

EPNcore vocabulary extension for Small Bodies

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Context

1) EPN-TAP v2.0 Recommendation, 22/8/2022

- Updates rely on thematic extensions, to be agreed with data providers:
 - New parameters + associated values
 - Included in next version
- **EPN-TAP v2.1 in progress**
 - Currently based on 94 published / validated data services
 - ~ 290 services declared in the registry

2) **Small bodies data & service center** — CNES/CNRS-INSU (France)

- Mapping existing vocabularies to a pivot format
 - => EPNCore, PDS4, SsODNet, JPL SBDb, MP3C (TAP table)

Europlanet VESPA: Data services connected via EPN-TAP / field

Open
Open in test | upgrade required
Drafted
Scheduled in 2025 (selection)
• New or upgraded in 2023/24
• New content in 2023/24

Atmospheres

- Titan profiles - CIRS (Cassini, LESIA)
- - Venus spectroscopy - VIRTIS (VEx, LESIA)
- - Mars & Venus Climate Databases (modeling, LMD)
 - GEM_Mars (modeling, IASB-BIRA)
- - Venus profiles - SPICAV/SOIR (VEx, IASB-BIRA)
- - Mars profiles - SPICAM (MEx, LATMOS)
- - Mars profiles - NOMAD (TGO, BIRA-IASB)
 - Venus cloud products (LATMOS)

Small bodies

- - MPCorb: Small bodies orbital cat (MPC/Heidelberg)
- - NEOCC: asteroid properties (ESA/ESRIN)
- - MP3C: Small body properties (OCA)
- - DynAstVO: NEO refined parameters (IMCCE)
- - Asteroid spectra + PDS SBN collections (CDS / LESIA)
- - M4ast (ground based spectroscopy, IMCCE)
- - Spectro_m_ast & Spectro_trojans (converted PDS4)
 - TNOs are cool (Herchel & Spitzer LESIA/LAM/Utinam)
 - SBNAF (from H2020 prog, Konkoly Obs)
 - Vesta & Ceres spectroscopy - VIR/DAWN (IAPS)
 - 1P/Halley spectroscopy (IKS / Vega-1, LESIA)
 - BaseCom (Nançay Obs, LESIA)
- - BAA comet section (UK)
- 67P illumination config (IRAP)
- Meteor_showers predictions (IMCCE)
- - Occultations predictions by sat. (IMCCE)
 - LuckyStar, occultations (ERC prog, LESIA)
- - Natural satellites db (IMCCE)
- - VIRTIS Rosetta at 67P (LESIA/PADC)
- - Recalibrated VIRTIS-M at 67P (LESIA/Munster/PADC)

Surfaces

- - Mars craters (Jacobs U / PADC + GEOPS)
- - Moon, Mercury, Venus, Earth craters (LESIA)
- - USGS planetary maps WMS (Jacobs U)
- - GMap: geol maps (H2020 prog, Jacobs U)
 - CRISM WCS service (MRO, Jacobs U)
 - M3 WMS service (Chandrayaan-1, Jacobs U)
 - HRSC nadir images, WMS (MEx, Frei Univ)
 - OMEGA cubes and maps (MEx, IAS)
- - VIMS satellites, w/geometry (Cassini, LPG)
- Mars topo preTharsis (GEOPS)
- - MESSENGER MASCS spectra (DLR)

Magnetospheres / radio

- - APIS (HST/Cassini, LESIA)
- - NDA (Jupiter & Sun radio, LESIA/CDN)
- - AMDA (CDPP / IRAP)
- - MASER & related services (LESIA)
 - RadioJove (PDS PPI: US amateur network)
- - Datasets from NASA PDS / PPI (UCLA)
- - Iitate HF data of Jupiter (Tohoku Univ, Jap)
 - UTR-2 Juno ground support (Kharkiv)
- MDISC & JASMIN (modeling, UCL)
- - Cluster & Themis data (IAP, Prague)
- Transplanet (CDPP / IRAP)
- - LOFAR Jupiter (CBK/PAS, Warsaw)
 - ASPERA & MARSIS atm obs (MEx, Iowa U)

Solid spectroscopy

- - SSHADE solid spectro & bandlists (IPAG & network)
 - Planetary Spectral Library (DLR)
 - CRISM spectral library (LESIA)
 - Berlin Reflectance Spectral Lib (DLR)
 - Hoserlab (Winnipeg U)

Solar

- - HELIO AR & 1T3 solar features (FP7 prog, LESIA)
- - Bass2000 (LESIA)
 - Radio Solar db (Nançay, LESIA)
- - CLIMSO (Pic du Midi, IRAP)
 - Gaia-DEM (SDO, IAS)
- - EIT_syn (SoHO, IAS)
 - e-Callisto (Windisch, Sw)
- - 3 sunspot services (ESCAPE-related, ROB)
- - 3 solar services (ESCAPE-related, KIS, Freiburg)

Generic / interdisciplinary

- - BDIP (LESIA)
- - PVOL (UPV/EHU & amateur network)
- - Europlanet Telescope Network (Adam M Univ)
 - Planetary spectra collection (LESIA)
- - PSA complete archive (ESA)
- - HST planetary data (LESIA, to CADC archive)
 - Catalogues of planetary maps (Budapest)
- - VizieR_planets: Planetary Science catalogues (CDS)
 - Planets properties (LESIA/IMCCE)
 - Nasa dust catalogue (IAPS)
- - Stellar spectra, support for observations (LESIA)
 - DARTS (JAXA - currently via PDAP)
 - ESAsky planetary data (ESA)
 - Interface with VAMDC ?

Exoplanets

- - Encyclopedia of exoplanets (LUTH/LESIA)
 - Catalogue of exo disks (LESIA)
 - Interface with DACE (Geneva)
- - ARTECS climate simulations (AOTS/INAF)
 - Atmospheric studies (UCL)
- - Exotopo: exoplanet surface simulations (GEOPS)

EPN-TAP updates

1) Correction to existing parameters in v2.0

- now distinguish absolute / apparent magnitudes
(initially intended for absolute mag, actually used for both)
 - arg_perihel => arg_periapsis
- target_classes: new values = interstellar_object, rogue_planet
- instrument_host_name & instrument_name: will use ObsFacility
- spatial coordinate frames: will use recent body-fixed & heliophys vocabularies

2) New parameters from existing services

- Mostly rotational quantities, 3-axial shapes, additional orbital quantities
- Some new physical quantities => requests for new UCDs (e.g. thermal inertia)

EPNCore vocabulary updates

One big issue: classification of Solar System objects / populations

Use case: get class / type from these services to query other services, e.g. to retrieve spectra of TNOs:
https://github.com/ePN-vespa/tutorials/blob/master/surfaces/TNO_spect/TNO_spectroscopy.md

Main sources:

- SsODNet resolver (up to 3 levels): http://vo.imcce.fr/webservices/ssodnet/?quaero#types_and_classes
- JPL SBDb (1 level): https://ssd.jpl.nasa.gov/tools/sbdb_query.html
- Existing EPN-TAP services with Small Bodies
- Other databases, including at PDS SBN, ESA's NEOCC...
- Various publications, including:
Wood 2019 The Dynamics of Small Solar System Bodies: <https://doi.org/10.1007/978-3-030-28109-0>

Findings:

- Many services recompute classes & types and publish their own values
 - This may change with time, and services are not necessarily consistent
 - Classes and types also evolve over time
- => often a matter of science / research — leave it to a few specialized services (MPCorb, SsODNet, JPL...)?

EPNCore vocabulary updates

But a basic classification is expected

dynamical_class: ~ consensual

{NEO, Mars-Crosser, MBA, Hungaria, Phocaea, Trojan *or co-orbital (associated with primary)*, Centaur, TNO, <values for comets from Levinson 1996, TBC>} + NULL

Subdivision of target_class - Preliminary

dynamical_type: indicative list for use by small services related to new publications?

{Aten, Apollo, Amor, Atira, Hilda, Cybele, resonances (*or Resonant, including Plutino = res 2:3*), Hot classical, Cold classical, Scattered Disk object, Detached object} + NULL

Subdivision of dynamical_class - Preliminary

New parameters:

parent_body: *refers to Trojans, quasi-satellites, objects in horseshoe orbit (plus satellites and exoplanets)*

dynamical_family (in the Main Belt)

EPNCore vocabulary updates

dynamical_class:

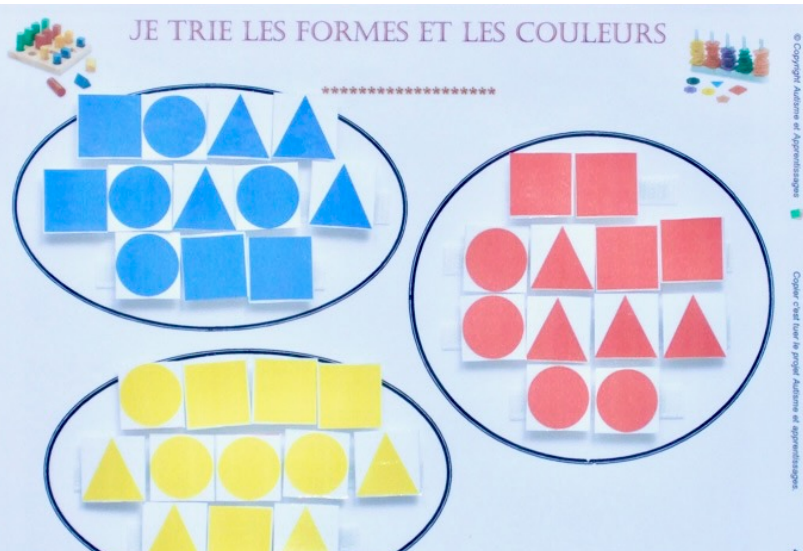
{NEO, Mars-Crosser, MBA, Hungaria, Phocaea, Trojan *or co-orbital* (associated with primary), Centaur, TNO, <values for comets from Levinson 1996, TBC>} + NULL

~ IAU resolutions / [somewhat] consensual

dynamical_type:

{Aten, Apollo, Amor, Atira, Hilda, Cybele, resonances (*or Resonant*, including Plutino = res 2:3), Hot classical, Cold classical, Scattered Disk object, Detached object} + NULL

Several schemes coexist which *cannot* be mapped



e.g.: group by colour or by shape?

Include *all* existing values?
(normalizing syntax and spelling)
Leave room for new values?
Leave it to data provider entirely?

EPNCore vocabulary updates

Additionally:

Similar (actually worth) issue with spectral types:

taxonomy_code:

Get classification from a few specialized services

+ use an associated taxonomy_description parameter to identify the classification scheme?

See: <https://voparis-wiki.atlassian.net/wiki/spaces/VES/pages/56901725/Small+bodies+sub-types>

Comments welcome! (Confluence/cloud, may require registration)