Newcomers to the IVOA

Interop meeting 25-29 April 2022

CENTRE DE DONNÉES ASTRONOMIQUES DE STRASBOURG

IVOA

Observatoire astronomique de Strasbourg | ObAS

Newcomers session

- A Brief History of the IVOA by G. Bruce Berriman
- Intro to the IVOA by A. Nebot
- Get a taste! Dancing the VOltz by Hendrik Heinl & Dave Morris

Intro to the IVOA

Interop meeting 25-29 April 2022

Ada Nebot

CENTRE DE DONNÉES ASTRONOMIQUES DE STRASBOURG

Observatoire astronomique de Strasbourg | ObAS

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The VO and the IVOA: what?

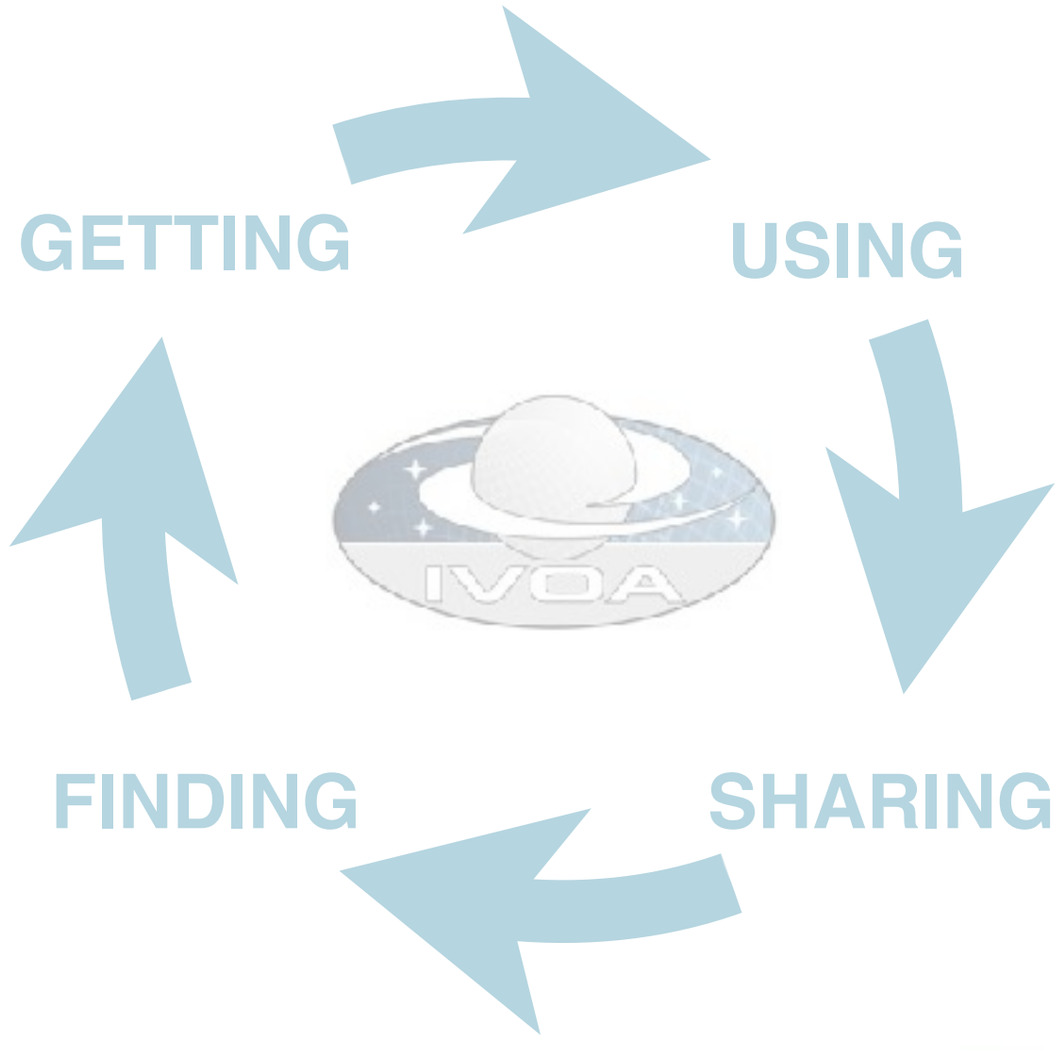
"A multi-wavelength digital sky that can be searched, visualised and analysed in new and innovative ways"

What is the Virtual Observatory?

- Framework for astronomical datasets, tools, services to work together in a seamless way

What is the International Virtual Observatory Alliance?

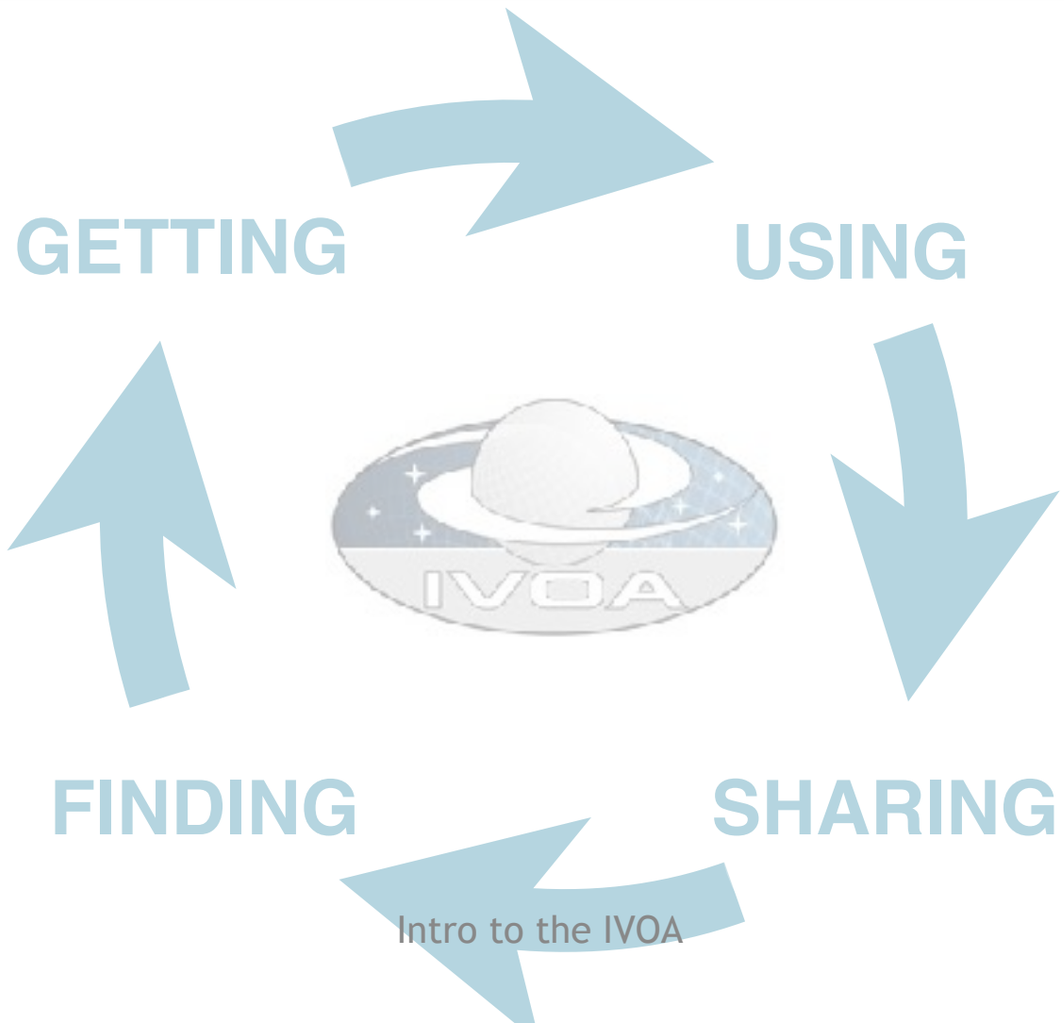
- A science driven organisation that builds the technical standards
- A place for discussing and sharing VO ideas and technology to enable science
- Promoting and publicising the VO



The VO and the IVOA: why?

Clear benefits

- Growth in the scientific return of data
- Capability to discover and fuse multiple data sets
- Application of the VO in planning new observations and observing strategies



The VO and the IVOA: who?

Who is the IVOA? **http://ivoa.net/**

- Exec, Tech Coordination, Standards & processes, Media, Science priorities
- **6 Working Groups:**
  - Applications, access, models, grid & web services, registry, semantics
- **8 Interest Groups**
  - Time-domain, radio, solar system, education, data curation, knowledge & discovery, theory
- Completely open to participation

Want to join the IVOA?

- Meetings: 2 interoperability meetings per year
- Email list: https://www.ivoa.net/members/index.html
- GitHub: https://github.com/ivoa-std)

The VO and the IVOA: where?

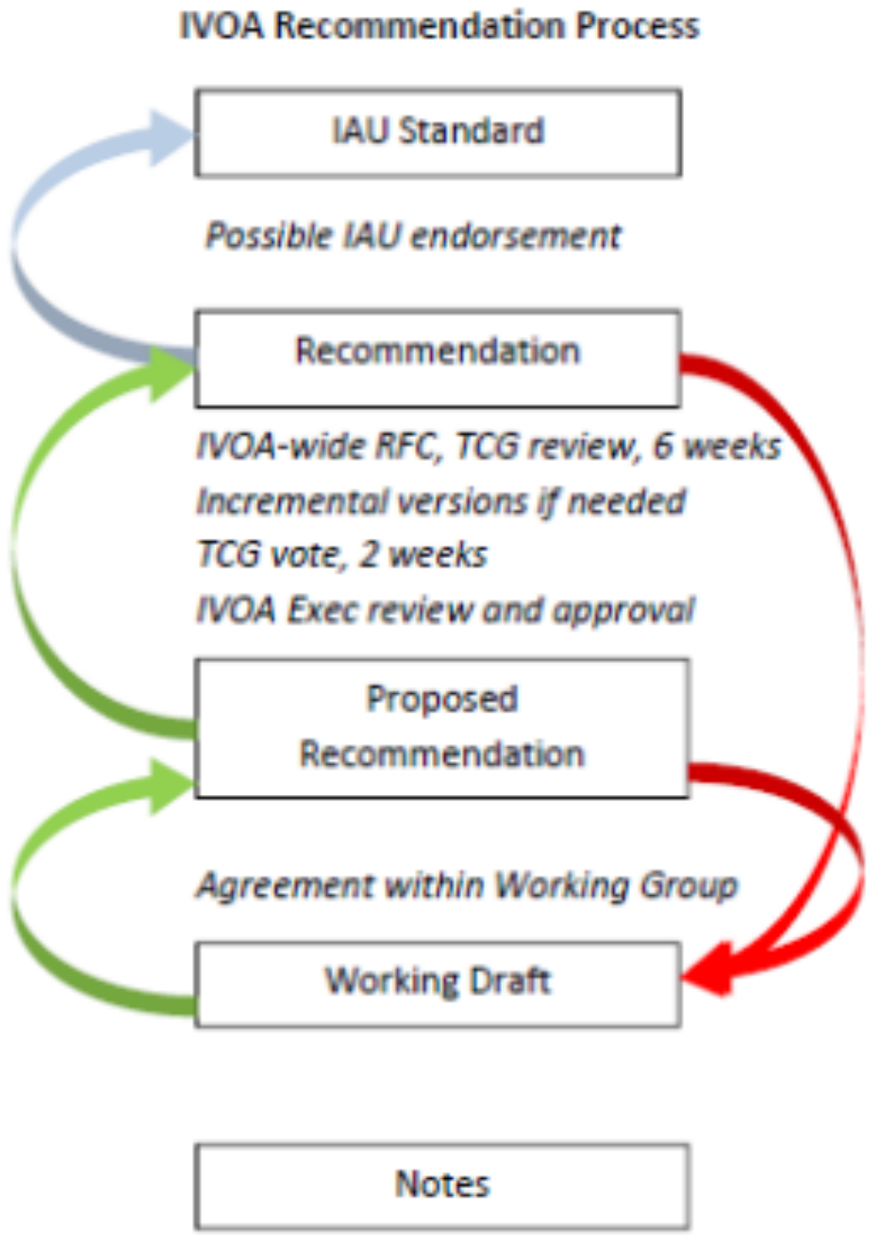
Existing global framework: populated by major data providers (space and ground based) that is heavily used by the community (e.g. Gaia data access is fully VO)

The VO and the IVOA: how?

Through the development and adoption of common standards scientifically driven, as an international community effort where astronomers, software engineers and documentalists are involved

IVOA development process of standards

- Build IVOA standards to match users needs:
  - Find and report the community needs
  - Find and report gaps in the existing standards
  - Propose new ways to fill the gaps
  - Implement & validate
  - Standardise when consensus is reached



OK… but where do I start?

- A science driven organisation! —> Start from a Scientific question

Let's see it with an example:

How can I explain **this**?
What is the nature **this**?
What is the impact on **this**?

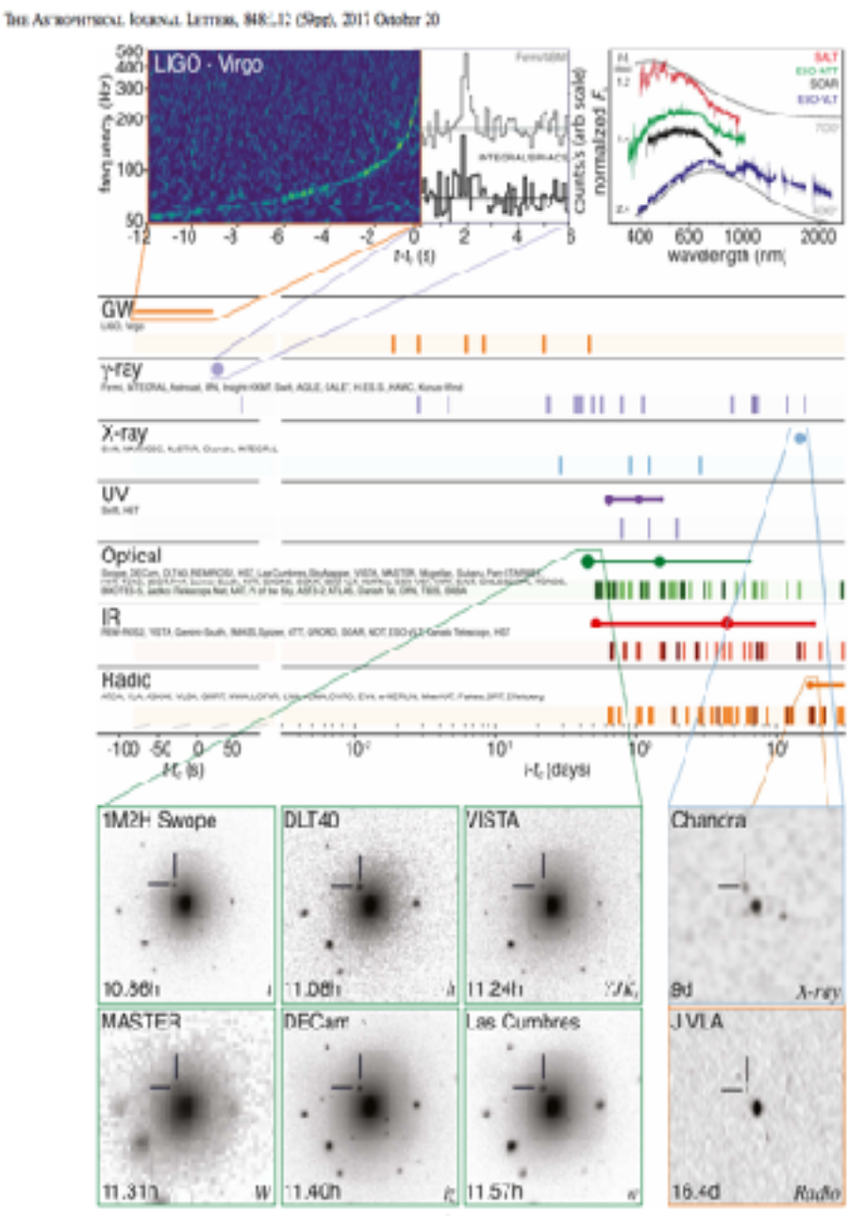
this : your favorite object / mechanism / etc.

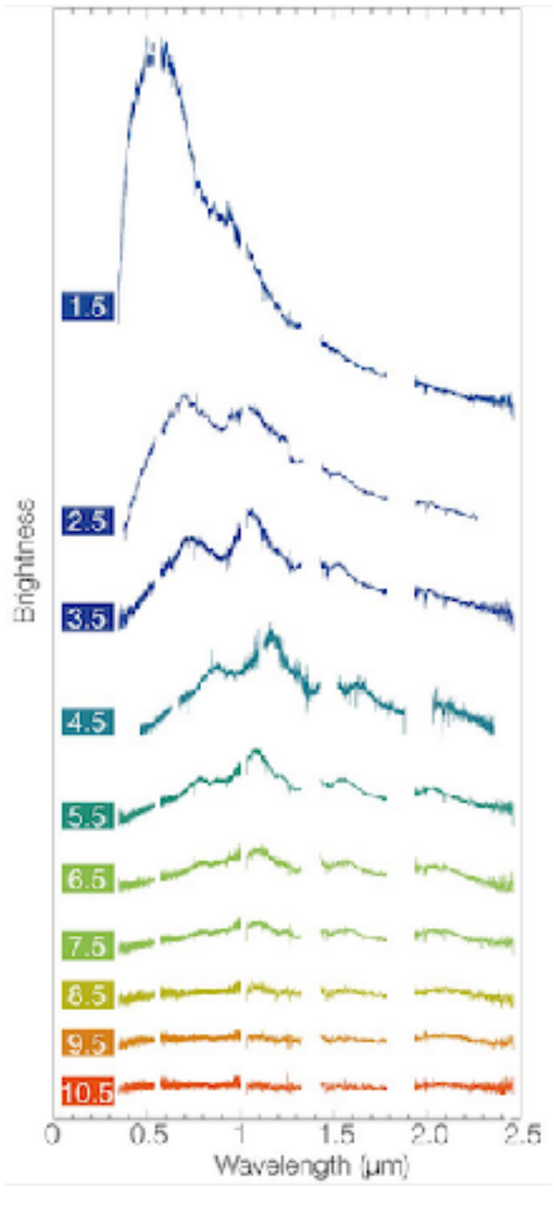
What type of data and analyses do I need to answer **this** question?

The IVOA will not give you the answers to your questions nor will it ask the questions for you.

The IVOA provides you with common formats and common ways of describing and accessing the data which when adopted will ease your work.

A multi-messenger view needed





- Multi-wavelength / messenger approach is needed - different data types
- Follow-up observations and reaction time for that can be crucial - alerts
- Analysis, Visualisation & navigation through the data
- Coordination & transmission of information

The IVOA should match user's needs

Some selected standards

1. **VOTable** the format for tabular data for allowing interoperability (coosys, timesys, ucd, utype, VOunits, datalink).
2. **HiPS** more than a format for images - tailored for large data volumes
3. Search for data:
   - **Cone search** — spatial + temporal search
   - **MOC** — spatial and temporal indexing for large data volumes and more complex areas in the sky
   - **ObsCore & ObsTAP** — description of observations (**ADQL**)
4. Planning of observations:
   - **ObjVisSAP** — visibility of object to plan observations
   - **ObsLocTAP** — facilitate coordination of observations
   - Facilities / observatory list (under dev.)
5. Alerts: **VOEvents & VOEvent Transport protocol**
6. Description of provenance **ProvenanceDM & ProvTAP**
7. Registering the services — **RM - Resource Metadata for the Virtual Observatory**
8. Communication : **Send / receive data among services & tools with SAMP**
9. **… many more! SLAP, SIAP, SSA, … each tailored to specific use cases**

VOTable

Standardisation of coordinate system annotation (time and coordinates), UCD, utypes, VOUnits, datalink

IVOA Recommendation

International Virtual Observatory Alliance

IVOA Documents

VOTable Format Definition
Version 1.4

IVOA Recommendation 21 October 2019

Interest/Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaApplications
Author(s):
Francois Ochsenbein, Roy Williams, Clive Davenhall, Markus Demleitner, Tom Donaldson, Daniel Durand, Pierre Fernique, David Giaretta, Robert Hanisch, Tom McGlynn, Alex Szalay, Mark Taylor, Andreas Wicenec
Editor(s):
Francois Ochsenbein, Mark Taylor, Tom Donaldson

Abstract

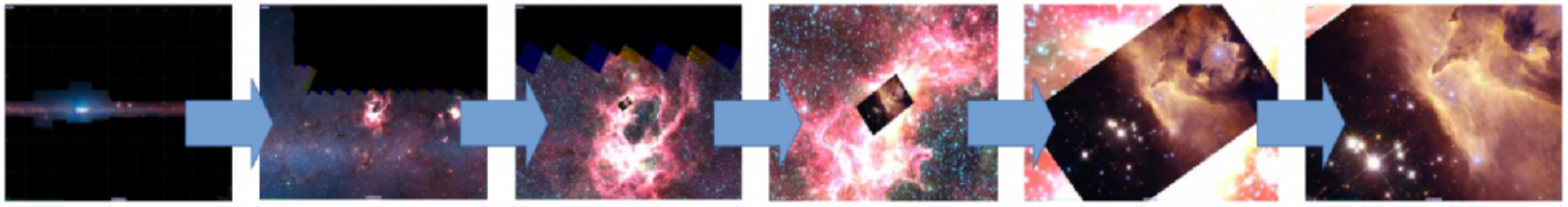
This document describes the structures making up the VOTable standard. The main part of this document describes the adopted part of the VOTable standard; it is followed by appendices presenting extensions which have been proposed and/or discussed, but which are not part of the standard.

Status of this document

This document has been produced by the Applications Interest Group.
It has been reviewed by IVOA Members and other interested parties, and has been endorsed by the IVOA Executive Committee as an IVOA Recommendation. It is a stable document and may be used as reference material or cited as a normative reference from another document. IVOA's role in making the Recommendation is to draw attention to the specification and to promote its widespread deployment. This enhances the functionality and interoperability inside the Astronomical Community.

Available formats: html, pdf

HiPS



IVOA Recommendation

HiPS - Hierarchical Progressive Survey
Version 1.0

IVOA Recommendation 19 May 2017

Interest/Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaApplications
Author(s):
Pierre Fernique, Mark Allen, Thomas Boch, Tom Donaldson, Daniel Durand, Ken Ebisawa, Laurent Michel, Jesus Salgado, Felix Stoehr
Editor(s):
Pierre Fernique

DOI:
10.5479/ADS/bib/2017ivoa.spec.0519F

Errata

No errata yet

Abstract

This document presents HIPS, a hierarchical scheme for the description, storage and access of sky survey data. The system is based on hierarchical tiling of sky regions at finer and finer spatial resolution which facilitates a progressive view of a survey, and supports multi-resolution zooming and panning. HiPS uses the HEALPix tessellation of the sky as the basis for the scheme and is implemented as a simple file structure with a direct indexing scheme that leads to practical implementations.

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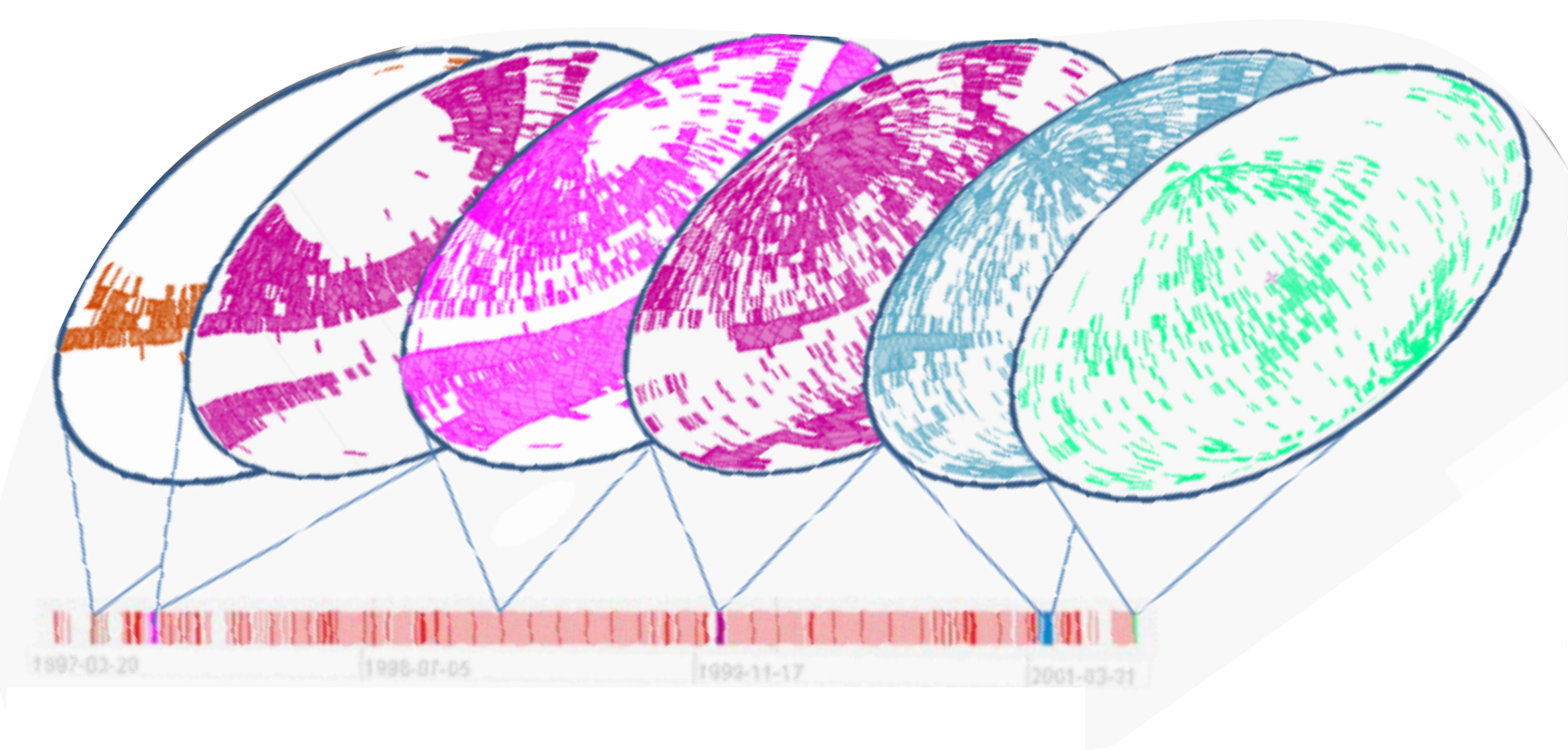
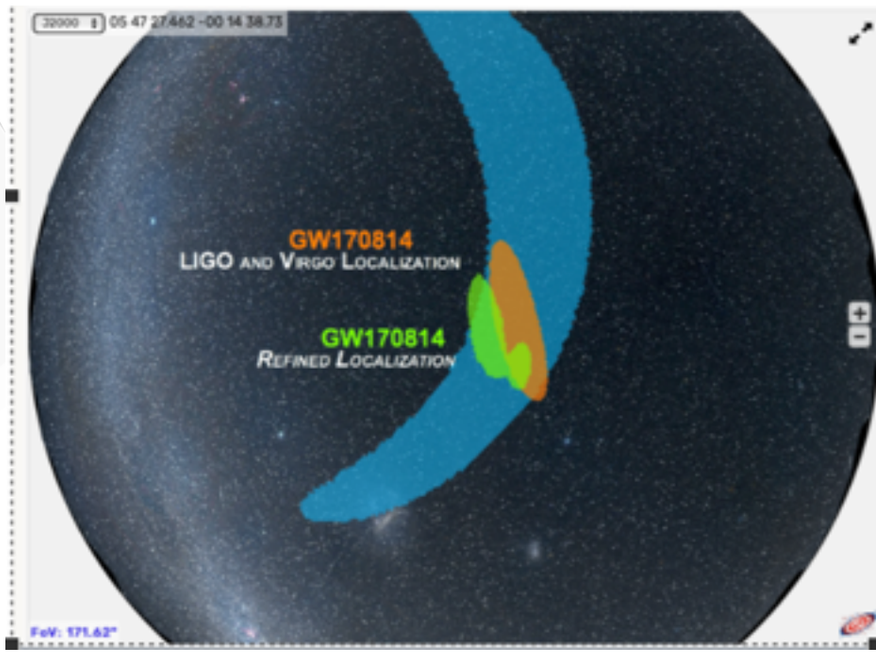
Search: know where & when

- Cone search extension to add a time interval for search in cats.
- Search by temporal+spatial coverage of surveys for the more complicated areas (ST-MOC = space-time multi-order coverage map)





Search: know where & when

International Virtual Observatory Alliance

MOC: Multi-Order Coverage map

Version 2.0

IVOA Recommendation 2022-03-17

Working group
Applications

This version
http://www.ivoa.net/documents/moc/20220317

Latest version
http://www.ivoa.net/documents/moc

Previous versions
Version1.1
Version1.0

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Editor(s)
Pierre Fernique, Ada Nebot, Daniel Durand

International Virtual Observatory Alliance

Simple Cone Search

Version 1.1

IVOA Working Draft 2020-08-28

Working group
Data Access Layer

This version
http://www.ivoa.net/documents/ConeSearch/20200828

Latest version
http://www.ivoa.net/documents/ConeSearch

Previous versions
REC 1.03
PR 2007-09-14
PR 2007-06-28
PR 2006-09-08

Author(s)
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Editor(s)
Marco Molinaro, Ada Nebot, Raymond Plante

ObsCore & ObsTAP

- **Goal: “ we need to give data providers a set of metadata attributes that they can easily map to their database system in order to support queries of the sort listed below.”**

- Science cases:
  - Support multi-wavelength as well as positional and temporal searches.
  - Support any type of science data product (**image, cube, spectrum, time series, instrumental data, etc.**).
  - Directly support the sorts of file content typically found in archives (FITS, VOTable, compressed files, instrumental data, etc.).

ObsCore & ObsTAP are Key IVOA standards for searching, finding and combining all sorts of data and allow for interoperability

ObsCore & ObsTAP

International Virtual Observatory Alliance

Observation Data Model Core Components and its Implementation in the Table Access Protocol

Version 1.1

IVOA Recommendation, May 09, 2017

Approved by IVOA executive committee March 20, 2017

Working Groups: Data Model, Data Access Layer

This version:

http://www.ivoa.net/Documents/ObsCore/20170509/REC-ObsCore-v1.1-20170509.pdf

Latest version:

http://www.ivoa.net/Documents/ObsCore/20170509/REC-ObsCore-v1.1-20170509.pdf

Previous version(s):

http://www.ivoa.net/Documents/ObsCore/20161004/PR-ObsCore-v1.1-20161004.pdf

Editors:

Mireille Louys, Doug Tody, Patrick Dowler, Daniel Durand

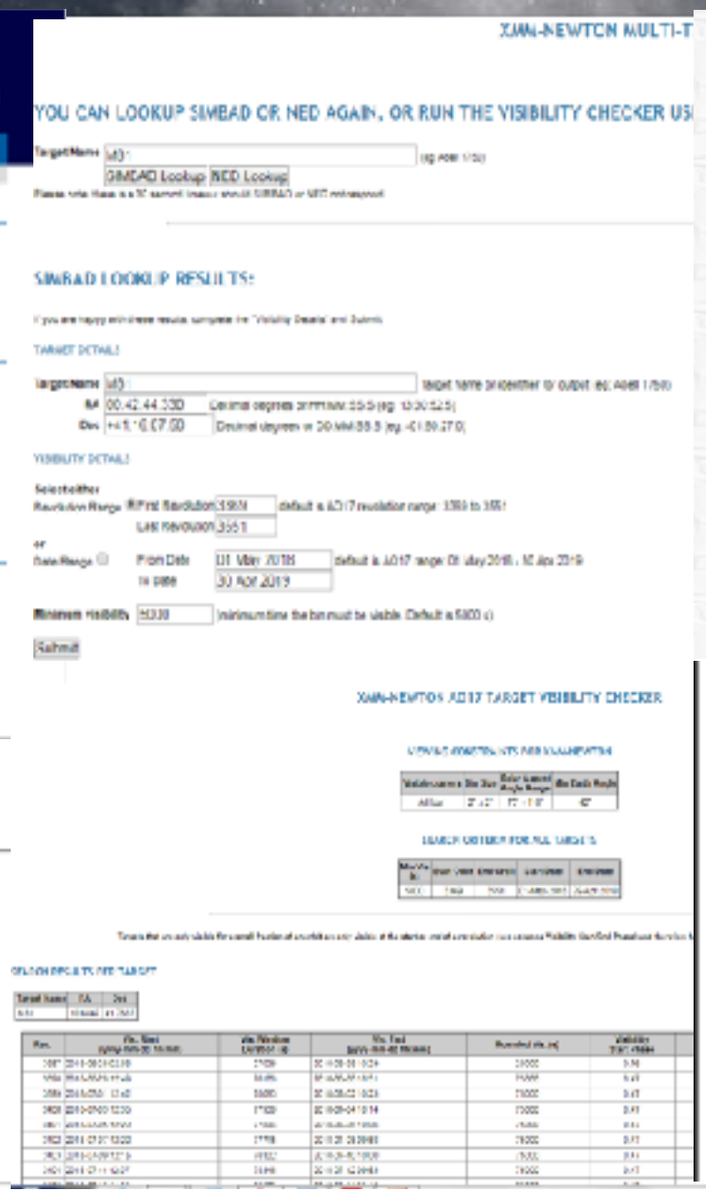
Authors:

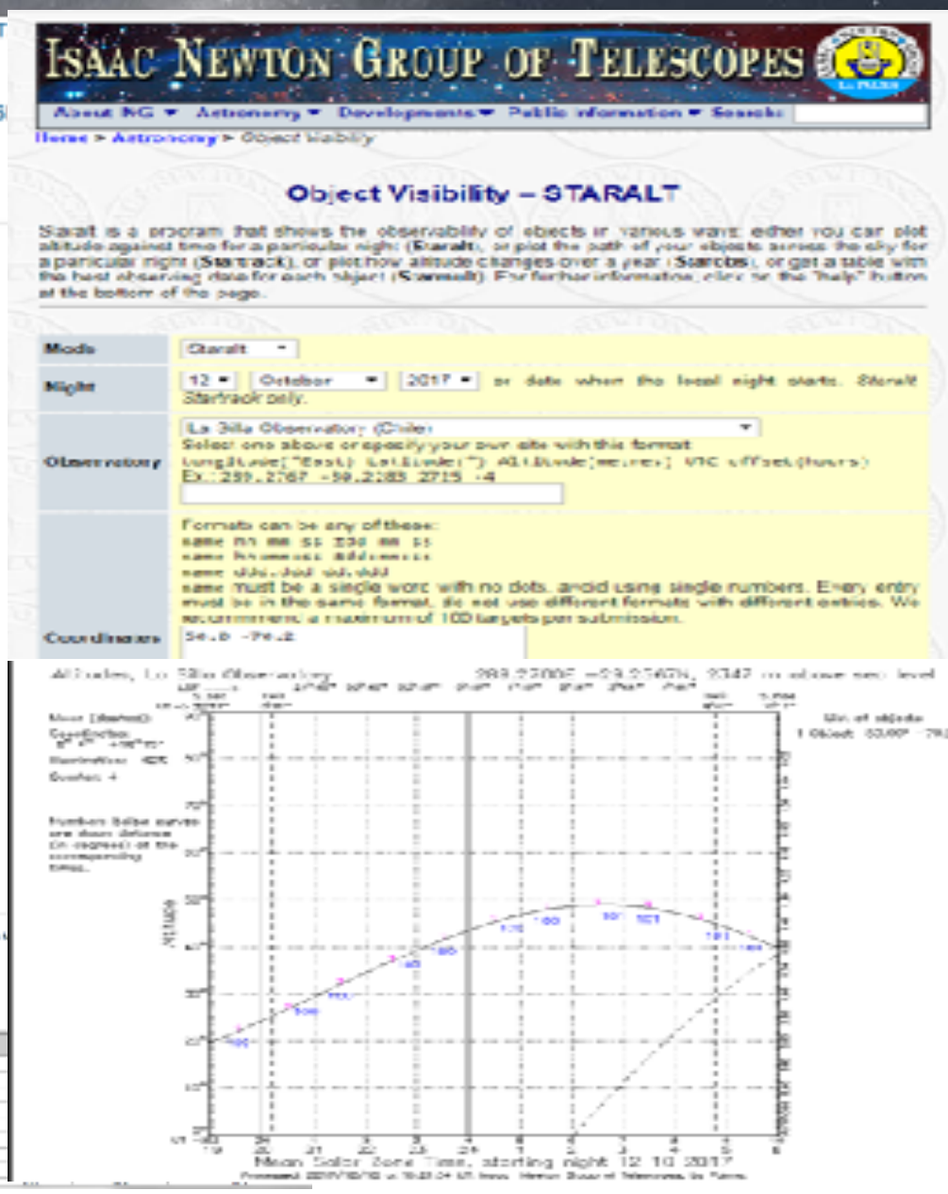
Mireille Louys, Doug Tody, Patrick Dowler, Daniel Durand, Laurent Michel, Francois Bonnarel, Alberto Micol and the IVOA DataModel working group

- Map the METADATA of your project data into ObsCore Keywords
- Set a TAP Service
- Register it

➡ Search, find, and combine the data coming from multiple missions

Visibility of an object





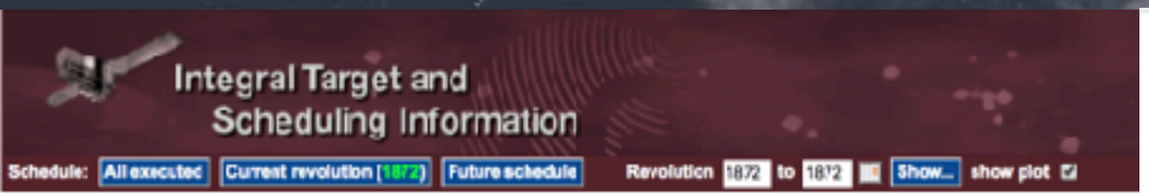
Different services have different inputs / outputs

Facilitate the work by having some level of standardisation inputs / outputs

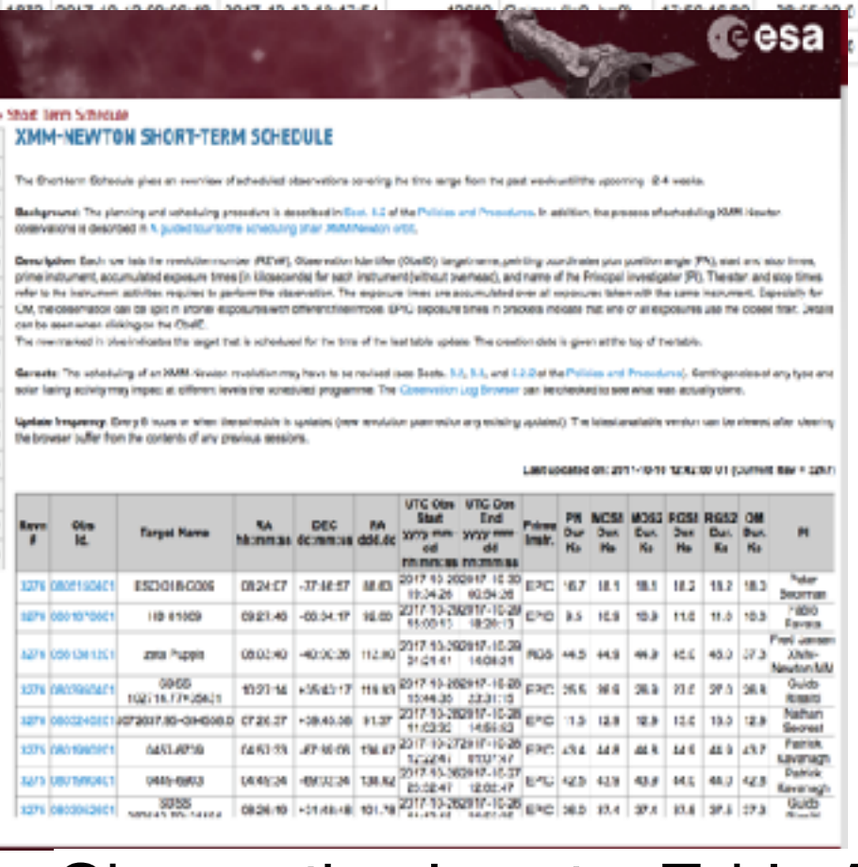
Object Visibility Simple Access Protocol, Aitor Ibarra, Richard Saxton, Jesús Salgado et al. 2020

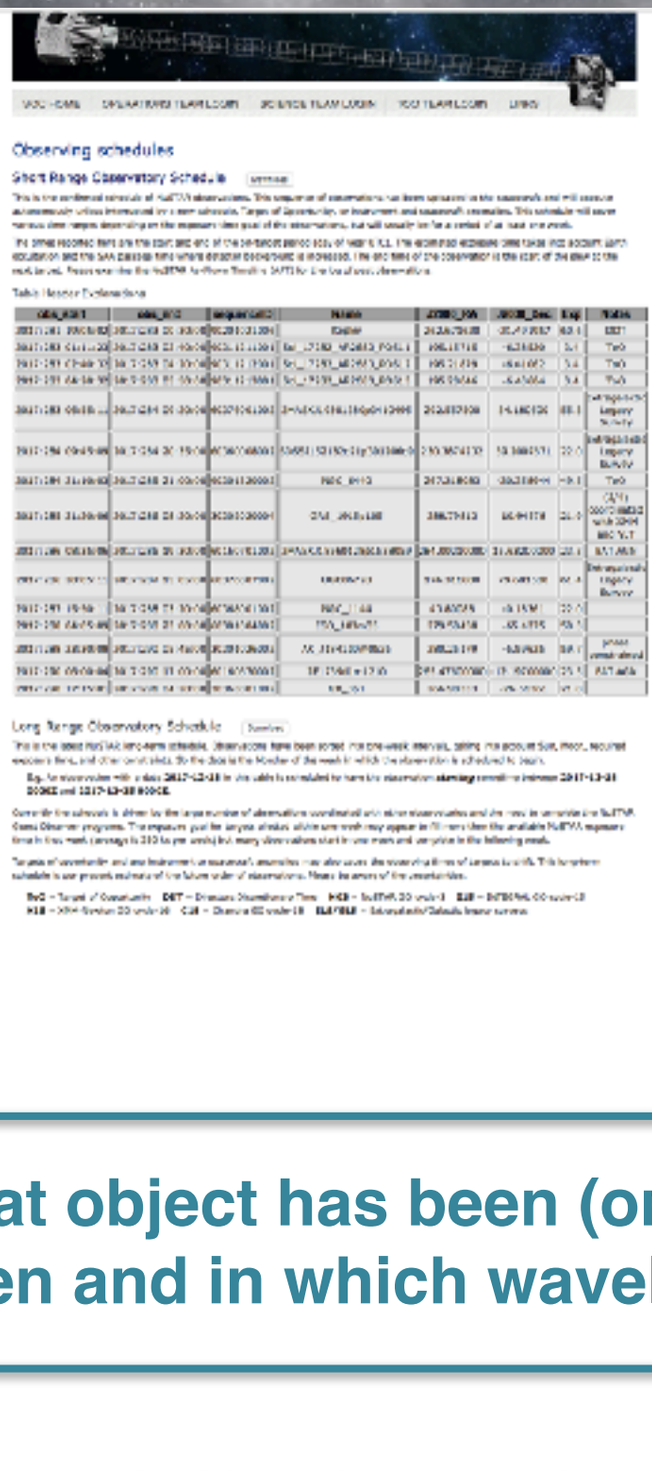
http://www.ivoa.net/documents/ObjVisSAP/index.html

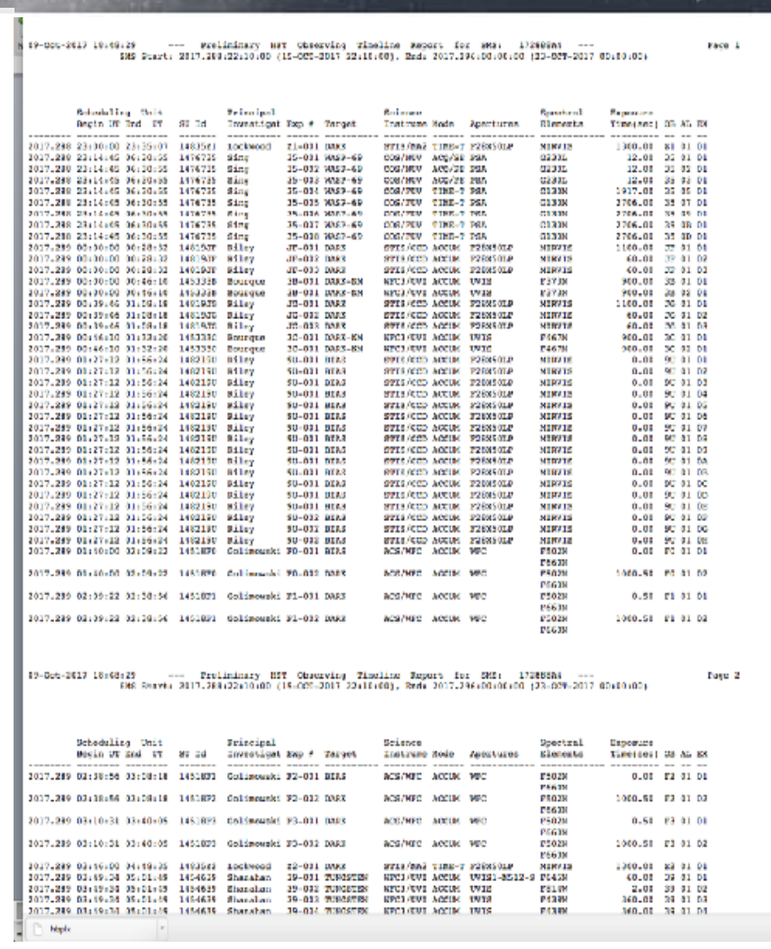
Coordination of observations



Rev	Start time (UTC)	End time (UTC)	Exp. time (s)	Target	Ra (J2000)	Dec (J2000)	Pattern	PI	Propo
1872	2017-10-10 13:29:15	2017-10-10 17:10:51	12660	Ga. Bulge region	17:46:06.00	-28:56:00.0	HEX	Erik Kuulkers	1420
1872	2017-10-10 17:13:34	2017-10-11 07:55:55	50060	Galactic Center	17:52:11.21	-25:21:49.7	5x5 Seq	Joern Wilms	1420
1872	2017-10-11 08:16:46	2017-10-11 11:56:32	12660	Galaxy (l=0, b=0)	17:42:23.76	-29:38:02.4	HEX	Rashid Sunyaev	1420
1872	2017-10-11 12:26:36	2017-10-11 12:56:36	1800	Galaxy (l=0, b=-30)	20:02:16.80	-41:20:31.2	HEX	Rashid Sunyaev	1420
1872	2017-10-11 13:27:21	2017-10-11 14:25:17	3660	Galaxy (l=0, b=-30)	19:59:40.80	-41:05:16.8	HEX	Rashid Sunyaev	1420
1872	2017-10-11 15:00:12	2017-10-11 17:38:07	9060	Galaxy (l=0, b=-30)	19:59:40.80	-41:05:16.8	HEX	Rashid Sunyaev	1420
1872	2017-10-11 18:41:00	2017-10-12 08:01:56	45060	GRS 1915+105	19:15:11.79	+10:56:45.7	5x5 Seq	Jerome Rodriguez	1420
								Rashid Sunyaev	1420
							HEX	Rashid Sunyaev	1420







What object has been (or will be) observed when and in which wavelength?

Observation Locator Table Access Protocol, Aitor Ibarra, Jesús Salgado et al. 2021
http://www.ivoa.net/documents/ObsLocTAP/

International Virtual Observatory Alliance

Observation Locator Table Access Protocol
Version 1.0

IVOA Recommendation 2021-07-24

Working group
Data Model Working Group

This version
http://www.ivoa.net/documents/ObsLocTAP/20210724

Latest version
http://www.ivoa.net/documents/ObsLocTAP

Previous versions

Author(s)
Aitor Ibarra, Jesús Salgado, Matthias Ehle, Carlos Gabriel, Peter Kretschmar, Erik Kuulkers, Bruno Merín, Jan-Uwe Ness, Emilio Salazar, Richard Saxton, Baptiste Cecconi, Karl Foster, Markus Demleitner, James Dempsey, Marco Molinaro, Celia Sánchez, Mark Taylor, María Díaz Trigo, Jaime Kennea, Mark Kettenis, Giorgio Matt, Julian Osborne, Emma de Oña Wilhelmi, Edward J. Salbol, Gregory Sivakoff, Lian Tao, Aaron Tohuvavohu, Bill Workman

Editor(s)
Jesús Salgado, Aitor Ibarra

International Virtual Observatory Alliance

Object Visibility Simple Access Protocol

Version 1.0

IVOA Working Draft 14 May 2020

This version:
ObjVisSAP-0.4-20200514
Latest version:
ObjVisSAP-0.5-20190319

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Working Group:
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Editor(s):
Aitor Ibarra, Richard Saxton, Jesús Salgado

Author(s):
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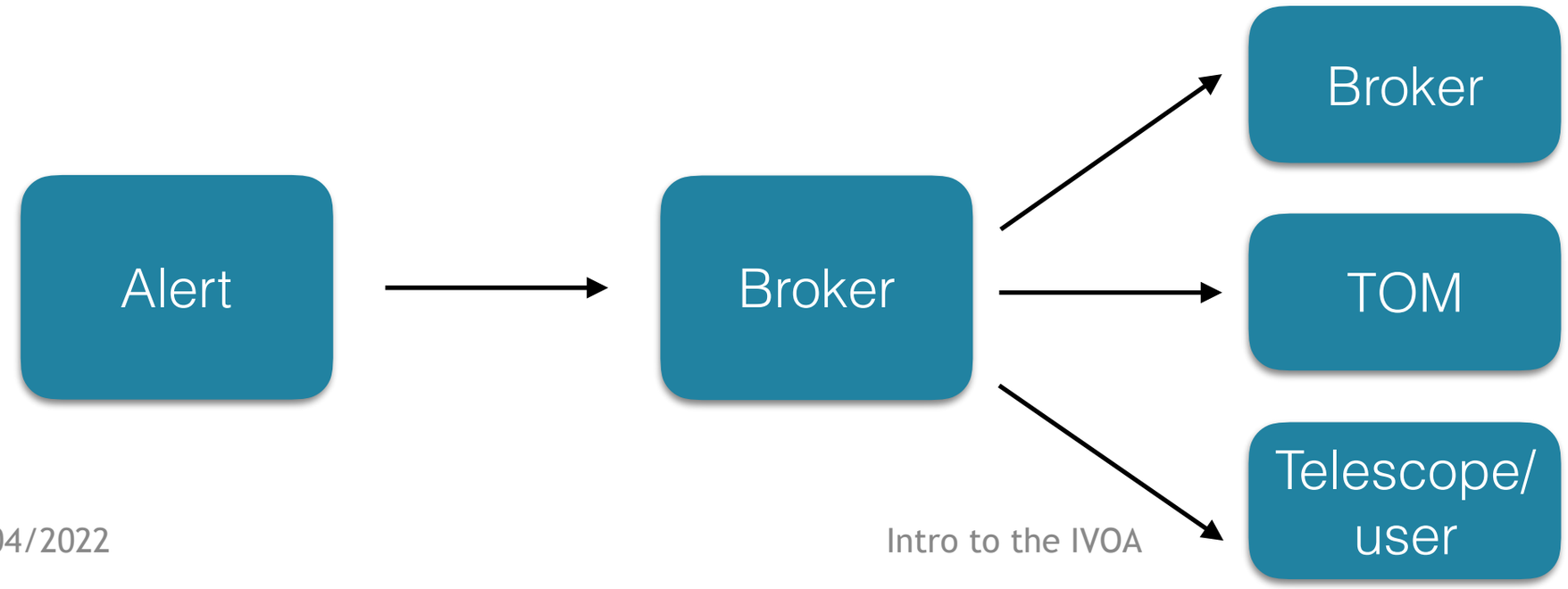
TBC: Representatives of a large multi-observatory collaboration

Alerts

1. VOEvent (REC):
    1. Container —> XML
    2. Content —> defined by the community: FRB, (GRB, SN, Neutrino,…)
2. VOEvent Transport protocol (REC):
    1. Works for low rates (10 Hz)
    2. Doesn’t scale for very high rates (10^3Hz)
3. Open questions:
    1. A VOEvents validation library is missing
    2. How to find who distributes alerts? Register in the registry? But needs to be fast… VOEvent + TAP service for alerts



Provenance

International Virtual Observatory Alliance

IVOA Documents

IVOA Provenance Data Model
Version 1.0

IVOA Recommendation 11 April 2020

Interest/Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaDataModel
Author(s):
Mathieu Servillat, Kristin Riebe, Catherine Boisson, François Bonnarel, Anastasia Galkin, Mireille Louys, Markus Nullmeier, Nicolas Renault-Tinacci, Michèle Sanguillon, Ole Streicher
Editor(s):
Mathieu Servillat

Abstract

This document describes how provenance information can be modeled, stored and exchanged within the astronomical community in a standardized way. We follow the definition of provenance as proposed by the W3C, i.e. that "provenance is information about entities, activities, and people involved in producing a piece of data or thing, which can be used to form assessments about its quality, reliability or trustworthiness." Such provenance information in astronomy is important to enable any scientist to trace back the origin of a dataset (e.g. an image, spectrum, catalog or single points in a spectral energy distribution diagram or a light curve), a document (e.g. an article, a technical note) or a device (e.g. a camera, a telescope), learn about the people and organizations involved in a project and assess the reliability, quality as well as the usefulness of the dataset, document or device for her own scientific work.

Status of this document

This document has been produced by the Data Model Working Group.
It has been reviewed by IVOA Members and other interested parties, and has been endorsed by the IVOA Executive Committee as an IVOA Recommendation. It is a stable document and may be used as reference material or cited as a normative reference from another document. IVOA's role in making the Recommendation is to draw attention to the specification and to promote its widespread deployment. This enhances the functionality and interoperability inside the Astronomical Community.

Available formats: pdf, tex

maintained by ::ivoa document coordinator::

Register your services

IVOA Recommendation

International Virtual Observatory Alliance

IVOA Documents

Resource Metadata for the Virtual Observatory
Version 1.12

IVOA Recommendation 02 March 2007

Interest/Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaRegReg
Author(s):
Robert Hanisch, the IVOA Resource Registry Working Group, the NVO Metadata Working Group
Editor(s):
Robert Hanisch
DOI:
10.5479/ADS/bib/2007ivoa.spec.0302H

Abstract

An essential capability of the Virtual Observatory is a means for describing what data and computational facilities are available where, and once identified, how to use them. The data themselves have associated metadata (e.g., FITS keywords), and similarly we require metadata about data collections and data services so that VO users can easily find information of interest. Furthermore, such metadata are needed in order to manage distributed queries efficiently; if a user is interested in finding x-ray images there is no point in querying the HST archive, for example. In this document we suggest an architecture for resource and service metadata and describe the relationship of this architecture to emerging Web Services standards. We also define an initial set of metadata concepts.

Status of this document

This document has been produced by the Resource Registry Working Group.
It has been reviewed by IVOA Members and other interested parties, and has been endorsed by the IVOA Executive Committee as an IVOA Recommendation. It is a stable document and may be used as reference material or cited as a normative reference from another document. IVOA's role in making the Recommendation is to draw attention to the specification and to promote its widespread deployment. This enhances the functionality and interoperability inside the Astronomical Community.

.html .doc .pdf

SAMP

International Virtual Observatory Alliance

IVOA Documents

Simple Application Messaging Protocol
Version 1.3

IVOA Recommendation 11 April 2012

Interest/Working Group:
http://www.ivoa.net/twiki/bin/view/IVOA/IvoaApplications
Author(s):
M. Taylor, T. Boch, M. Fitzpatrick, A. Allan, J. Fay, L. Paioro, J. Taylor, D. Tody
Editor(s):
T. Boch, M. Fitzpatrick, M. Taylor
DOI:
10.5479/ADS/bib/2012ivoa.spec.1104T

Errata

No errata yet

Abstract

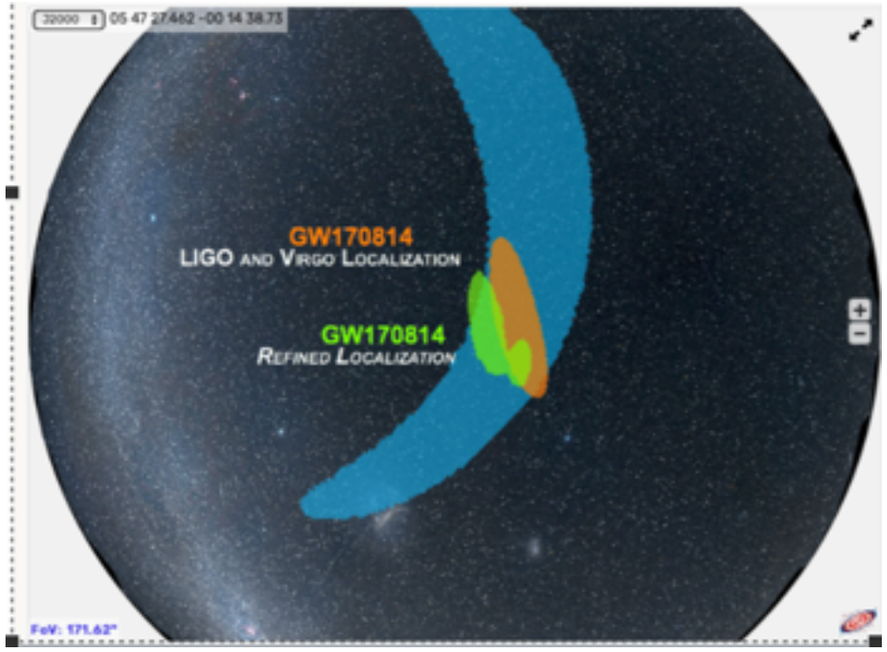
SAMP is a messaging protocol that enables astronomy software tools to interoperate and communicate. IVOA members have recognised that building a monolithic tool that attempts to fulfil all the requirements of all users is impractical, and it is a better use of our limited resources to enable individual tools to work together better. One element of this is defining common file formats for the exchange of data between different applications. Another important component is a messaging system that enables the applications to share data and take advantage of each other's functionality. SAMP supports communication between applications on the desktop and in web browsers, and is also intended to form a framework for more general messaging requirements.

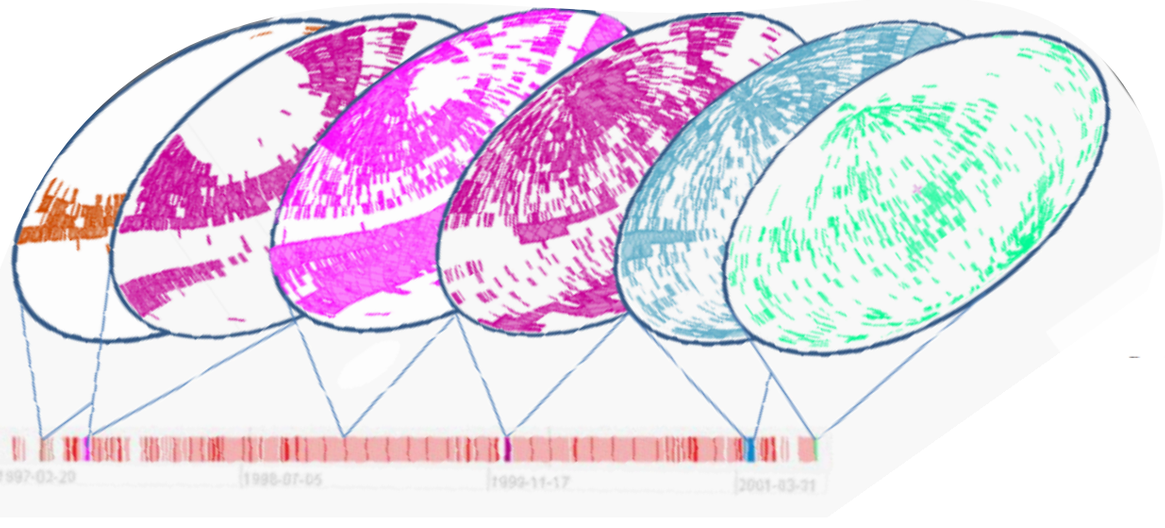
Status of this document

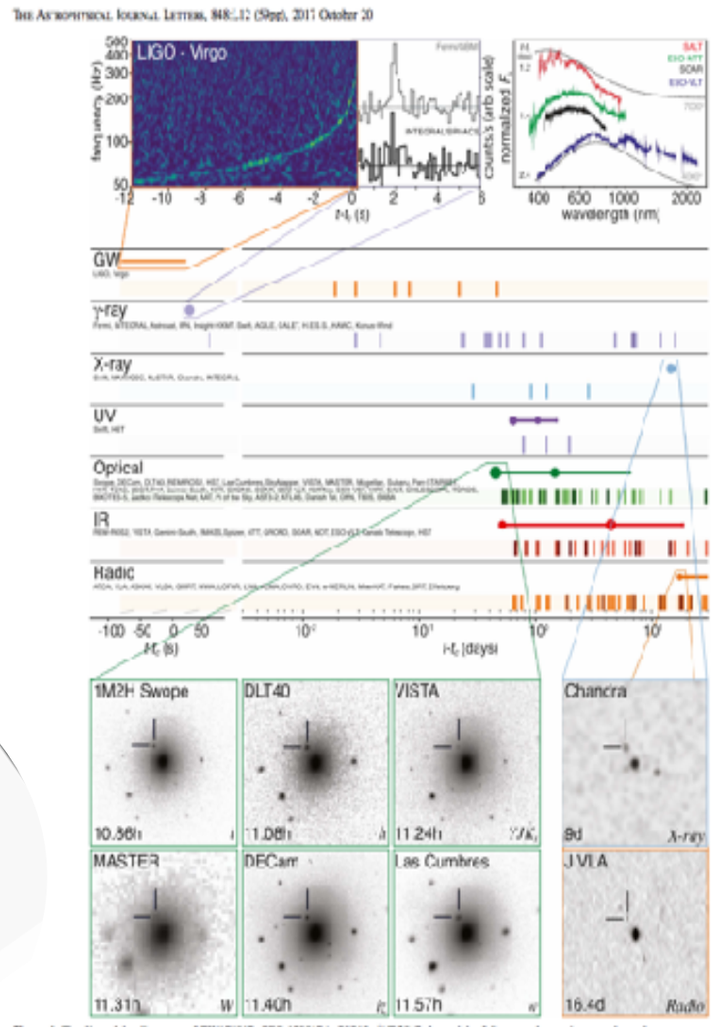
This document has been produced by the Applications Interest Group.
It has been reviewed by IVOA Members and other interested parties, and has been endorsed by the IVOA Executive Committee as an IVOA Recommendation. It is a stable document and may be used as reference material or cited as a normative reference from another document. IVOA's role in making the Recommendation is to draw attention to the specification and to promote its widespread deployment. This enhances the functionality and interoperability inside the Astronomical Community.

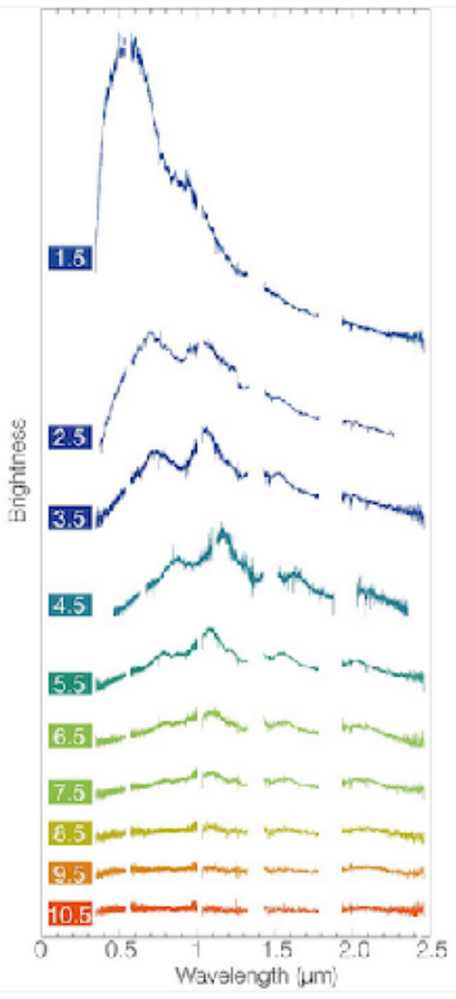
Available formats: PDF, HTML

In a multi-messenger landscape









Publishing your data in the VO

- https://wiki.ivoa.net/twiki/bin/view/IVOA/PublishingInTheVO
  - Check the Q&A section! How do I publish images? spectra? catalogues or generic data tables?

CSP Panel Session, IVOA Interoperability Virtual meeting, April 2022

Publishing your data in the VO

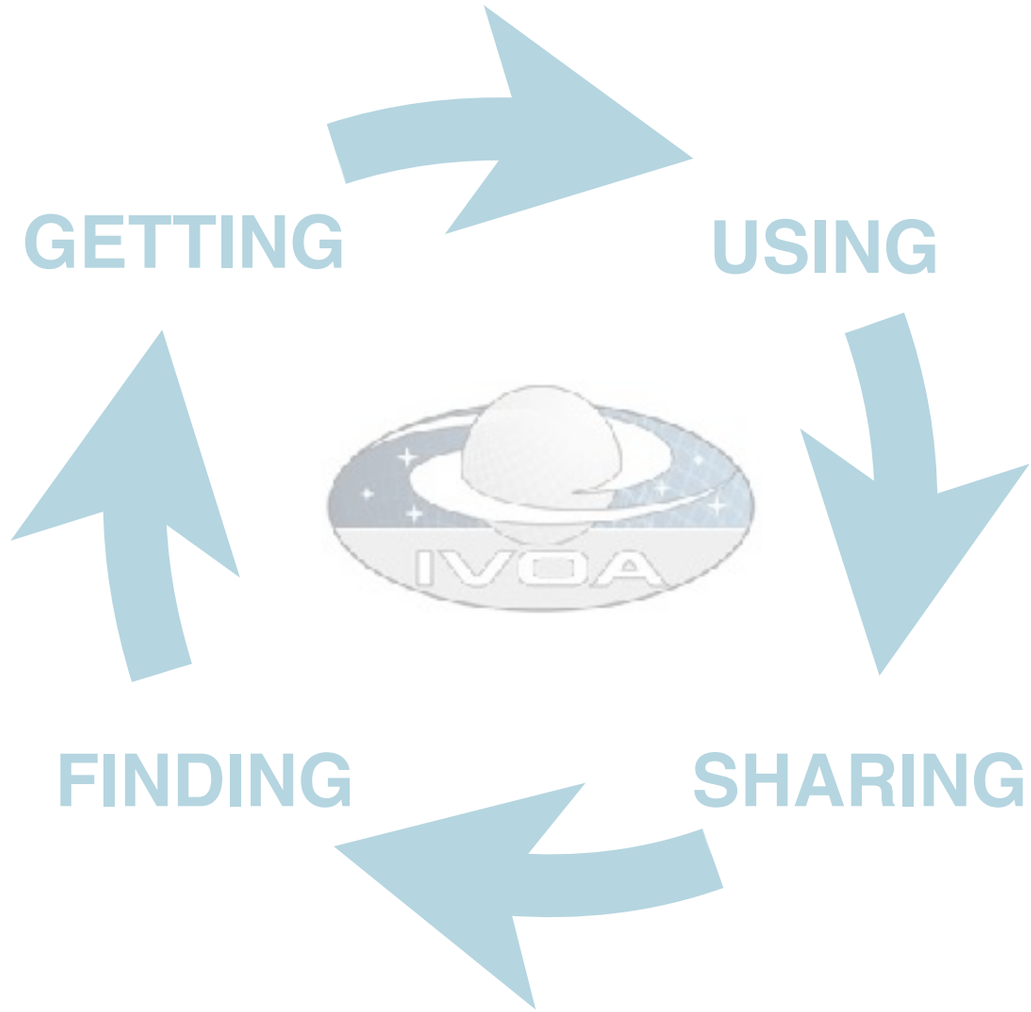
Tuesday April 26 - 15:00 UTC

Session minutes (this topic does not yet exist; you can create it)">Session minutes

Speaker	Title	Time	Materials
Ada Nebot	Summary of the Project Survey + Intro to the panel	10 + 2	
Dongwei Fan	LAMOST and the China Virtual Observatory	10 + 2	
Tamara Civera	Observatorio de Javalambre in Spain	10 + 2	
Alberto Micol	European Southern Observatory	10 +2	
Yan Grange	Netherlands Virtual Observatory	10 + 2	
All	Open discussion	30	

Summary

The IVOA standards are built to enable access, discovery and ultimately **interoperability**



The IVOA needs the community to participate!

Some useful links

- ivoa.net
- IVOA Docs : https://www.ivoa.net/documents/
- IVOA GitHub : https://github.com/ivoa
- IVOA mailing list : https://www.ivoa.net/members/index.html