Virtual European Solar & Planetary Access (VESPA)

Providing access to Solar System & heliophysics data

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VESPA ASTRO-CC workshop 2026

25-27 mars 2026

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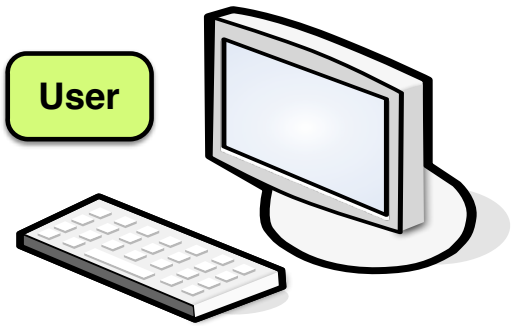
Science users, but also
education / outreach
=> FAIR access

Scope:
- Planetary Science
- Heliophysics
- Exoplanets

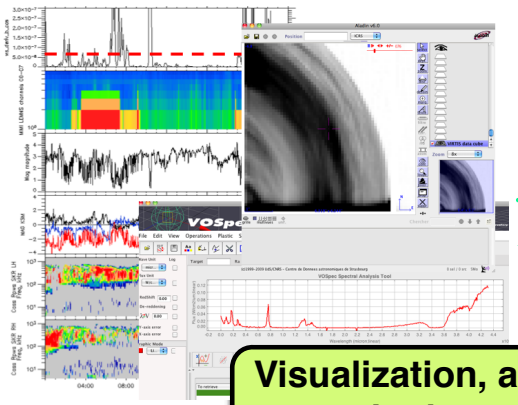
Research teams, institutes
EU projects
=> Open Science



Queries

Answers

Data access



Data exchange

Visualization, analysis and other tools

Catalogue / Registry

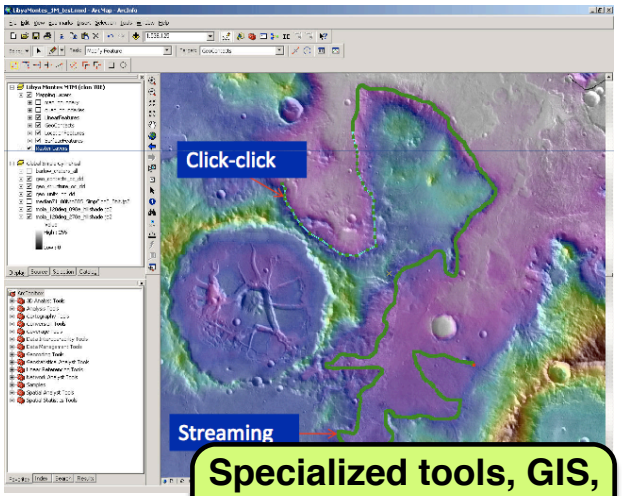
Rosetta
SSHADE
PSA
AMDA…
PVOL
PDS

Data bases

Space agency archives
Telescope archives

Publication

Data providers



Specialized tools, GIS, Mass processing…

What VESPA provides to the community

1- A vocabulary to describe physical & observational parameters making sense to researchers:

EPNCore metadata

Very broad scope: surfaces, atmospheres, small bodies, magnetospheres, heliophysics

2- A user interface to search data based on science-relevant parameters:

VESPA portal (other access modes are available)

3- Data services provided by VESPA participants and other teams:

Currently 95 data services open (much more in progress) and ~70 planetary HiPS

+ New or updated data infrastructures: SSHADE, PVOL, AMDA, MASER

4- Connection / adaptation of powerful display and analysis tools:

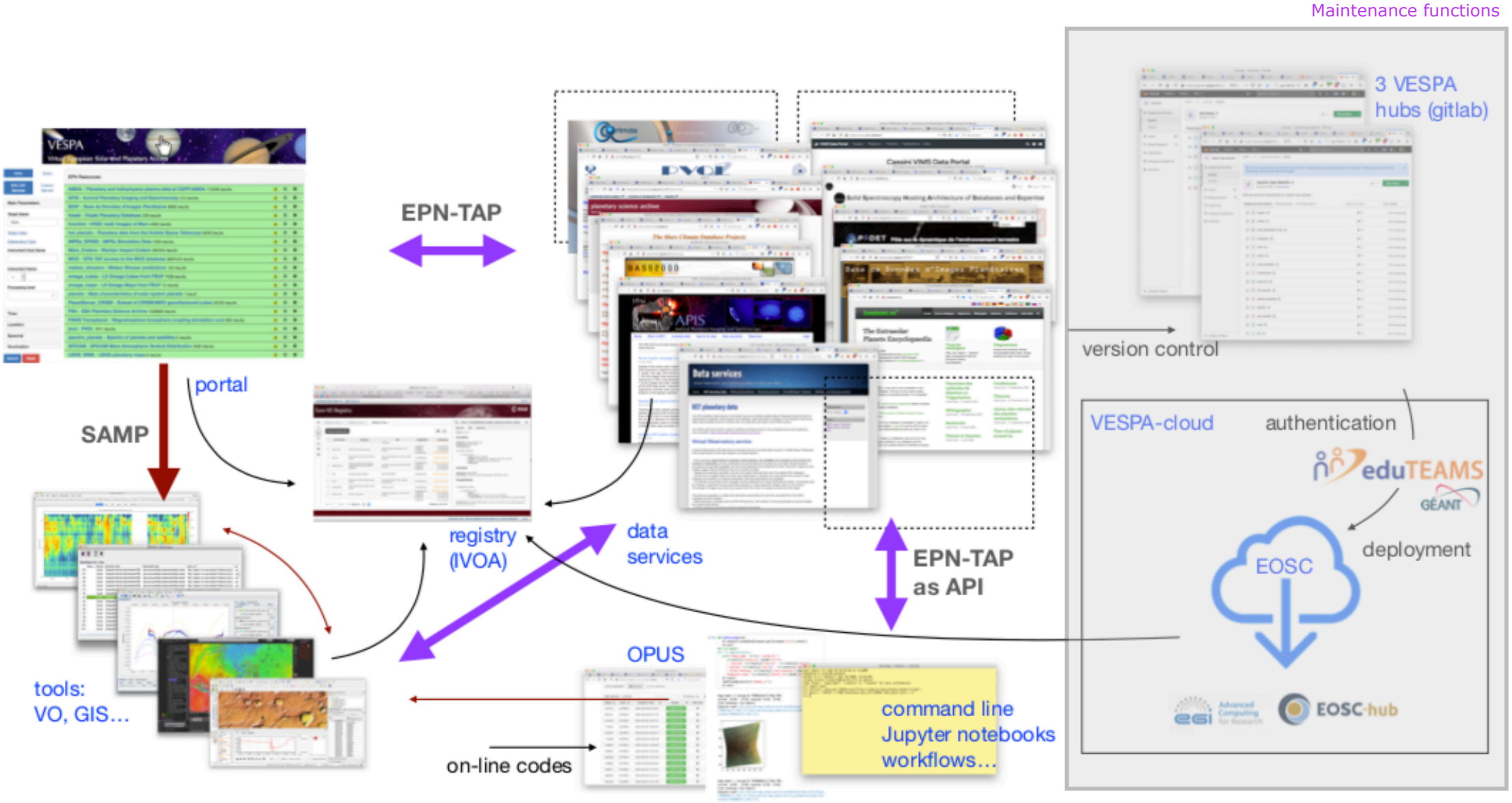
Tools from astronomy (VO, with planetary science updates) **+ GIS** and others + Jupyter notebooks

=> Contributive, interoperable, Open Science system, providing FAIR access to the data

This data system is available for - users *to access* data

- science teams *to distribute* data

VESPA: infrastructure



VESPA service (as seen in the portal)

A table providing description of each file / data element

Describing parameters

Data elements

Results in service apis

Show 10 entries

Column visibility | Show all | Hide all

granule_uid	dataproduct_type	target_name	time_min	time_max	access_url	granule_gid	obs_id	ta
o4bd01ycq_cyl_pdf	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_cyl.pdf	cylindric_proj	o4bd01ycq	pl
o4bd01ycq_pol_n_pdf	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_pol_n.pdf	polar_proj_north	o4bd01ycq	pl
o4bd01ycq_pol_s_pdf	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_pol_s.pdf	polar_proj_south	o4bd01ycq	pl
o4bd01ycq_proc	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_proc.fits	processed_data	o4bd01ycq	pl
o4bd01ycq_proc_pdf	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_proc.pdf	processed_data	o4bd01ycq	pl
o4bd01ycq_x2d	image	Saturn	1997-10-11T03:53:03.524	1997-10-11T04:09:43.724	o4bd01ycq_x2d.fits	original_data	o4bd01ycq	pl
o4bd01yeq_cyl_pdf	image	Saturn	1997-10-11T04:15:43.524	1997-10-11T04:28:37.134	o4bd01yeq_cyl.pdf	cylindric_proj	o4bd01yeq	pl
o4bd01yeq_pol_n_pdf	image	Saturn	1997-10-11T04:15:43.524	1997-10-11T04:28:37.134	o4bd01yeq_pol_n.pdf	polar_proj_north	o4bd01yeq	pl
o4bd01yeq_pol_s_pdf	image	Saturn	1997-10-11T04:15:43.524	1997-10-11T04:28:37.134	o4bd01yeq_pol_s.pdf	polar_proj_south	o4bd01yeq	pl
o4bd01yeq_proc	image	Saturn	1997-10-11T04:15:43.524	1997-10-11T04:28:37.134	o4bd01yeq_proc.fits	processed_data	o4bd01yeq	pl

Showing 1 to 10 of 15,506 entries

Plotting tools

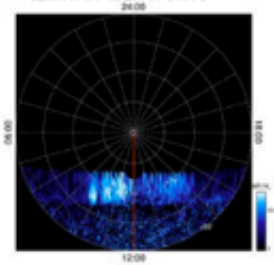
TOPCAT

Aladin

SPLAT

CASSIS

Example queries



Example EPN-TAP request:

Typical for surfaces (assuming all data are correctly described)**:**

Mars, a given region (Tharsis volcanoes area)

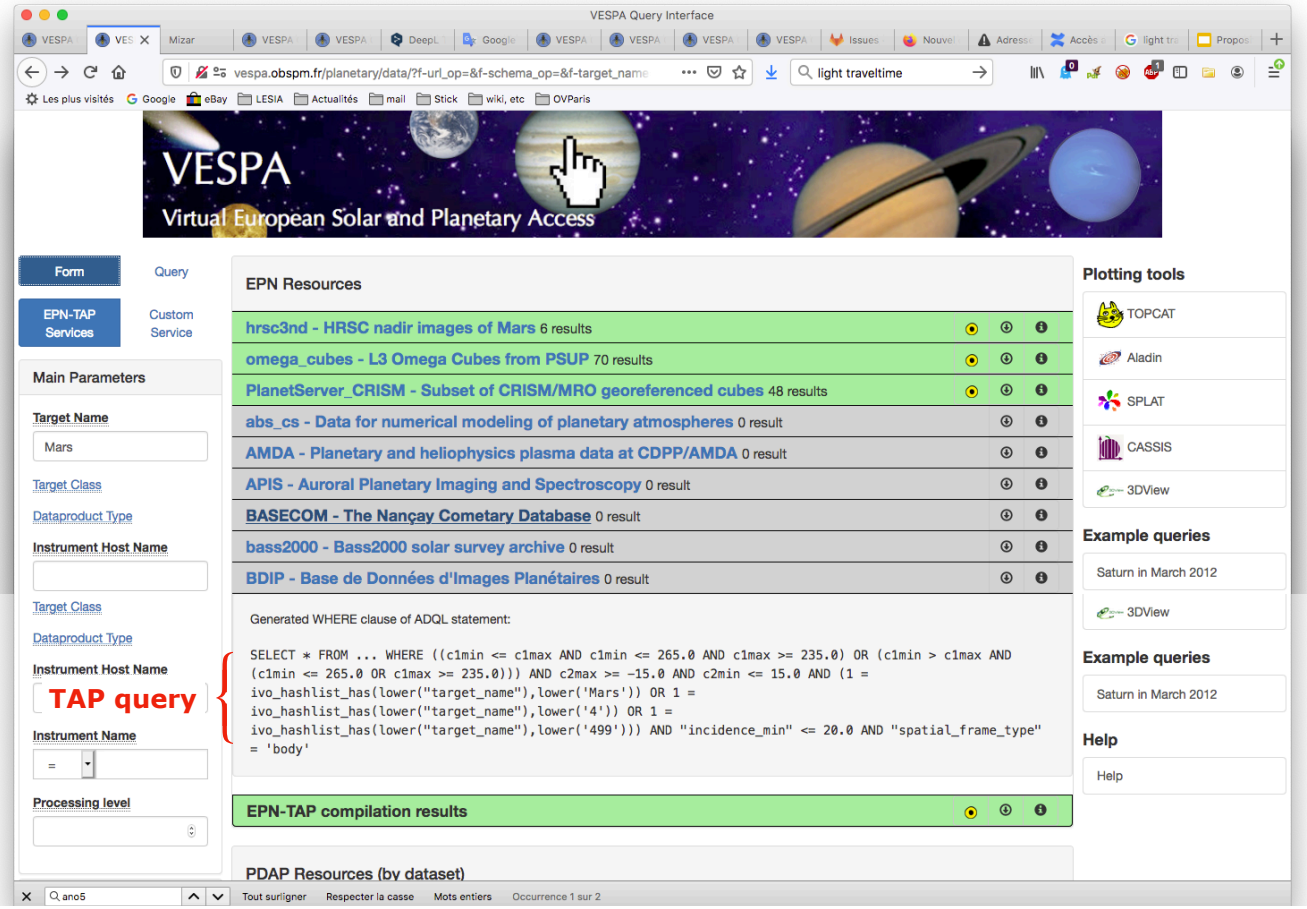
Illumination conditions (i ≤ 20° / phase)

Local time or season, etc

Results from all services
=> need to be described at similar level

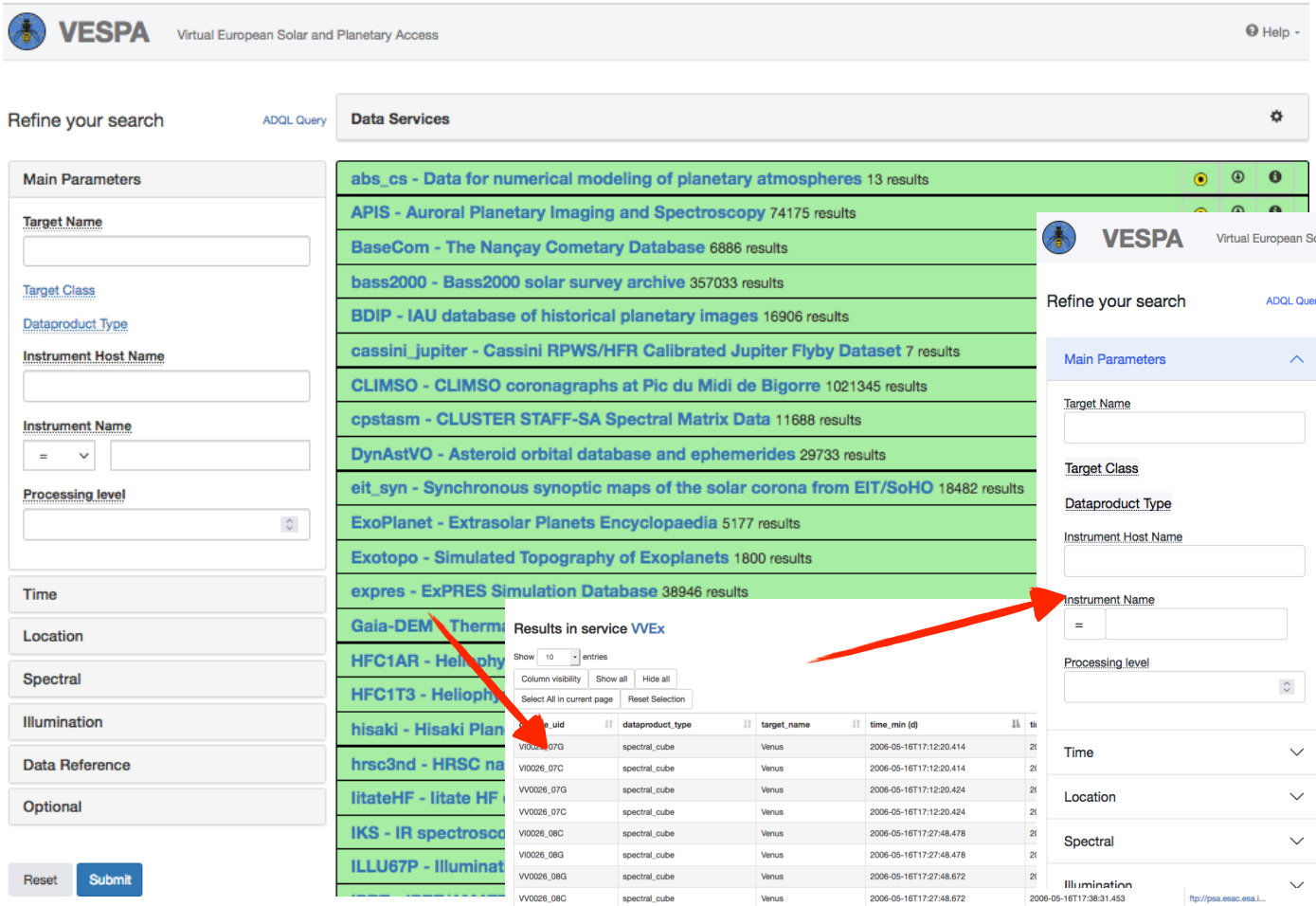
Footprints can be sent to plotting tools
from the portal

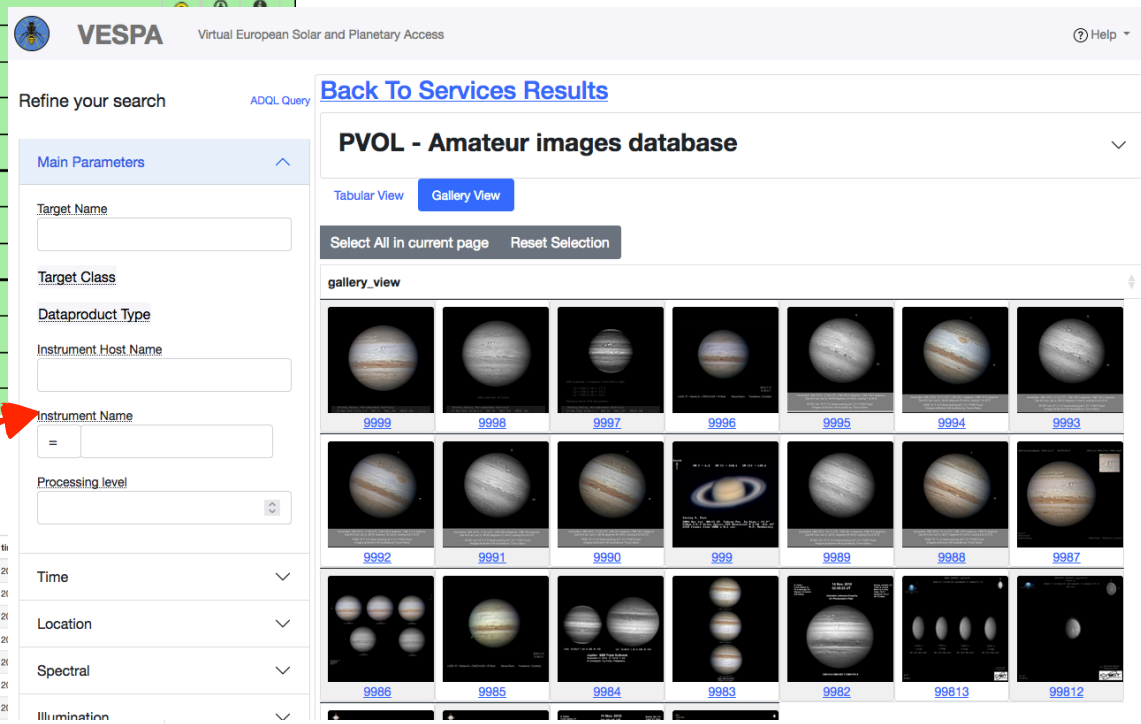
https://vespa.obspm.fr



VESPA portal

Redesigned from UX analysis





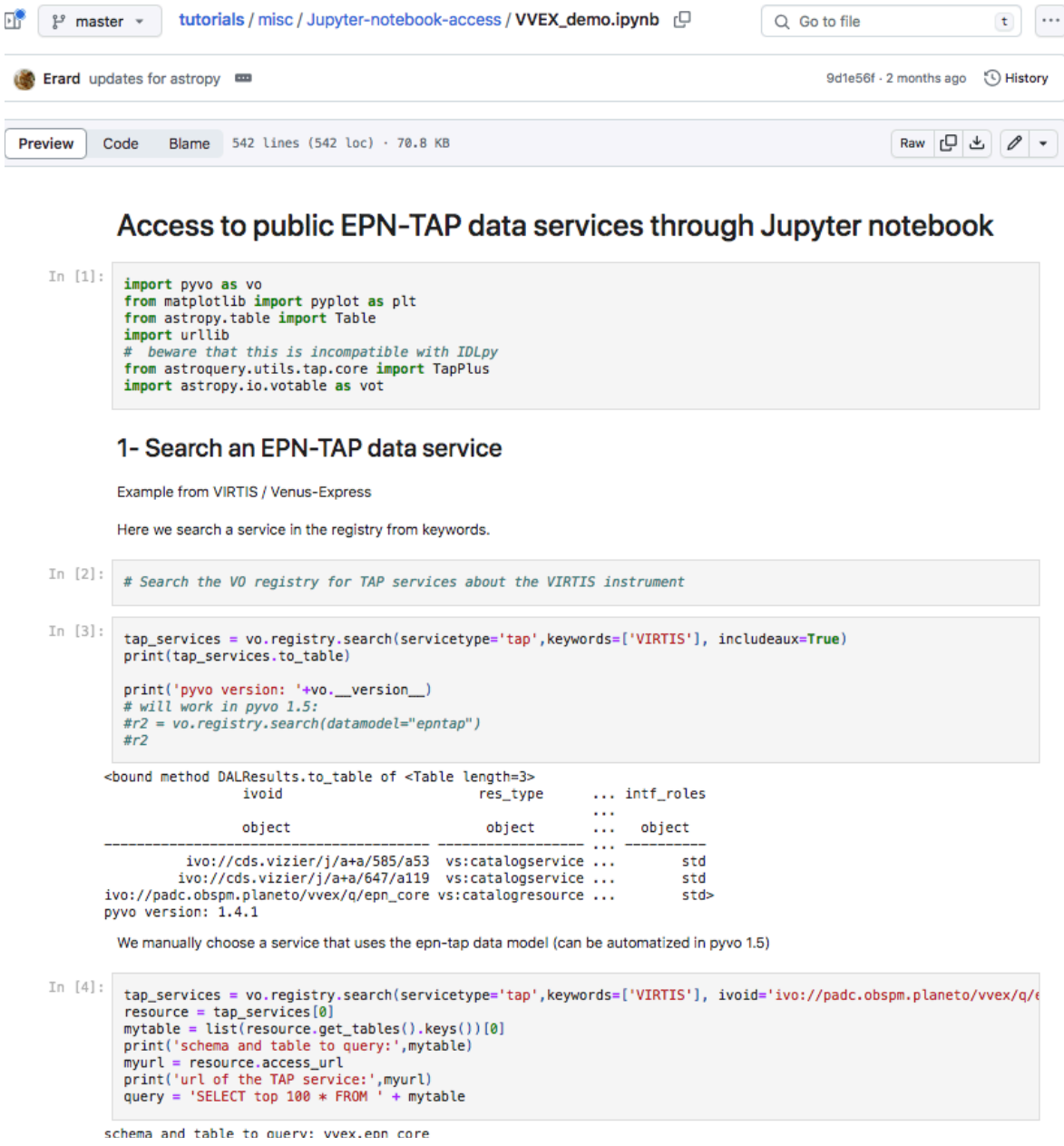
Alternative access:

VESPA portal: Queries all services, discovery tool

VO tools (internal clients)

Other TAP web clients (taphandle, etc)

Jupyter notebook, command line (python libs)



master tutorials / misc / Jupyter-notebook-access / VVEX_demo.ipynb

Go to file t

Erard updates for astropy

9d1e56f · 2 months ago History

Preview Code Blame 542 lines (542 loc) · 70.8 KB Raw

Access to public EPN-TAP data services through Jupyter notebook

In [1]:
```
import pyvo as vo
from matplotlib import pyplot as plt
from astropy.table import Table
import urllib
#  beware that this is incompatible with IDLpy
from astroquery.utils.tap.core import TapPlus
import astropy.io.votable as vot
```

1- Search an EPN-TAP data service

Example from VIRTIS / Venus-Express

Here we search a service in the registry from keywords.

In [2]:
```
# Search the VO registry for TAP services about the VIRTIS instrument
```

In [3]:
```
tap_services = vo.registry.search(servicetype='tap',keywords=['VIRTIS'], includeaux=True)
print(tap_services.to_table)

print('pyvo version: '+vo.__version__)
# will work in pyvo 1.5:
#r2 = vo.registry.search(datamodel="epntap")
#r2
```

```
<bound method DALResults.to_table of <Table length=3>
                ivoid                        res_type      ... intf_roles
                                                           ...
                object                        object       ...   object
---------------------------------------- ------------------ ... ----------
         ivo://cds.vizier/j/a+a/585/a53  vs:catalogservice ...        std
        ivo://cds.vizier/j/a+a/647/a119  vs:catalogservice ...        std
ivo://padc.obspm.planeto/vvex/q/epn_core vs:catalogresource ...        std>
pyvo version: 1.4.1
```

We manually choose a service that uses the epn-tap data model (can be automatized in pyvo 1.5)

In [4]:
```
tap_services = vo.registry.search(servicetype='tap',keywords=['VIRTIS'], ivoid='ivo://padc.obspm.planeto/vvex/q/e
resource = tap_services[0]
mytable = list(resource.get_tables().keys())[0]
print('schema and table to query:',mytable)
myurl = resource.access_url
print('url of the TAP service:',myurl)
query = 'SELECT top 100 * FROM ' + mytable
```

```
schema and table to query: vvex.epn_core
```

Main portal: https://vespa.obspm.fr/

Geoportal: https://padc-findme.obspm.fr

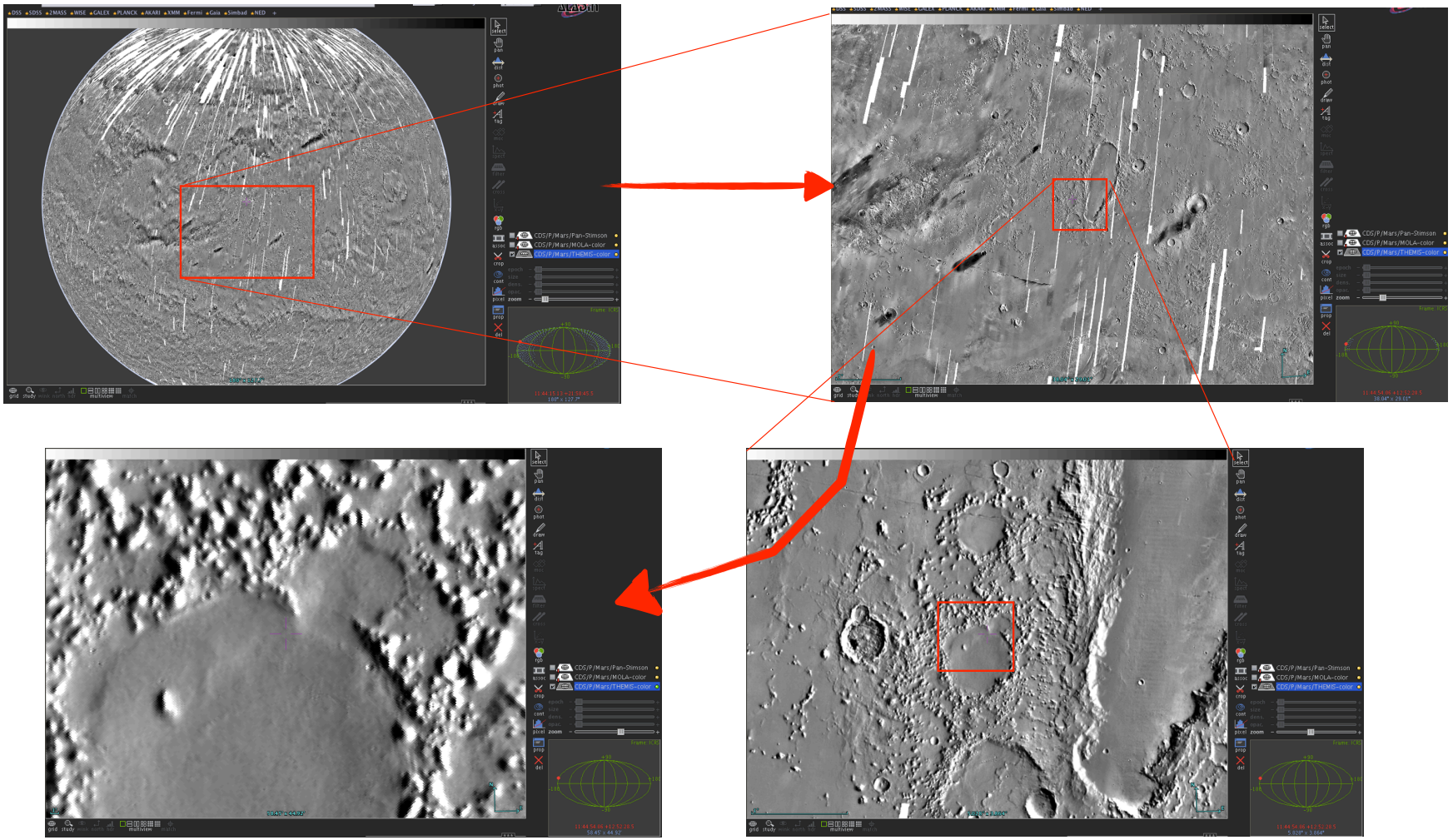
Tutorials: https://github.com/epn-vespa/tutorials

Web site: http://www.europlanet-vespa.eu/

Intermission: Using VO tools in practical Planetary Science situations

VESPA and VO tools: images and maps

Multiresolution maps (**HiPS**) in Aladin



http://aladin.u-strasbg.fr/AladinLite/doc/API/examples/mars-visualisation/

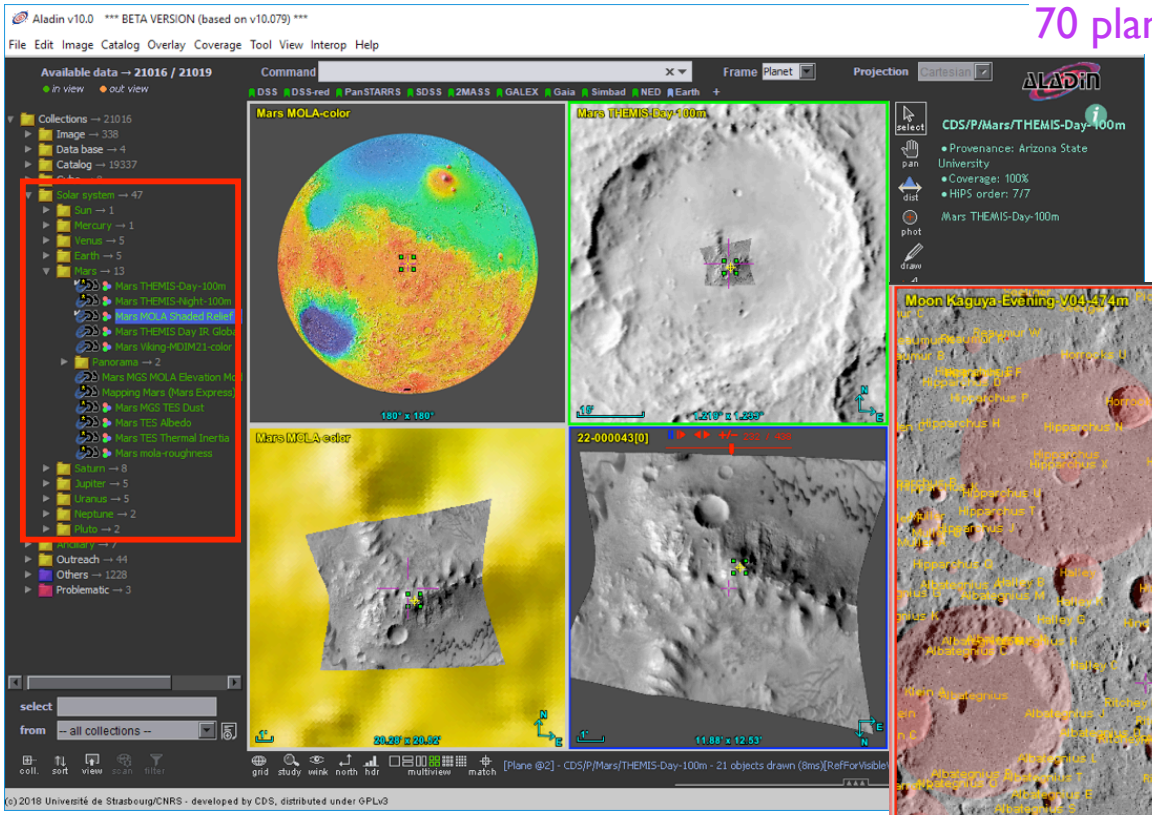
Currently 68 planetary HiPS available for use (from USGS maps and more)

VESPA and VO tools: overplotting elements

Aladin (CDS/CNRS):

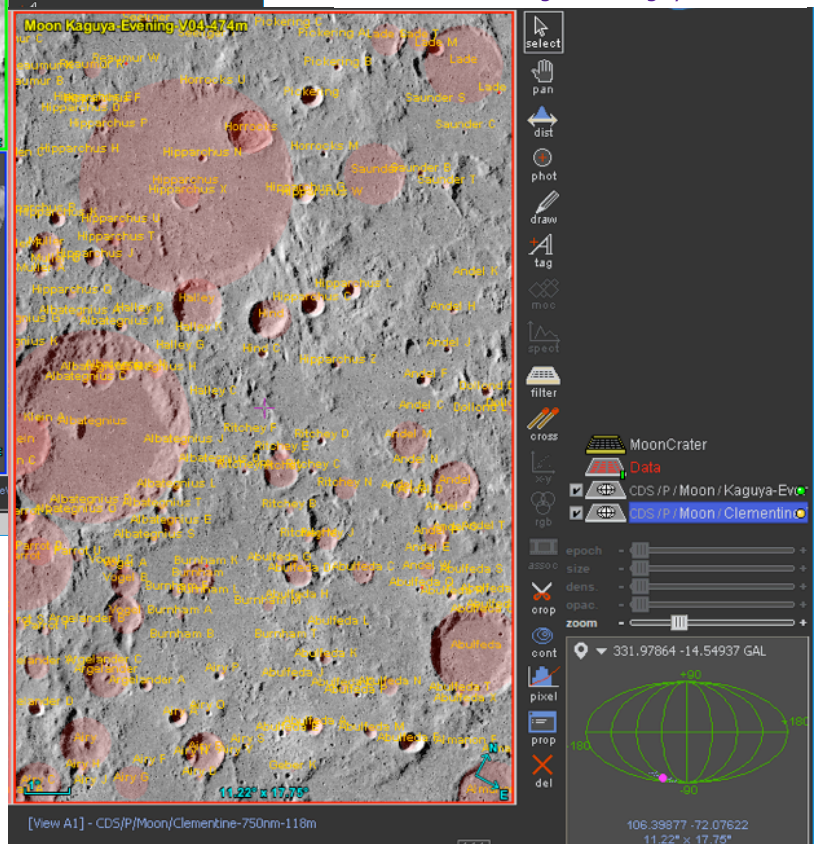
Georeferenced images + objects superpositions

70 planetary HiPS (USGS maps and more)



CRISM cubes on MOLA HiPS

Lunar crater catalogue on Kaguya HiPS



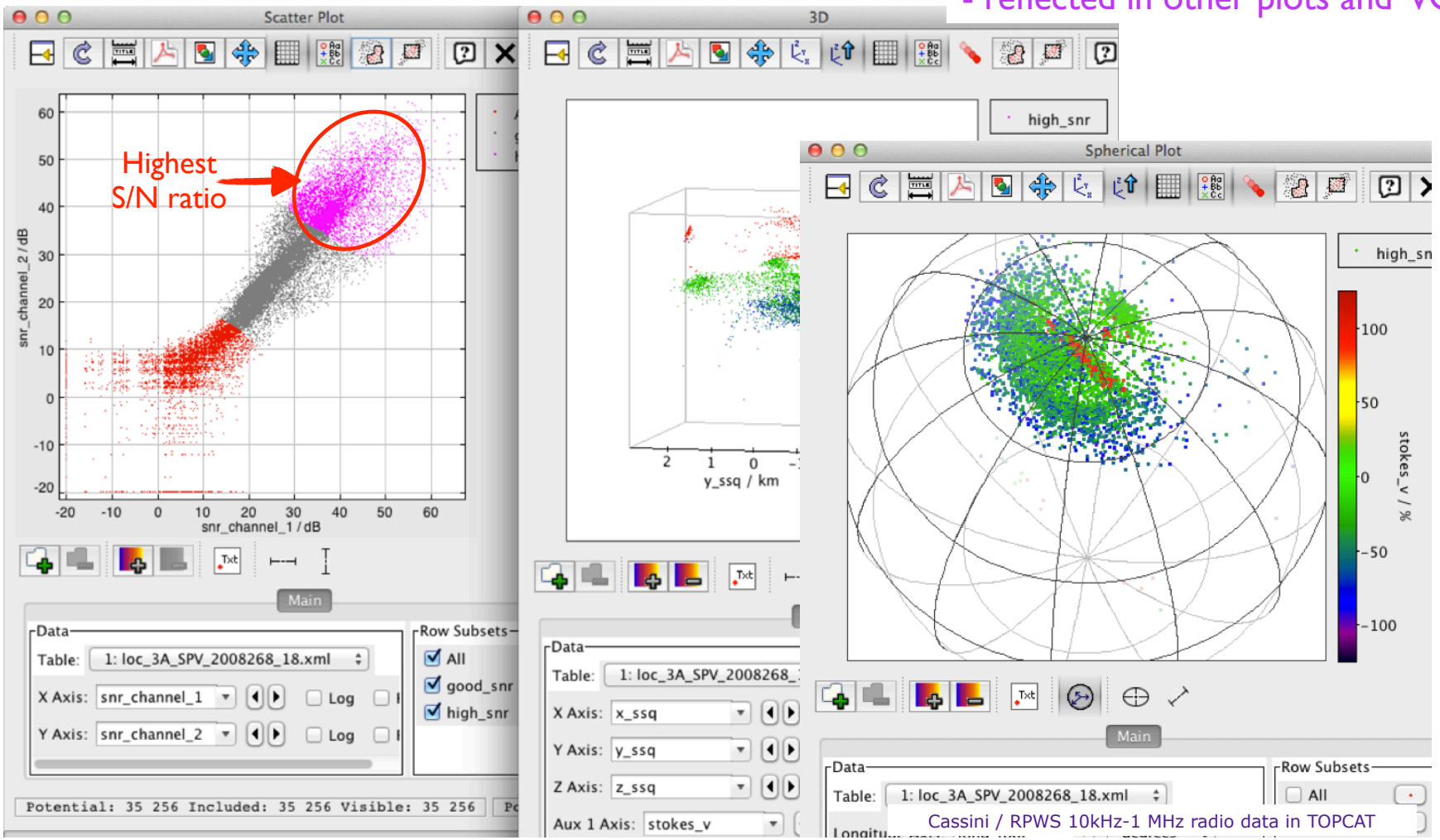
Relies on IAU planetary coordinate frames (fits' WCS)

VESPA and VO tools: tabular data

TOPCAT (Bristol Univ):

Allows data selection

- by formula or graphically
- reflected in other plots and VO tools

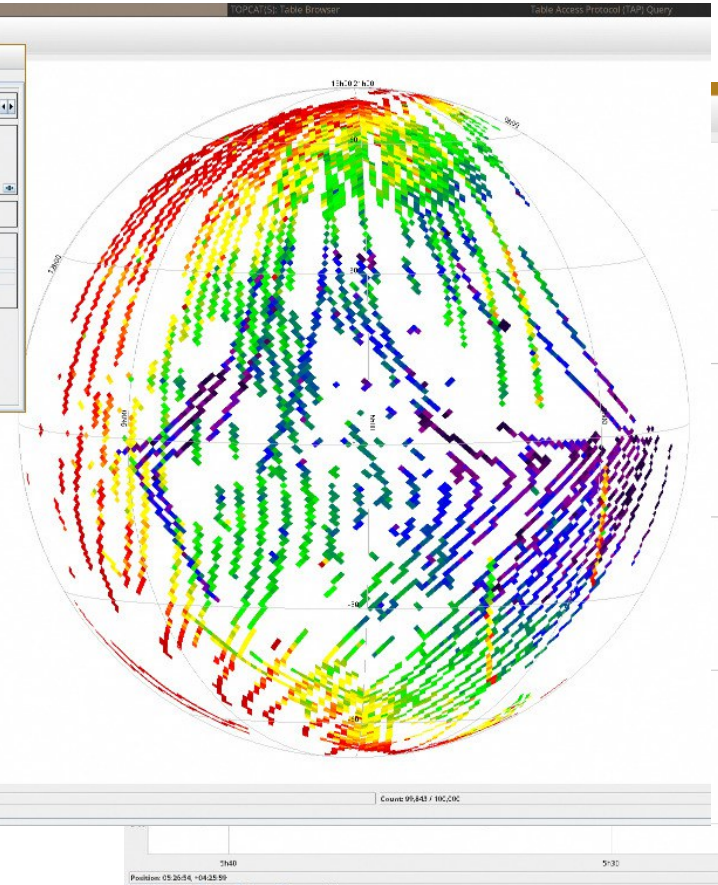


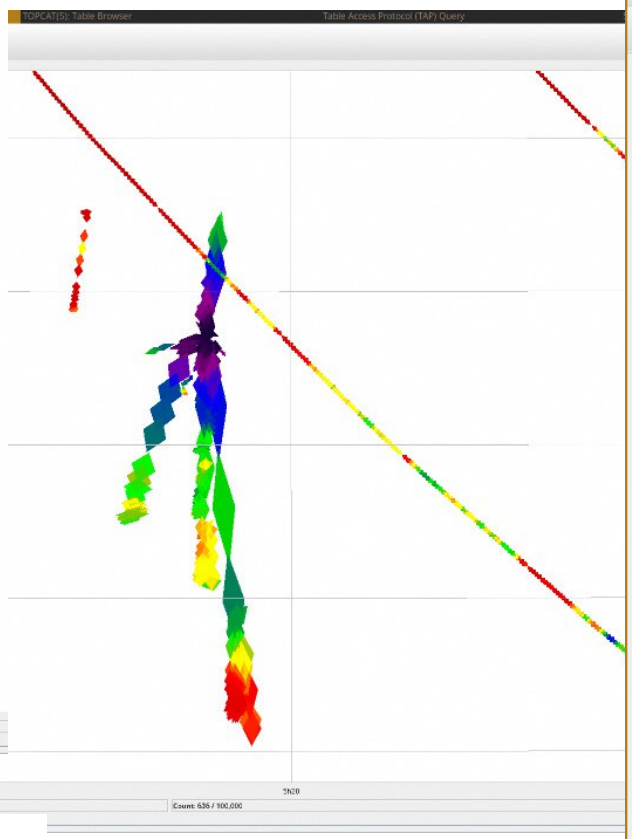
VESPA and VO tools: spectra support

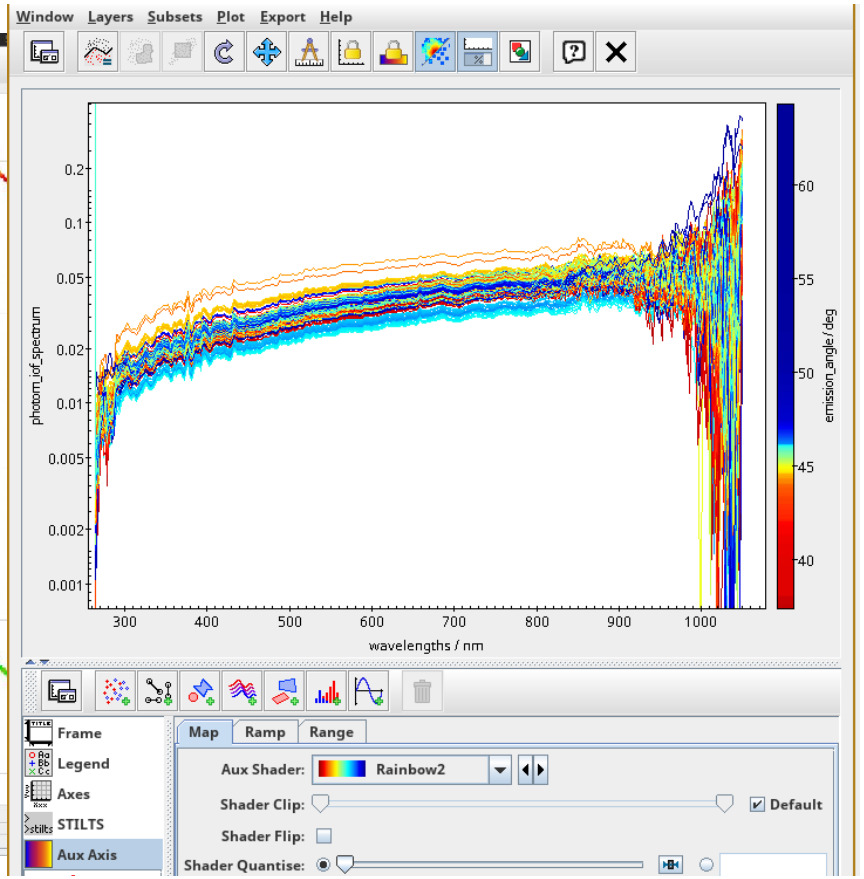
TOPCAT (Bristol Univ):

New graphic functions

- MOC and datalink support
- Can now include spectra in tables (powerful, but demanding)



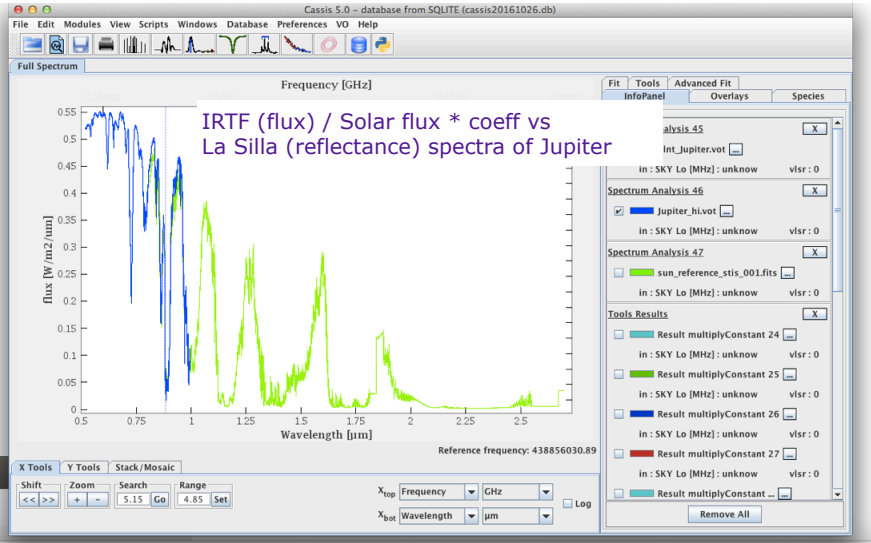


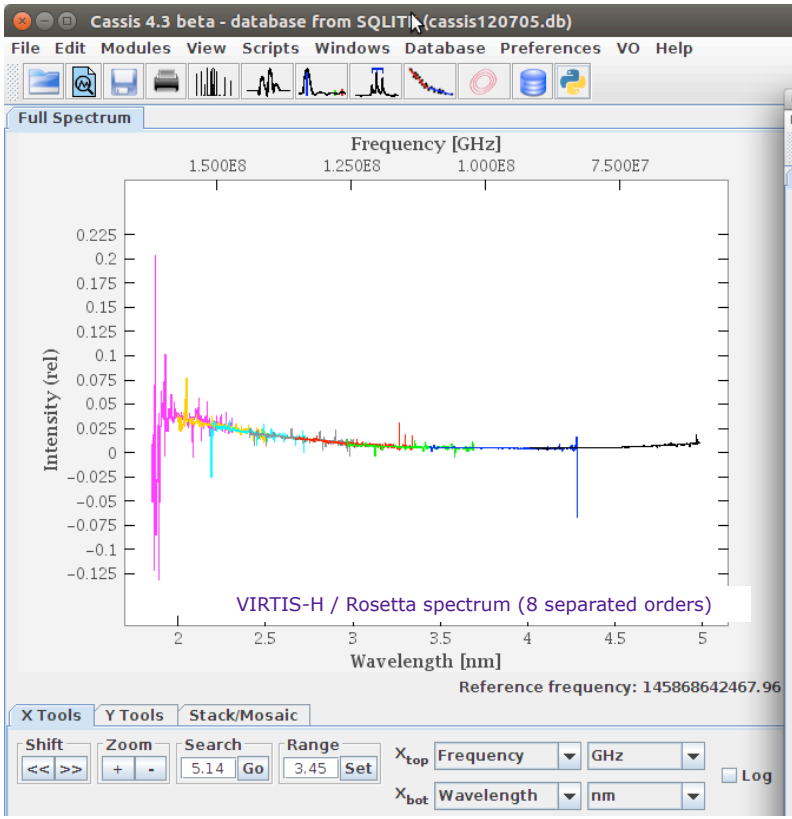


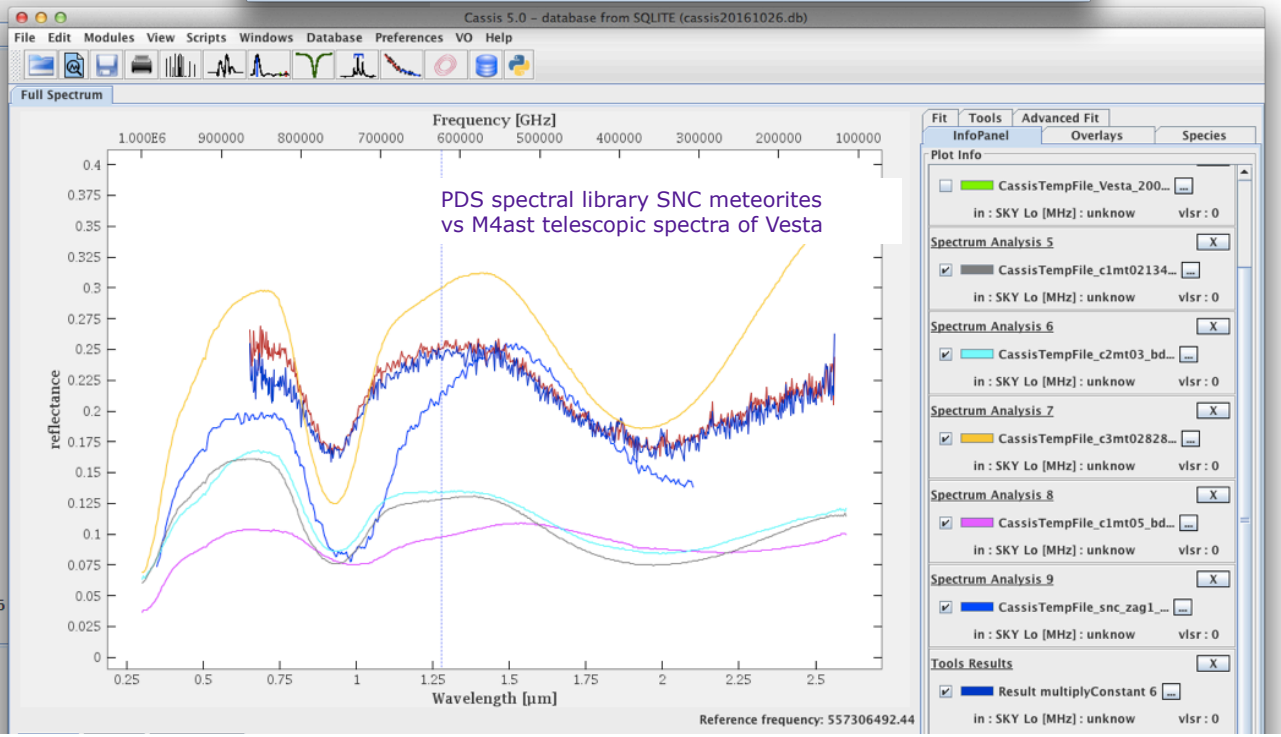
Mercury MESSENGER footprints (MOCs) and spectra in TOPCAT

VESPA and VO tools: spectroscopy

CASSIS from v6 (IRAP/CNRS)
- Supports data in flux & various types of reflectance (scaling)
- Auto converts spectral axis & flux
- Supports échelle spectra

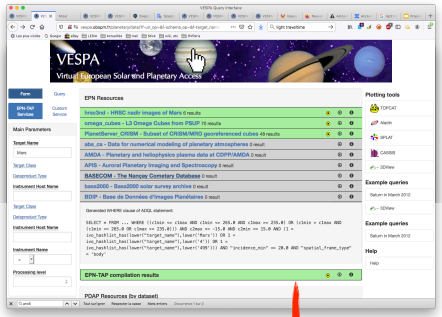






VESPA VO-GIS bridge

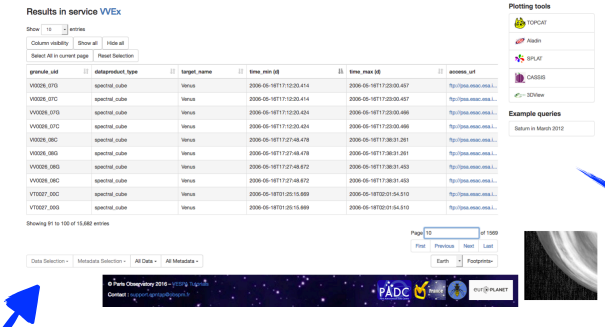
Portal



EPN-TAP query

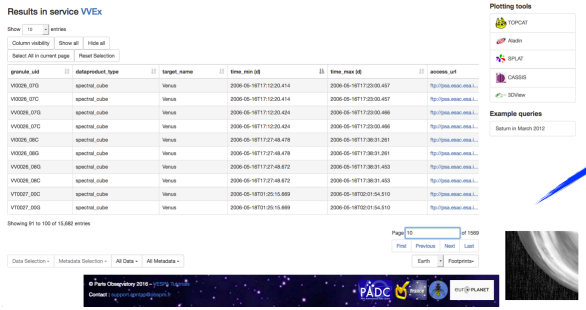
TAP servers

service with fits images & spectra



link:
geofits image,
spectrum

service with OGC-type products

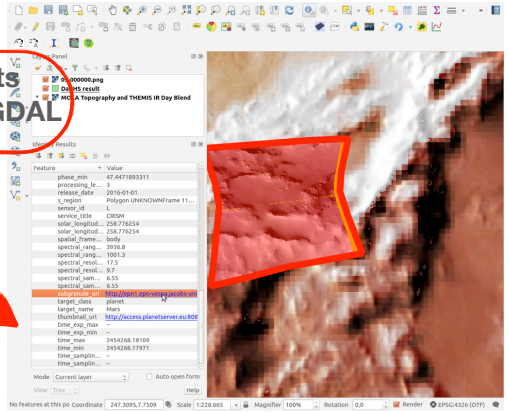


link:
WMS/WCS query

SAMP interface

Geofits driver / GDAL

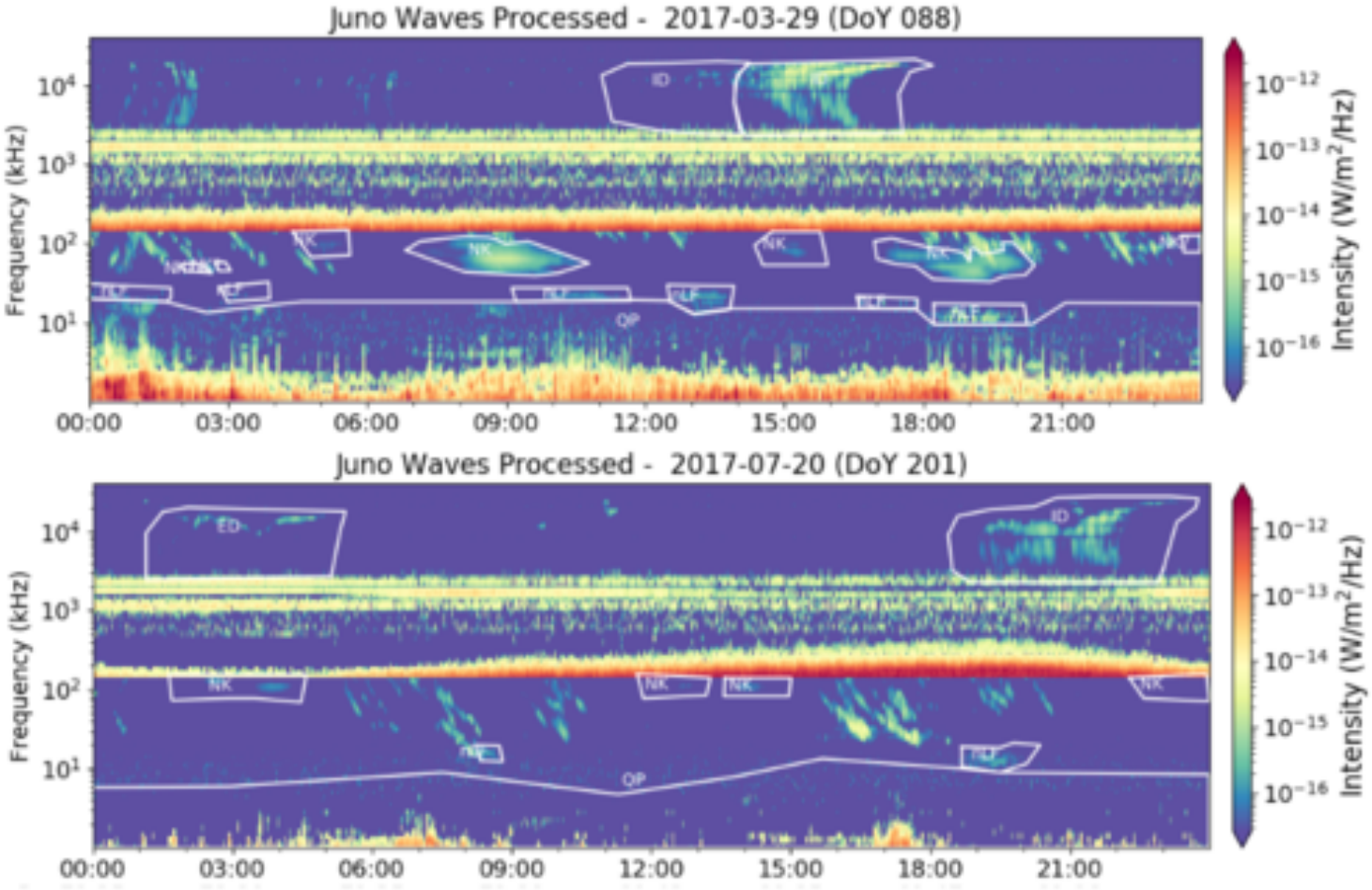
QGIS



Std OGC query

OGC servers

Locating features in dynamical spectra: TFCat

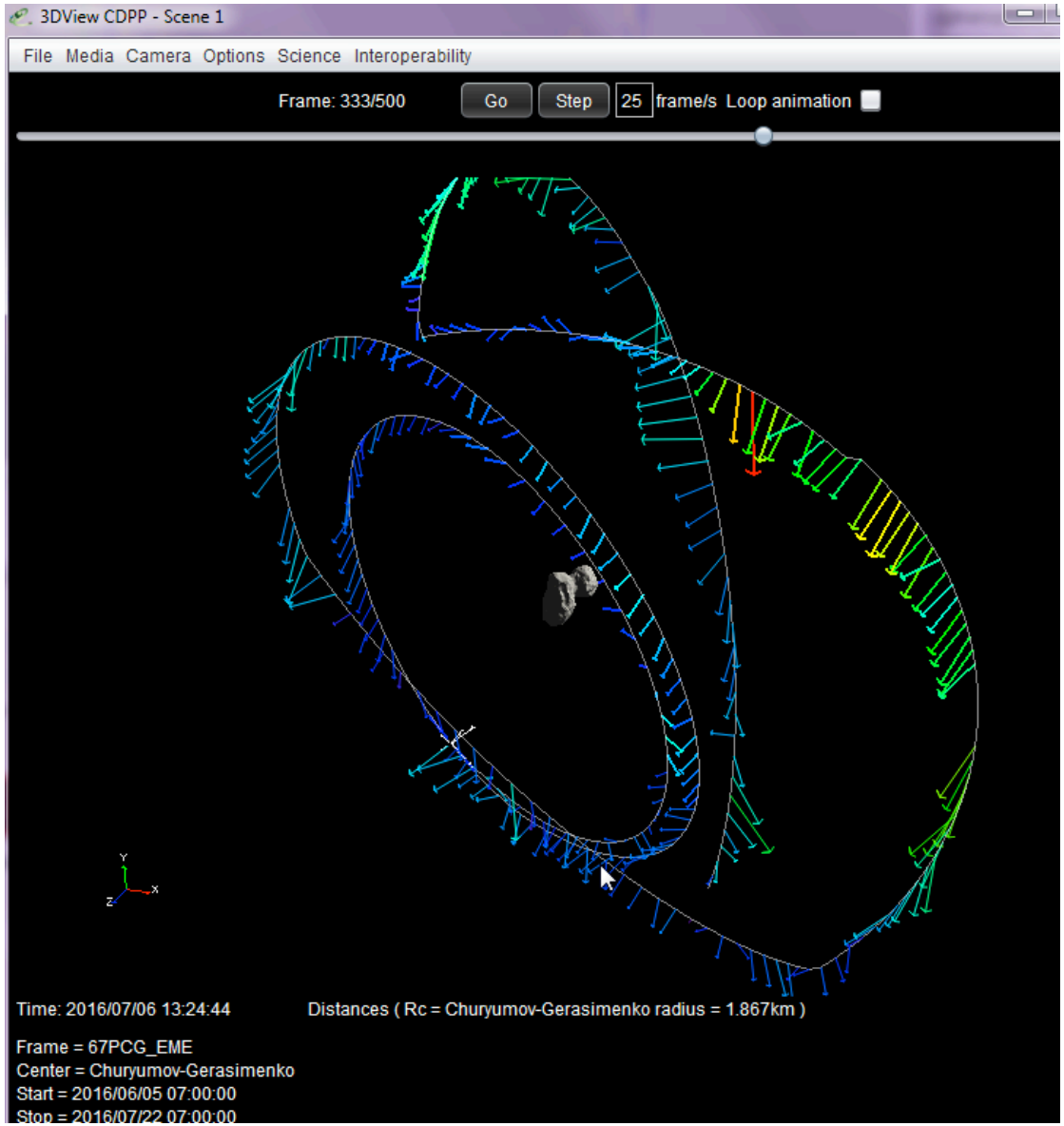


Jupiter radio emissions identified in Juno/Waves data (dynamical spectra), in Autoplot

VESPA and VO tools: space borne data

3Dview (CNES/IRAP):

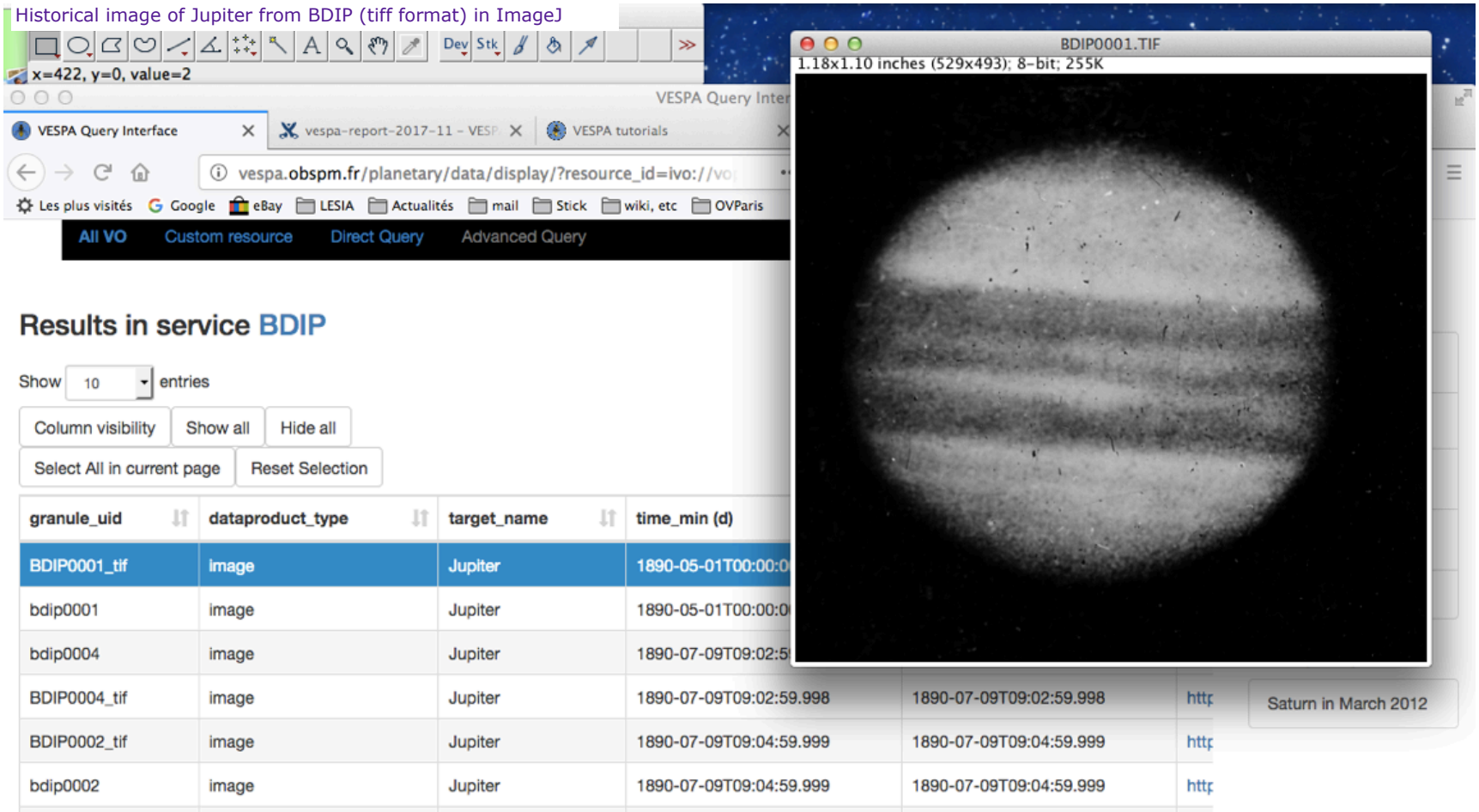
- Spice kernels from all space missions
- image projection capacities
- Better Spice support from collaboration with ESA



VESPA and VO tools: image processing interface

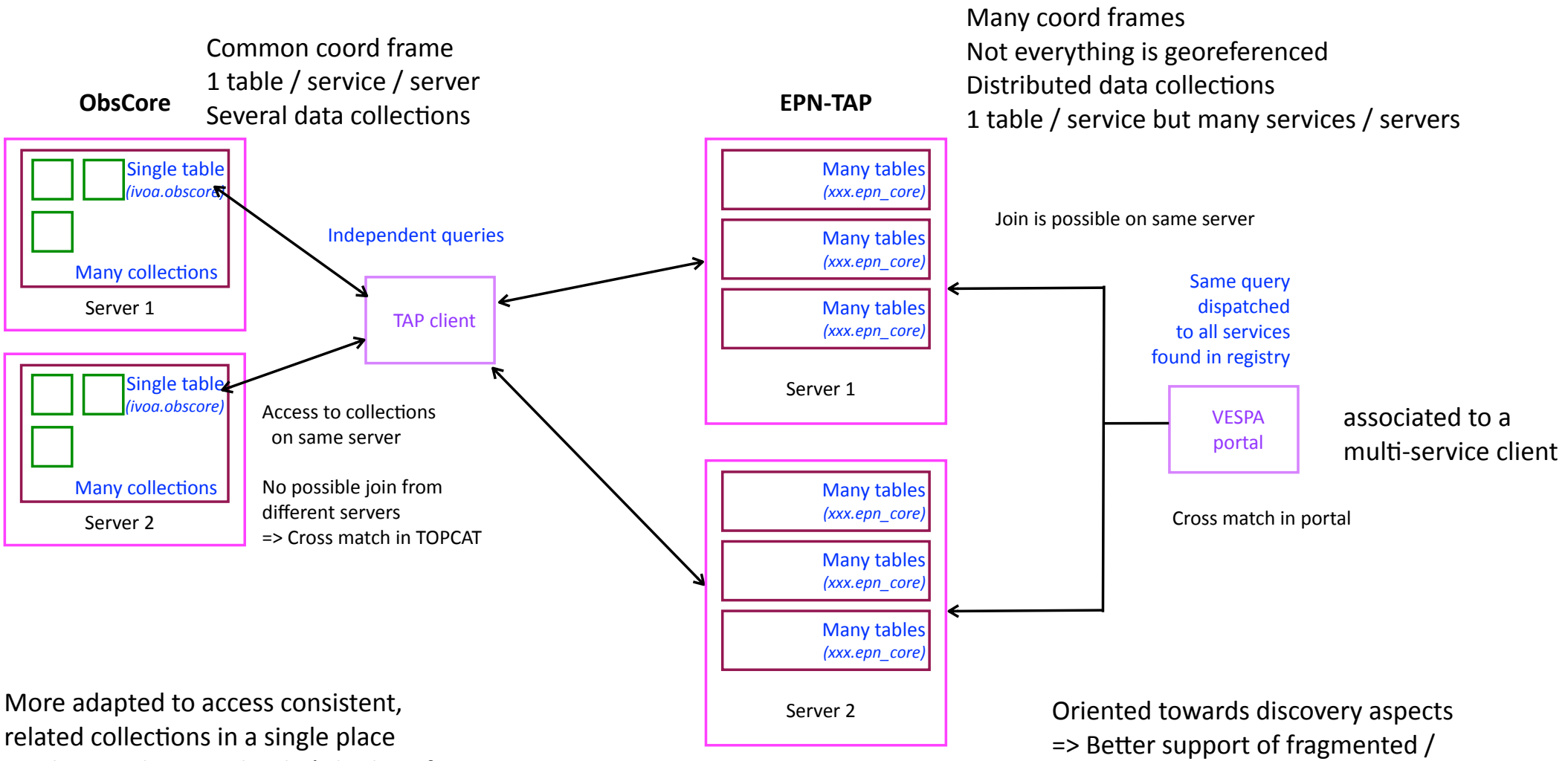
ImageJ (open source):

- SAMP connection installed (input only)
- Provides support for unusual data types (TIFF…) & format conversion
- Provides image processing functions in the VO



Service implementation

ObsCore vs EPN-TAP



More adapted to access consistent, related collections in a single place
=> The user knows what he's looking for
(or knows how to query the registry)

Oriented towards discovery aspects
=> Better support of fragmented / heterogeneous archives

VESPA service installation

1- Install data server

Preferred solution: DaCHS - in a VM or container

- will handle internal database and registration

2- Design data service

Identify EPN-TAP parameters of interest, gather information, organize

3- Set up data service

Write a configuration file, ingest data, make data available

4- Tests, tests, tests

- **Compliance with EPN-TAP standard** (use taplint validator)
- **Check this actually provides a service to the users**
- **Publish when OK**

VESPA service installation

Pre-requirements:

0a- Access to VESPA wiki

https://voparis-wiki.obspm.fr You may have access already - drop a line if not

0b- Backing up your work

Service definition files (not the data) will be stored in a common gitlab at Paris Observatory

https://voparis-gitlab.obspm.fr/vespa

This ensures sustainability and simplifies interactions / support

This also makes it simple to deploy the service on a final server when ready

Consider this as your own backup space on a common server - requires an invitation

=> Send your email, we will sent back an invitation to eduTEAMS VESPA Virtual Organisation

when validated, log in the gitlab to create your account, we'll provide access

VESPA service installation

1- Install the TAP server (currently Debian 12, DaCHS on port 80, awstats, postgres…)

=> clone https://voparis-gitlab.obspm.fr/vespa/dachs/docker_dachs_server

then edit the .env file with your info

then type cd conf

docker up -d

Options (in dev):

- host on EOSC VM (one example running)
- host at PADC: you're still in charge, DaCHS is updated via CI on updates; lfs possible
- private services: required to handle PI experiments (ground segment of space instrument)

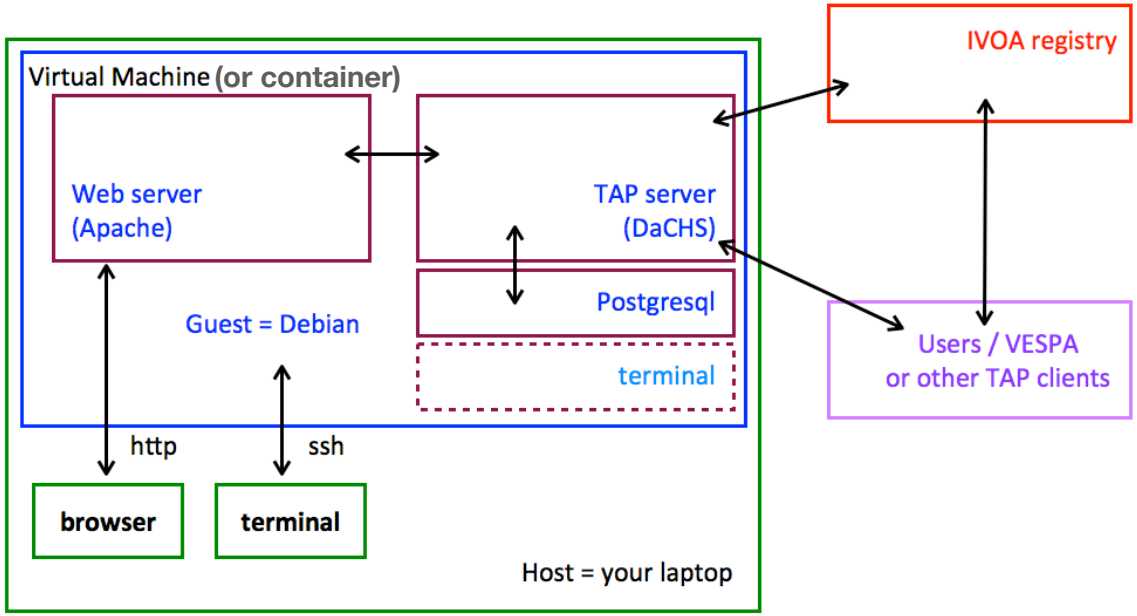
  private VESPA portal available for cross-matches

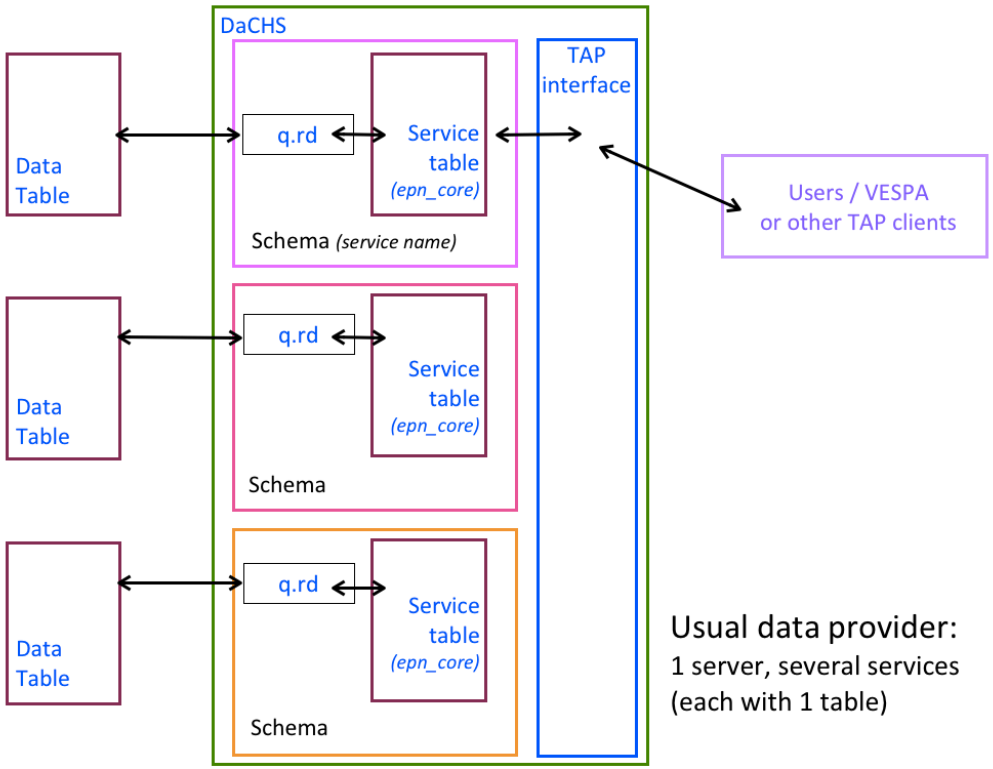
VESPA service installation

1- Install data server

Preferred solution: DaCHS 2.6+ - in a VM or container

- will handle internal database and registration





Usual data provider:
1 server, several services
(each with 1 table)

VESPA service installation

2- Design data service

Identify EPN-TAP/ EPNCore parameters, gather information, organize

EPN-TAP services consist in 1 table describing

- a series of elements (granules) - rows
- with standard parameters - columns (some are mandatory)

=> need to identify

- granules / granularity (usually: files)
- If there are natural / convenient ways to group them
- values of EPN-TAP mandatory parameters
- quantities of interest (search and descriptive parameters) and how to store them in EPN-TAP parameters

This is science, not technical work — you must know or imagine how users want to access your data

=> Make it as complete as possible, remain consistent with existing services!

Typical metadata from EPNCore

EPNCore vocabulary:

A core of ~ 40 columns / parameters always present (can be empty)

~ 180 standard columns / parameters available to chose from (new ones are possible)

1- Basic info

Target name or ID + class, time, data IDs, release date, etc

2- Provenance info

Instrument, Observer, etc + possibly processing history

3- Link to the data

File (URL + format) or scalar quantities (eg, orbital parameters)

Thumbnail if possible (used in the portal)

4- Coverages

Spatial, temporal, spectral, illumination conditions; possibly other ones

- beware that units / scales are predefined

VESPA service installation

2- Design data service

Identify EPN-TAP/ EPNCore parameters, gather information, organize

- examples are available from voparis-gitlab

=> Docs:

https://ivoa.net/documents/EPNTAP/

Detailed vocabularies:

http://www.europlanet-vespa.eu/EPN_TAP.shtml

=> Template / guide (XLS sheet):

https://voparis-wiki.atlassian.net/wiki/download/attachments/56898983/EPN-TAP_parameters_List_template.xlsx?version=2&modificationDate=1713947811158&cacheVersion=1&api=v2

=> Complete example (and links to shorter ones):

https://voparis-wiki.obspm.fr/display/VES/Setting+up+an+EPN-TAP+service+in+EPN-2024

VESPA service installation

3- Set up data service

Write a configuration file (q.rd), with support from VESPA teams

Ingest data (various possible situations, the simplest one is via a CSV file)

Includes general info describing the service itself (for the registry)

4- Validation

Test, check data access, review

Publish (*both* in the IVOA registry and the VESPA portal)

Docs:

https://voparis-wiki.obspm.fr/display/VES/Building+the+resource+descriptor+for+your+EPN-TAP+service+in+DaCHS

http://docs.g-vo.org/DaCHS/tutorial.html#epn-tap

Main portal: https://vespa.obspm.fr/

Geoportal: https://padc-findme.obspm.fr

Tutorials: https://github.com/epn-vespa/tutorials

Web site: http://www.europlanet-vespa.eu/