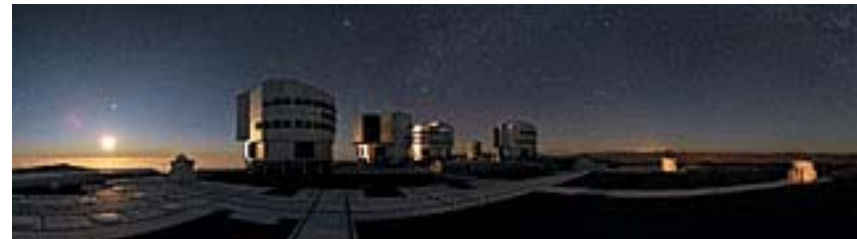
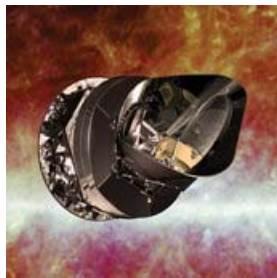


# FAIR Principles and the VO DADI Status

Françoise Genova

# Research infrastructures in astronomy



**And data!**

# The astronomical data infrastructure

- Includes
  - Observatory archives
  - Very large surveys
  - Value-added databases
  - Journals and the ADS bibliographic database
  - Long tail of data (results attached to publications)
  - Modeling results

# Early standards

- A long tradition of international collaboration to build telescopes and instruments
- Early work on standards by practitioners
  - Data format FITS (1977)
    - Integrates data & metadata
    - Enables sharing telescopic observations
    - Enables tool development
  - Bibcode (late 80's)
    - Identifies a bibliographic reference
    - Human readable
    - Long before DOIs!
    - Links between databases and journals

# Early data sharing

- Open science is currently a hot topic
- Astronomy has been a pioneer
  - CDS created in 1972 (remote access to IBM mainframe!)
  - FITS data format 1977
  - IUE (1978-1996) database – remotely accessible
  - Bibcode (publication ID) end of 90's
  - Networked on-line data & bibliographic services started 1993-94
  - VO concept ~2000, precursors beforehand

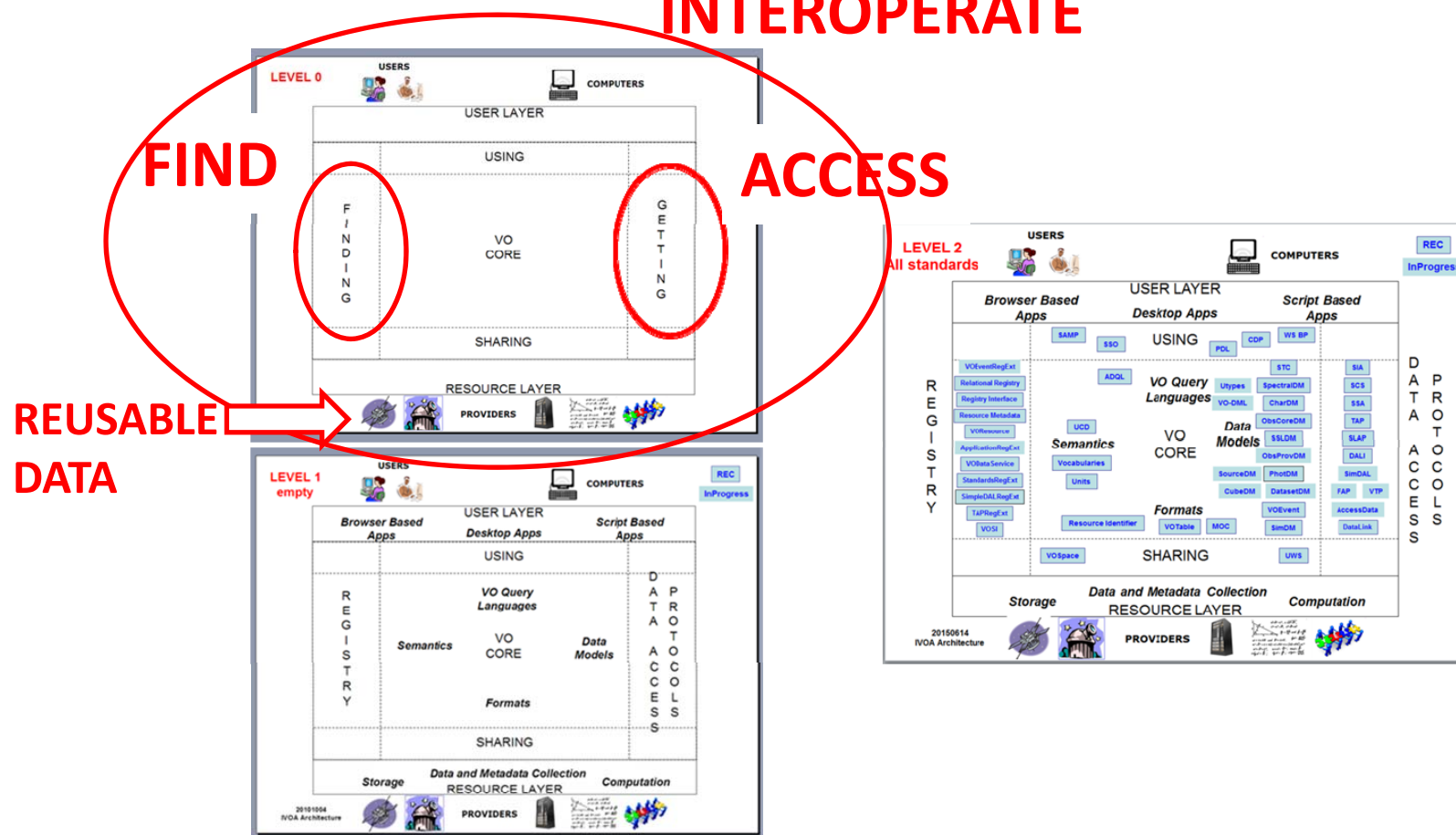
# The astronomical Virtual Observatory

- The astronomical interoperability framework
- Developed and maintained by the International Virtual Observatory Alliance
  - Created in 2002
  - Gathers national initiatives + Euro-VO + ESA
  - All continents represented
- IVOA oversees the development of interoperability standards
  - Thin interoperability layer on top of data holdings



# The VO architecture

INTEROPERATE



# Astronomical data is open and FAIR

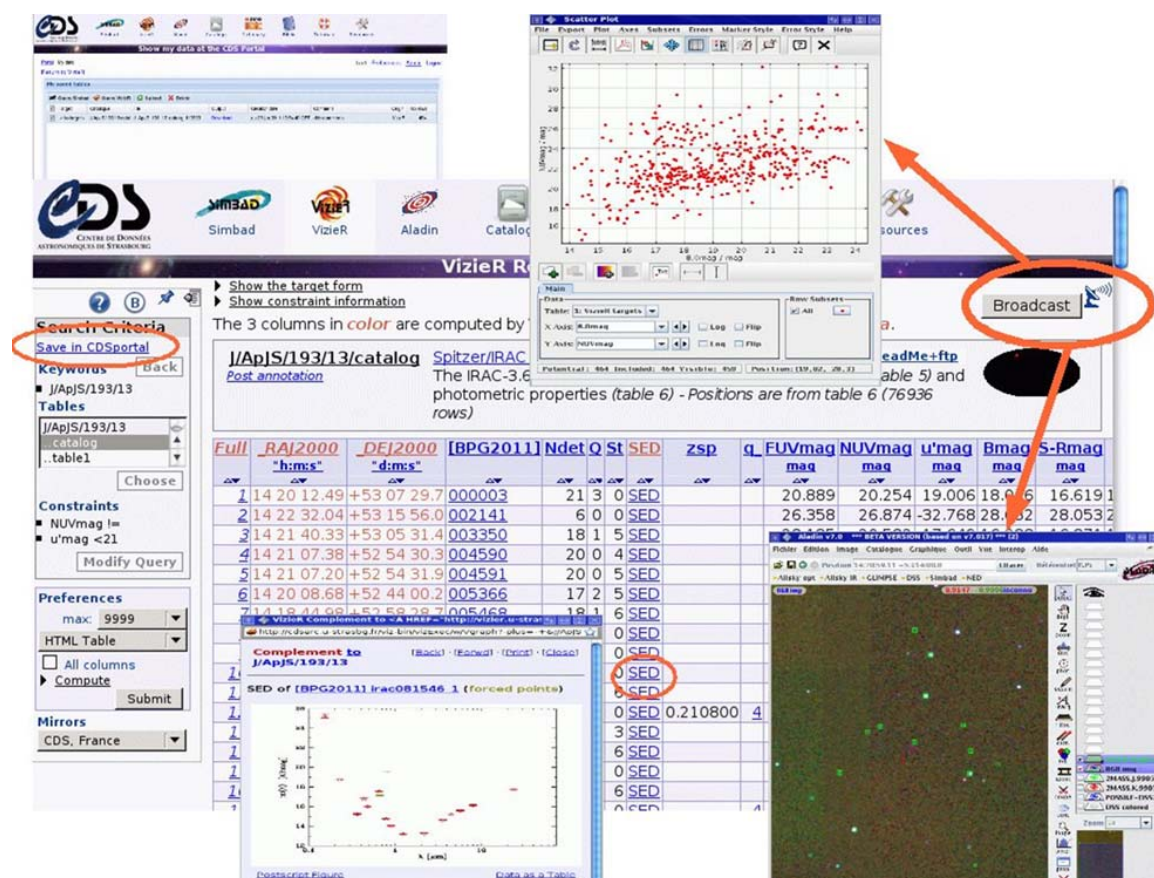
- Data providers
  - Reusable data (FITS)
  - In general short embargo period for observations
- VO developers
  - Framework to find, access, interoperate data
  - Interoperable tools (Applications WG)



# The astronomical Virtual Research Environement

- Open and inclusive
  - Anyone can register a resource
  - Anyone can develop an interoperable tool
- More than 100 authorities declared at least one resource in the IVOA Registry of Resources
  - Big players and smaller teams
- Operational and used

# Interoperable VO tools



# The astronomical Virtual Research Environement

- Open and inclusive
  - Anyone can register a resource
  - Anyone can develop an interoperable tool
- More than 100 authorities declared at least a resource in the IVOA Registry of Resources
  - Big players and smaller teams
- Operational and used
- The VO framework is reused

## ASTERICS WP4 DADI

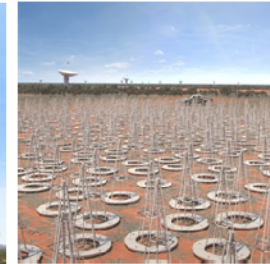
- Data Access, Discovery and interoperability
- Make the ESFRI and pathfinder project data available for discovery and usage by the whole astronomical community, interoperable in the VO, and accessible with a set of common tools
- Fully aligned with the current IVOA priorities
- Astronomy + astroparticle physics

# Projects involved in ASTERICS/DADI

ESO – Associate Partner ELT/VLT

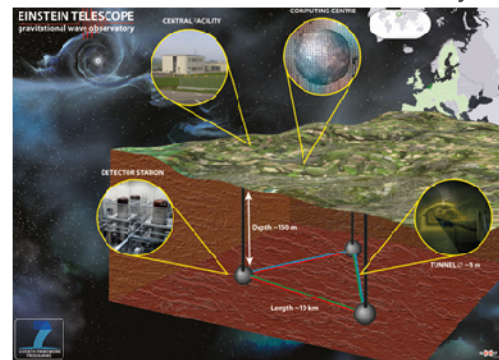
ESA – close collaboration – space requirements! (incl. Planetary sciences)

CTA

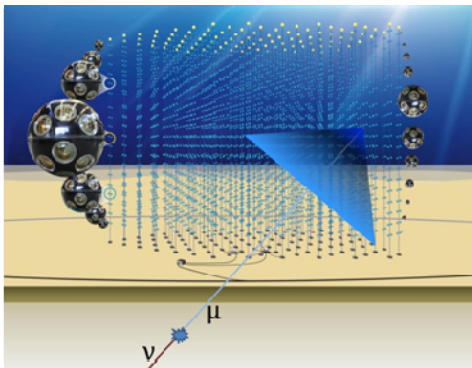


SKA

EGO/ET

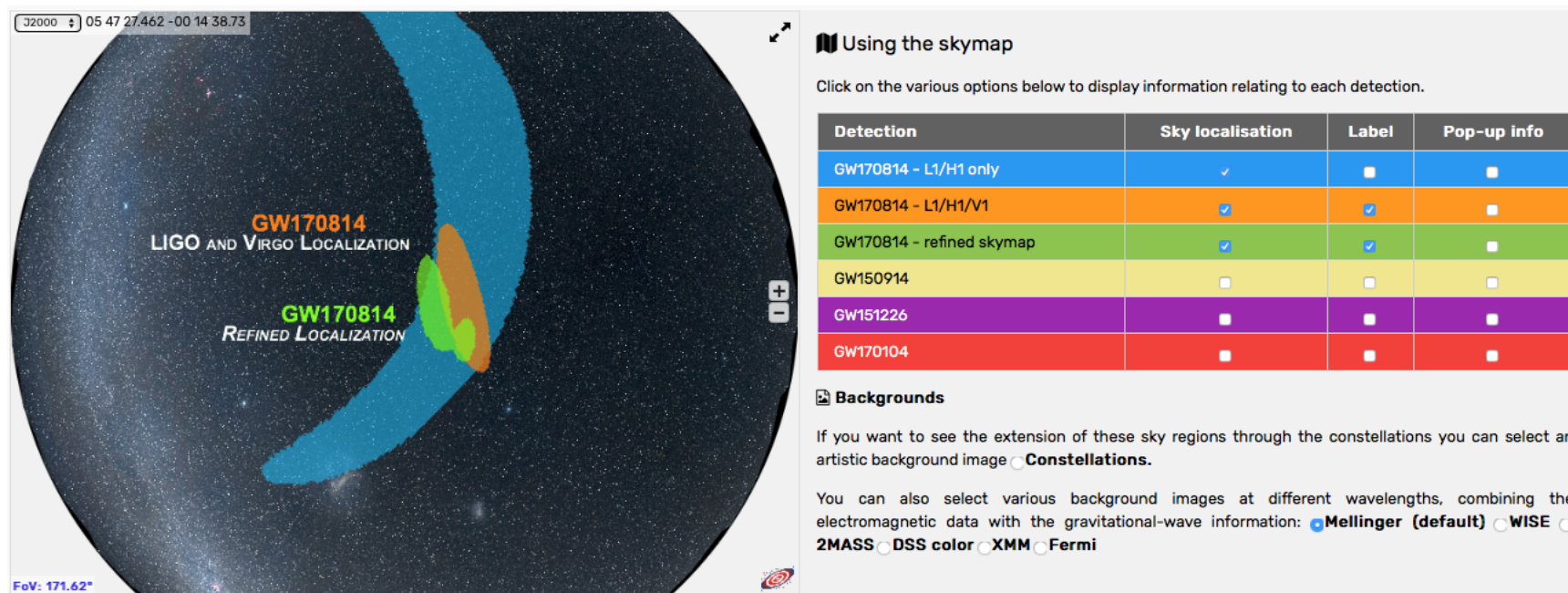


KM3Net





# An example of the results




## The VO is reused

- Starting point: Thin interoperability layer for astronomy
- Building blocks reused by data providers in the archival systems
- ASTERICS: Astrophysics/Astroparticle physics
- Standards and tools customized by planetary studies & the Virtual Atomic and Molecular Data Centre
- Registry customized by Material Sciences in a RDA Working Group

# Cross-disciplinary use

## VESPA data services

- A table describing each of the service files (using std parameters)
- Stored in postgresql + TAP-handling application at the institutes
- Searches through an optimized interface, connected to VO tools



Results in service titan

Show 10 entries

Column visibility Show all Hide all

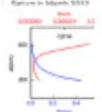
granule_id	dataprodukt_type	target_name	time_min	time_max	access_url
79N_R02_La001_profile_C042.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C042.txt
79N_R02_La001_profile_C08.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C08.txt
79N_R02_La001_profile_C08H.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C08H.txt
79N_R02_La001_profile_C08H.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C08H.txt
79N_R02_La001_profile_C082.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C082.txt
79N_R02_La001_profile_C085.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C085.txt
79N_R02_La001_profile_C082H.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C082H.txt
79N_R02_La001_profile_HCN.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_HCN.txt
79N_R02_La001_profile_C08H.q.votable	profile	Titan	2005-02-14T12:00:00.000	2005-02-14T12:00:00.000	79N_R02_La001_profile_C08H.txt

Plotting tools

- TSPCAT
- Aladin
- SPLAT
- CASPER

Example queries

Explains in tabular form



- Planetary sciences
  - EuroPlaNet/VESPA
  - IVOA IG
- Virtual Atomic and Molecular Data Centre  
VAMDC

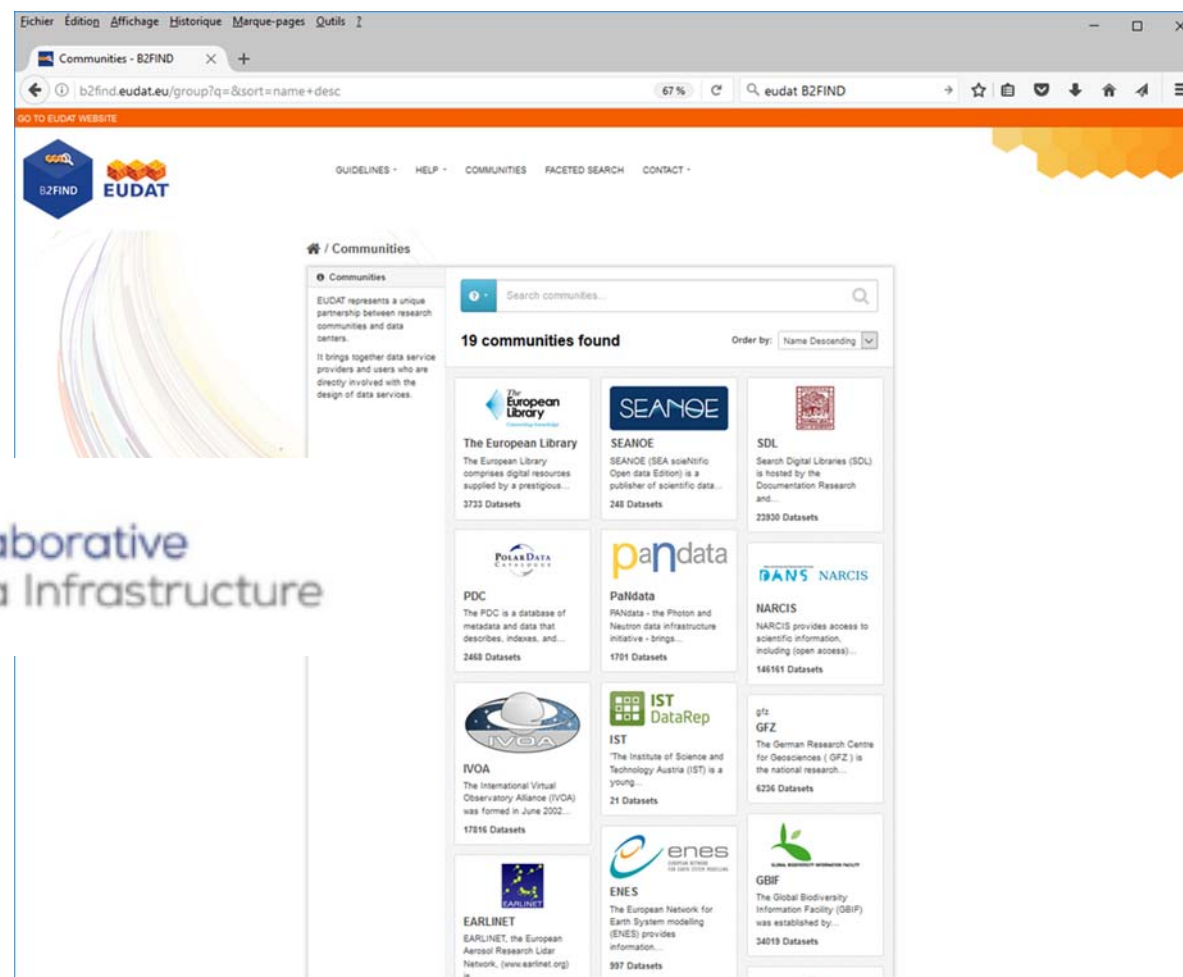


## Key building blocks for disciplinary reuse

- Registry of resources
  - OAI-PMH
  - Dublin Core with disciplinary extensions
- Vocabularies: W3C SKOS-RDF

# RELATIONSHIP WITH GENERIC INITIATIVES

# IVOA in EUDAT B2FIND Registry



The screenshot shows the EUDAT B2FIND website interface. The browser address bar displays 'b2find.eudat.eu/group?q=&sort=name+desc'. The page features a navigation bar with links for GUIDELINES, HELP, COMMUNITIES, FACETED SEARCH, and CONTACT. A sidebar on the left contains the EUDAT logo and a description of the infrastructure. The main content area, titled 'Communities', lists 19 communities found, sorted by Name Descending. The communities are displayed in a grid format, each with a logo, name, and dataset count. The IVOA community is highlighted in the grid.

Community	Description	Datasets
The European Library	The European Library comprises digital resources supplied by a prestigious...	3733 Datasets
SEANOE	SEANOE (SEA scientific Open data Edition) is a publisher of scientific data...	248 Datasets
SDL	Search Digital Libraries (SDL) is hosted by the Documentation Research and...	23930 Datasets
POLAR DATA	PDC is a database of metadata and data that describes, indexes, and...	2468 Datasets
pandata	PANdata - the Photon and Neutron data infrastructure initiative - brings...	1701 Datasets
DANS NARCIS	NARCIS provides access to scientific information, including (open access)...	146161 Datasets
IST DataRep	The Institute of Science and Technology Austria (IST) is a young...	21 Datasets
GFZ	The German Research Centre for Geosciences (GFZ) is the national research...	6236 Datasets
ENES	The European Network for Earth System modelling (ENES) provides information...	397 Datasets
GBIF	The Global Biodiversity Information Facility (GBIF) was established by...	34019 Datasets
IVOA	The International Virtual Observatory Alliance (IVOA) was formed in June 2002...	17816 Datasets
EARLINET	EARLINET, the European Aerosol Research Lidar Network, (www.earlinet.org) is...	

# IVOA is a WDS Network member



Network Members — Wor... X +

www.icsu-wds.org/community/membership/community/membership/network-mx 120% Rechercher

Member Name	Field(s)	LoA <sup>†</sup>
International VLBI Service for Geodesy and Astrometry	Space sciences Earth sciences Geodesy, Astrometry	Yes
International Laser Ranging Service	Space sciences Earth sciences Physics Geodesy, Space Geodesy	Yes
International GNSS Service	Space sciences Earth sciences Geodesy, GPS, GNSS, Precise positioning, navigation, and timing	Pending
International Virtual Observatory Alliance (IVOA)	Astronomy	Yes
International Oceanographic Data and Information Exchange (IODE)	Earth sciences Oceanography	Yes
NASA ESDIS Project	Earth sciences Physics Geography Computer sciences Mathematics Systems science Engineering Environmental studies and forestry	Yes
International Space Environment Service (ISES)	Earth sciences Space sciences Space weather, Solar-Terrestrial physics	Yes
CLARIN ERIC	Cultural and ethnic studies Political science Psychology Sociology Statistics History Languages and linguistics	Pending

> WDS Members' Forum  
 > SolDataCon Conference  
 > Data Stewardship Award  
 > Promotion

f g+ in t v

# IVOA gateways to RDA

- FG co-chair of RDA Technical Advisory Board
- Lessons learnt from building the IVOA are taken into account
- Staff from several IVOA national initiatives participate actively

Certification, Long Tail of Data, Provenance, Dynamic Data Citation, Federated Identity Management, Research Data Repository Interoperability, Repository Platforms for Research Data, Units of Measures

- Participation in ENVRI-RDA Summer School (MM)
- Disciplinary Collaboration Framework IG (D. Schade)
- Discussion of RDA status and activities at each IVOA meeting



# DADI STATUS

<https://www.asterics2020.eu/dokuwiki/doku.php?id=open:wp4:start>

## 2017 Deliverables

- Third Technology Forum, 22-23 March, Strasbourg
- Third School, 14-16 November, Madrid
- This ESFRI Forum & Training Event
- Repository of DADI Products

## 2017 Milestones and RDA

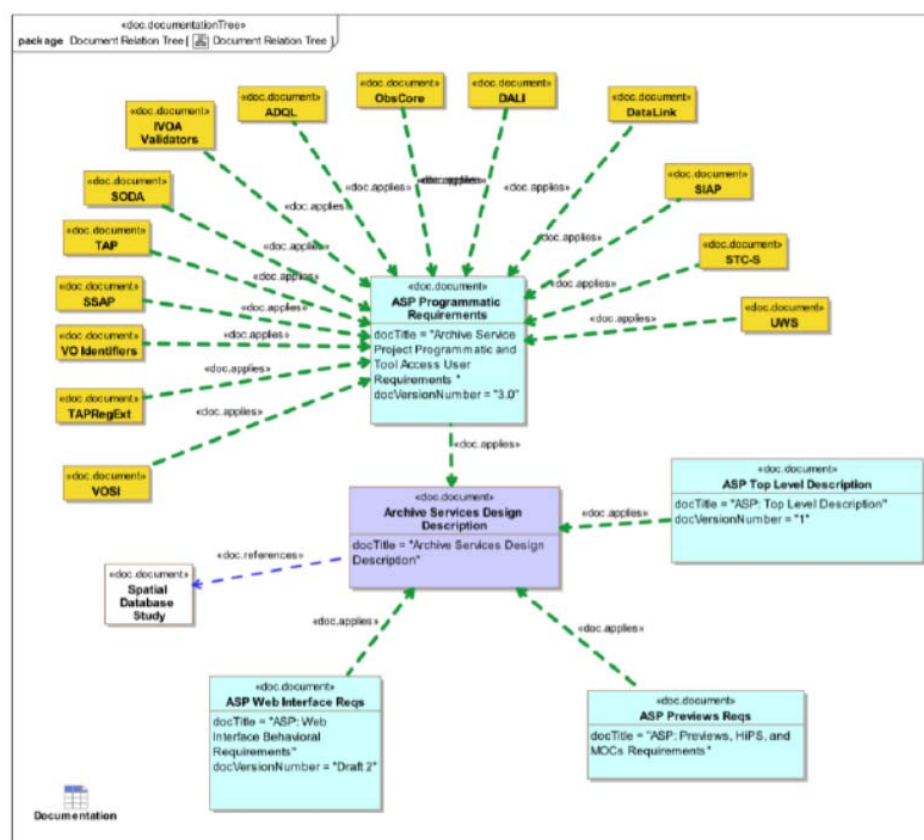
- Two IVOA Interoperability meetings
  - 14-19 May, Shanghai
  - 27-29 October, Santiago (+ADASS)
- Two RDA Plenary meetings
  - P9 Barcelona, 5-7 April
  - P10 Montreal, 19-21 September



# Specific meetings

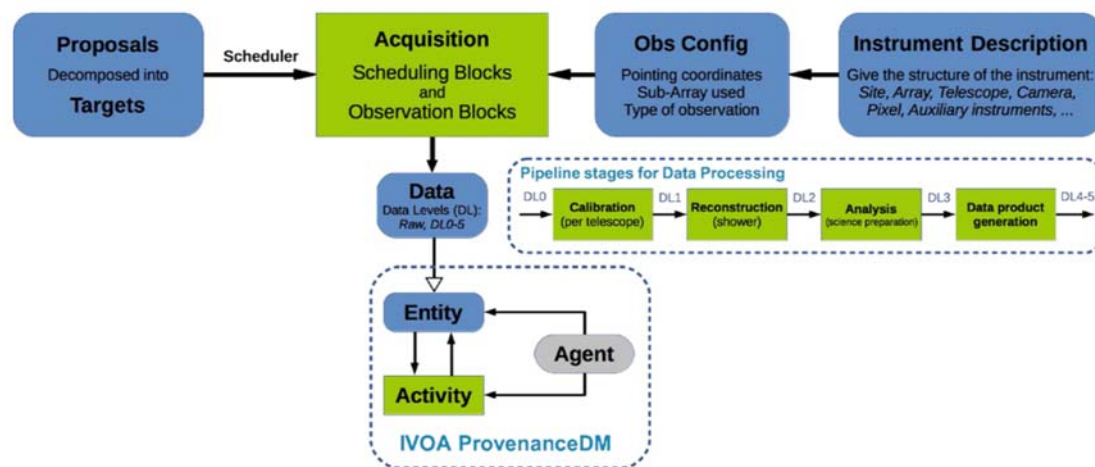
- SVO School, 6-8 March, La Palma
- DADI-CLEOPATRA Time Domain meeting, 21 March, Strasbourg
- Provenance Day, 3-4 May, Montpellier
- GAPS Time Series face-to-face, 22 June 2017, Padova
- Third Cosmology School, Cracow, 10-23 July
- Observatoire Virtuel 2017 @ OCA, 26-27 September, Nice
- Time Series Data Meeting, 5-6 December, Strasbourg

# VO standards in ESO plans



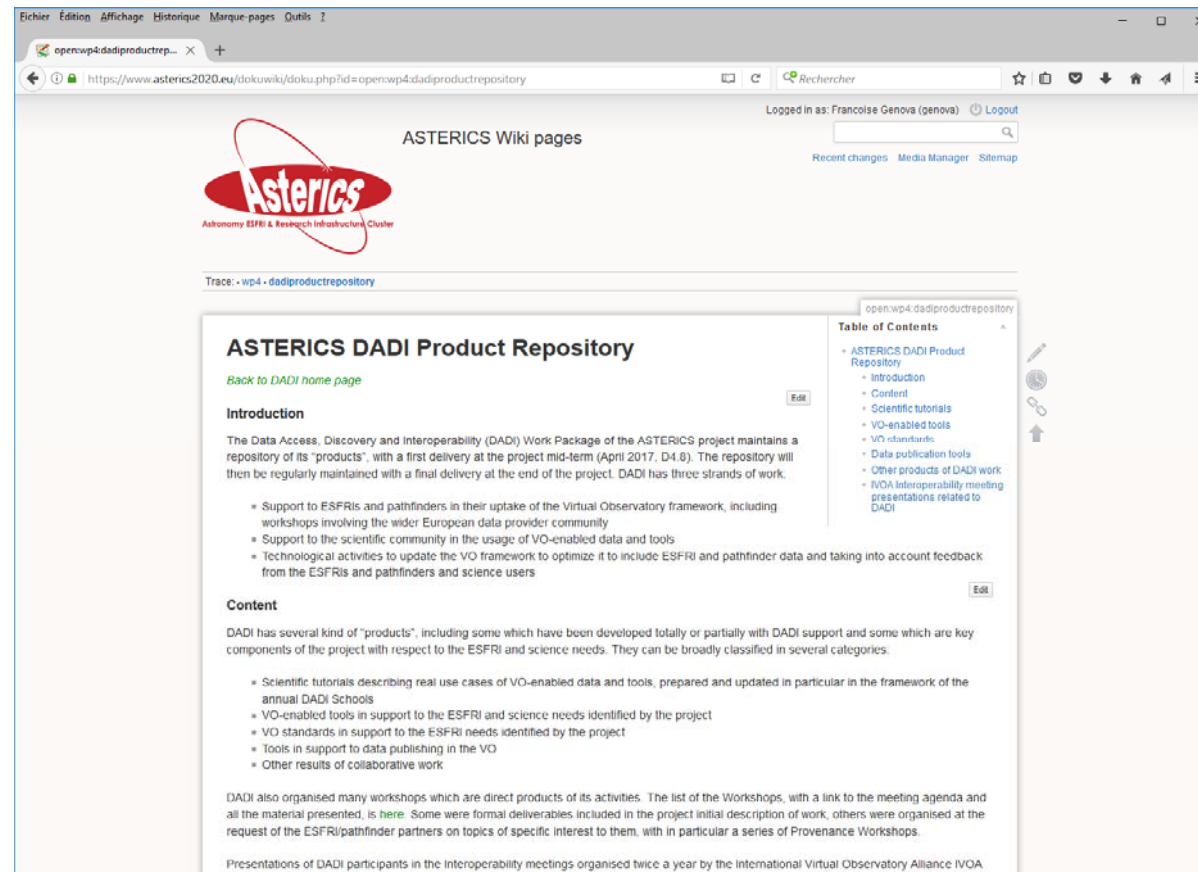
# ... and in CTA pipeline

## Acquisition and Data Processing



## D4.8 Repository of DADI « products »

A living  
document



The screenshot shows a web browser window displaying the ASTERICS Wiki pages. The page title is "ASTERICS DADI Product Repository". It includes a "Table of Contents" on the right side with links to "Introduction", "Content", "Scientific tutorials", "VO-enabled tools", "VO standards", "Data publication tools", and "Other products of DADI work". The main content area has sections for "Introduction" and "Content". The "Introduction" section states that the repository maintains a collection of "products" and lists three strands of work: support to ESFRIs and pathfinders, support to the scientific community, and technological activities to update the VO framework. The "Content" section lists various types of products, including scientific tutorials, VO-enabled tools, VO standards, and tools for data publishing. The page also mentions that DADI has organized many workshops and that the repository includes material from these workshops.

## Next year

- Fourth Technology Forum, March?, Edinburgh
- Data Providers Forum & Training Event, 27-28 June, Heidelberg
- Fourth School, November?, Strasbourg

# DADI Impact

- The ESFRIs and pathfinders become consumers AND actors of the VO
- High impact on the IVOA standards, tools and topics (requirements/feedback/effort/expertise), among which
  - Milestone reached with the completion of the Multi-D standards
  - Key role also on leadership & activity in the Time Domain
  - Impact of the Education activities & leadership
- Good relationship with RDA from its beginning
- Ready to highlight impact at IAU & in the ASTERICS Integration Event