Planetary Data Focus Session

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Main Planetary Sciences Groups and Standards

- IPDA: International Planetary Data Alliance
  http://planetarydata.org

- SPASE: Space Physics Archive Search and Extract
  http://spase-group.org

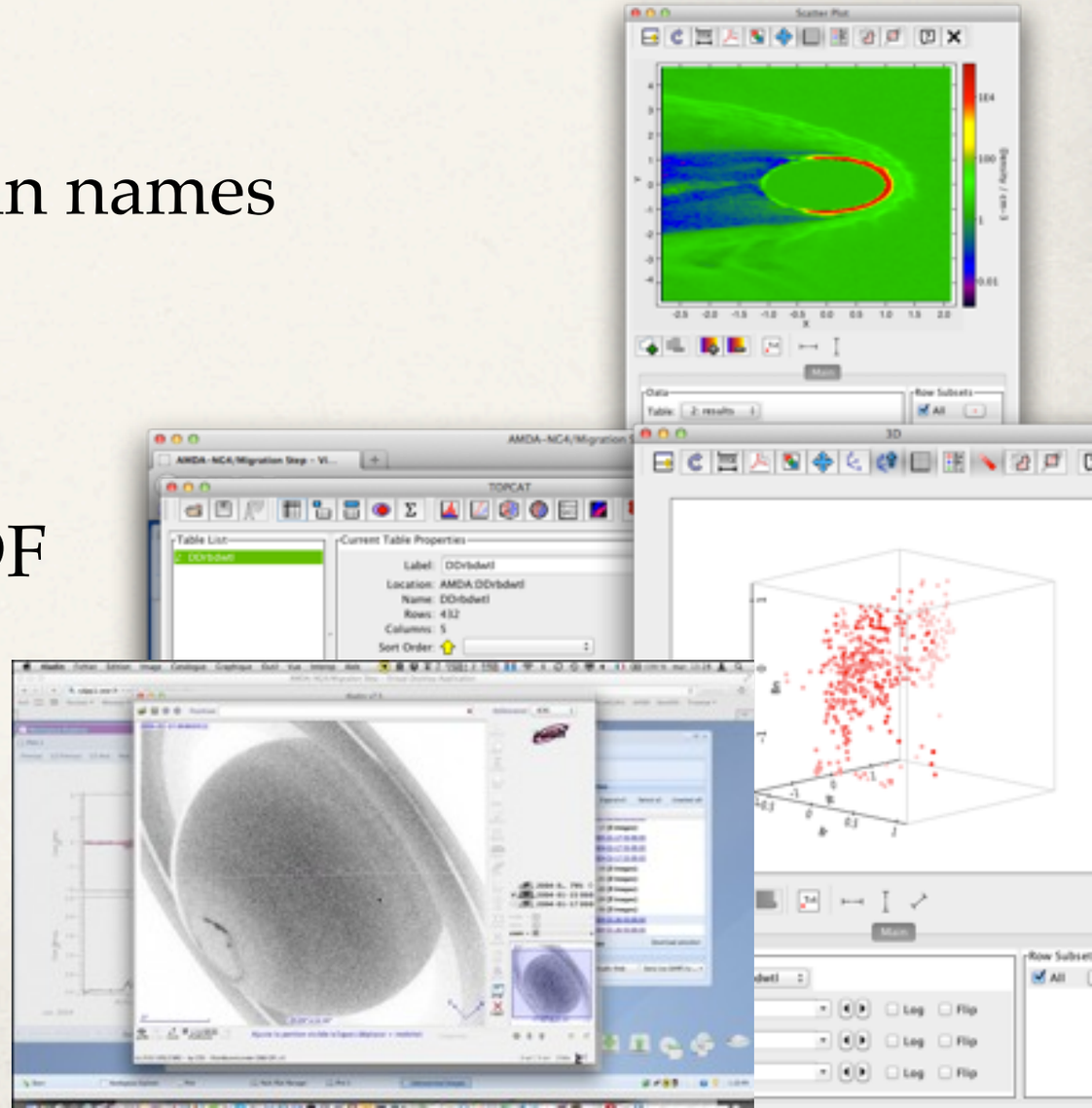
- PDS: NASA Planetary Data System
  https://pds.jpl.nasa.gov

- EPN: Europlanet (EU project)
  http://voparis-europlanet.obspm.fr/Tdocum.shtml

- IMPEx: Integrated Medium for Planetary Exploration (EU Project)
  http://impex-fp7.oeaw.ac.at

Discussions on Planetary Sciences in recent IVOA Interops

- Many presentations since 2012 (Urbana) in App, Semantics, DaM and DAL sessions.
- EPN-TAP = TAP with specific column names
- Use of SAMP and TOPCAT
- Evolution of TOPCAT to include CDF
- A lot of Demo
- New set of UCDs proposed



IVOA/IPDA Collaboration Study
after Heidelberg Interop + IPDA Paris Meeting

- **Mid-2013, IVOA and IPDA proposed to study possible interactions.**

- **Authors**

- Baptiste Cecconi	Obs. Paris/CNES
- Christophe Arviset	ESA/ESAC
- Stéphane Erard	LESIA/VO-Paris
- Nicolas André	IRAP/CNRS
- Chuck Acton	NASA/PDS/NAIF
- Jean Aboudarham	LESIA/VO-Paris
- Benoît Carry	IMCCE/VO-Paris
- Mireille Louys	CDS/Univ. Strasbourg
- Chiara Marmo	IDES/Univ. Paris Sud
- Angelo Pio Rossi	Jacobs Univ. Bremen
- Florian Topf	Austrian Acad. Science
- Enrique Solano	CAB/INTA-CSIC
- Maria Teresa Capria	INAF/IASF
- Dan Crichton	NASA/PDS
- Todd King	UCLA/SPASE/PDS

- Link to document

- **14 topics identified**:
  - *Standard List Coordinate Systems and Reference Frame*
  - *Standardization of observation geometry*
  - *Link with EuroPlaNet developments*
  - *Extension of IVOA Cone Search to moving targets*
  - *Standard List of Ground based Observatories*
  - *Standard List of Space based Missions*
  - *Link with ESO planetary images (same with HST database or else)*
  - *Cross-matching of registries*
  - *Promoting and extending SAMP*
  - *Extending IVOA Data Models and Semantics to Planetary Sciences*
  - *Proposing new serialization examples in IVOA standards for format used in planetary sciences*
  - *FITS keyword standardization for Planetary targets*
  - *Implementation of IVOA standards in MPC*
  - *Exoplanets*

Standard Lists and Semantics

- **Continued**
  - UCD for solar system sciences. *See next session's talk: B. Cecconi et al.*
- **New**
  - List of planetary coordinate systems + description/reference
    - Inputs expected from SPASE, IPDA, EPN, IMPEx
    - Merged by IPDA
    - Endorsed by IAU
    - Instantiated in STC by IVOA
  - List of Ground Based Observatories
    - Inputs expected from IVOA/IAU
    - Endorsed by IAU
  - List of Space Missions
    - Inputs expected from SPASE [Space Physics], IPDA [Planetary], IVOA [Astronomy]
    - Merged + endorsed by IPDA

Formats and Descriptors

- New serialization examples
  - *For instance: netCDF, CDF, HDF5...*

```
<PARAM value="5.6" datatype="float" name="Minimum Frequency" unit="Hz" ucd="em.freq"
  utype="spec:Char.SpectralAxis.Coverage.Bounds.Range.Min"/>
```

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  <PARAM value="Frequency" datatype="char" arraysize="*" name="Spect
   utype="spec:Char.SpectralAxis.Name"/>
  <PARAM datatype="int" name="Number of Frequencies" ucd="meta.num
   utype="spec:Length"/>
  <PARAM value="5.6" datatype="float" name="Minimum Frequency" unit=
   utype="spec:Char.SpectralAxis.Coverage.Bounds.Range.Min"/>
  <PARAM value="5.6" datatype="float" name="Maximum Frequency" unit
   utype="spec:Char.SpectralAxis.Coverage.Bounds.Range.Max"/>
  <PARAM datatype="float" name="Frequency" unit="Hz" ucd="em.freq" a
   utype="spec:Char.SpectralAxis.Coverage.Location.Value"
   value="5.60000  7.46772  9.95836  13.2797  17.7088  23.6150  31.491
          56.0000  74.6772  99.5836  132.797  177.088  236.150  314.911
          560.000  746.772  995.836  1327.97  1770.88  2361.50  3149.11
          5600.00  7467.72  9958.36  13279.7  17708.8  23615.0  31491.1
          56000.0  74677.2  99583.6  132797.  177088.  236150.  314911. 419941.
          560000.  746772.  995836.  1.32797e+06  1.77088e+06  2.36150e+06  3.14911e+06  4.19941e+06
          5.60000e+06"/>
...
```

VOtable

```
<?xml version="1.0" encoding="UTF-8"?>
<netcdf xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns="http://www.unidata.ucar.edu/namespaces/netcdf/ncml-2.2"
    xmlns:thredds="http://www.unidata.ucar.edu/namespaces/thredds/InvCatalog/v1.0"
    xsi:schemaLocation="http://www.unidata.ucar.edu/namespaces/netcdf/ncml-2.2 http://www.unidata.ucar.edu/schemas/netcdf/ncml-2.2.xsd http://
www.unidata.ucar.edu/namespaces/thredds/InvCatalog/v1.0 http://www.unidata.ucar.edu/schemas/thredds/InvCatalog.1.0.2.xsd">
    <dimension name="dim_freq" length="49"/>
    <dimension name="dim_1" length="1"/>
```

```
<variable name="Minimum Frequency" type="double" shape="dim_1">
    <attribute name="utype">spec:Char.SpectralAxis.Coverage.Bounds.Range.Min</attribute>
    <attribute name="unit">Hz</attribute>
    <attribute name="ucd">em.freq;stat.min</attribute>
    <values>5.6</values>
</variable>
```

```
Range.Min</attribute>
    <attribute name="ucd">em.freq;stat.min</attribute>
    <values>5.6</values>
    560000. 746772. 995836. 1.32797e+06 1.77088e+06 2.36150e+06 3.14911e+06 4.19941e+06
    5.60000e+06</values>
  </variable>
...
```

ncml

- New FITS keywords: *See Marmo et al. (given by Stéphane Erard)*

- Description of Geometry of Observation
  - *Description of orientation, location for observer and target, viewing angles...*
  - *Input documentation from IPDA/PDS group*
  - *to be used in IVOA standards (STC, ObsTAP...)*

Protocols

- **Existing**
  - EPN-TAP as a standard for planetary data discovery
    - EPNcore data model: to be proposed soon to IVOA DaM (by P. Le Sidaner)
    - complementary with ObsTAP (not competing!!): we also need ObsTAP to be able to find background stars for calibrations or occultations.
    - EPN-TAP client: VESPA (Virtual European Solar and Planetary Access)
  - SAMP
    - Ready to use and very powerful: spread the word !
- **New**
  - «MovingConeSearch»
    - What ? extension of ConeSearch with «moving target» = named solar system object; i.e., ConeSearch with RA(t),Dec(t).
    - Use cases, ideas and implementation examples to be proposed.

Sharing planetary data from Astronomy Repositories

- Cross-matching registry records
  - On going project for PDS/SPASE (planetary magnetospheres)
  - Join with VOResource (as used for EPN-TAP)
  -Advantage:
- ESO images of planets
  - A lot of planetary images are present in ESO archive. Difficult to search (only keyword based in title or abstract)
  - Push ESO to add keywords/protocols and open public data.
- Exoplanet datasets from astronomical observatories
  - Exoplanet datasets are produced by astronomical missions/observatories.
  - Comparison with solar system planets not easy: not the same standards.
  - Implementation of planetary science standards on these databases to be studied.
- Minor planets
  - MPC (Minor Planet Center) is proposing to adopt IVOA interfaces (incl. EPN-TAP)

Summary Table for IVOA/IPDA standards and other groups

#	Title	IPDA Standard	IPDA Project	IVOA Standard	IVOA WG	Other Group
1	***Standard List Coordinate Systems and Reference Frame***	PDS4	Geometry	STC	DaM	IAU, SPASE, EPN
2	***Standardization of observation geometry***	PDS4	Geometry	STC, ObsTAP	DAL, DaM	IAU, NAIF
3	***Link with Europlanet developments***	none yet		TAP, SAMP, VOTable	DAL, App, ReR	SPASE, EPN
4	***Extension of IVOA ConeSearch for moving targets***			ConeSearch	DAL	EPN
5	***Standard List of Ground Based Observatories***	PDS4	PDS4 Implementation	ivo-id	Semantics, ReR	EPN
6	***Standard List of Space Missions***	PDS4	PDS4 Implementation	ivo-id	Semantics, ReR	SPASE, NAIF, NSSDC
7	***Link with ESO planetary images (same with HST database or else)***			ObsTAP	DAL	ESO, HST...
8	***Cross-matching of registries***	PDS4	PDS4 Registry	ivo-id, VOResource	ReR	SPASE, EPN, IMPEx
9	***Promoting and extending SAMP***			SAMP	App	SPASE, EPN, IMPEx
10	***Extending IVOA Data Models and Semantics for Planetary Sciences***	PDS4	PDS4 Implementation	UCD, VOResource, Char, STC...	DaM, ReR...	EPN
11	***Proposing new serialization examples in IVOA standards***	PDS4	PDS4 Implementation	SpectrumDM, ImageDM...	DAL, DaM	EPN, SPASE
12	***FITS keyword standardization for Planetary Targets***	PDS4	PDS4 Implementation	FITS, STC	DAL, DaM	EPN
13	***Implementation of IVOA Standards on MPC***			VOTable, ConeSearch, SAMP	App, DAL	IAU
14	***Exoplanets***	none yet	none yet	ObsTAP, SAMP, STC...	DAL, DaM	EPN

Other ideas from this last 2 days

- SIAv2
  It can be used for planetary sciences, but we would need 1 extra keyword «RefFrame» which states which reference frame and coordinate system is used for the request. For astronomy applications, sky coordinates in J2000 is always assumed.

- ESA team knows how to implement TAP (see Gaia archive).
  Would it be possible to set up an EPN-TAP server on top of PSA (ESA-Planetary Science Archive) ?

- Link with big repositories containing planetary observations (e.g.: LOFAR with Jovian observations)
  We should investigate how to help them efficiently sharing planetary data.

- QuickViz plugin for Aladin: *SAMPify it !*

Presentations

Time	Speaker	Topic	Materials
Wednesday 10h-11h30			
10h00	Baptiste Cecconi	Introduction and presentation of the IPDA/IVOA interaction study (10 min)	
10h10	Stéphane Erard	Planetary VO infrastructure, and plans for a future Europlanet program (10 min)	
10h20	Cyril Chauvin	Deployment feedback on IVOA standards (TAP, SAMP, etc) for Planetary Sciences (7 min)	
10h27	Pierre Le Sidaner	IVOA Registry for Planetary Sciences (7 min)	
10h34	Chiara Marmo (Stéphane)	Planetary FITS (7 min)	
10h41	Alain Sarkissian	Report on IPDA activities (10 min)	
10h51	Dave Heather	Report on PSA and PSA-UG activities (10 min)	
11h01	All	Panel Discussion	