



Semantics: OntoPortal and best practices on vocabularies outside IVOA

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ASTRO-CC Tech-Forum #1, Trieste, Oct. 2025

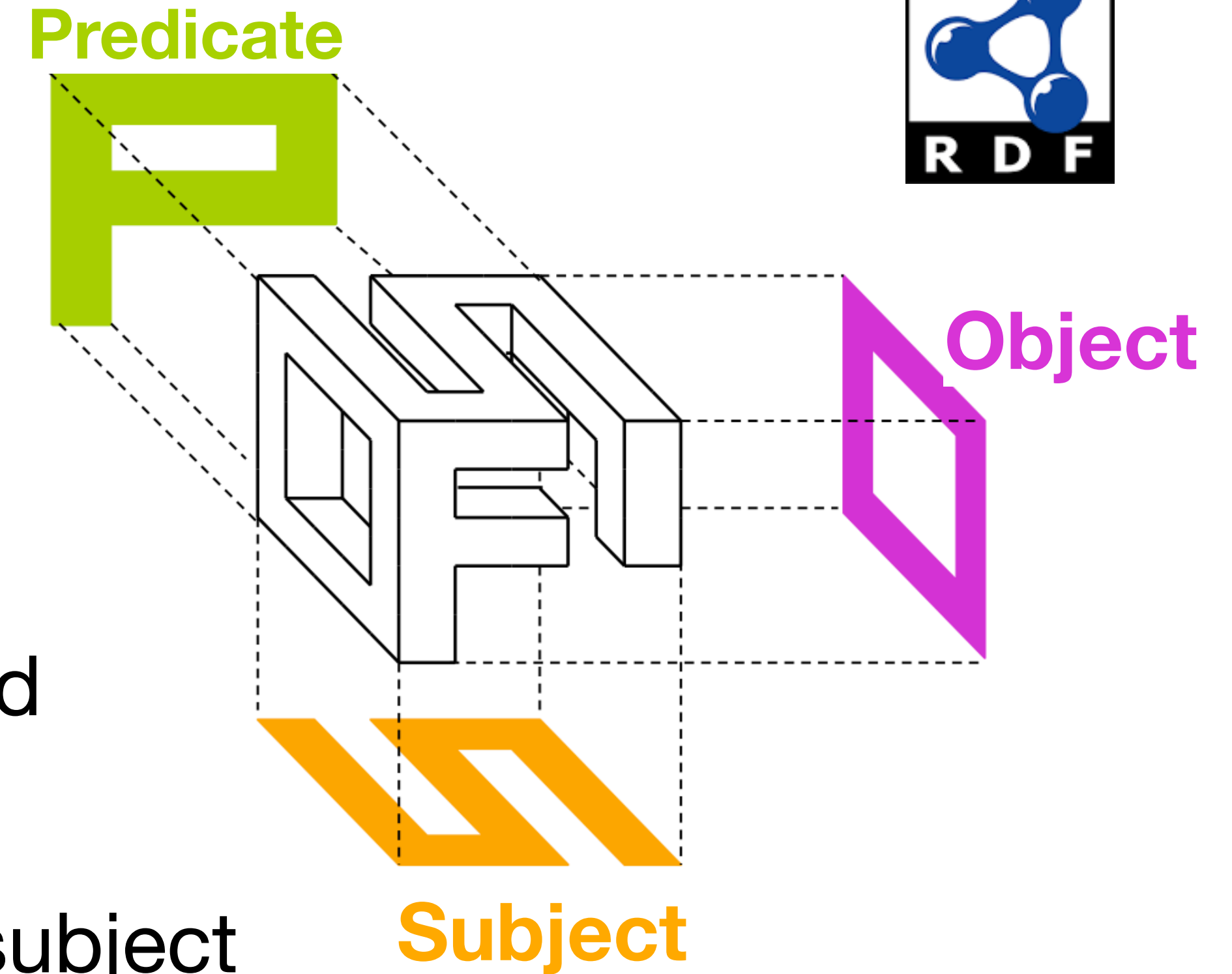
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(2) INRAE, Montpellier, France

FAIR-IMPACT: EU funded project (Grant Agreement: 101057344). <https://fair-impact.eu>

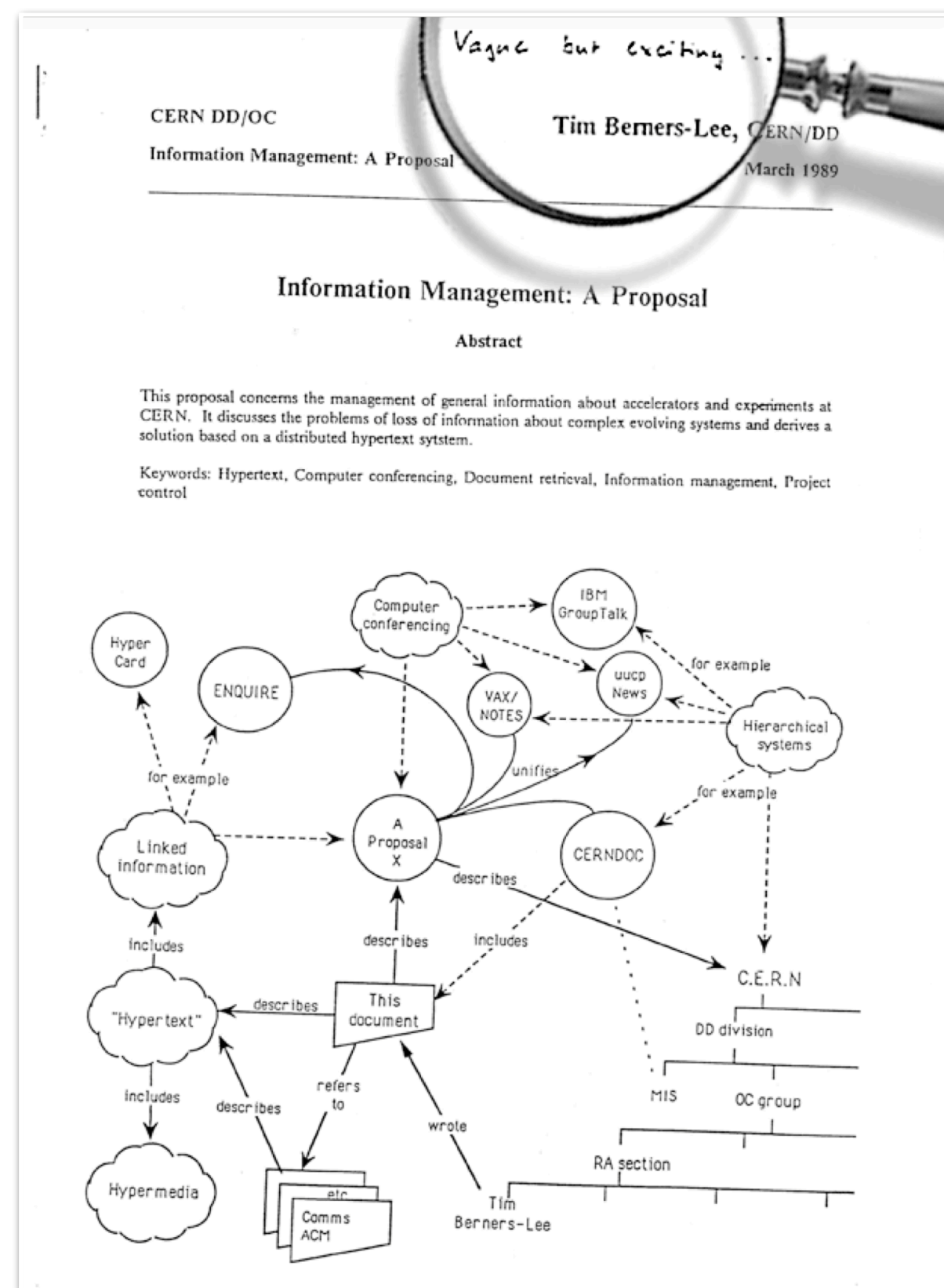
OPAL: funded by OSCARS, an EU funded project (Grant Agreement: 101129751). <https://oscars-project.eu/>

What is Linked Data (still learning)



- goes back to the roots of the web

- linking resources using oriented and tagged graph
- Triples with object/prediccate/subject
- RDF (Resource Description Framework) is W3C standard
- Several serialisation (RDF/XML, Turtle, JSON-LD...)
- SPARQL is the query language



How does this feed into Open Science?

Linked-data and publications

- A use case: When publishing data, the dataset landing page contains linked-data elements (often in JSON-LD following schema.org).
- Many ways to describe additional metadata on a research product:
 - attribution (e.g., with schema.org or datacite)
 - provenance (e.g., with Prov-O or VO-Prov)
 - access (e.g., with DCAT)
 - content (e.g., with SoSO (science on schema.org), or I-Adopt)etc.
- All those **metadata schema and content** can be represented in RDF (in XML, TTL or JSON-LD), and can be fed into graph databases.
=> enable powerful search capabilities.





Semantic Artefacts in Astronomy

interoperability, subjects, schemas

- Astronomy:
 - **IVOA vocabularies = many controlled lists for interoperability** (RDF)
 - UAT thesaurus = subject keywords for publications (RDF)
 - IVOA metadata schemas = data model for interfaces, protocols, formats, registry... (XML schemas only)
- Heliophysics:
 - **metadata schema for the resource registry** (XML schema only)
=> list of terms embedded in schema
 - UAT thesaurus = subject keywords for publications (RDF)
- Planetary Sciences:
 - **information model for the archive** (OAIS implementation, XML schema only)
=> list of terms embedded in schema

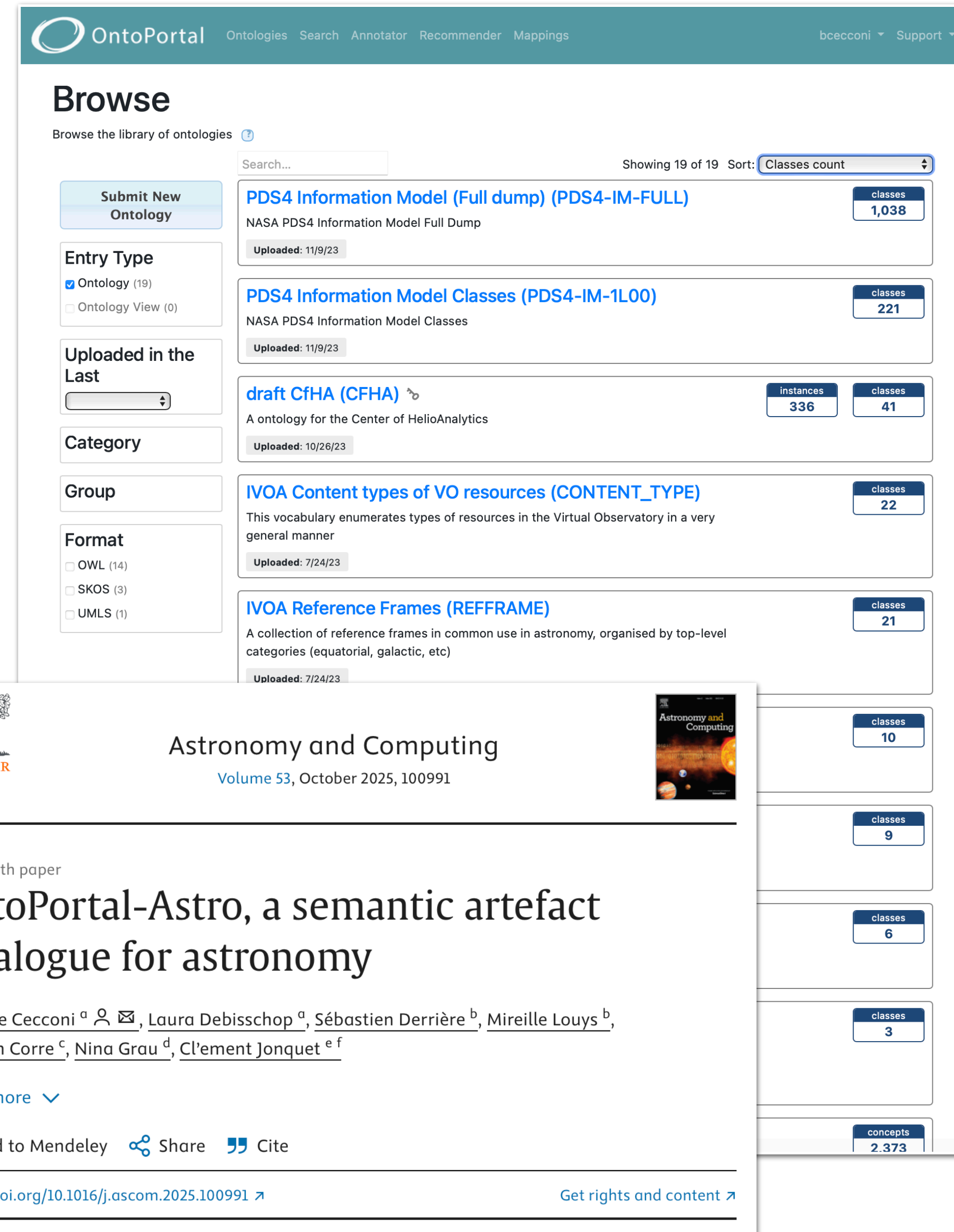
Ontoportals prototype

<http://voparis-ontoportals-dev.obspm.fr/>

- Goal: gathering semantic artefact catalogues from astronomy, heliophysics, planetary sciences
- Sources:
 - IVOA: <http://ivoa.net/rdf> 
 - UAT (Unified Astronomy Thesaurus) 
 - SPASE (Space Physics Archive Search and Extract) 
 - PDS4 Information model 
 - etc.

upcoming version: <http://padc-ontoportals.obspm.fr>

future official URL: <https://ontoportals-astro.eu>



The screenshot shows the Ontoportals web interface. At the top, there is a navigation bar with 'Ontoportals' and various menu items like 'Ontologies', 'Search', 'Annotator', 'Recommender', and 'Mappings'. Below this is a 'Browse' section with a search bar and a list of ontologies. The list includes:

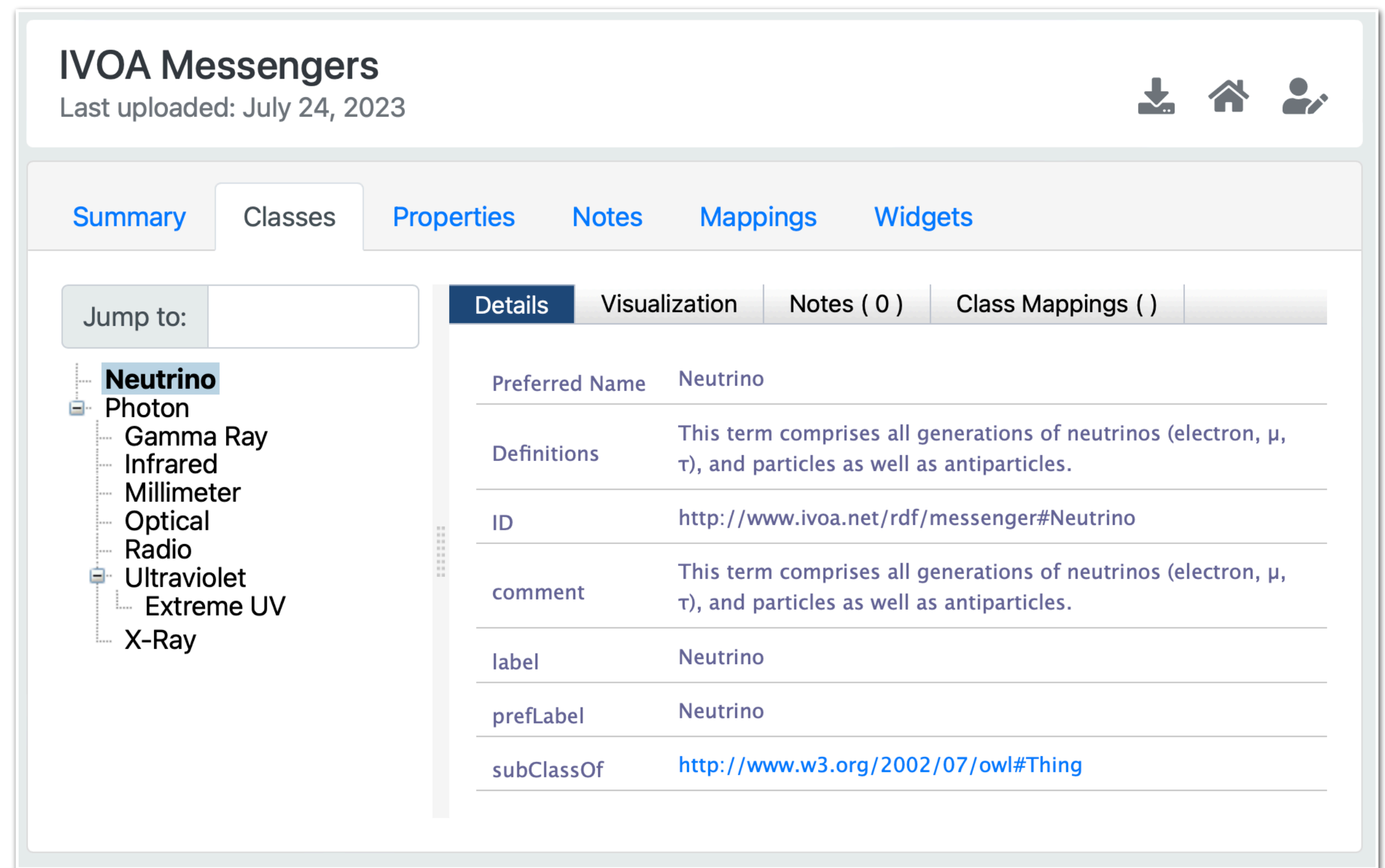
- PDS4 Information Model (Full dump) (PDS4-IM-FULL)**: 1,038 classes, uploaded 11/9/23.
- PDS4 Information Model Classes (PDS4-IM-1L00)**: 221 classes, uploaded 11/9/23.
- draft CfHA (CFHA)**: 336 instances, 41 classes, uploaded 10/26/23.
- IVOA Content types of VO resources (CONTENT_TYPE)**: 22 classes, uploaded 7/24/23.
- IVOA Reference Frames (REFFRAME)**: 21 classes, uploaded 7/24/23.

Below the list, there is a detailed view of a paper from 'Astronomy and Computing', Volume 53, October 2025, 100991. The paper is titled 'Ontoportals-Astro, a semantic artefact catalogue for astronomy' and is a full-length paper. The authors listed are Baptiste Cecconi, Laura Debisschop, Sébastien Derrière, Mireille Louys, Carmen Corre, Nina Grau, and Clément Jonquet. The interface also shows options to 'Add to Mendeley', 'Share', and 'Cite', along with a DOI link: <https://doi.org/10.1016/j.ascom.2025.100991>.

Ontoportals prototype

Importing community semantic artefacts

- **Successfully imported catalogues:**
 - IVOA Reference Frames
 - IVOA Messenger
 - IVOA Time Scales
 - IVOA Reference Positions
 - IVOA Content levels for VO resources
 - IVOA Content types of VO resources
 - IVOA Unified Astronomy Thesaurus
 - Unified Astronomy Thesaurus (UAT)
 - PDS4 Information Model Classes
- **Errors while importing catalogues:**
 - IVOA Relationship types in the VO
 - IVOA Roles of dates
 - IVOA DALI Examples
 - IVOA Semantics
 - IVOA Datalink core



IVOA Messengers
Last uploaded: July 24, 2023

Summary | **Classes** | Properties | Notes | Mappings | Widgets

Jump to:

- Neutrino**
- Photon
 - Gamma Ray
 - Infrared
 - Millimeter
 - Optical
 - Radio
- Ultraviolet
 - Extreme UV
 - X-Ray

Details | Visualization | Notes (0) | Class Mappings ()

Preferred Name	Neutrino
Definitions	This term comprises all generations of neutrinos (electron, μ , τ), and particles as well as antiparticles.
ID	http://www.ivoa.net/rdf/messenger#Neutrino
comment	This term comprises all generations of neutrinos (electron, μ , τ), and particles as well as antiparticles.
label	Neutrino
prefLabel	Neutrino
subClassOf	http://www.w3.org/2002/07/owl#Thing

OPAL - Ontology Portal for Astronomy Linked-data

Status: setting up the project

- **Advisory and User Group (AUG)**
A. Raugh (NASA/PDS, USA), J. Bartlett (Harvard, UAT+ADS, USA), S Derrière (CDS, France), V Delouille (ROB, Belgium), B Seignovert (Nantes, France), R McGranaghram (JPL, USA), R Krahl (Helmholtz, Germany), E Henley (MetOffice, UK)
First meeting (online): 2025-09-25
- **Hired 2 ontologists:** *Elsa David (OPAL/ObsParis), Liza Fretel (OPAL/ObsParis).*
Technical support: *Imad Bourouche (INRAE), Stéphane Aicardi (CNRS/ObsParis)*
- **New version** will include:
 - ontology FAIR evaluation
 - recommender / annotator
 - browse ontologies and mappings
 - advanced APIs (e.g., API search within ontology)
- 2 instances planned: production (public) + staging/test (private)





Welcome to Ontoport-Astro,

The home of ontologies and semantic artefacts in astronomy and related domains.

Search an ontology or term (e.g., exoplanet)



OBSF
31K concepts

UAT
2K concepts

REFFRAME
171 concepts



Do you want to share an ontology?

Uploading an ontology or another semantic artefact (vocabulary, terminology, thesaurus, ...) is a way of sharing your knowledge with others.

By uploading and sharing your ontology to Ontoport-Astro, you can:

- ✓ Discover new insights and knowledge by exploring other ontologies or semantic resources in the repository.
- ✓ Map your ontology to other relevant ones in the domain and collaborate with other users.
- ✓ Precisely describe your ontology with relevant metadata and get a FAIR score for your ontology.
- ✓ Contribute to knowledge sharing and semantic interoperability in your domain.
- ✓ Get feedback and suggestions from other users who can use and comment on your ontology.

[↑ Submit ontology](#)

[Discover ontologies >](#)

OPAL - Ontology Portal for Astronomy Linked-data

Status: Vocabularies currently being worked on

- **ObsFacility** (Liza) - Observation Facilities (= observation platforms)
 - cross-matching of existing list of terms.
 - if id-matching and name/acronym matching not enough
 - => we are testing LLMs [*Fretel et al. 2025*]
 - Goal: list of terms (with synonyms and meronyms) and name resolver

Fretel et al., Ontology Mapping 2025 (OM2025) workshop. <https://arxiv.org/abs/2510.05744>

- **RefFrame** (Elsa) - Reference / Coordinate Frame vocabulary
 - work with NASA/Heliophysics team
 - to be merged with IVOA RefFrame vocabulary
- **UCD** (Elsa) - Several options available currently being reviewed.



OPAL - Ontology Portal for Astronomy Linked-data

Status: Vocabularies currently being worked on

- **ProcessingLevel** (Elsa):
 - many lists of terms => propose vocabulary covering all cases, and listing the labels used in the various contexts.
- **UAT (Unified Astronomy Thesaurus)** extension for heliophysics (Elsa):
 - led by Ryan McGranaghm (NASA/Heliophysics).
 - reorganised hierarchy in UAT for heliophysics terms
 - new terms for heliophysics regions, new top level concept (Heliophysics)

Starting discussions: similar work for planetary sciences.



URIs, Metadata and Provenance

How could we improve vocabulary quality.

- **Vocabulary metadata**
 - possible include metadata for, e.g., preferred namespace prefix, version, vocabulary URI, version vocabulary URI
 - MOD (Metadata for Ontology Description and Publication Ontology) ontology proposes generic keywords [developed within FAIR-IMPACT]
- **VEP info stored within vocabulary ?**
 - currently, VEP information is disconnected from vocabulary
 - most of the VEP sections could be included in the published vocabularies, using MOD properties.
 - MOD includes, e.g., a “knowUsage” property equivalent to “used-in”
 - Currently testing



URIs, Metadata and Provenance

How could we improve vocabulary quality.

- **Vocabulary and Term URIs**

- current all IVOA vocabs are [http://ivoa.net/rdf/...](http://ivoa.net/rdf/)
- many (many!) communities uses <https://w3id.org> (with redirections from a community managed git repo: <https://github.com/perma-id/w3id.org>)
- bad experience with purl, but this community seems organised to be more resilient.



Next steps

New vocabularies & Mapping between vocabularies

- Work with IHDEA to produce **SPASE RDF schema/ontology**
- Work with IPDA to produce **PDS4 RDF schema/ontology**
- Work with VAMDC (**virtual atomic and molecular data** center) to produce an ontology from their vocabulary
- Ontology for **Instrument-types** ?
(based on PDS4 information model and archive content)
- Vocabulary for **Instruments** (mounted on ObsFacilities): PDS4 context products: SPASE instruments, NSSDC instruments...
- Start building domain ontologies, e.g., **Small bodies**



Next steps

Vocabulary development and management

- Propose new mapping using OntoPortal.
- Implementation of FAIR practices in vocabularies
 - e.g., attribution, provenance, versioning, licence...
- Update practices to include each term's provenance in ontology
- Identify related semantic artefacts in other portals (e.g., in EarthPortal: GEMET, SOSA...)
- Work with astronomy data alliance to produce semantic artefacts from their XML schema.



Next steps

Knowledge graphs & representing variables

- EU project (started in Feb 2024): **OSTrails**, with focus on building Science Knowledge Graphs (SKG) => astronomy pilot project led by ObsParis
- Participation to SKG RDA working group
- Explore use of RDA **I-Adopt** framework (<https://i-adopt.github.io>) for describing measurements and quantities and link to concepts in our ontologies.
- Explore *Science-on-Schema.org* (SOSO) to expose metadata. Following up work done by R. Ringuette (IHDEA/Heliophysics) on SPASE registry (mapping SPASE to schema.org, for richer landing page metadata)



* Ringuette et al. (2025). Improving FAIR for HDRL's Metadata: Mapping to Schema.org and DataCite. [doi:10.5281/zenodo.15594513](https://doi.org/10.5281/zenodo.15594513).