

VESPA: developing the Planetary Science Virtual Observatory

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Réunion annuelle ASOV

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- Résultats Europlanet-RI (terminé déc 2012)
 - => Infrastructure OV définie, mise en place
 - => Quelques services en ligne (démonstateurs) + bcp de projetsRôle majeur des partenaires français (VO-Paris/CDPP/IPAG)
- Suite européenne dans Horizon 2020 :
 - WPVO dans Europlanet H2020:VESPA (~ 25% du total)
 - Objectifs ? — Surtout mise en ligne de contenu
 - 16 partenaires : français (OV-Paris, IRAP, IPAG, LATMOS, GEOPS, CDS)
& européens (IAPS, Jacobs U, IWF Graz, IASB, UCL, IAP Prague, EHU Bilbao)
- Contexte spatial :
 - Thèmes à soutenir (pour développements lourds)

Planetary Science VO — Objectives in EPN-RI (FP7: 2009-2012)

- Make data search in archives easy
- Allow quick-look visualisation of data
- Allow external users to include their data

Initial set-up in Europlanet

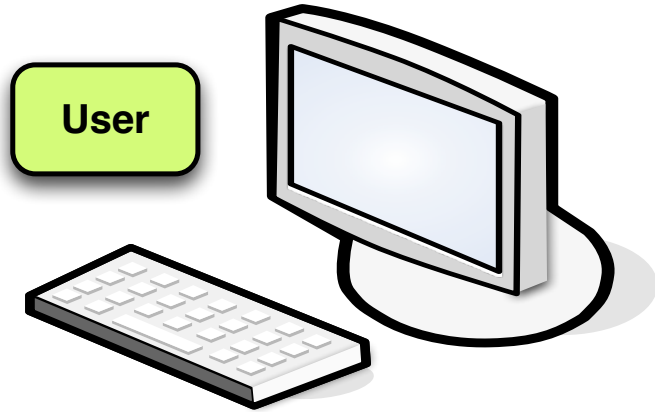
- Make "small" derived data sets accessible
- Develop specific processing/visualisation tools

Contributions by external users

Constraint: minimise developments

Success: the user doesn't see the infrastructure

User's experience



User

Queries

Answers

Data access

Catalogue / Registry

SSODnet

GhoSST
KIDA

PSA

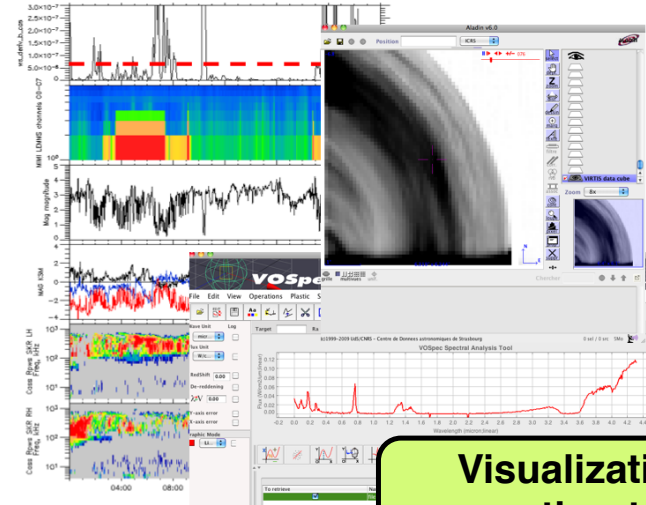
AMDA...

EPN

PDS

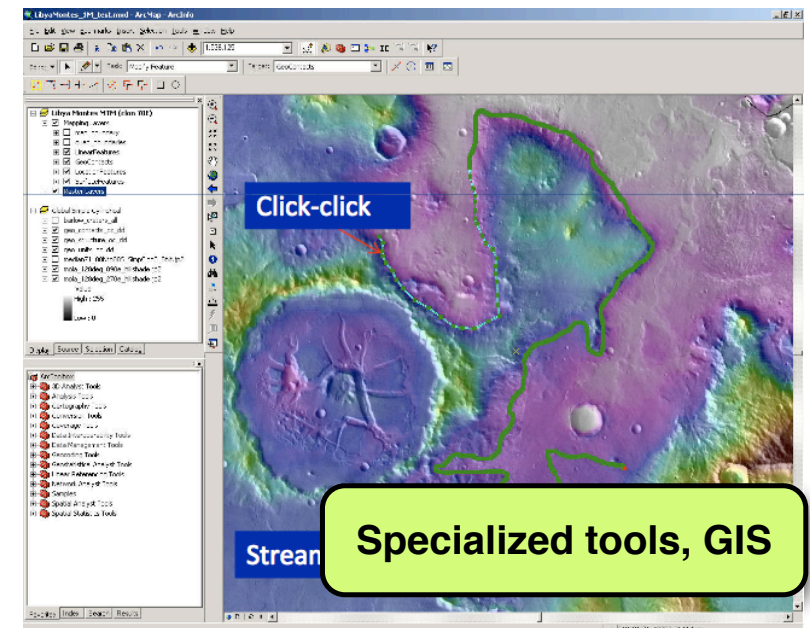
Data bases

Space agency archives



Data exchange

Visualization and other tools



Click-click

Stream

Specialized tools, GIS

VESPA access

- Global search interface for Planetary Science services
- Supports EPN-TAP + PDAP

<http://vespa.obspm.fr>



Query form: All VO

Target name

Resource type

Dataset ID

Time selection

Time min

Dataproduct type

Query results for all resources

gran

EPN Resources

Auroral Planetary Imaging and Spectroscopy

Results : 341
[DISPLAY RESULTS](#)
▶ Description :
Credits: Creator

Base de Donn

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Extrasolar Pla

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Heliophysics F

Results : 0
[DISPLAY VOTABLE](#)
▶ Description :
Credits: Creator

Results in service apis

Show entries

Search:

Show / hide columns

dataproduct_type	target_name	time_min (d)	time_max (d)	access_url
image	Titan	2009-01-23T16:09:22	2009-01-23T16:19:22	jb9z01011_proc.f
image	Titan	2009-01-23T16:21:40	2009-01-23T16:38:20	jb9z01021_proc.f
image	Titan	2009-01-23T16:41:58	2009-01-23T16:51:58	jb9z01031_proc.f
image	Titan	2009-01-23T17:42:54	2009-01-23T17:52:54	jb9z01041_proc.f
image	Titan	2009-01-23T17:55:12	2009-01-23T18:11:52	jb9z01051_proc.f
image	Titan	2009-01-23T18:15:30	2009-01-23T18:25:30	jb9z01061_proc.f
image	Titan	2009-01-23T19:18:47	2009-01-23T19:28:47	jb9z01071_proc.f
image	Titan	2009-01-23T19:31:05	2009-01-23T19:47:45	jb9z01081_proc.f
image	Titan	2009-01-23T19:51:23	2009-01-23T20:01:23	jb9z01091_proc.f
image	Titan	2009-01-23T16:09:22	2009-01-23T16:12:42	jb9z01a1q_proc.f
image	Titan	2009-01-23T16:21:40	2009-01-23T16:25:00	jb9z01a4q_proc.f
image	Titan	2009-01-23T16:33:40	2009-01-23T16:37:00	jb9z01a7q_proc.f
image	Titan	2009-01-23T16:37:40	2009-01-23T16:41:00	jb9z01a8q_proc.f
image	Titan	2009-01-23T17:46:54	2009-01-23T17:50:14	jb9z01aeq_proc.f
image	Titan	2009-01-23T17:59:12	2009-01-23T18:02:32	jb9z01ahq_proc.f
image	Titan	2009-01-23T18:11:12	2009-01-23T18:14:32	ib9z01alq_proc.f

Plotting tools

- TOPCAT
- Aladin
- VOSpec
- SPLAT

Plotting tools

- TOPCAT
- Aladin
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- SPLAT

Example queries

- Saturn in March 2012

SELECTED DATA

- 1 selected data
- 1 : image

PREVIEW

First data services

- EPN-TAP services:

Public services at VO-Paris:

- **APIS**: Aurorae images/spectra data base (HST)
- **BDIP**: Historical planetary images in Meudon (ground-based)
- **Encyclopedia of Extra-Solar Planets** (compilation of published data)
- **Atmospheric profiles of Titan** (Cassini/CIRS)
- **IKS / Halley** (Vega-1), **M4ast** (asteroid spectrosc.)
- **BaseCom** (comets from Nançay), **Jupiter radio observations** (from Nançay)
- **Solar feature catalogues** (from HELIO program)

Projects at VO-Paris (from existing databases):

TNO data compilation, **VIRTIS/VEx & /Rosetta**, **MASER** (radio service)

Other services in development: Rome, Toulouse, Graz

- Other targeted data centres/services (with specific interfaces):

ESO archive, **GhoSST**, **PSA** (special Rosetta project), **AMDA (CDPP)**

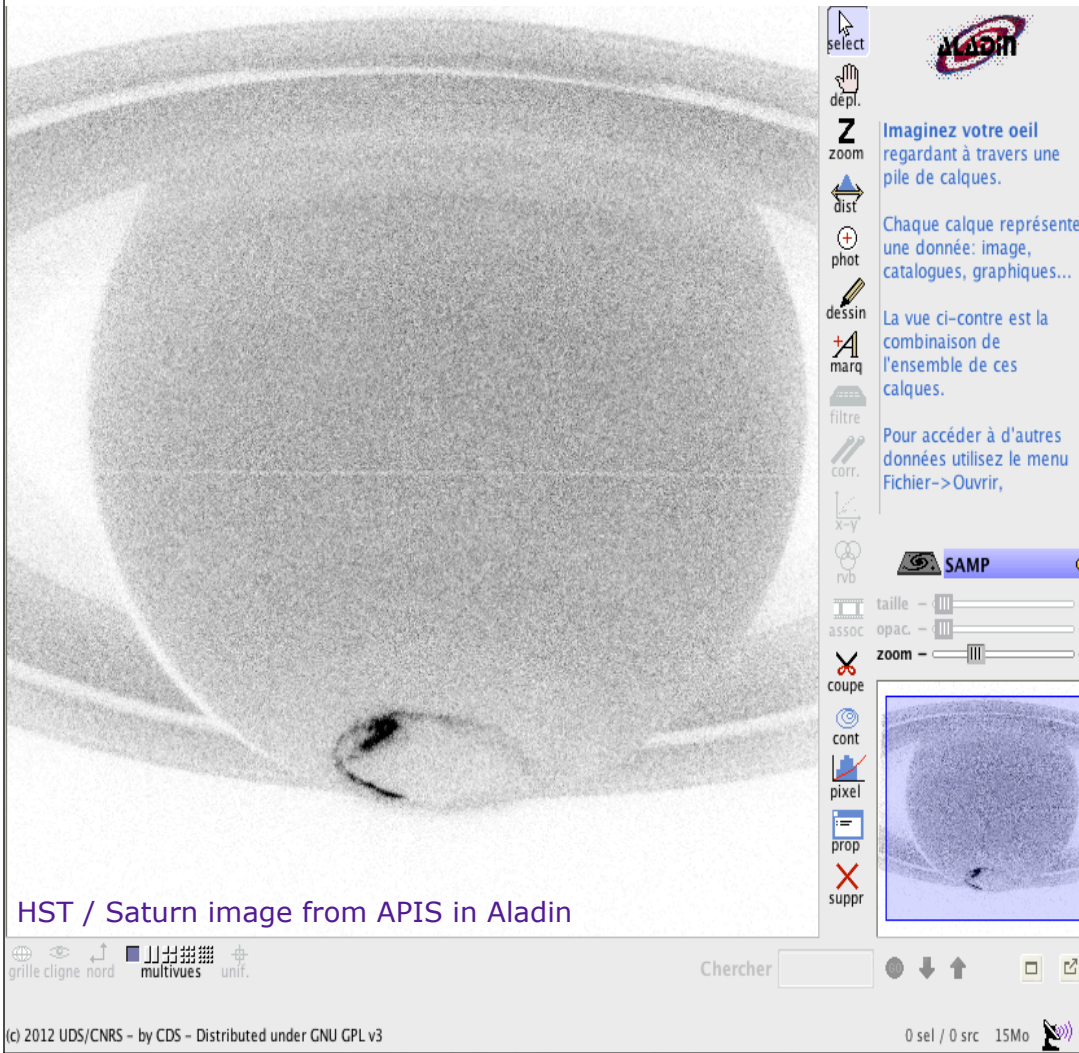
- Space data centres accessible by **VESPA** (via **PDAP**, limited):

PSA and **DARTS** (ESA & JAXA archives, with minimal interface)

Visualization tools: IVOA

Aladin:

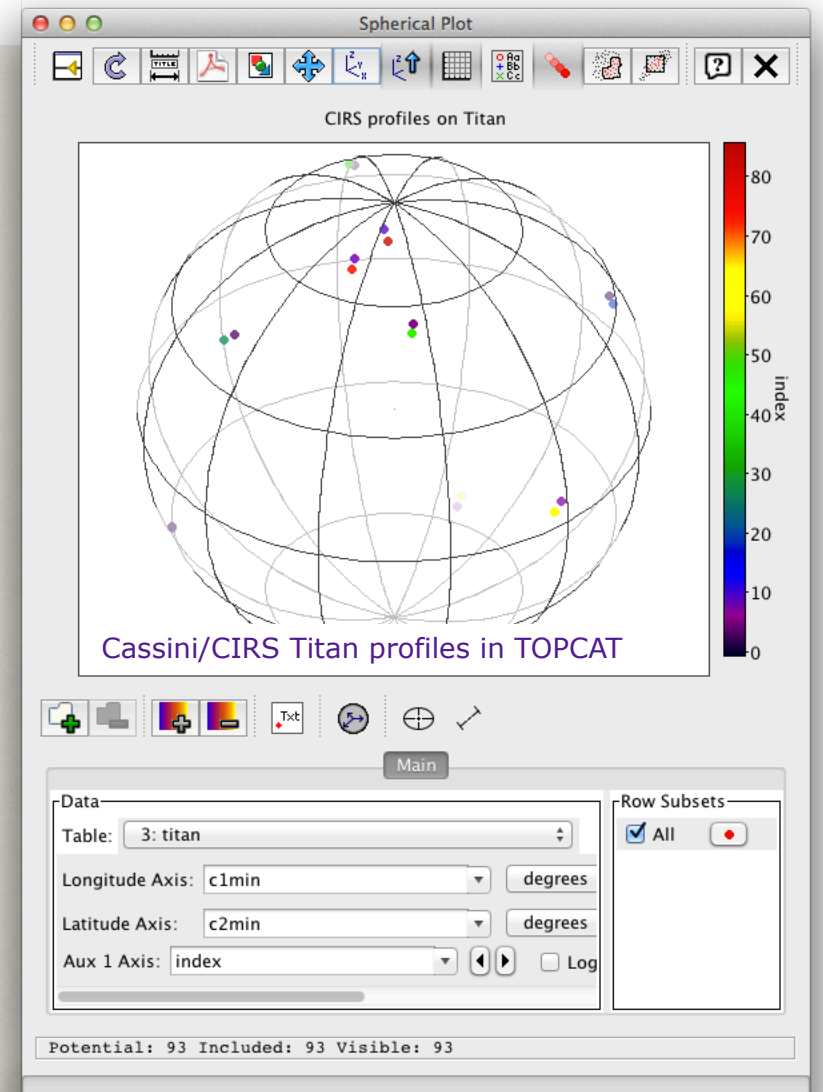
- plots images/cubes
- handles sky/spheroid coordinates



The screenshot shows the Aladin software interface. The main window displays a large, grayscale image of Saturn, identified as an HST image from APIS. To the right of the image is a vertical toolbar with various icons for manipulation, including 'select', 'depl.', 'zoom', 'dist', 'phot', 'dessin', 'marq', 'filtre', 'corr.', 'rvb', 'taille', 'assoc', 'opac.', 'zoom', 'coupe', 'cont', 'pixel', 'prop', and 'suppr'. Below the toolbar, there is a small inset window showing a zoomed-in view of a portion of the Saturn image. The interface is in French, with instructions such as 'Imaginez votre oeil regardant à travers une pile de calques.' and 'Chaque calque représente une donnée: image, catalogues, graphiques...'. The bottom of the window features a search bar labeled 'Chercher' and a status bar with the text '(c) 2012 UDS/CNRS - by CDS - Distributed under GNU GPL v3' and '0 sel / 0 src 15Mo'.

TOPCAT:

- Handles tables
- 2D/3D plots



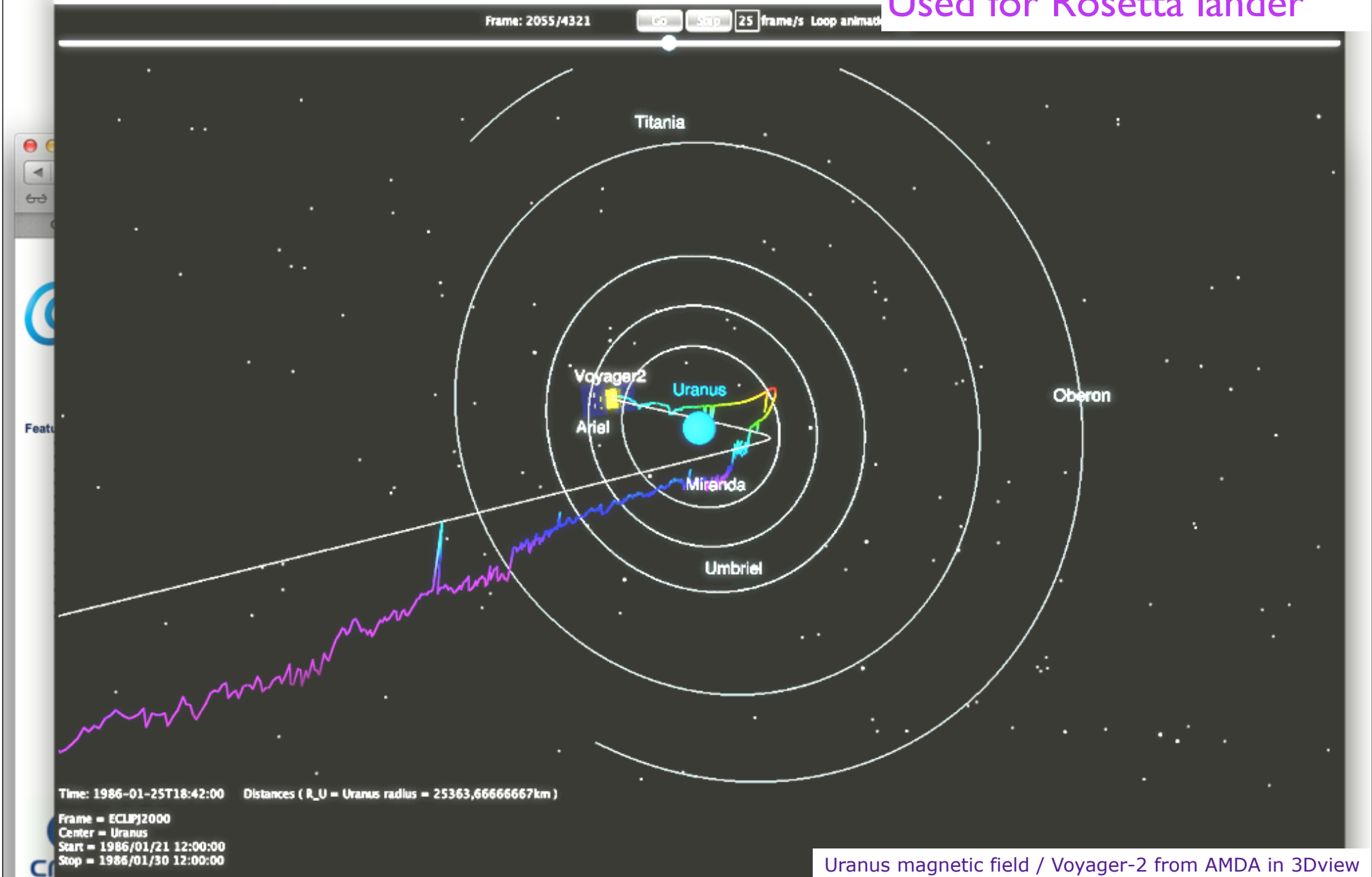
The screenshot shows the TOPCAT software interface. The main window displays a 3D spherical plot titled 'CIRS profiles on Titan'. The plot shows a grid of latitude and longitude lines on a sphere, with several colored dots representing data points. A color scale on the right side of the plot is labeled 'Index' and ranges from 0 (purple) to 80 (red). Below the plot, there is a control panel with a 'Main' button and a 'Data' section. The 'Data' section includes a 'Table' dropdown set to '3: titan', 'Longitude Axis' set to 'c1min' (degrees), 'Latitude Axis' set to 'c2min' (degrees), and 'Aux 1 Axis' set to 'index'. A 'Row Subsets' section on the right has a checked 'All' button. At the bottom of the window, a status bar displays 'Potential: 93 Included: 93 Visible: 93'.

Visualization tools: adapt other existing tools

3Dview / CNES:

Spacecraft trajectories+data

Used for Rosetta lander



Visualization tools / GIS

PlanetServer:

- Mars GIS with access to CRISM, Marsis, etc...
- New techno, *fast*
- Includes spectral library
- VO interface in H2020

The screenshot displays the PlanetServer GIS interface. The main map shows Mars with several yellow rectangular overlays representing CRISM footprints. A 'TABLE OF CONTENTS' panel on the left lists overlays and layers. The 'Layers' panel shows the selected IR data for 'frt00003e12_07'. The 'DIAGRAMS' panel on the right shows a spectral plot of 'Average Spectrum' vs 'Wavelength' for the selected footprint. The plot shows several curves representing different spectral bands. Below the plot, there are fields to 'Select library' and buttons for 'Load' and 'Save'.

TABLE OF CONTENTS

Overlays

- MOLA RGB
- THEMIS IR day
- CRISM footprints

Layers

Reset Select All Deselect All

- IR: frt00003e12_07
- IR: data.233;data.81;data.13

Data

IR	VNIR	Summary products
Band Nr.	Wavelength	Bad
band1	1.00135	yes
band2	1.0079	yes
band3	1.01445	yes
band4	1.021	no
band5	1.02755	no

R: band234
G: band82
B: band14

Grayscale RGB

DIAGRAMS

Spectrum Histogram Cross Section

frt00003e12_07_if1661_trr3_1_01

Average Spectrum

Wavelength

Select library

Select library

Load Save

Save for GIS

Coord 77.13111, 22.26446

Mars: CRISM on MOLA+MOC,
PlanetServer demo

On-line visualization of spectral cubes

<http://voplus.obspm.fr/apericubes/js9/demo.php>



APERICubes Demonstrator - a tool for exploring VIRTIS cubes

Version 1.6 by Renaud Savalle History

Cube Import

Choose the PDS file to be processed and click on Process:

V0072_05.CAL

The results of the processing will be displayed in the Results frame.

Results

Processing file: /var/www/apericubes/pds/V0072_05.CAL
Output directory: /var/www/apericubes/js9fits/V0072_05

SAMP Apps

- Cassini
- Ins
- VOSpec
- emitter

SAMP Status

SAMP status: Not connected

Image (JS9 Help)

Frame: 0 70

Region Stats

Region Stats			
Position x	27.58	y	37.13
width	7.50	height	7.50
min	0.10	max	0.12
counts	0.04		
bgnd	0.11	noise	0.00
Centroid x	27.03	y	35.98
FWHM	4.93		

3D Plot

X Proj

X Projection

Y Proj

Spectrum

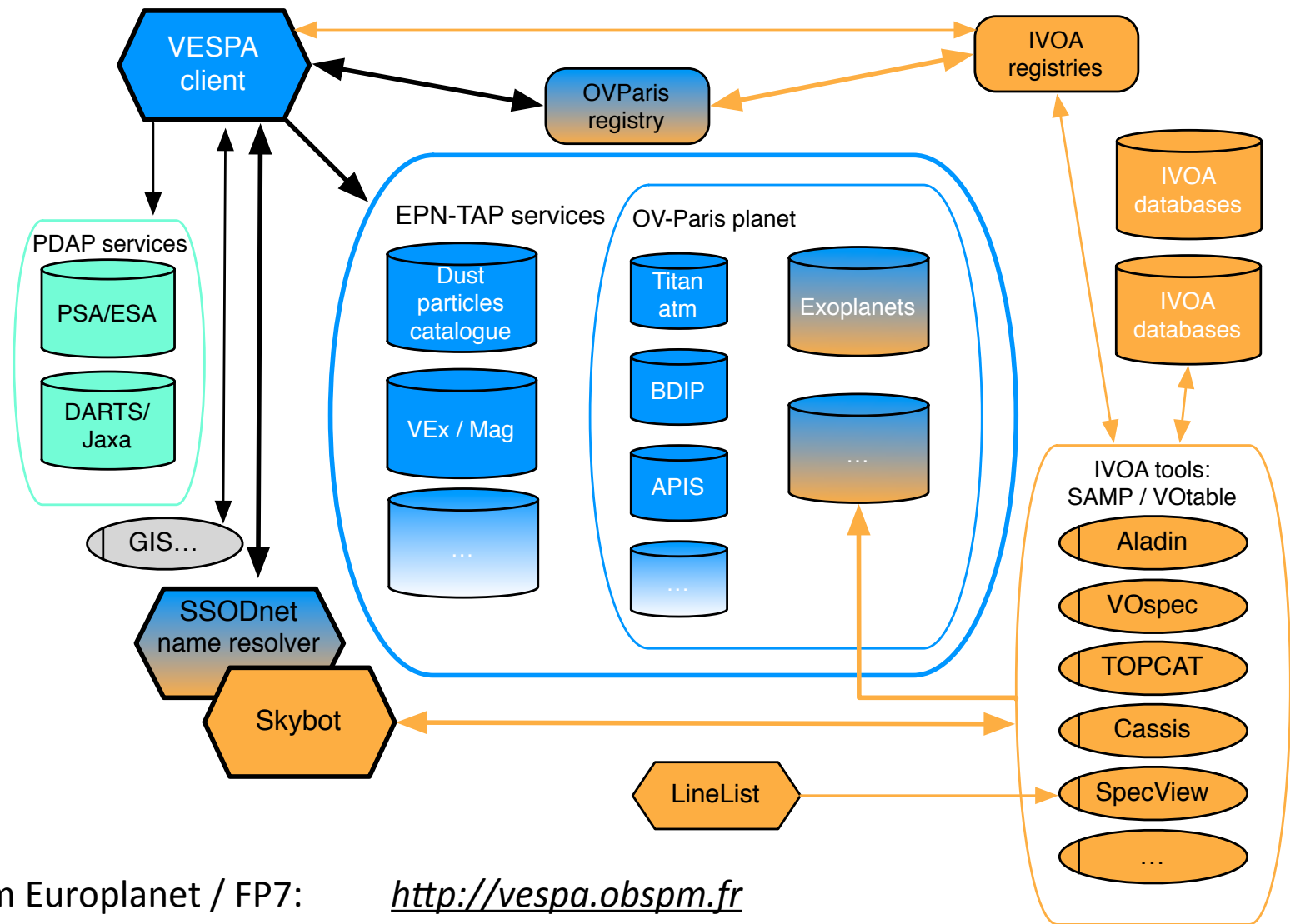
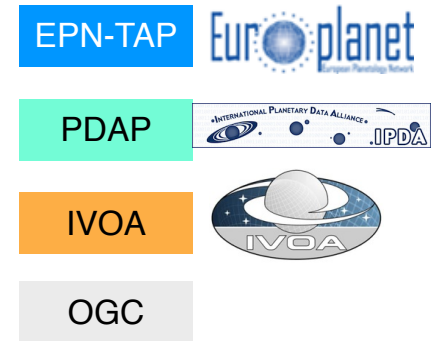
Spectrum for pixel (33,40)

- Currently a demonstrator, specific to VIRTIS
- Based on JavaS version of DS9 +home-made PDS to FITS conversion
- Linked to search interface and other visu tools

VIRTIS / Venus-Express imaging spectroscopy in APERICubes

VESPA Architecture

- Centered on data services
- Specific access protocol / user interface to query services together
- Connected to visualization tools from astro community
- All standards are maintained by world-wide alliances



Existing prototype from Europlanet / FP7:

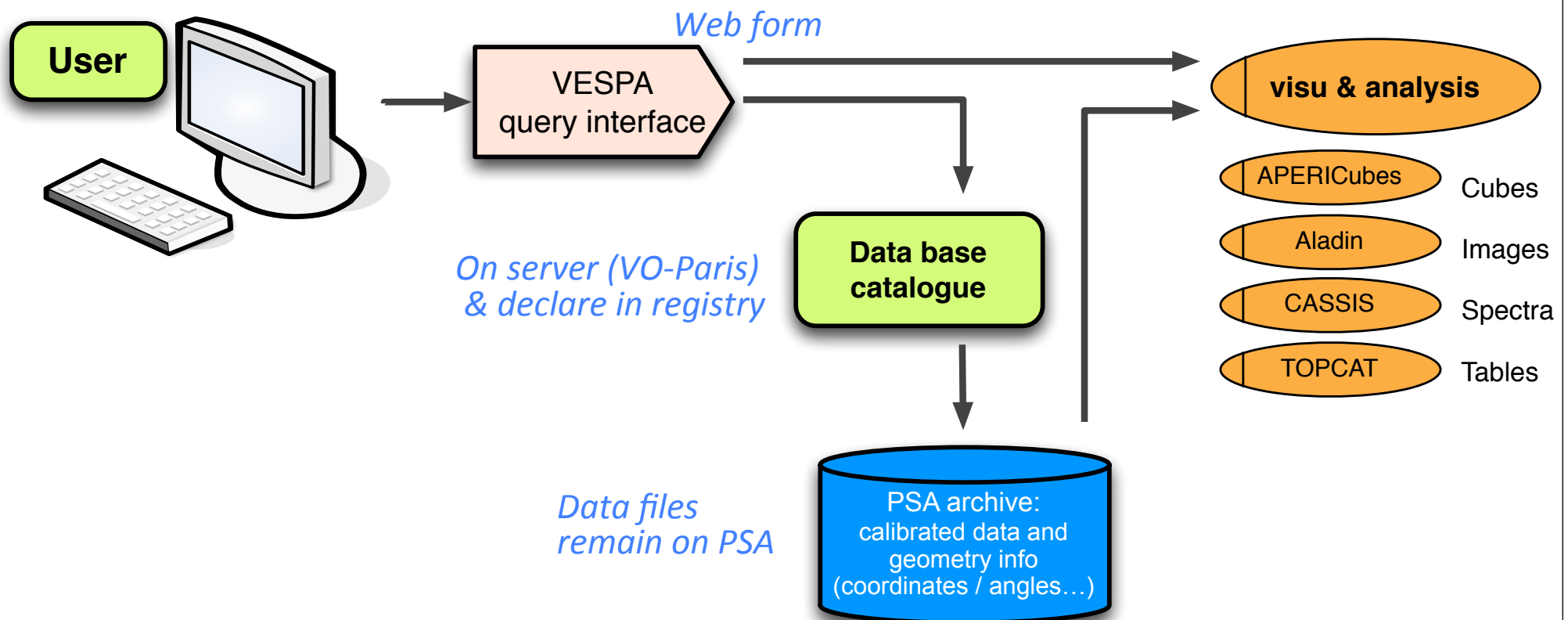
<http://vespa.obspm.fr>

VO can easily provide search & visu functions to PDS (or other) datasets

Archive file VIRTIS_INDEX.TAB => turned to catalogue of the data service

- VESPA can readily use those as search parameters

- VO tools provide quick-look and basic analysis functions for images, spectra, tables
- A specific tool is being devised to analyse spectral cubes on-line (APERICubes)
- Data URL are sent directly from the search interface, no need to download



IVOA loan standards

LEVEL 2
All standards



COMPUTERS

REC

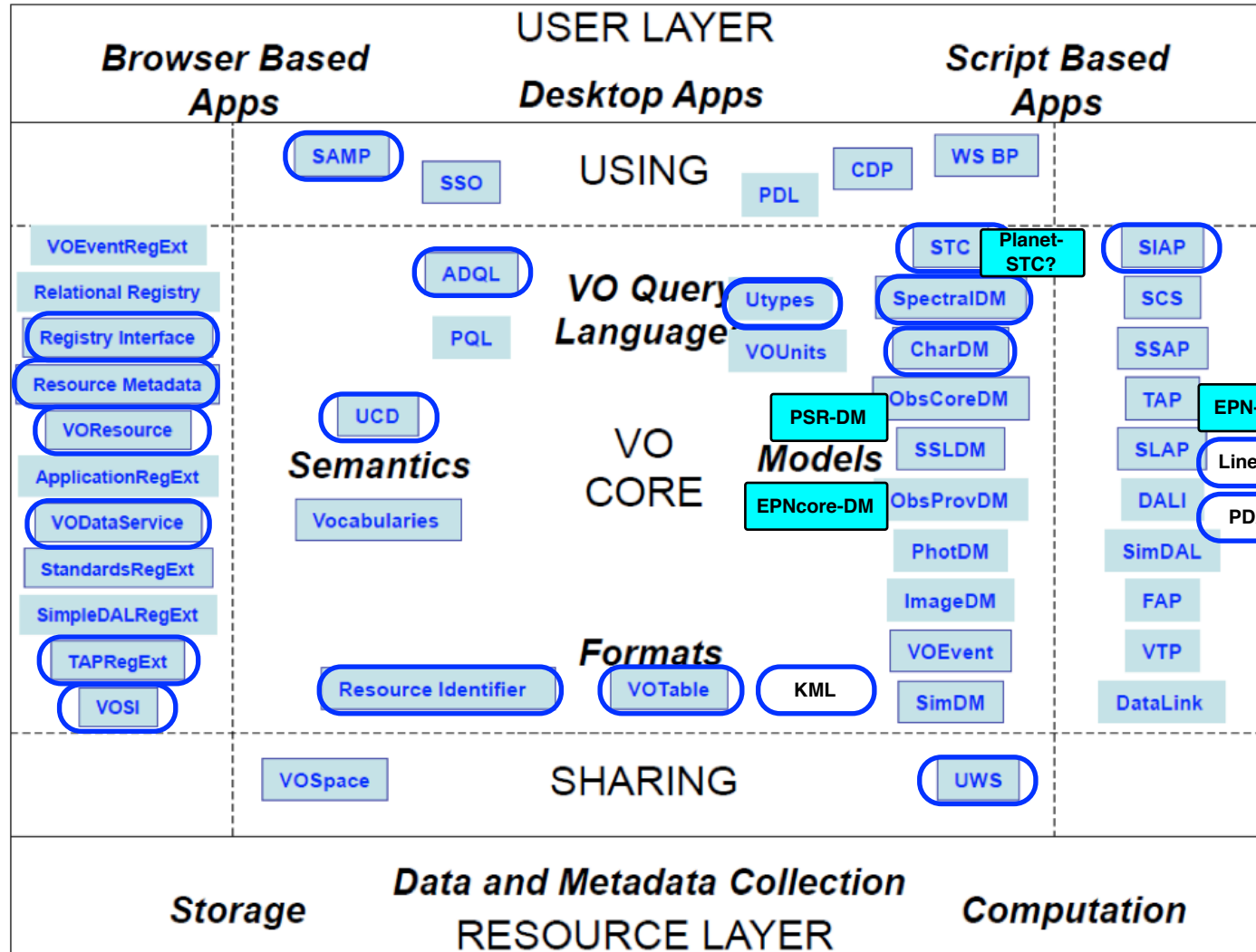
InProgress

EPN specific

Used by EPN

R
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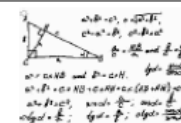
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20121120
IVOA Architecture



PROVIDERS



Altogether

- Very efficient data mining & quick-look system

Planetary science supported from Europlanet developments

Based on IVOA standards & tools + IAU references

Some areas to be optimized in collaboration with IVOA / IPDA / IAU
(e.g. description of coordinate systems)

- Science value increases with number of connected services

Related data services increase science coverage

Services can provide extra information on same objects (exoplanets),
or same information on new objects (small bodies)

Need for reference laboratory data (e.g. mineral spectroscopy)

+ modeling (e.g. GCM)

+ ground support observations for space missions (Venus?)

- New data services to be implemented

=> Europlanet #3 pgr being set up for Horizon 2020 (2015-2019?)

Europlanet/IDIS package to evolve into a full VO activity: **VESPA**

Coordination: VO-Paris - new objectives / partners / activities

JRA tasks

Coord: VO-Paris
Deputy: IAPS/INAF

Tools & Interfaces

Improvement of visu tools
Client / query interface
Enlargement of EPN-TAP for spectroscopy
Interface studies, new cases
Workflow studies & demonstrators

SSHADE: solid spectroscopy

Finalization of infrastructure
I/O interface studies

Magnetospheres

Data calibration / evaluation?
I/O interface studies

GIS-VO link / planetary surfaces

GIS-VO link
I/O interfaces

Planetary atmospheres

New services
Radiative transfer codes interfaces

Small bodies, asteroids & comets

Astorb successor?
Shape models / 3D interfaces?

Exoplanets

Workflows, services,
use cases

Coordination

JRA / VESPA
Development

Training

Training session during conferences
Continuation of FP7 resource list

Dissemination & sustainability

New standards and reference lists + validation
(meetings with IVOA/IPDA/IAU/PDS)

Amateur community link

New services, validation/implementation

Data validation
+ ingestion

Service
implementation

Enlarging VO content
from thematics

Service
implementation

Service
implementation

Service
implementation

Service
implementation

Coordination

VAA / VESPA
Data ingestion / meetings / support

VAA tasks

Coord: VO-Paris
Deputy: Jacobs U

Lead: IPAG, Grenoble

Lead: IRAP, Toulouse

Lead: Jacob Univ., Bremen

Lead: IASB, Brussels

Lead: IAPS/INAF, Rome

Lead: VO-Paris

VESPA in Europlanet H2020

*Euromet H2020 / VESPA
French contributions*

Tools & interfaces

 VO-Paris (co-lead)
CDPP
CDS

Thematics

**solid spectroscopy
/ SSHADE**

 IPAG
(lead)

Magnetospheres

 CDPP
(lead)

**planetary surfaces
/ GIS-VO link**

 GEOPS

Planetary atmospheres

 LATMOS


**Small bodies,
asteroids & comets**

 IMCCE


Exoplanets

 LESIA
(lead)

Coordination

 VO-Paris
(lead)

Users training

 CDPP
(co-lead)

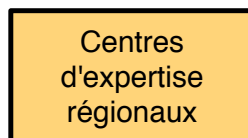
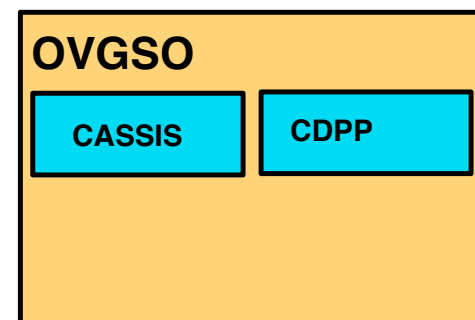
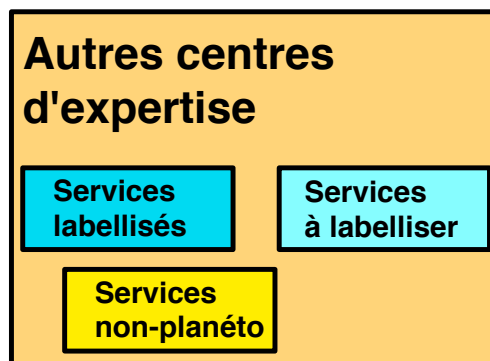
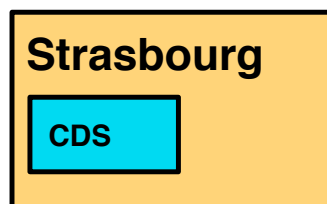
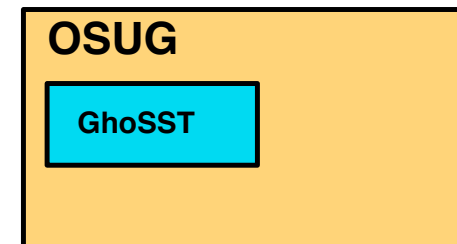
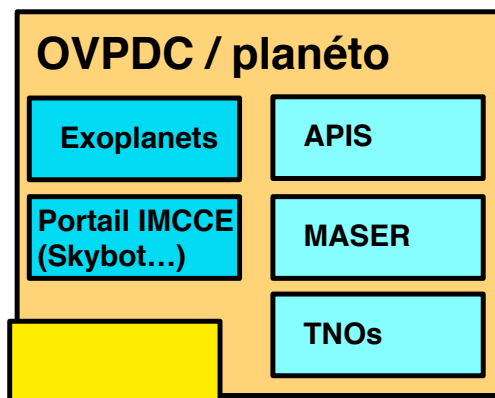
 VO-Paris
(co-lead) **Sustainability**

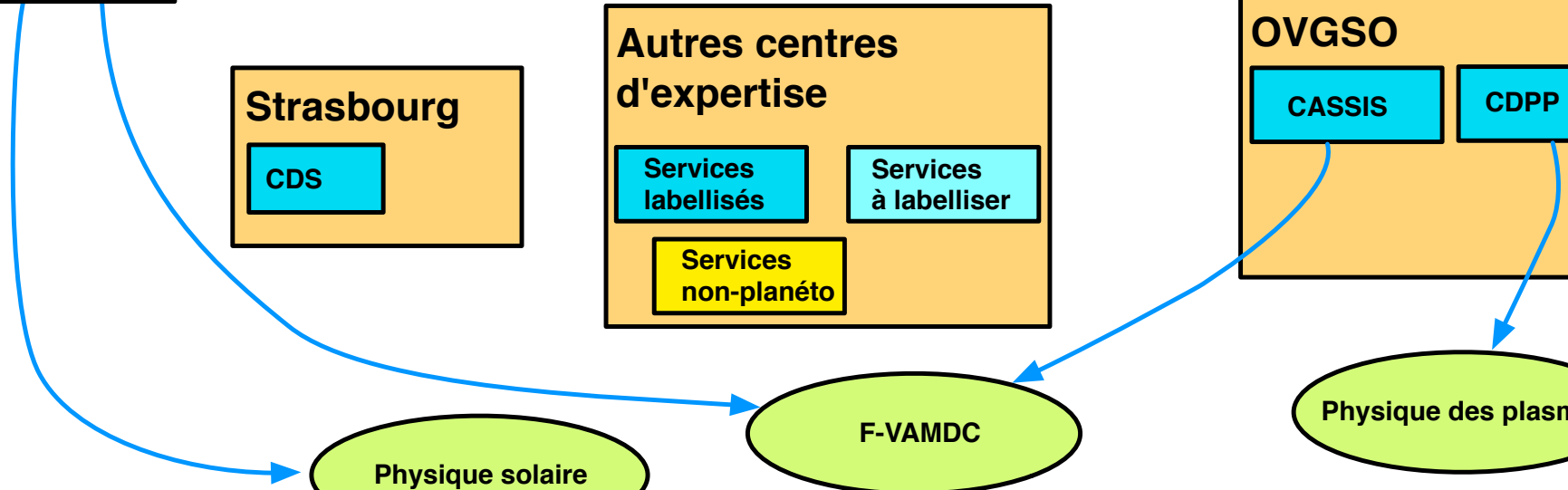
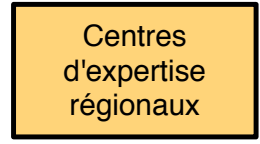
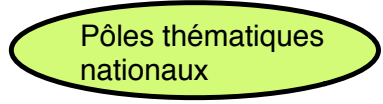
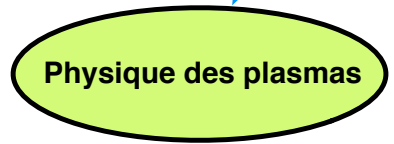
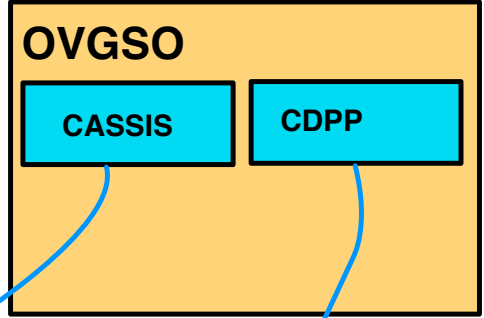
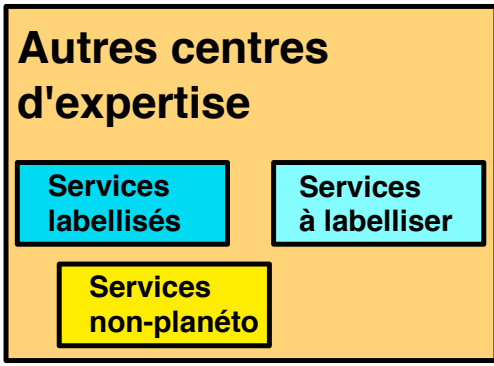
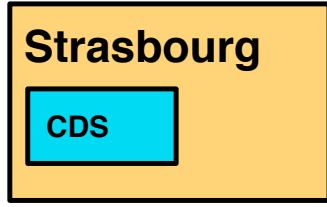
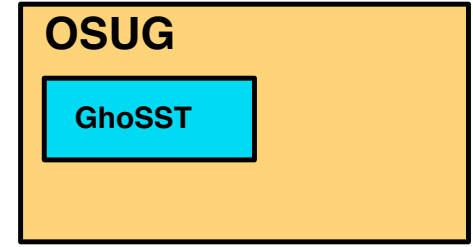
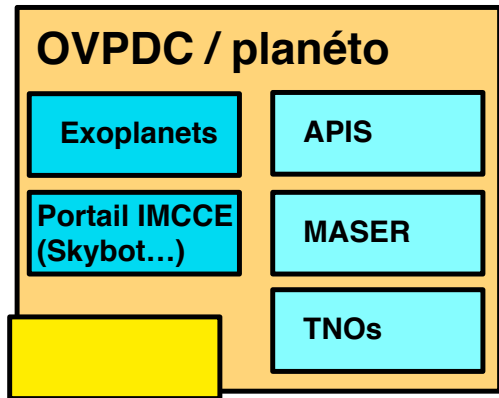
New standards and reference lists + validation
(meetings with IVOA/IPDA/IAU/PDS)

 CDPP, VO-Paris

Enlarging VO content

Organisation nationale





OVPDC / planéto

Exoplanets	APIS
Portail IMCCE (Skybot...)	MASER
	TNOs

Planétologie / VESPA-Fr

OSUG

GhoSST

Strasbourg

CDS

Autres centres d'expertise

Services labellisés	Services à labelliser
Services non-planéto	

OVGSO

CASSIS	CDPP
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Physique solaire

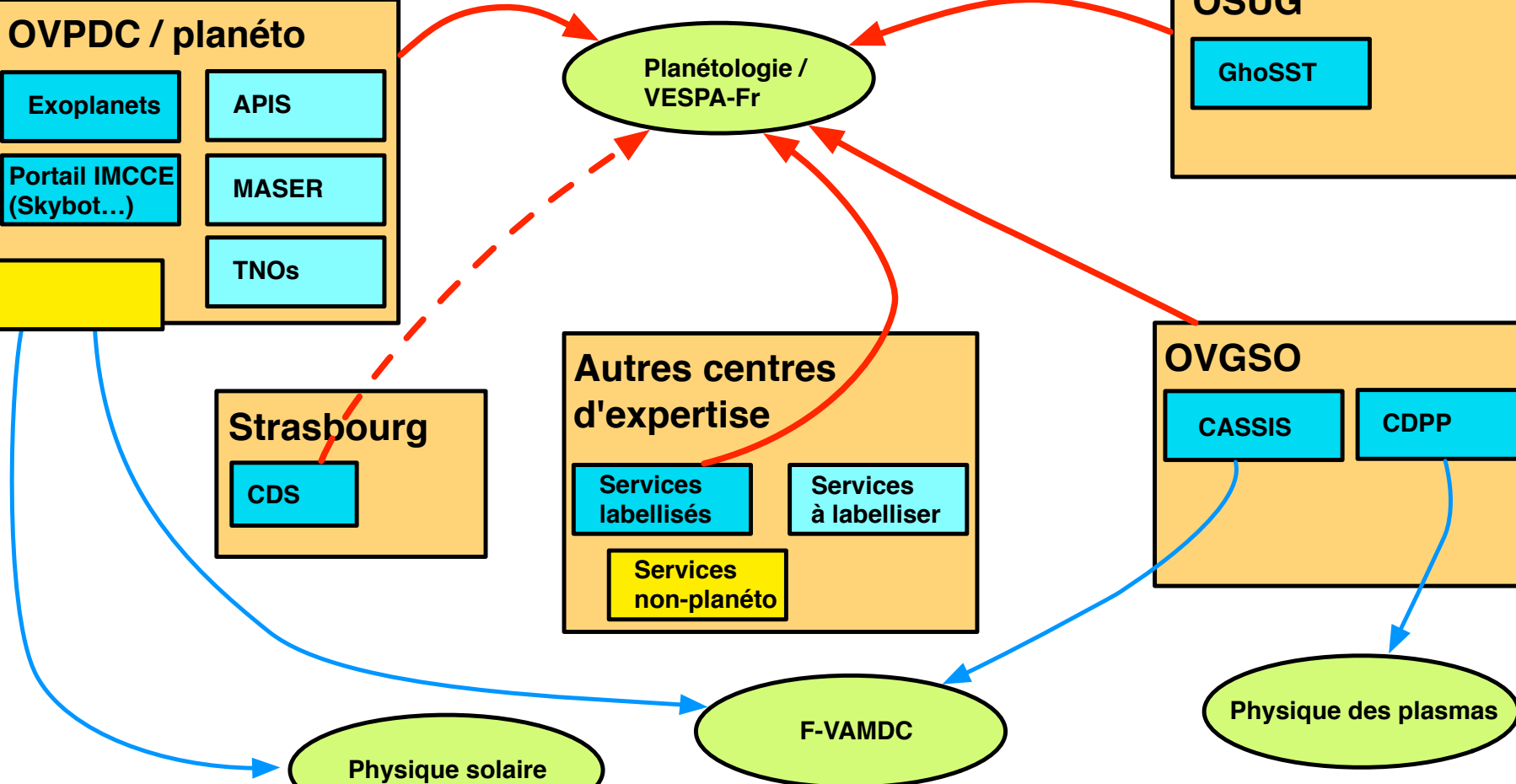
F-VAMDC

Physique des plasmas

Interférométrie

Pôles thématiques nationaux

Centres d'expertise régionaux



Rôle et structure des pôles thématiques

Définition

- Rassemble des services de données *labellisés* dans un domaine
La granularité attendue se déduit des pôles existants

Rôles

- Ouvrir un espace de discussion entre fournisseurs de données
Notamment concertation sur les services à contributions multiples
- Pilotage des services, priorités de développement ?
Pas clair: - Pas de moyens propres
- L'implémentation est dans les centres d'expertise / OSU
- Veiller à l'interopérabilité dans le domaine
 - Registry communs
 - Protocoles compatibles => interface de recherche commune (VESPA)
 - Sortie en VOTable => outils de visu/traitement dispo immédiatement via VESPA

=> Seul moyen de gérer les interfaces thématiques !!
(surfaces/atmosphères, surfaces/petits corps, etc)

Rôle et structure des pôles thématiques

Structure

- Direction: responsable scientifique + chef de projet / adjoint technique
- Comité de gestion (science et administration)
 - Responsables des services labellisés
 - Représentants des centres d'expertise / OSU associés
(fournissant des services de données)
 - Représentant INSU (et/ou PNP, CNES... ?)
- Comité utilisateur
 - 1 ou 2 personnes / sous-thématique planéto ?
Surfaces / Atmosphères / Petits Corps / Exoplanètes / Intérieurs, etc
=> intégrer les fournisseurs de "petits services" (non-labellisables par l'INSU)
 - Correspondants de pôles en interaction ?
Solaire, Plasma, VAMDC ?
 - Ateliers + système de gestion de tickets
Utilisateurs de base

Services de référence en planéto

- Existants:

CDPP, CASSIS (OVGSO)

GhoSST (OSUG DC)

Encyclopédie des planètes extrasolaires, portail IMCCE (VO-Paris)

+ Lien avec services solaires via EPN-TAP => lien avec le pôle solaire ?

- En développement (et proposés à labellisation en 2015):

APIS, TNOs are cool, MASER (VO-Paris)

MP3C (OCA)

+ autres ?

Proposition d'organisation nationale

