations	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:ops@ivoa.net">ops@ivoa.net</a>	Mark Taylor	Steve Groom
Solar System	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:ssig@ivoa.net">ssig@ivoa.net</a>	Anne Raugh	Baptiste Cecconi
Theory	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:theory@ivoa.net">theory@ivoa.net</a>	Gerard Lemson	Simon O'Toole
Time Domain	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:voevent@ivoa.net">voevent@ivoa.net</a>	Brent Miszalski	Mark Cresitello-Dittmar
Radio	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:radioig@ivoa.net">radioig@ivoa.net</a>	Mark Lacy	François Bonnarel

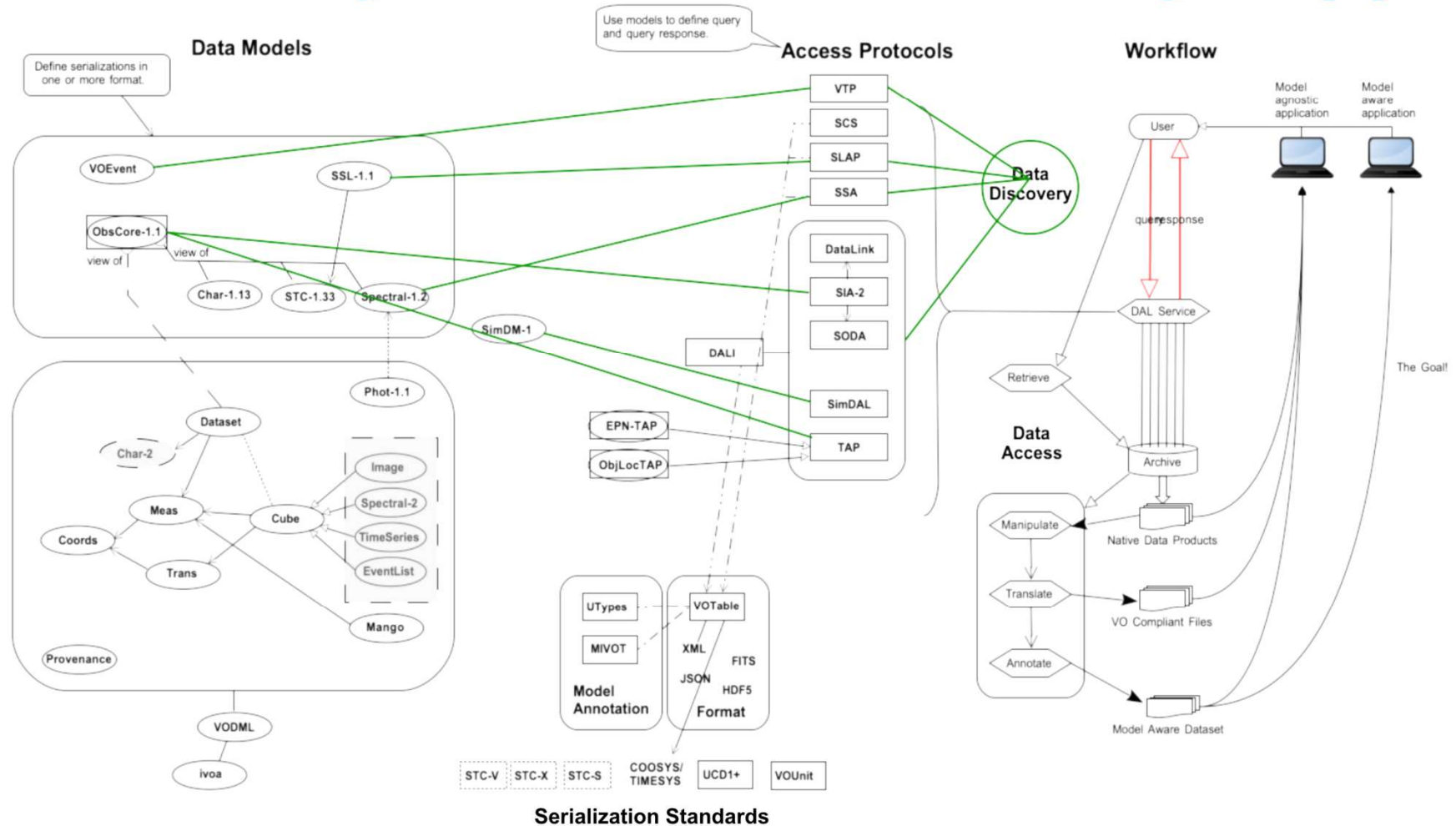
# Les Standards de l'IVOA

- **VOTable** the format for tabular data for allowing interoperability (coosys, timesys, ucd, utype, VOunits, datalink) - used by many other standards
- **HiPS** more than a format for images - tailored for large data volumes
- Standards describing *web services to search and transport data*:
  - **Simple Cone search** — spatial + temporal search for catalogs
  - **Simple Image Access**
  - **Simple Spectral Access**
  - **MOC** - spatial and temporal indexing for large data volumes in complex areas of the sky
  - **TAP + ADQL** — Table Access Protocol & astronomical data query language
  - **ObsCore & ObsTAP** — description of observations
- Planning of observations: (under dev.)
  - **ObjVisSAP** — visibility of objects
  - **ObsLocTAP** — facilitate coordination of observations from different facilities
  - Alerts: **VOEvent**



# Les Standards de l'IVOA

## Model Ecosystem: Data Discovery Support



# Les protocoles simples de l'OV

(accès aux données)

## Protocoles “Simple”

- **Simple Cone Search (SCS)** pour les tables  
BUT: Récupérer des données de l'OV autour d'une position: (RA, Dec [...]) => **VOTable**
- **Simple Image Access (SIA)** pour les images
- **Simple Spectral Access (SSA)** pour les spectres

# Les accès utilisateurs aux données

Accès via...	inte rop	
<ul style="list-style-type: none"><li>• <b>Web</b><ul style="list-style-type: none"><li>• Sesame</li><li>• Vizier</li><li>• Simbad</li></ul></li></ul>		<a href="https://cds.unistra.fr/">https://cds.unistra.fr/</a>
<ul style="list-style-type: none"><li>• <b>Outils IVOA</b><ul style="list-style-type: none"><li>• TopCat</li><li>• Aladin</li><li>• Cassis</li></ul></li></ul>		<a href="https://www.ivoa.net/astronomers/applications.html">https://www.ivoa.net/astronomers/applications.html</a>
<ul style="list-style-type: none"><li>• <b>Modules Python</b><ul style="list-style-type: none"><li>• AstroPy</li><li>• PyVo</li><li>• AstroQueries</li></ul></li></ul>		<a href="https://docs.python.org/3/py-modindex.html">https://docs.python.org/3/py-modindex.html</a>

# Démo: Télécharger un catalogue avec TOPCAT



- Utilisons TOPCAT (<https://www.star.bris.ac.uk/~mbt/topcat/>) pour récupérer un catalogue depuis le CDS (service VizieR)
- VO / VizieR / Catalogue Selection / All rows / by Keyword: **planetary nebula** / Search Catalog
- Chargement des tables de V/84:
  - main : NP connues
  - pospn : candidats à **confirmer**
  - notpn : candidats rejetés

**TOPCAT & STIL: Starlink Table/VOTable Processing Software**

Show affiliations

Taylor, M. B.

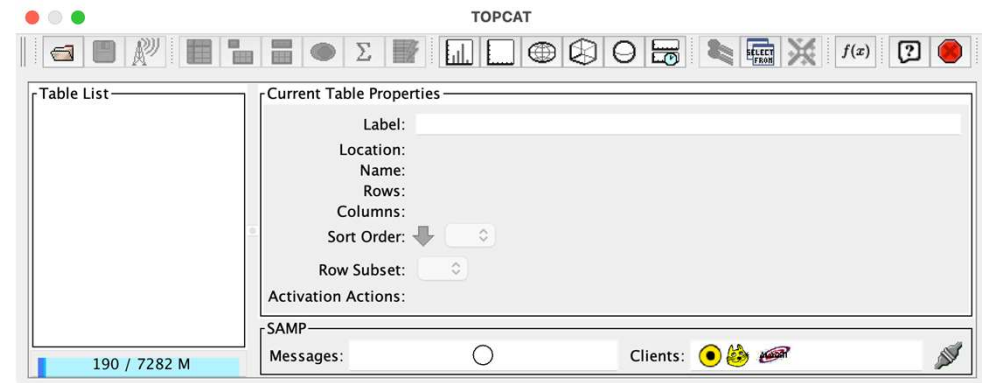
The Starlink Tables Infrastructure Library (STIL) is a pure-Java, open source library for I/O and manipulation of tabular data such as astronomical catalogs. It is designed to be high-performance and to cope with large tables. The core library is format-neutral, with the work of serialization and deserialization performed by pluggable format-specific I/O handlers. This means that the programmer sees a high-level abstraction of a table which is easy to work with, and also that support for new data formats can be added easily. Supplied handlers provide support for VOTables, FITS table extensions, relational databases via SQL and plain text tables, amongst others. The VOTable handler is believed to be the only existing library capable of reading or writing all the defined VOTable encoding formats (tabledata, fits, binary).

TOPCAT, based on STIL, is a user-friendly graphical program for viewing, analysis and editing of tables. It has facilities for plotting, cross matching, row selection, sorting and manipulation of data and metadata. Synthetic columns can be created and row selections made using a powerful and extensible algebraic expression language.

**Publication:** Astronomical Data Analysis Software and Systems XIV ASP Conference Series, Vol. 347, Proceedings of the Conference held 24-27 October, 2004 in Pasadena, California, USA. Edited by P. Shopbell, M. Britton, and R. Ebert. San Francisco: Astronomical Society of the Pacific, 2005., p.29

**Pub Date:** December 2005

**Bibcode:** [2005ASPC...347...29T](#)



VizieR Catalogue Service

Sky Plot (4)

Table Browser

	_RAJ2000
1	82.0
2	296.0
3	267.0
4	250.0
5	290.0
6	268.0
7	75.0
8	300.0
9	315.0
10	147.0
11	29.0
12	66.0
13	251.0
14	308.0
15	117.0
16	118.0
17	120.0
18	120.0
19	76.0

Total: 347 V

Position: equatorial

Lon: \_RAJ2000

Lat: \_DEJ2000

Count: 1,143 / 1,143

STILTS

16: V\_8



# Accès aux images avec Aladin

- Command: HCG 92 => DSS2
- OV=Arbre des collections => Image/Infrared/JWST  
- NIRCam+MIRI / MIRI
- L'arbre est mis a jour en fonction du FOV de l'image affichée (via la couverture spatiale)
- Réalisation d'une composition d'image (transparence)

Aladin v12.0

Available data → 35582  
 ● in view ● out view

Command **hcg 92**

Frame ICRS Projection Spheric

DSS2 color  
 PanSTARRS  SDSS  2MASS  WISE  GALEX  PLANCK  AKARI  XMM  Fermi  Gaia  Simbad  NED +

**Collections** → 35582  
 Image → 626  
 Gamma-ray → 24  
 X-ray → 66  
 UV → 26  
 Optical → 164  
 Infrared → 165  
   VISTA → 12  
   UKIDSS → 11  
   UltraVista → 6  
   HST → 7  
   2MASS → 8  
   DIRBE → 20  
   UKIRT-WFCAM → 1  
   VISIONS → 4  
   JWST → 15  
     Southern Ring Nebula  
     Webb's First Deep Field SMAC 0723  
     Cosmic Cliffs in the Carina Nebula  
     Stephans-Quintet NIRCam+MIRI  
     JWST First Images  
     Cartwheel Galaxy  
     Stephans Quintet MIRI  
     JWST OPEN (beta)  
     JWST F150W (beta)  
     JWST F200W (beta)  
     JWST F210M (beta)  
     JWST F212N (beta)  
     JWST F444W (beta)  
     JWST F480M (beta)  
     JWST F115W (beta)  
   WISE → 16  
   Spitzer → 11  
   MSX → 5  
   ISO → 2  
   IRIS → 5  
   AKARI-FIS → 9  
   HERSCHEL → 22  
   Quest-for-the-Missing-Dust → 5  
   PILOT → 3  
   APEX → 2  
   JPS-PR1 850um  
 Radio → 104  
 Gas-lines → 77  
 Data base → 4  
 Catalog → 33513  
 Cube → 24

select  
 from -- all collections --

grid studywink redonorthhdr multview match

coll. sort view scan filter

Welcome to Aladin,  
 your professional sky atlas.  
 • Discover all astronomical data available over the net!  
 • Compare them with your own data.  
 • Prepare your observation missions.  
 To start, type any object name, such as M1, and press ENTER...  
 Or easier, clic in the main frame and enjoy the sky...

select  
 pan  
 dist  
 phot  
 draw  
 tag  
 moc  
 spect  
 filter  
 cross  
 rgb  
 assoc  
 crop  
 cont  
 pixel  
 prop  
 del

CDS / P / JWST / Step... 60%  
 CDS / P / DSS2 / color

epoch —————+  
 size —————+  
 dens. —————+  
 opac. —————+  
 zoom —————+

22:35:57.50 33:57:36.0  
 5.752' x 5.091'  
 180 90 sky  
 no time filter

0 sel / 0 src 4 views 150fps / 563Mb



# PRISM et l'OV: Démo Lundi

- **Interopérabilité avec les outils IVOA et plus**  
(Aladin, Topcat, Carte du ciel, Cassis, Sharpcap ☺)
- **Affichage des alertes**  
(Transients)
- **Console Python**  
(Accès algorithmique)



# WIVONA

We Implement  
Virtual Observatory  
Needs of Astrams



# Tutoriel IVOA

- Web site
  - <https://ivoa.net/>
- Wiki
  - <https://wiki.ivoa.net/>
- Newsletter
  - <https://ivoa.net/newsletter>
- Social Media
  - Twitter: <https://twitter.com/IVOAastro>
  - Facebook: <https://www.facebook.com/IVOAastro>
- Education Interest Group
  - <https://wiki.ivoa.net/twiki/bin/view/IVOA/IvoaEducation>

The screenshot shows the IVOA website homepage. At the top, there is a navigation bar with links for Home, Astronomers, Deployers, Members, and About. Below the navigation bar, the text reads: "INTERNATIONAL VIRTUAL OBSERVATORY ALLIANCE". The main content area contains a paragraph about the Virtual Observatory (VO) vision, followed by three sections: "To learn more about the IVOA as an organisation, read the 'About' section.", "To learn more about the VO from a user's point of view, including how to find VO tools and services, read the 'Astronomers' section. There is also a page about the VO for students and the public.", and "To learn how to publish VO services, or write VO-compatible software, start by reading the 'Deployers/Developers' section." Below this, it states "Internal IVOA discussions are publicly viewable in the 'Members' section." To the right of the main text is the IVOA logo and two news items: "IVOA NEWS March 2022 Issue of the IVOA Newsletter" and "UPCOMING MEETINGS IVOA Northern Spring Interop, 25-29 April 2022". At the bottom, there are three columns of links: "For Astronomers" (Getting Started / Using the VO, VO Glossary / VO Applications, IVOA newsletter / VO for Students & Public), "For Deployers/Developers" (Intro to VO Concepts / IVOA Standards / Guide to Publishing in the VO / Technical Glossary), and "For Members" (IVOA Calendar / Working Groups / Twiki / Documents in Progress / Mailing Lists / IVOA Roadmap). The footer contains the copyright notice: "© IVOA.net. Contact the IVOA Webmaster".

# Tutoriel Python

- Langage Python : nombreux tutoriel via Google
- Notebook OV : [t.ly/ugxOR](https://t.ly/ugxOR)
- Fichier/Sauver dans votre Google Drive (gratuit)
- Utiliser Google Colab
  - Exécution du code pas a pas

# BACKUP SLIDES

# Who is the IVOA ?

A structured organization

- **5 Committees**

- Executive
- Technical Coordination Group
- Standards and Processes
- Media
- Science Priorities

- **6 Working Groups (WGs)**

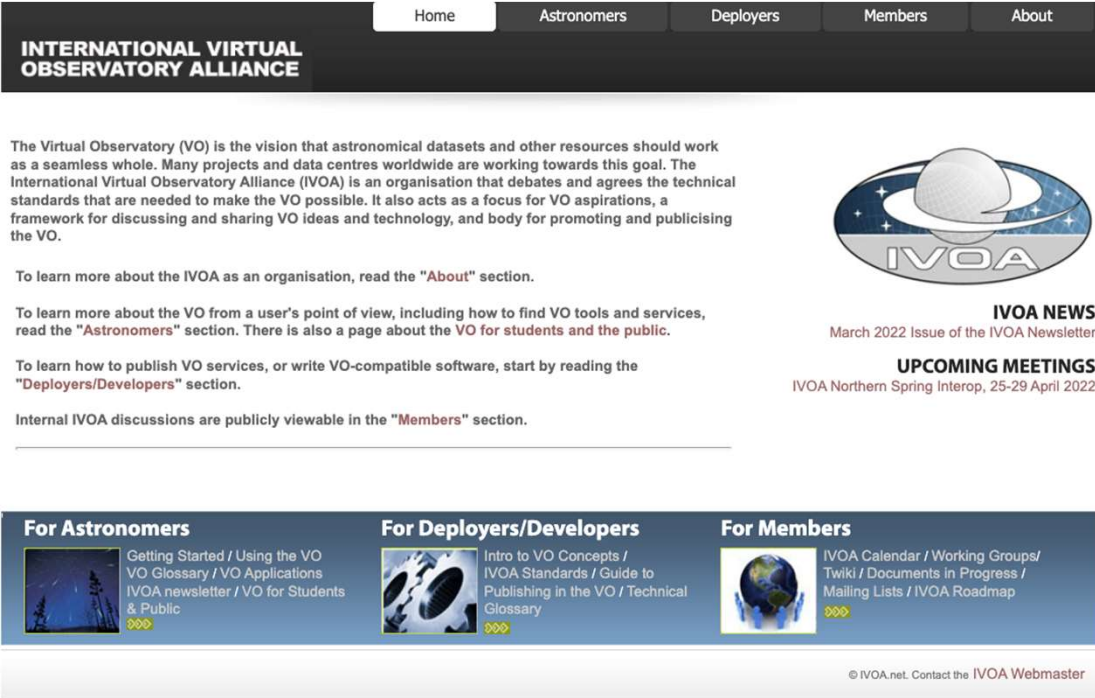
- Data Models
- Semantics
- Data Access
- Grids and Web Services
- Registry
- Applications

- **8 Interest Groups (IGs)**

- Time-domain
- Radio
- Solar System
- Education
- Data Curation
- Knowledge and Discovery
- Theory
- Operations

# Where to start with the IVOA ?

- Web site
  - <https://ivoa.net/>
- Wiki
  - <https://wiki.ivoa.net/>
- Newsletter
  - <https://ivoa.net/newsletter>
- Social Media
  - Twitter: <https://twitter.com/IVOAastro>
  - Facebook: <https://www.facebook.com/IVOAastro>
- Education Interest Group
  - <https://wiki.ivoa.net/twiki/bin/view/IVOA/IvoaEducation>



The screenshot shows the IVOA website homepage. At the top is a navigation bar with links for Home, Astronomers, Deployers, Members, and About. Below the navigation bar is the IVOA logo and a main text area. The main text area contains a paragraph about the Virtual Observatory (VO) and the IVOA, followed by three sections: "To learn more about the IVOA as an organisation...", "To learn more about the VO from a user's point of view...", and "To learn how to publish VO services...". To the right of the main text area is the IVOA logo and two sections: "IVOA NEWS" and "UPCOMING MEETINGS". Below the main text area is a horizontal bar with three sections: "For Astronomers", "For Deployers/Developers", and "For Members". Each section has a small image and a list of links. At the bottom right of the page is the copyright notice: "© IVOA.net. Contact the IVOA Webmaster".

INTERNATIONAL VIRTUAL OBSERVATORY ALLIANCE

Home Astronomers Deployers Members About

The Virtual Observatory (VO) is the vision that astronomical datasets and other resources should work as a seamless whole. Many projects and data centres worldwide are working towards this goal. The International Virtual Observatory Alliance (IVOA) is an organisation that debates and agrees the technical standards that are needed to make the VO possible. It also acts as a focus for VO aspirations, a framework for discussing and sharing VO ideas and technology, and body for promoting and publicising the VO.

To learn more about the IVOA as an organisation, read the "About" section.

To learn more about the VO from a user's point of view, including how to find VO tools and services, read the "Astronomers" section. There is also a page about the VO for students and the public.

To learn how to publish VO services, or write VO-compatible software, start by reading the "Deployers/Developers" section.

Internal IVOA discussions are publicly viewable in the "Members" section.

**IVOA NEWS**  
March 2022 Issue of the IVOA Newsletter

**UPCOMING MEETINGS**  
IVOA Northern Spring Interop, 25-29 April 2022

**For Astronomers**  
Getting Started / Using the VO  
VO Glossary / VO Applications  
IVOA newsletter / VO for Students & Public

**For Deployers/Developers**  
Intro to VO Concepts /  
IVOA Standards / Guide to  
Publishing in the VO / Technical  
Glossary

**For Members**  
IVOA Calendar / Working Groups/  
Twiki / Documents in Progress /  
Mailing Lists / IVOA Roadmap

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# IVOA Contacts (1/2)

## IVOA Working Group Links

Working Group Page	Previous Messages	Subscribe	Send Mail	Chair	Vice Chair
Applications	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:apps@ivoa.net">apps@ivoa.net</a>	TBD	Adrian Damian
Data Access Layer	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:dal@ivoa.net">dal@ivoa.net</a>	James Dempsey	Grégory Mantelet
Data Model	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:dm@ivoa.net">dm@ivoa.net</a>	Laurent Michel	Jesus Salgado
Grid & Web Services	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:grid@ivoa.net">grid@ivoa.net</a>	Giuliano Taffoni	Dave Morris
Registry	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:registry@ivoa.net">registry@ivoa.net</a>	Renaud Savalle	Tess Jaffe
Semantics	<a href="#">archive</a>	<a href="#">options</a>	<a href="mailto:semantics@ivoa.net">semantics@ivoa.net</a>	Markus Demleitner	Carlo Maria Zwölf

## Interest Groups

Interest Group Page	Previous Messages	Subscribe	Mailing List	Chair	Vice Chair
Data Curation & Preservation	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:datacp@ivoa.net">datacp@ivoa.net</a>	Gilles Landais	Tim Jenness
Education	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:edu@ivoa.net">edu@ivoa.net</a>	Hendrik Heini	Shanshan Li
Knowledge Discovery in Databases	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:kdd@ivoa.net">kdd@ivoa.net</a>	Raffaele d'Abrusco	Yihan Tao
Operations	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:ops@ivoa.net">ops@ivoa.net</a>	Mark Taylor	Steve Groom
Solar System	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:ssig@ivoa.net">ssig@ivoa.net</a>	Anne Raugh	Baptiste Cecconi
Theory	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:theory@ivoa.net">theory@ivoa.net</a>	Gerard Lemson	Simon O'Toole
Time Domain	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:voevent@ivoa.net">voevent@ivoa.net</a>	Brent Miszalski	Mark Cresitello-Dittmar
Radio	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:radioig@ivoa.net">radioig@ivoa.net</a>	Mark Lacy	François Bonnarel

# IVOA Contacts (2/2)

## Other Groups/Committees/Activities

Group/Committee Page	Previous Messages	Subscribe	Mailing List	Chair	Vice Chair
Interop	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:interop@ivoa.net">interop@ivoa.net</a>	N/A	N/A
Exec			<a href="mailto:exec@ivoa.net">exec@ivoa.net</a>	Bruce Berriman	Severin Gaudet
Technical Coordination Group			<a href="mailto:tcg@ivoa.net">tcg@ivoa.net</a>	Janet Evans	Marco Molinaro
Liaison Committee				Masatoshi Ohishi	
Standing Committee on Science Priorities				Ada Nebot	Francesca Civano
Standing Committee on Standards & Processes	<a href="#">archives</a>	<a href="#">options</a>	<a href="mailto:stdproc@ivoa.net">stdproc@ivoa.net</a>	Patricia Dowler	N/A
IVOA Document Coordinator			<a href="mailto:ivoadoc@ivoa.net">ivoadoc@ivoa.net</a>	Giulia lafrate	N/A

From <https://www.ivoa.net/members/index.html>

# The IVOA Standard Process

- The Recommendation Process
- Standards in progress are on Github: <https://github.com/ivoa-std>
- All published standards: <https://www.ivoa.net/documents/>

Home Astronomers Deployers

**INTERNATIONAL VIRTUAL OBSERVATORY ALLIANCE**

**Documents & Standards**

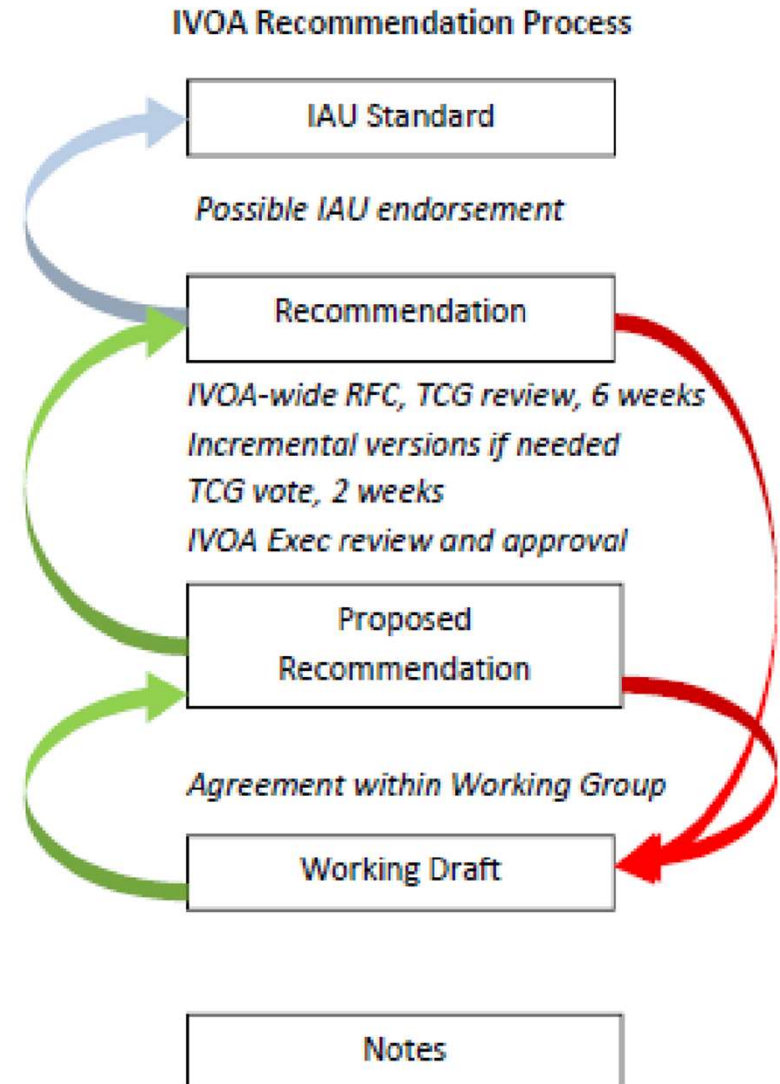
DOCUMENTS XML SCHEMA VOCABULARIES DOC SUBMISSION

- Technical Specifications
- Notes
- Promotion process
- IVOA Technical Assessment and Roadmap Documents
- Submission Log

**Technical Specifications**

>>

Group	Title	Most stable	In progress	Version history
App	SAMP - Simple Application Messaging Protocol	1.3		1.3 1.3 1.3 1.3 1.2 1.2 1.1 1.1 1.0 1.0
	VOTable - VOTable Format Definition	1.4		1.4 1.4 1.4 1.4 1.4 1.3 1.3 1.3 1.2 1.2 1.0 1.0
	MOC - HEALPix Multi-Order Coverage Map	2.0		2.0 2.0 2.0 2.0 2.0 2.0 2.0 1.1 1.1 1.1 1.1 1.0 1.0 1.0
	HIPS - Hierarchical Progressive Survey	1.0		1.0 1.0 1.0 1.0 1.0 1.0
DAL	DALI - Data Access Layer Interface	1.1		1.1 1.1 1.1 1.1 1.1 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	DataLink	1.0	1.1	1.1 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	Simple Cone Search	1.03	1.1	1.1 1.03 1.02 1.01 1.00
	SIA - Simple Image Access	2.0		2.0 2.0 2.0 2.0 2.0 2.0 2.0 1.0 1.0 1.0 1.0 1.0 1.0
	SIAD - Simple Image Access	1.0		1.0 1.0 1.0 1.0 1.0 1.0



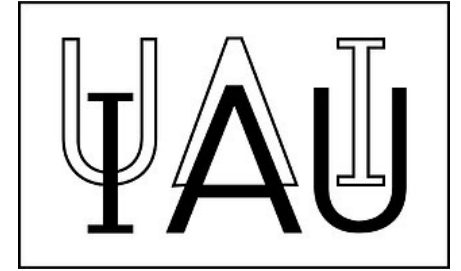


# VOTable: exemple

```
▼<VOTABLE xmlns="http://www.ivoa.net/xml/VOTable/v1.3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="1.4"
xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.3 http://www.ivoa.net/xml/VOTable/votable-1.4.xsd">
  ▼<RESOURCE type="results">
    <INFO name="QUERY_STATUS" value="OK"/>
    ▼<INFO name="QUERY" value=" SELECT * FROM gaiadr3.gaia_source WHERE CONTAINS(POINT('ICRS',gaiadr3.gaia_source.ra,gaiadr3.gaia_source.dec),BOX('ICRS',
11.255999999999998, 41.459263888888889 , 0.019444444444444445, 0.019444444444444445))=1 ">
      <![CDATA[ SELECT * FROM gaiadr3.gaia_source WHERE CONTAINS(POINT('ICRS',gaiadr3.gaia_source.ra,gaiadr3.gaia_source.dec),BOX('ICRS', 11.255999999999998,
41.459263888888889 , 0.019444444444444445, 0.019444444444444445))=1 ]]>
    </INFO>
    ▼<INFO name="CAPTION" value="How to cite and acknowledge Gaia: https://gea.esac.esa.int/archive/documentation/credits.html">
      <![CDATA[ How to cite and acknowledge Gaia: https://gea.esac.esa.int/archive/documentation/credits.html ]]>
    </INFO>
    <INFO name="PAGE" value="" />
    <INFO name="PAGE_SIZE" value="" />
    ▼<INFO name="JOBID" value="16560935450590">
      <![CDATA[ 16560935450590 ]]>
    </INFO>
    <INFO name="JOBNAME" value="" />
    <COOSYS ID="GAIADR3" epoch="J2016.0" system="ICRS" />
    ▼<RESOURCE>
      <COOSYS ID="t232771-coosys-1" epoch="J2016.0" system="ICRS" />
    </RESOURCE>
    ▼<TABLE>
      ▼<FIELD datatype="long" name="solution_id" ucd="meta.version">
        <DESCRIPTION>Solution Identifier</DESCRIPTION>
      </FIELD>
      ▼<FIELD ID="DESIGNATION" arraysize="*" datatype="char" name="designation" ucd="meta.id;meta.main">
        <DESCRIPTION>Unique source designation (unique across all Data Releases)</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="long" name="source_id" ucd="meta.id">
        <DESCRIPTION>Unique source identifier (unique within a particular Data Release)</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="long" name="random_index" ucd="meta.code">
        <DESCRIPTION>Random index for use when selecting subsets</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="ref_epoch" ucd="meta.ref;time.epoch" unit="yr" utype="stc:AstroCoords.Time.TimeInstant">
        <DESCRIPTION>Reference epoch</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="ra" ref="t232771-coosys-1" ucd="pos.eq.ra;meta.main" unit="deg" utype="stc:AstroCoords.Position3D.Value3.C1">
        <DESCRIPTION>Right ascension</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="float" name="ra_error" ucd="stat.error;pos.eq.ra" unit="mas" utype="stc:AstroCoords.Position3D.Error3.C1">
        <DESCRIPTION>Standard error of right ascension</DESCRIPTION>
      </FIELD>
      ▼<FIELD datatype="double" name="dec" ref="t232771-coosys-1" ucd="pos.eq.dec;meta.main" unit="deg" utype="stc:AstroCoords.Position3D.Value3.C2">
        <DESCRIPTION>Declination</DESCRIPTION>
      </FIELD>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```



# The IVOA and the IAU

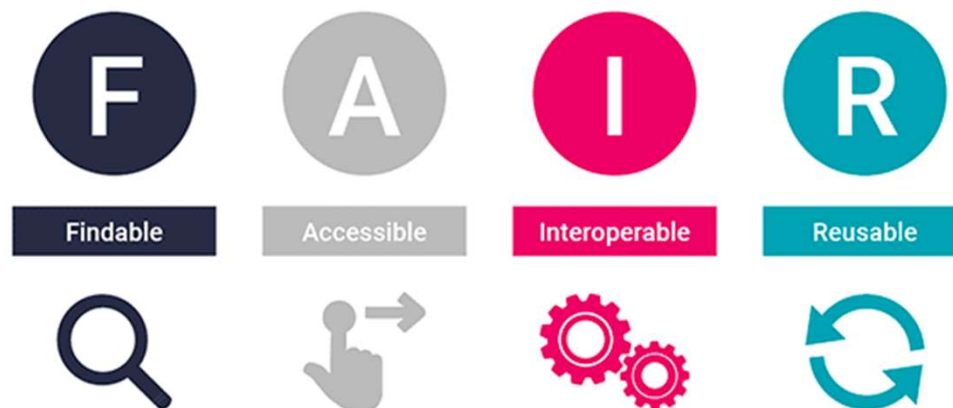


- IVOA
  - IVOA standards can be endorsed by the IAU (Commission 5)
- IAU
  - A IAU A Working Group “Virtual Astronomy and Data Centres“ has been formed in Commission B2 of the International Astronomical Union.

# Open Science and the FAIR Principles

- Data should be:

- Findable
- Accessible
- Interoperable
- Reusable

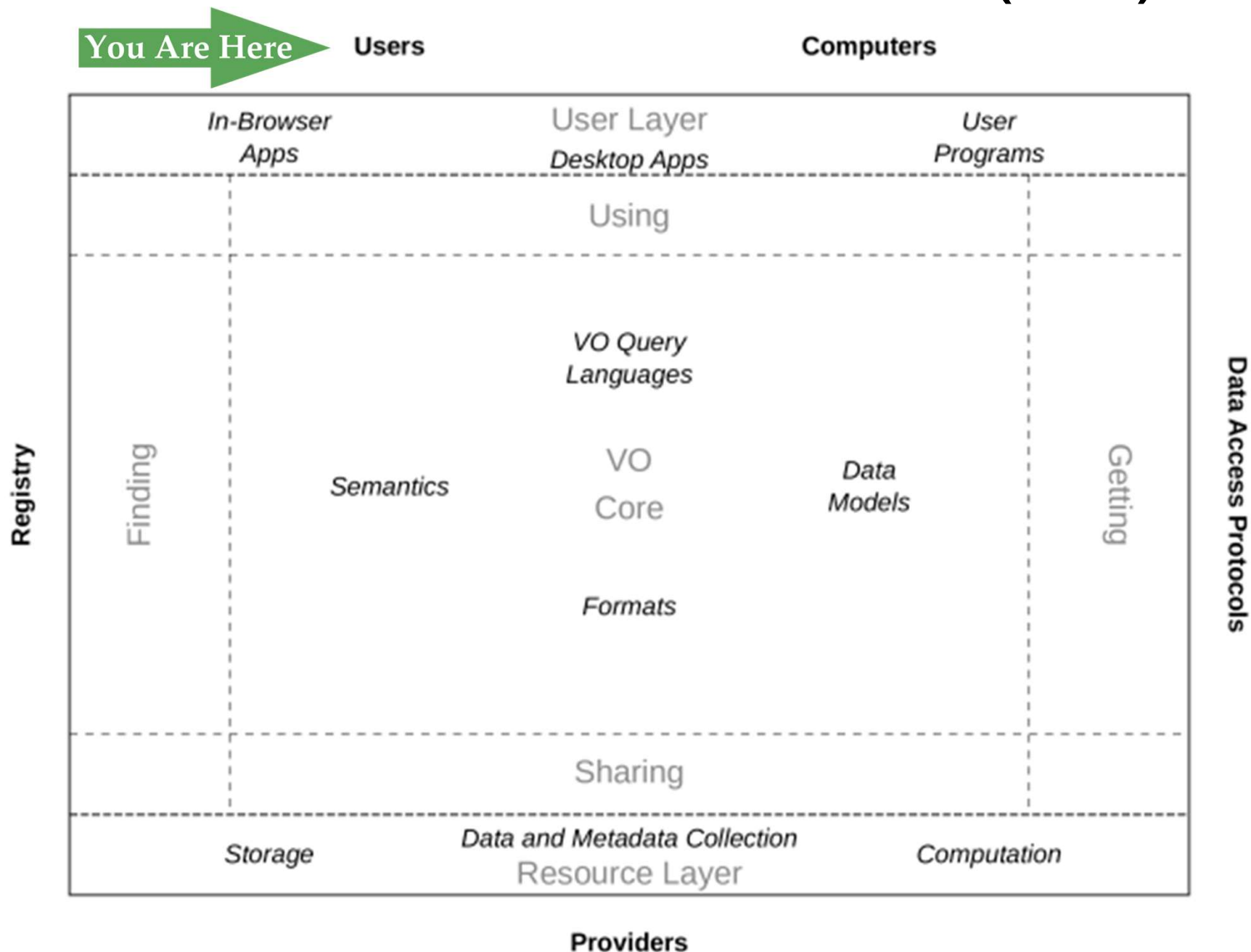


- <https://www.go-fair.org/fair-principles/>

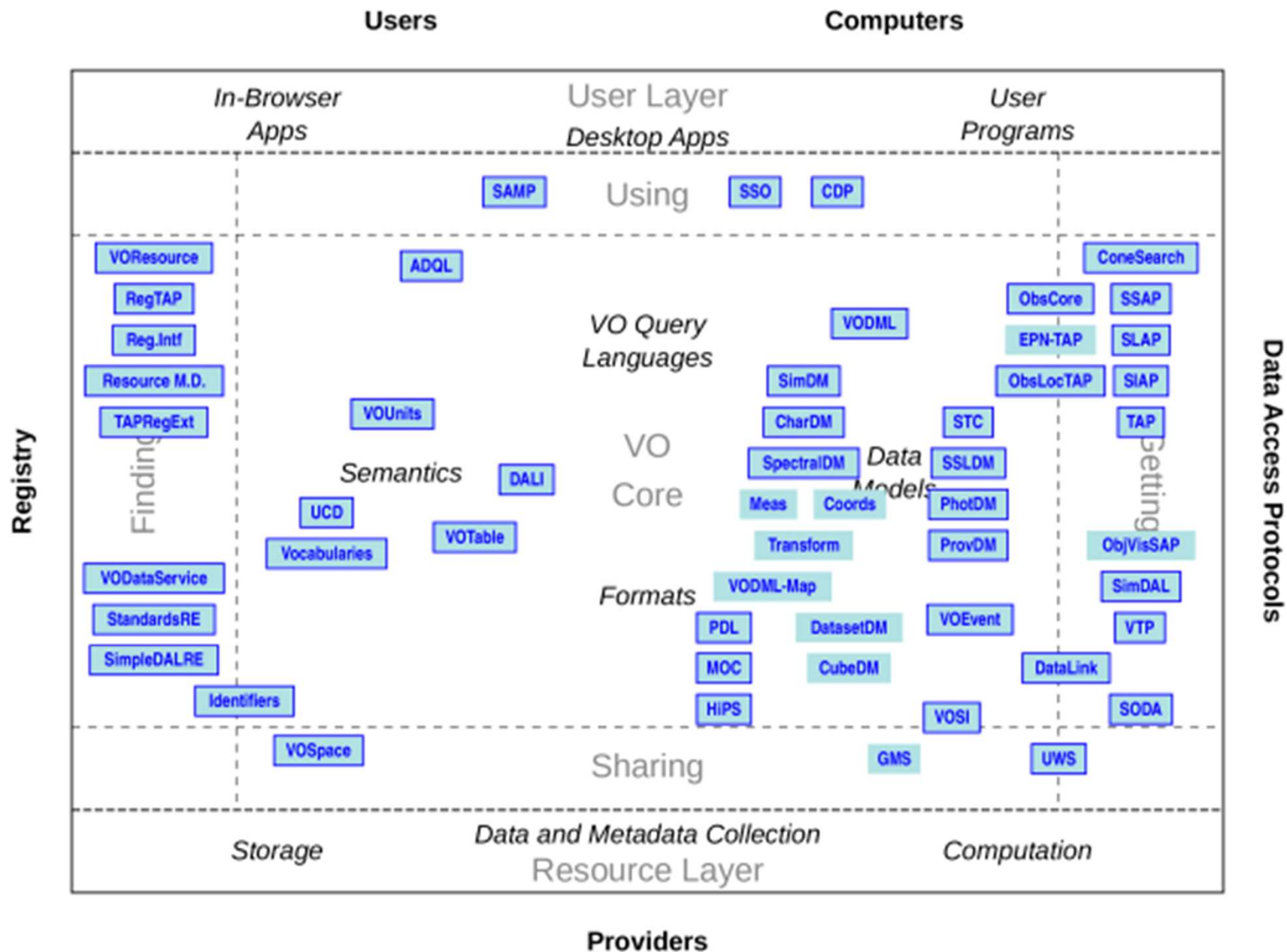
- Where do we stand ?

- FAIR standards for astronomical data by Simon O'Toole, James Tocknell <https://arxiv.org/abs/2203.10710>

# The IVOA Architecture (1/2)



# The IVOA Architecture (2/2)



# UCD Example (1/2)

Portal Simbad **VizieR** Aladin X-Match Other Help

VizieR CEA

VizieR home · Photometry viewer · Query VizieR using TAP · X-match tables · Query images/spectra

**Search Criteria**

Preferences  
max: 50  
HTML Table  
 All columns  
Compute

Mirrors  
CDS, France

**Gaia DR3 is available in CDS**  
[Gaia DR3 in VizieR](#)

Find catalogs among 22357 available

Clear Find... Expand search

**Wavelength** **Mission** **Astronomy**

Radio	AKARI	Abundances
Millimeter	ANS	Ages
IR	ASCA	AGN
optical	BeppoSAX	Associations
UV	Cassini-Huygens	Asteroseismology
EUV	CGRO	Atomic_Data
X-ray	Chandra	Binaries:cataclysmic

**UCD search** clear spect.line.intensity;em.line.Halpha

Search catalogs containing a type of columns (UCD). Use the logical characters '|' (or) or '&' (and) to link them together.

Simple examples  Textual search  UCD tree

Choose catalogs containing a type of column by clicking on the below checkbox

<input type="checkbox"/> Position	<input type="checkbox"/> J2000	<i>pos.eq*</i>
	<input type="checkbox"/> Galactic	<i>pos.gal*</i>
	<input type="checkbox"/> parallax	<i>pos.parallax*</i>
<input type="checkbox"/> Motion	<input type="checkbox"/> redshift	<i>src.redshift*</i>
	<input type="checkbox"/> radial velocity	<i>spect.dopplerVeloc* phys.veloc*</i>
	<input type="checkbox"/> proper motion	<i>pos.pm*</i>
<input type="checkbox"/> Flux	<input type="checkbox"/> Radio	<i>phot.flux*;em.radio*</i>
	<input type="checkbox"/> IR	<i>phot.flux*;em.IR* phot.flux*;em.mm*</i>
	<input type="checkbox"/> Optic	<i>phot.flux*;em.opt*</i>
	<input type="checkbox"/> High energy	<i>phot.flux*;em.X-ray* phot.flux*;em.gamma*</i>
<input type="checkbox"/> Magnitude	<input type="checkbox"/> magnitude IR (K band) (2mass)	<i>phot.mag*;em.IR.K*</i>
	<input type="checkbox"/> magnitude Optical (B band) (SDSS G)	<i>phot.mag*;em.opt.B*</i>
	<input type="checkbox"/> color	<i>phot.color*</i>
	<input type="checkbox"/> absolute	<i>phys.magAbs*</i>

# UCD Example (2/2)

## Catalog

**Search Criteria**  
Keywords  
spect.line.inten...



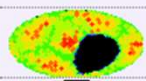





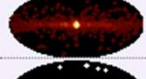













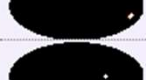


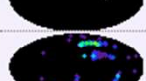


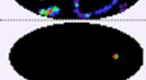





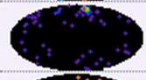


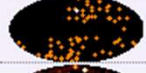




**Preferences**  
max: 50  
HTML Table  
 All columns  
Compute

**Mirrors**  
CDS, France



Gaia DR3 is available in CDS  
[Gaia DR3 in VizieR](#)

17 catalogs found

<input type="checkbox"/>	Reset All	Show table details	or	Query selected Catalogs		
<input type="checkbox"/>	ALL					
<input type="checkbox"/>	 <a href="#">II/249</a>		(e)	WHAM Northern Sky Survey, V-1.1 (Haffner+, 2003)	<a href="#">2003ApJS...149..405H</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">III/177</a>		(e)	H-alpha emission stars in the Orion region (Wiramihardja+ 1993)	<a href="#">1989PASJ...41..155W</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">V/84</a>		(e)	Strasbourg-ESO Catalogue of Galactic Planetary Nebulae (Acker+, 1992)	<a href="#">1992ESOPN...1....1A</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/ApJ/858/90</a>		(e)	Radial profiles of 5 nearby galaxies (Gallagher+, 2018)	<a href="#">2018ApJ...858...90G</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/453/493</a>			53 Line-strength indices in IC 4200 (Serra+, 2006)	<a href="#">2006A&amp;A...453..493S</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/513/A65</a>		(e)	Rotation measures in the fourth Galactic quadrant (Nota+, 2010)	<a href="#">2010A&amp;A...513A..65N</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/534/A53</a>		(e)	Equivalent widths of 18 subgiant of $\omega$ Cen (Pancino+, 2011)	<a href="#">2011A&amp;A...534A..53P</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/560/A30</a>			286 H $\alpha$ spectra of $\pi$ Aqr (Zharikov+, 2013)	<a href="#">2013A&amp;A...560A..30Z</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/570/A30</a>		(e)	H $\alpha$ emission-line stars in M42 (Pettersson+, 2014)	<a href="#">2014A&amp;A...570A..30P</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+A/591/A74</a>		(e)	Nebular emission lines towards NGC3372 center (Damiani+, 2016)	<a href="#">2016A&amp;A...591A..74D</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+AS/91/285</a>		(e)	HII galaxies spectrophotometric catalogue (Terlevich+, 1991)	<a href="#">1991A&amp;AS...91..285T</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/A+AS/104/233</a>		(e)	Emission-line stars in Vela Molecular Ridge (Pettersson+ 1994)	<a href="#">1994A&amp;AS...104..233P</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/AJ/130/1324</a>		(e)	Faint emission-line galaxies at $z \leq 1.6$ (Drozdovsky+, 2005)	<a href="#">2005AJ...130.1324D</a>	<a href="#">ReadMe+ftp</a> 
<input type="checkbox"/>	 <a href="#">J/AJ/131/716</a>		(e)	H $\alpha$ scale length in Virgo and field spirals (Koopmann+, 2006)	<a href="#">2006AJ...131..716K</a>	<a href="#">ReadMe+ftp</a>
<input type="checkbox"/>	 <a href="#">J/MNRAS/460/1758</a>		(e)	Optical emission lines in galaxy cluster cores 1 (Hamer+, 2016)	<a href="#">2016MNRAS.460.1758H</a>	<a href="#">ReadMe+ftp</a>

# A few high level IVOA Standards

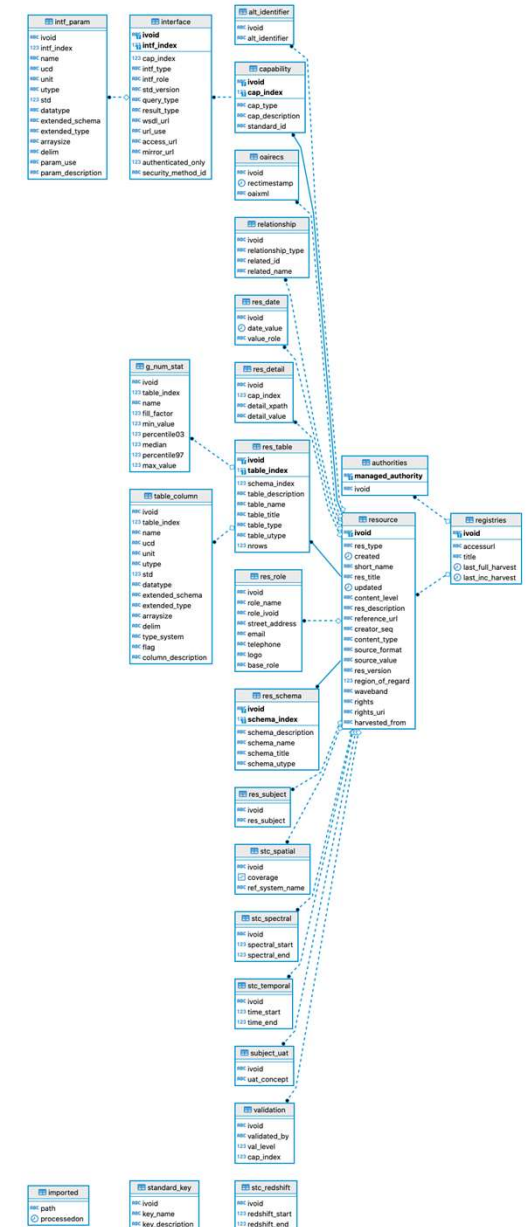
- **VOTable** the format for tabular data for allowing interoperability (coosys, timesys, ucd, utype, VOunits, datalink) - used by many other standards
- **HiPS** more than a format for images - tailored for large data volumes
- Standards describing *web services to* search and transport data:
  - **Simple Cone search** — spatial + temporal search for catalogs
  - **Simple Image Access**
  - **Simple Spectral Access**
  - **MOC** — spatial and temporal indexing for large data volumes in complex areas of the sky
  - **TAP + ADQL** — Table Access Protocol & astronomical data query language
  - **ObsCore & ObsTAP** — description of observations
- Planning of observations: (under dev.)
  - **ObjVisSAP** — visibility of objects
  - **ObsLocTAP** — facilitate coordination of observations from different facilities
  - Alerts: **VOEvent**



# The IVOA Registry

The “yellow pages” of the VO

- FAIR: Data must be FINDABLE
- A decentralized database for the VO resources
- The Registry of Registries lists all publishing registries
- Publishing Registries are harvested using the OAI protocols into Full Searchable Registries (FSR)
- FSR data is consolidated into a SQL database: the RegTAP
- Client applications query the RegTAP using TAP+ADQL
  - By service type
  - By keyword
  - By position, coverage...



# ADQL+TAP: Gaia DR3 Example (1/3)

→ EUROPEAN SPACE AGENCY [ABOUT ESAC](#) [SIGN IN](#)

## gaia archive

HOME SEARCH VISUALISATION HELP

Basic **Advanced (ADQL)** Query Results








gaia

Job name:

```
1 SELECT *, DISTANCE(  
2   POINT(302.95, -43.98),  
3   POINT(l, b)) AS ang_sep  
4 FROM gaiadr3.gaia_source  
5 WHERE 1 = CONTAINS(  
6   POINT(302.95, -43.98),  
7   CIRCLE(l, b, 5./60.))  
8 AND has_epoch_photometry = 'True'  
9 AND has_xp_continuous = 'True'
```

Ctrl+Space for query autocompletion

[Reset Form](#) [Submit Query](#)

Status	Job	Creation date	Num. rows	Size	
✓	<input type="checkbox"/> <input type="text" value="16563449266810"/>	27-Jun-2022, 17:48:46	126	64 KB	      

1-1 of 1

Download format:  [Apply jobs filter](#) Filter this session  Select all jobs  [Delete selected jobs](#)

(v3.1.2)

# ADQL+TAP: Gaia DR3 Example (2/3)

## gaia archive



HOME SEARCH VISUALISATION HELP

Basic Advanced (ADQL) Query Results

16563449266810 ✕

solution_id	designation	source_id	random_index	ref_epoch	ra	ra_error	dec	dec_error	parallax
				yr	deg	mas	deg	mas	mas
1636148068921376768	Gaia DR3 4685933603473054592	4685933603473054592	136480508	2016	12.611177029520247	0.039704867	-73.17517038321668	0.040363196	0.02730
1636148068921376768	Gaia DR3 4685933702191476096	4685933702191476096	597198294	2016	12.665219643192067	0.066944286	-73.16088919286007	0.06357211	-0.0333
1636148068921376768	Gaia DR3 4685933702191541760	4685933702191541760	764819592	2016	12.676638861795785	0.023454312	-73.15859793380181	0.024598584	0.01307
1636148068921376768	Gaia DR3 4685933740911955328	4685933740911955328	643388729	2016	12.689235178857171	0.056724537	-73.14758328247756	0.0548091	0.39381
1636148068921376768	Gaia DR3 4685933740911962496	4685933740911962496	598732896	2016	12.709240299757937	0.0343464	-73.15522743917938	0.03344348	-0.0346
1636148068921376768	Gaia DR3 4685933770962517760	4685933770962517760	20532	2016	12.654110937262992	0.06580994	-73.14826239454312	0.06017794	-0.0169
1636148068921376768	Gaia DR3 4685933809631423744	4685933809631423744	1407113877	2016	12.693695556153548	0.012557918	-73.13550846769998	0.012317287	-0.0056
1636148068921376768	Gaia DR3 4685935145299775744	4685935145299775744	595543928	2016	12.935459493924848	0.028904758	-73.22020036934993	0.025328187	-0.0044
1636148068921376768	Gaia DR3 4685935149662028928	4685935149662028928	423241273	2016	12.918069125720821	0.023954641	-73.22244765034232	0.02127379	0.02335
1636148068921376768	Gaia DR3 4685935184021695232	4685935184021695232	1751812606	2016	12.990525362618543	0.022298038	-73.20259685935292	0.020033794	0.02010
1636148068921376768	Gaia DR3 4685935248431641472	4685935248431641472	233164610	2016	12.899222674763346	0.09151232	-73.21257611562453	0.07767047	0.08447
1636148068921376768	Gaia DR3 4685935248428682624	4685935248428682624	67506922	2016	12.862632695522498	0.046045206	-73.21885585619738	0.045737457	0.06070
1636148068921376768	Gaia DR3 4685935252741248384	4685935252741248384	566808759	2016	12.861813081289931	0.023635319	-73.22089432269104	0.024252184	0.01721
1636148068921376768	Gaia DR3 4685935282738752768	4685935282738752768	1365761046	2016	12.789154671151458	0.057175726	-73.21978825858386	0.05618938	0.10422
1636148068921376768	Gaia DR3 4685935287100985600	4685935287100985600	35576132	2016	12.820098935669774	0.029863976	-73.21731950310561	0.030796407	0.00607
1636148068921376768	Gaia DR3 4685935287102308096	4685935287102308096	445823162	2016	12.79393370987717	0.05749646	-73.21790137779954	0.056541152	0.10495
1636148068921376768	Gaia DR3 4685935287102308096	4685935287102308096	445823162	2016	12.79393370987717	0.05749646	-73.21790137779954	0.056541152	0.10495

1-20 of 126

Gaia DR3 Data Model Show query in ADQL form VOTable Download results

# ADQL+TAP: Gaia DR3 Example (3/3)

The screenshot displays the Gaia archive interface with a query executed and data ready for download. The interface is divided into three main sections:

- Left Panel (Navigation):** Shows the 'gaia archive' logo and navigation tabs: HOME, SEARCH, VISUALISATION, HELP. Below these are tabs for 'Basic', 'Advanced (ADQL)', and 'Query Results'. A sidebar lists various data releases and categories like 'Gaia Data Release 1-3', 'Astrophysical parameters', 'Auxiliary', etc.
- Center Panel (Query and Results):** Features the 'Gaia Job DataLink' header (with 'DataLink' circled in red). It provides information about the DataLink protocol and ancillary products. A 'Job ID: 16563449266810' is displayed. Below this, there's a dropdown for 'IDs Column: source\_id' and a 'Show Data' button. The 'Data release' is set to 'Gaia DR3' and 'Data structure' to 'INDIVIDUAL'. A list of data products is shown with download icons:
  - MCMC MSC (126)
  - XP mean continuous spectra (126)
  - Epoch photometry (126)
  - MCMC GSP-Phot (92)
  - XP mean sampled spectra (18)At the bottom, there's a 'Download format' dropdown set to 'VOTable' and a 'Save All Data' button. A note states: 'Depending on the amount and type of data retrieved, Archive response times range from seconds to minutes.'
- Right Panel (Query Execution and Results):** Shows a 'Query examples' section with a 'Reset Form' and 'Submit Query' button. Below this is a table of results:

Num. rows	Size	Actions
126	64 KB	[Info] [Download] [Share] [Print] [Refresh] [Link]

At the bottom of this panel, there are filters: 'Apply jobs filter', 'Filter this session' (checked), 'Select all jobs' (unchecked), and 'Delete selected jobs'. The version '(v3.1.2)' is noted in the bottom right corner.

anonymous1656....zip

Show all x

# Publishing in the VO

- <https://wiki.ivoa.net/twiki/bin/view/IVOA/PublishingInTheVO>
- Prepare metadata
- Organize data (DB)
- Publish data: DIY or use a toolkit ?
  - Reading the specs and implementing the standards
  - Re-using server software (ex: for TAP/ADQL: GAVO dachs, CDS VOLLLT...)
- Register your services so they appear in client applications
  - Create a Publishing Registry
  - Register your service in public Registries: EURO-VO, NAVO

# IVOA Education Interest Group

- <https://wiki.ivoa.net/twiki/bin/view/IVOA/IvoaEducation>
- Tutorials
  - <https://wiki.ivoa.net/twiki/bin/view/IVOA/EduResourcesTutorials>
  - <https://www.euro-vo.org/scientific-tutorials/>
  - <http://vo-for-education.oats.inaf.it/>
  - <http://cdsweb.u-strasbg.fr/tutorials/>
  - <https://svo.cab.inta-csic.es/main/index.php> *in spanish !*

# LOGICIELS

- **Aladin** <https://aladin.cds.unistra.fr/>
- **TOPCAT** <http://www.star.bris.ac.uk/~mbt/topcat/>

# Les principes « FAIR »

**Findable, Accessible, Interoperable, Reusable**

- **F** : Les données doivent être **findable** (faciles à trouver) et identifiables par les humains et les machines :
  - → catalogues, métadonnées, mots clés issus de thésaurus disciplinaires,
  - → identifiants uniques et pérennes (DOI)
- **A** : Les données doivent être **accessibles** facilement, avec des conditions connues :
  - → des licences claires, des protocoles « ouverts »,
  - → données présentes dans des entrepôt certifiés ... et accessibles
- **I** : Les données doivent être **interopérables** à plusieurs niveaux :
  - **Sémantique** : vocabulaires contrôlés, métadonnées disciplinaires précises
  - **Syntaxique** : protocoles d'échanges ouverts et standards (CSW, WMS, SOS, DAP ...)
  - **Contenus** : formats de fichiers aux standards internationaux disciplinaires (ex : NetCDF, ODV, etc.)
- **R** : Réutilisables : l'objectif final des principes FAIR : la pérennité et réutilisation des données :
  - Pas de « R » sans « FAI »
    - Identifiants uniques et pérennes (DOI) pour l'identification et la citation des données
    - Licences claires d'utilisation des données
    - Standards communs : protocoles d'échanges et formats standards des données qui répondent à des normes communautaires pertinentes pour le domaine
  - Authentification d'accès, si nécessaire