EPN2020-RI

Europlanet Research Infrastructure

B. Cecconi
and the VESPA and PSWS teams

EPN2020-RI

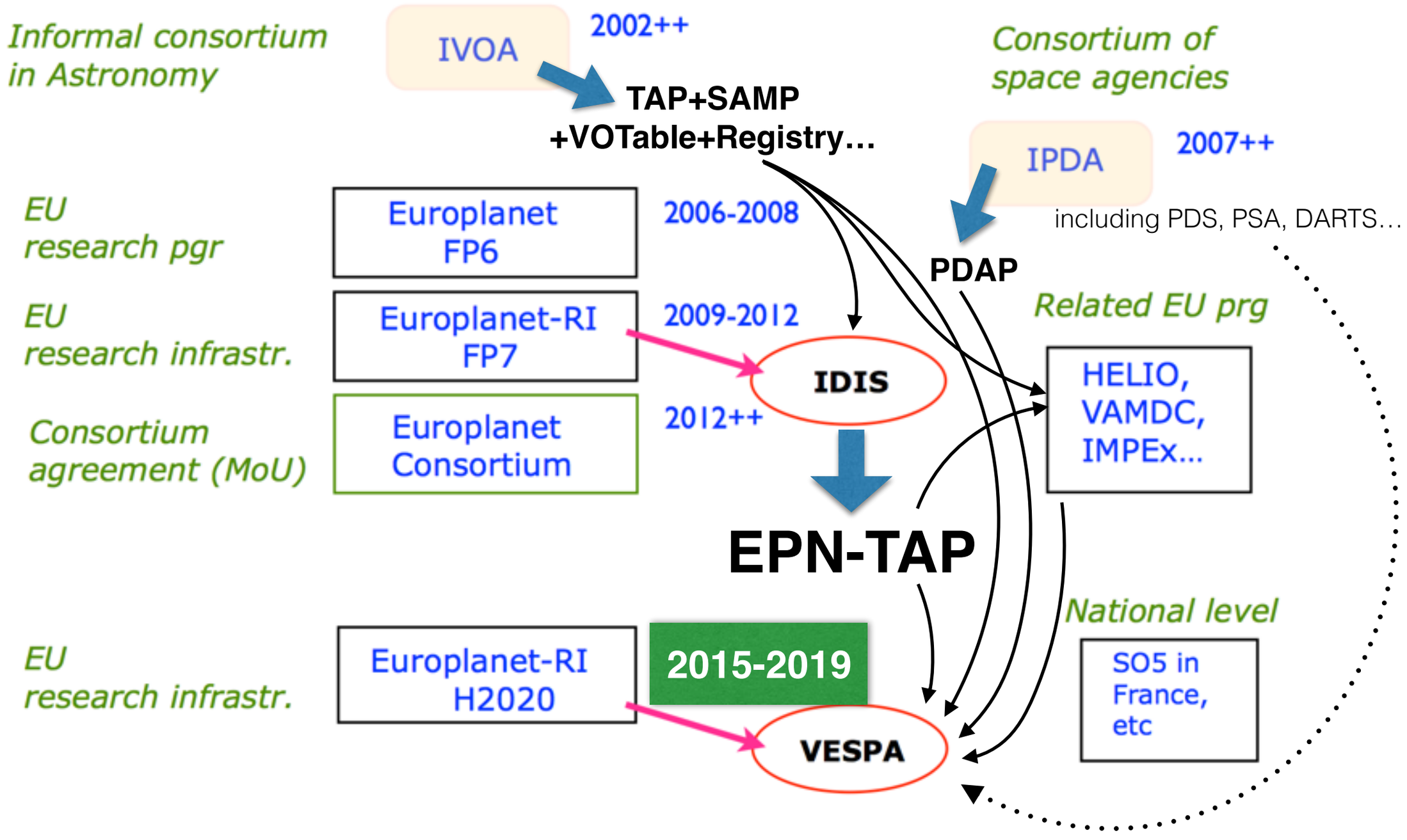
- H2020-Advanced Infrastructures with ~10M€ grant.

- Selected to start in September 2015.
  Kick-Off meeting in Nantes, Sept. 27th 2015.

- Two work-packages are linked to data or event handling and distribution:
  - **VESPA** (Virtual European Solar and Planetary Access)
  - **PSWS** (Planetary Space Weather Service)
  Each of these include JRA (Joint Research Activities) and VA (Virtual Access).

- We plan to use IVOA standards in both work packages.

Short history of the solar system and planetary virtual observatory



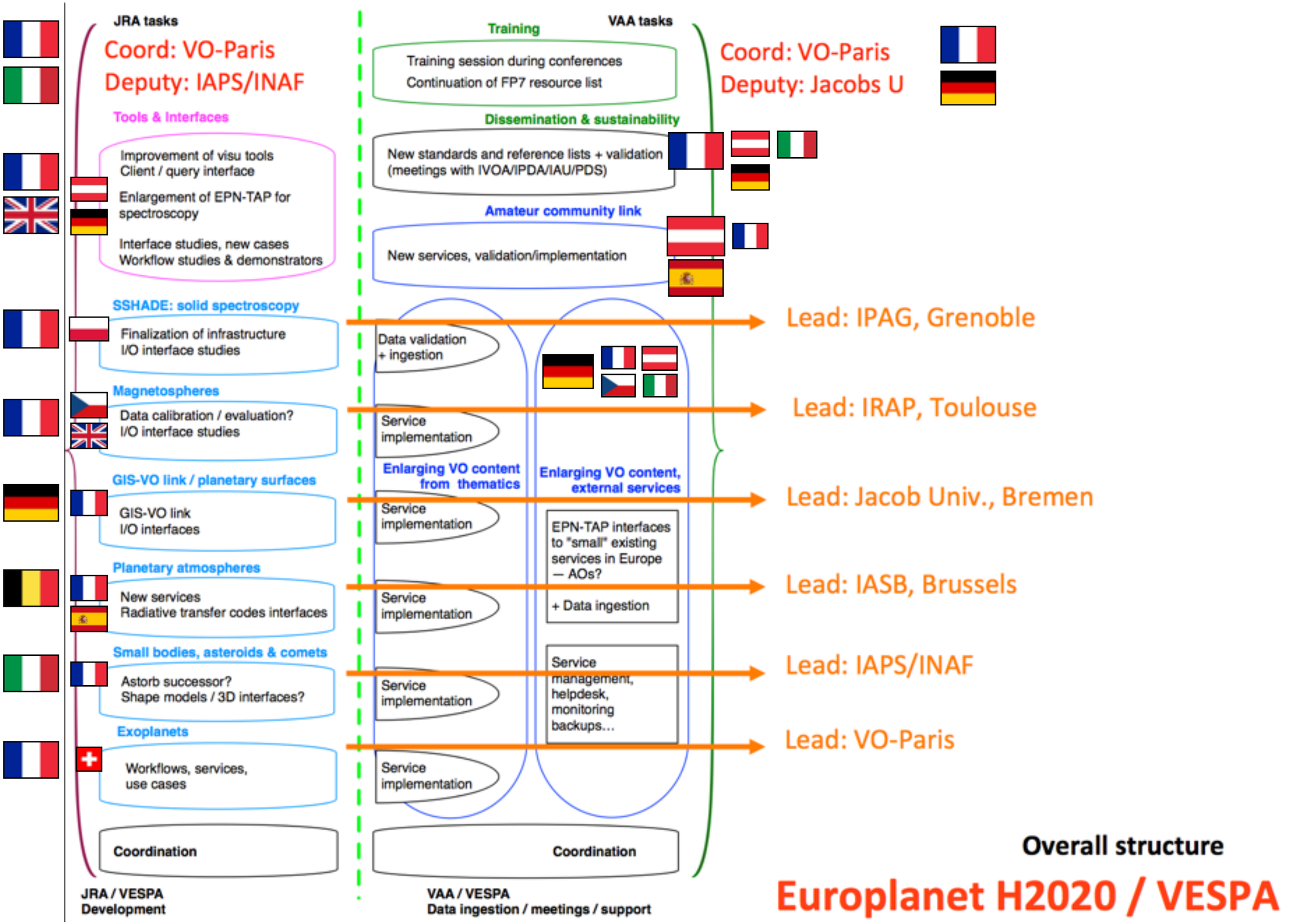
Recent Publications

- Erard, S., B Cecconi, P. Le Sidaner, J. Berthier, F. Henry, C Chauvin, N André, et al. **2014**. "*Planetary Science Virtual Observatory Architecture* ." **Astronomy and Computing** 7-8 (November). Elsevier B.V.: 71–80. doi:10.1016/j.ascom.2014.07.005.

- Erard, S., B Cecconi, P. Le Sidaner, J. Berthier, F. Henry, M Molinaro, M Giardino, et al. **2014**. "*The EPN-TAP Protocol for the Planetary Science Virtual Observatory*." **Astronomy and Computing** 7-8 (August). Elsevier B.V.: 52–61. doi:10.1016/j.ascom.2014.07.008.

- Génot, V, N André, B Cecconi, M Bouchemit, E Budnik, N. Bourrel, M Gangloff, et al. **2014**. "*Joining the Yellow Hub: Uses of the Simple Application Messaging Protocol in Space Physics Analysis Tools* ." **Astronomy and Computing** 7-8 (November). Elsevier B.V.: 62–70. doi:10.1016/j.ascom.2014.07.007.

VESPA work packages



Overall structure

Europlanet H2020 / VESPA

VESPA – Objective & Status

Europlanet-RI FP7

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

Status:
- Infrastructure & demonstrator ready (12 services + interface)
- Uses IVOA standards & tools + IAU references
- Handles all Planetary Science, including exp. work and simus

Europlanet-RI H2020

Objectives:
- Increase accessible content (~50 new data services)
- Adapt existing tools to PS specificities
- Develop automated processing
- Users & providers training

Status:
- 25% of Europlanet proposal, 18 main partners in Europe
- Coordination @ OV-Paris
- Proposal under review, expected kick-off mid-2015

EPN-TAP
EuroPlaNet-Table Access Protocol

- TAP is an IVOA standard: lots of tools for data distribution, query and display.

- TAP = access protocol for tabular data (such as metadata tables of data collections); query language in ADQL (similar to SQL); interoperable output using VOTable.

- EPN-TAP is using a predefined set of column names adapted to planetary sciences (as well as solar and exoplanetary datasets)

- EPN-TAP is complementary to IVOA ObsTAP (astronomical observation TAP), and reuses some of its keywords.

EPN-TAP keywords

- 19 mandatory set of query keywords: *spatial range, spectral range, temporal range, spatial resolution, spectral resolution, temporal resolution, target name, target type, data type, processing level, physical parameter, observatory name and type, instrument name*…
  Response keywords: *access url, access format, preview url*…

- any additional keywords allowed
  - new mandatory keywords under study, as derived by recent implantation tests
  - optional metadata (easy extension with predefined keywords, e.g. species)
  - additional metadata: specific to each services.
  - reuse of ObsTAP keywords when possible for better interoperability
  - **See Presentation during DM session**

PDAP vs EPN-TAP

- PDAP (Planetary Data Access Protocol), developed by IPDA (mainly by J. Salgado at ESAC).
  Currently implemented by ESA/PSA and JAXA/DARTS

PDAP-core Query Keywords (V1.0 2011-Nov-09)	**EPNcore Query Keywords**
RESOURCE_CLASS -	- ~~RESOURCE_TYPE~~
	- ***DATAPRODUCT_TYPE*** (from list)
TARGET_NAME -	- TARGET_NAME
TARGET_TYPE -	- TARGET_CLASS (from list)
START_TIME/STOP_TIME -	- TIME (MIN/MAX)
TIME_SERIES EXTENSION ?	- ***SAMPLING STEP*** (MIN/MAX)
	- ***EXPOSURE TIME*** (MIN/MAX)
[WAVELENGTH] -	- SPECTRAL RANGE (MIN/MAX)
SPECTRUM EXTENSION ?	- ***SPECTRAL SAMPLING*** (MIN/MAX)
	- ***SPECTRAL RESOLUTION*** (MIN/MAX)
[SPACECRAFT_ALTITUDE] -	- SPATIAL RANGE (C1,C2,C3) (MIN/MAX)
FLY-BY EXTENSION ?	- ***SPATIAL RESOLUTION*** (MIN/MAX)
	- ***SPATIAL FRAME TYPE*** (from list)
	- ***INCIDENCE ANGLE*** (MIN/MAX)
	- ***EMERGENCE ANGLE*** (MIN/MAX)
INSTRUMENT_NAME -	- INSTRUMENT HOST NAME
INSTRUMENT_HOST_NAME -	- INSTRUMENT NAME
INSTRUMENT_TYPE -	- MEASUREMENT TYPE
RETURN_TYPE -	***(always VOTable)***

OBScore vs EPNcore

- ObsCore = observations in astronomy
- EPNcore = observations in solar system

EPNcore	ObsCore
resource_type	
dataproduct_type	**dataproduct_type**
target_name	**target_name**
target_class	
time_min	t_min
time_max	t_max
time_scale	
time_sampling_step_min	t_resolution
time_sampling_step_max	
time_exp_min	t_exptime
time_exp_max	
spectral_range_min	em_min
spectral_range_max	em_max
spectral_sampling_step_min	
spectral_sampling_step_max	
spectral_resolution_min	
spectral_resolution_min	
c1min	
c1max	
c2min	
c2max	
c3min	
c3max	

EPNcore	ObsCore
c1_resol_min	s_resolution
c1_resol_max	
c2_resol_min	
c2_resol_max	
c3_resol_min	
c3_resol_max	
spatial_frame_type	(default=RA,DEC)
incidence_min	
incidence_max	
emergence_min	
emergence_max	
phase_min	
phase_max	
instrument_host_name	
instrument_name	
measurement_type	o_ucd
granule_gid	obs_collection
processing_level	calib_level
granule_uid	obs_id
	obs_publisher_did
access_url	access_url
access_format	access_format
access_estsize	access_estsize

EPNcore	ObsCore
preview_url	
thumbnail_url	
file_name	
species	
	s_fov
ra	s_ra
dec	s_dec
	s_region
	em_res_power
target_region	
target_element	
solar_longitude	
local_time	
target_distance	
particle_spectral_type	
particle_spectral_range_min	
particle_spectral_range_max	
particle_spectral_sampling_step_min	
particle_spectral_sampling_step_max	
particle_spectral_resolution_min	
particle_spectral_resolution_max	
spatial_coordinate_description	
spatial_origin	
time_origin	
time_scale	

DaCHS
EPN-TAP server framework

- DaCHS = Data Center Helper Suite. Developed by Markus Demleitner (Univ. Heidelberg, German Astronomical VO). Software package available can be installed on a debian linux virtual machine, and contains everything needed for a TAP service. Internal database is PgSQL. Includes a self-publishing registry.

- Current improvements:
  - native implementation of EPN-TAP
  - automated database construction from a series of FITS files or PDS files. Soon for a series of CDF files.

- Used at VOPDC (Paris, France) for planetary data and solar data, Observatory of Nançay (Nançay, France), CDPP (Toulouse, France) and Graz (Austria)
  NB: INAF (Rome, Italy) is using another framework (VODance) but it seems to be less stable and more difficult to update.

EPN-TAP set up in short

- Install an IVOA TAP server.
  DaCHS framework is very easy to set up.

- Build your SQL EPNcore table (= metadata + access URL table) or use built-in capabilities of DaCHS.

- Register your service at IVOA (at ESAC, for instance), or use self-publishing registry feature of DaCHS

- Enjoy!

- *NB: VESPA is planning **annual open calls** for teams who wants help for EPN-TAP server set up.*
  Depending on database complexity, 1 to 3 PM are needed to this task.
  Local server also needed on the long term (hosting in VESPA institutes is possible, but not encouraged).

Services currently available in VESPA

http://vespa.obpsm.fr

- **EPN-TAP services**
  - **Public services at VO-Paris**
    - **APIS**: Aurorae images/spectra database (from HST)
    - **BDIP**: Historical planetary images in Meudon (ground-based)
    - **Encyclopedia of Extra Solar Planets** (compilation of published data)
    - **Atmospheric profiles of Titan** (Cassini/CIRS occultations)
    - **IKS / Halley** (Vega-I data)
    - **Solar Feature Catalog** (from HELIO program)
  - **Projects at VO-Paris**
    - **TNO** data compilation
    - **VIRTIS/VEx & /Rosetta** database (metadata, with URLs @ PSA)
    - **RadioJOVE** amateur radio data
    - **BASS2000** solar observation database
  - **Other services in development**
    - Rome (dust), Toulouse (CDPP), Graz (VEx/MAG, IMPEx database), Nançay (Decameter Array, Solar database…), Tohoku Univ. (Jupiter data, Japan), Switzerland (solar radio data: E-Callisto), ESA/PSA
- **Space data centres** accessible by VESPA (via **PDAP**)
  - **ESA/PSA** and **JAXA/DARTS** archives

Training for users and providers

- Twice per year: **user training splinters** at EGU and EPSC (VO tools)

- Each year: **Open AO for external providers** (non-EPN) to set up DaCHS server and EPN-TAP service on their datasets

- 4 implementation workshops (Toulouse, Rome, Graz, Prague) to help 4-5 data providers each time.

- ~25 new data providers at end of EPN2020-RI program + as many form insider teams

Tools and interfaces

- **SAMP**:
  - new message types will be proposed after assessment of planetary science based use cases (e.g. PDS data cubes, images, spectrum, catalogs; geojson…)

- **TOPCAT**:
  - Time plot “hidden” feature very useful (to be enhanced, e.g.: Y axis for spectrograms)
  - Action configuration: load VOTable in URL column ?
  - Enhanced STILTS/TOPCAT scripting (use of params, column-wise statistics…)

- **Aladin**:
  - Adding planetary images display features

- **Spectral tools**:
  - work with: CASSIS, VOSpec, Specview…
  - interface with VAMDC for atomic and molecular states and emission lines

- **TAP/ADQL** needs from planetary community:
  - upper/lower case (in all TAP servers)
  - multi-valued field listing separator (solution will be proposed to IVOA)

- **Data Model**
  - EPNcore DM
  - VOFacility

Amateur community linking

- Planetary observations by amateurs
  - Spain (PVOL)
- Directory of amateur observatories
  - Austria (EPN-RI JRA3)
- Radio Amateur observations
  - France (coordination with RadioJOVE from USA)

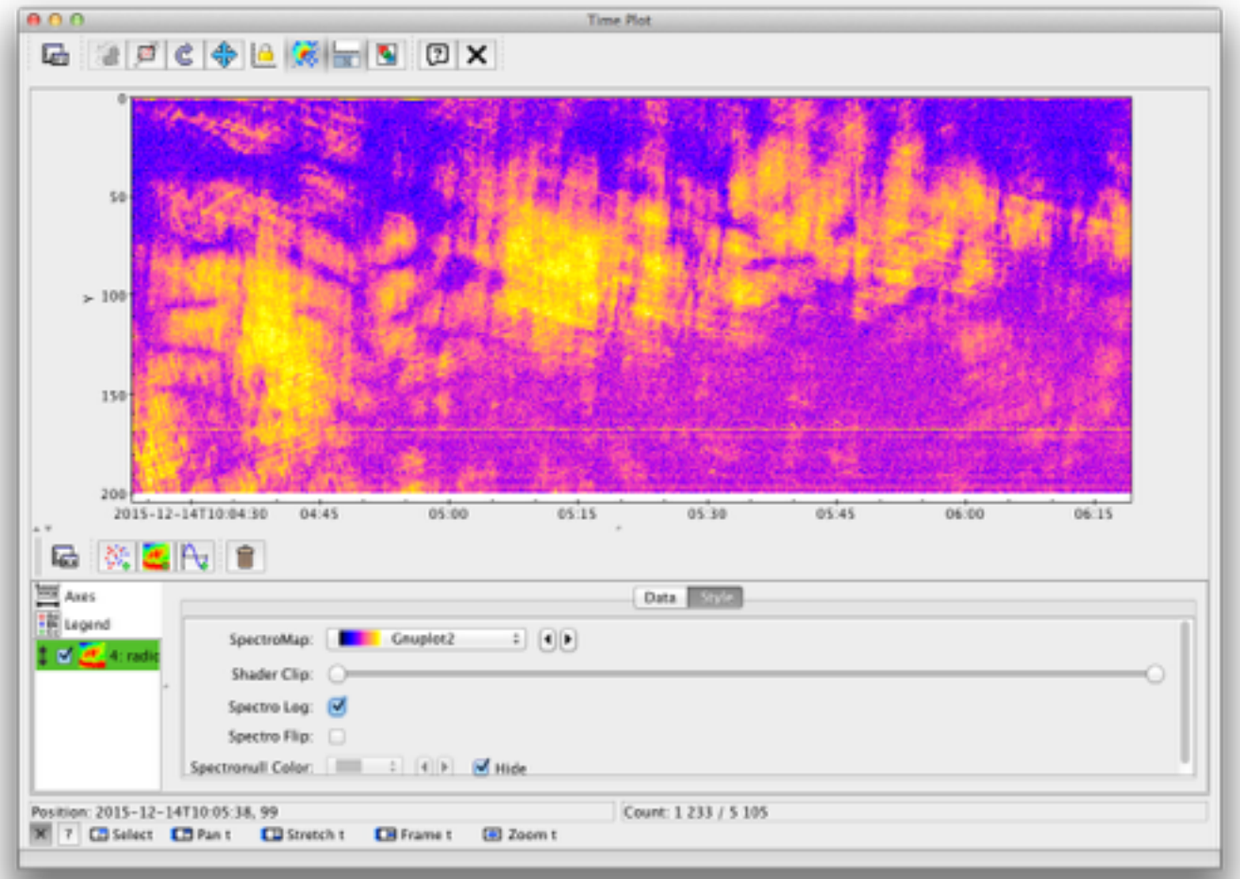
- Coordination on data formats and metadata:
  - FITS for images; CDF for radio
  - VESPA metadata
- Data validation
- Data distribution
  - VESPA EPN-TAP
- All services using IVOA registry

Amateur community linking RadioJOVE Example

- Data translated into CDF with VESPA metadata

The VOParis team has built a data format translator that produces CDF files, including additional metadata. Those CDF files are ISTP compliant (required for HPDE and SPDF interoperability), PDS4 compliant (required for PDS archiving) and VESPA compliant. These CDF files can be loaded into plotting software for rapid data display. Here an example of data loaded in TOPCAT:

Picture of RadioJOVE antennas © Radio-JOVE/GSFC

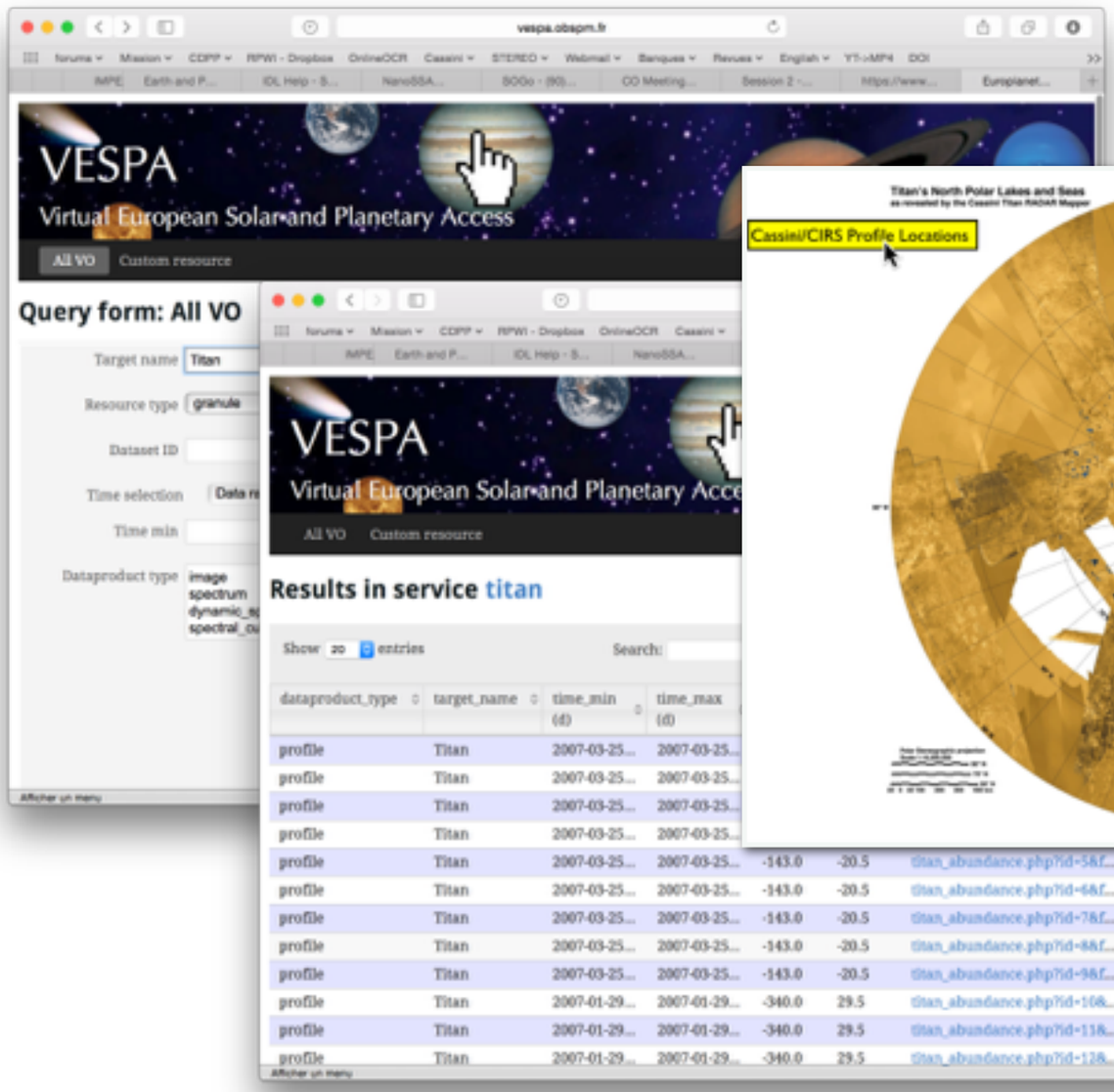


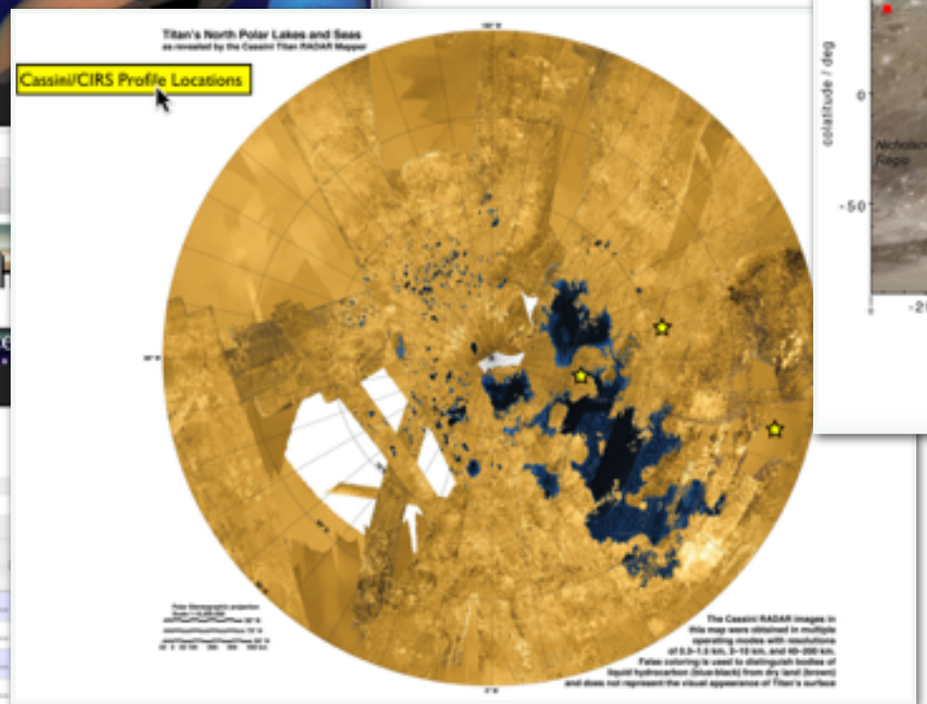
Amateur community linking RadioJOVE Example

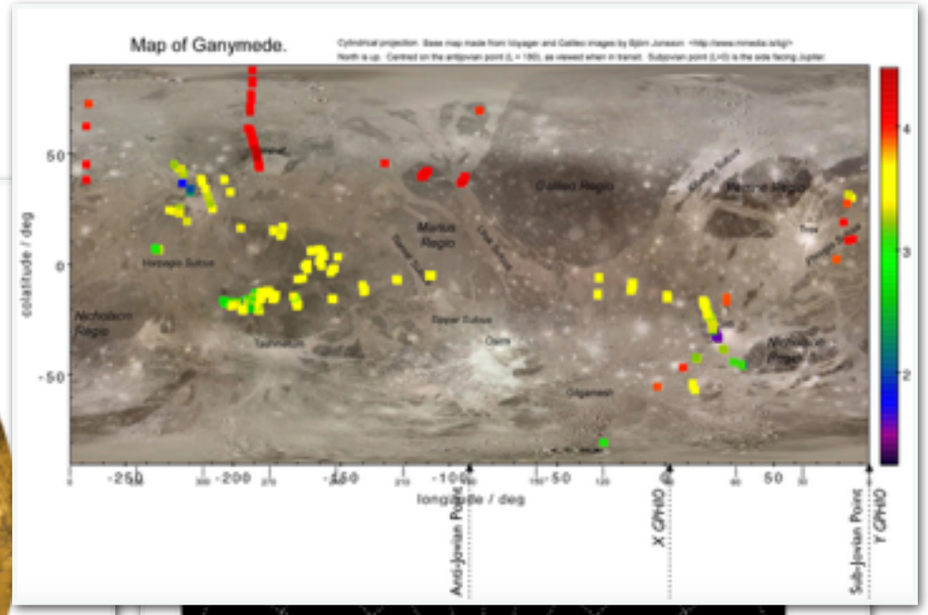
- Draft service for RadioJOVE with validation stage
- Coordination with NASA/JUNO ground observation support team
- See talk in Application session

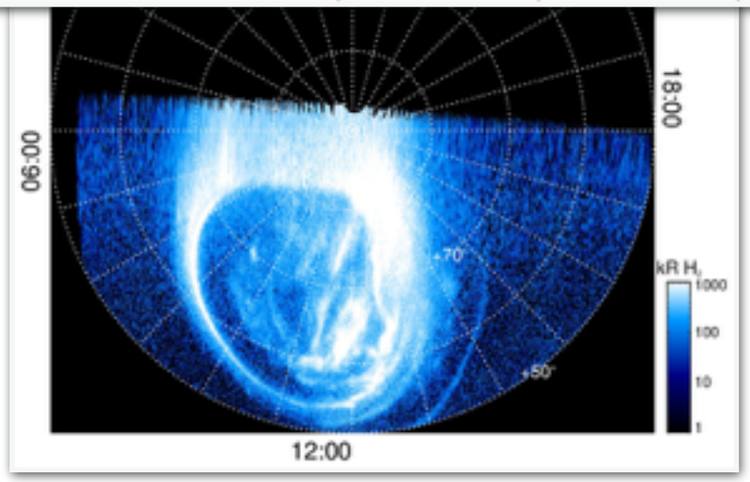
Link with OGC/GIS (planetary surfaces)

- Planetary-GIS Workshop (Madrid, May 2015), BCecconi and APRossi in SOC
- Community discussions: https://openplanetary.slack.com/









Imaginary Interface

Send access_url using SAMP to TOPCAT +some editing

Cassini/CIRS Profile Locations

Titan's North Polar Lakes and Seas
as revealed by the Cassini Titan RADAR Mapper

180° W
90° W
270° W
0° W
80°N
70°N

Cassini/CIRS@LESIA
Titan GCM@LMD

Titan GCM Database from LMD
Solar Long

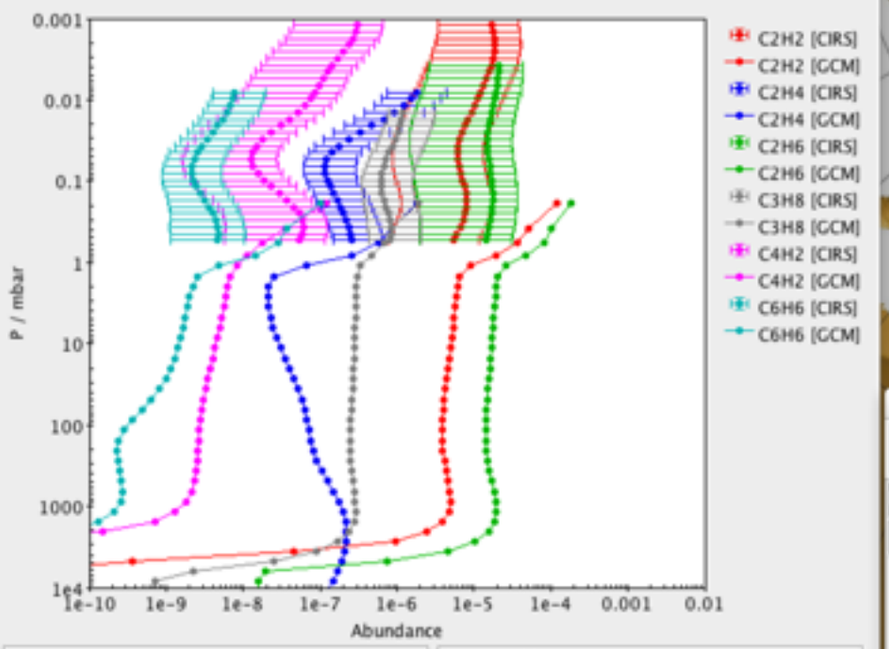
Select Profile:

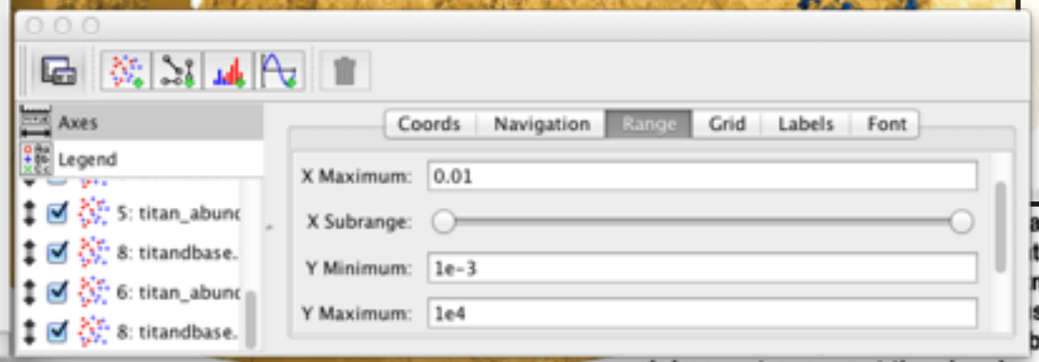
- ☐ ✓
- ☐ ✓ ✓
- ☐ ✓ ✓ ✓
- ☐ HCN
- ☐

select all

Display Profiles
Retrieve Dataset

Plane Plot





ap were obtained in multiple
ting modes with resolutions
m, 2–10 km, and 40–200 km.
sed to distinguish bodies of
black) from dry land (brown)
and does not represent the visual appearance of Titan's surface

Workflows and computing services

- Studying workflows (following HELIO developments): MSSL involved.
  Assessment of PDL for automated interfacing
  Using UWS for job management.

- Adding interoperable interfaces on existing services:
  - **VOISE**: VOronoi Image SEgmentation, dynamic decomposition of images.
  - **H3PCool**: calculate the cooling by H^{3+} in an atmosphere consisting primarily of molecular hydrogen, H_2 (giant planets).
  - **SMA**: spectral matrix wave analyzer (poynting flux and polarization of low frequency waves)

- Other services planned:
  - Radiative transfer codes for planetary atmospheres
  - **ARTEMIS-P**: Anisotropic Ray Tracer for Electromagnetism in Magnetospheres, Ionospheres and Solar Wind, including Polarization.

Standard nomenclatures for observatories and instruments

- On-going work started as an IPDA-IVOA task.

- First steps:
  - compilation of list of named spacecraft and ids
  - same for ground based observatories
  - VOFacility DM extending from VOResource.

- See talk in Semantics session (Thursday morning)

Used names	NAIF/SPICE id	NSSDC id	SANA id	PDS/PSA id
Cassini Cassini-Huygens Cassini Orbiter	-82	1997-061A	52	CO
Mars-Express MARS-EXP-ORB MEx	-41	2003-022A	37	mex
WIND	-8	1994-071A	?	—
Rosetta	-226	2004-006A	97	—
Hubble Space Telescope HST	-48	1990-037B	?	—
SOHO	-21	1995-065A	15	—
MAVEN	-202	2013-063A	8CA	?

PSWS-VOEvent

- PSWS: Planetary Space Weather Services
  lead = N. André (Toulouse), M. Grande (Aberystwyth)

- Building an alert service for planetary space weather.
  Predictions of:
  - solar wind events
  - planetary atmosphere features
  - meteoroids showers on planets
  - radiation dose predictions

- Assessment of VOEvent for planetary space weather events (and links with twitter for amateurs)

Summary

- Implementation of new VESPA services
  - using EPN-TAP, all registered in IVOA registry.
  - including amateur community
  - data provider implementation workshops
  - user training workshops

- Linking with other VO communities:
  - Planetary surfaces (GIS)
  - Heliophysics (SPASE / IMPEx)

- Testing IVOA technologies for
  - event triggering (VOEvent)
  - workflow and job management

- Standard nomenclature for observatories / facilities