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Neutrinos in the IVOA: starting a High-Energy Interest Group

Jutta Schnabel, FAU Erlangen (ECAP)

GNN Common data format group,

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Overview

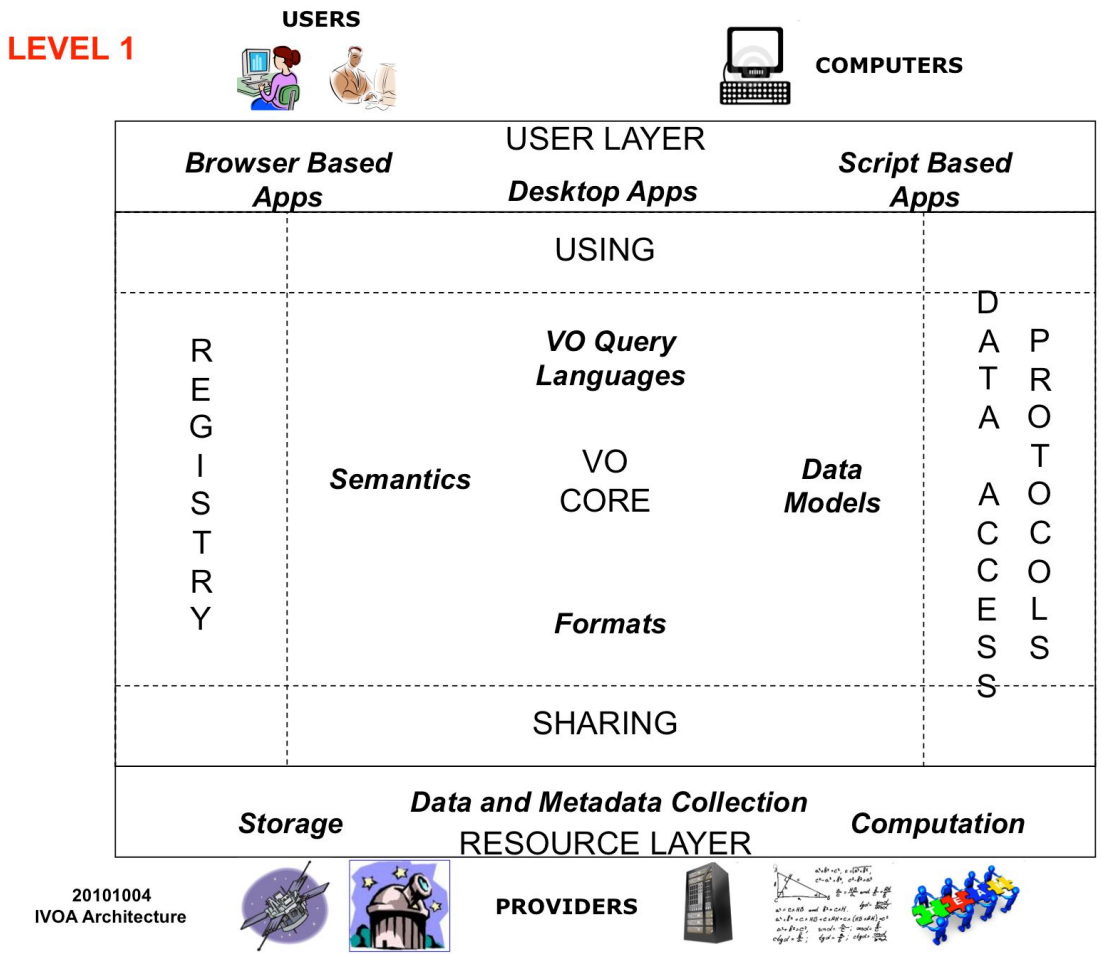
Contributing in the IVOA

- Reminder: what is the IVOA? - current developments
- The Standards and IVOA note for High Energy in the IVOA
- Input for the Interoperability Meeting

IVOA in a nutshell

Cooperation and technical implementation

- **International Virtual Observatory Alliance** (IVOA) acts as standard-setting organization with national substructures, an Executive Committee and various working groups
  - Working groups on applications and services, but also semantics, data models and “interest groups”
- bringing together providers of astrophysics data in the **Virtual Observatory** (VO)
  - “everyone” can provide data, by registering own data server or using e.g. national VO repositories
  - access is generally open for all data, and services are provided as open desktop software or hosted by various institutions online (e.g. the CDS portal)

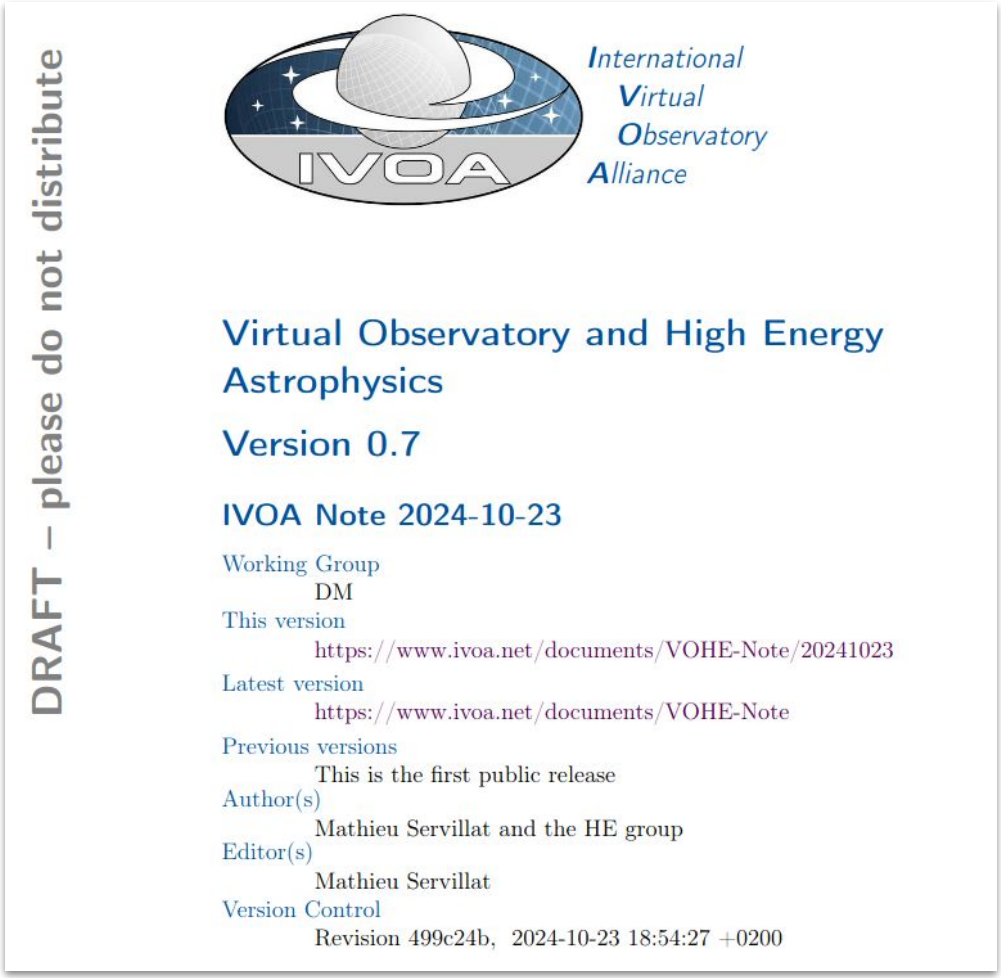


https://ivoa.net/deployers/intro_to_vo_concepts.html

High Energy Interest Group (HEIG)

Current developments and plans

- Started forming in 2023 from Virtual Observatory involvement in ESCAPE project
- Includes X-Ray (Chandra), VODF-initiative (Gammaray and neutrino) and tentatively Gravitational Waves through various representatives
- Wiki page: **VO Wiki**
- Planning to ask for official establishment of the HEIG as part of the IVOA at the IVOA Interoperability Meeting (Malta, 15-17 Nov)
- Introducing work program and options in a IVOA Note (Virtual Observatory and High Energy Astrophysics, draft@Github)
- Presenting view and interest from different messenger type experiments at meeting (10’ for neutrinos)



The note and proposed topics

Experiments, Commonalities

Commonalities in data

- Event counting
- Data levels: event lists, and expected responses from experiment associated with the list (e.g. IRFs), high-level maps or source models (but with high variation)
- partially high level of background
- various duration of valid time intervals

Use Cases

- re-analyse event-list data for a source in a catalog
- observation preparation
- transient or variable sources
- Multi-wavelength and multi-messenger science Extended source searches

Challenges

- Low Count rate statistics
- Event selection & binning
- Unfolding techniques for interpretation
- So far little unified tools for data extraction

Useful VO concepts under development

- Dataset: bundling different product, e.g. an event list and connected IRFs
- Cube: Multi-dimensional sparse data
- Mango: complex quantities in query response tables

Topics for the Interest Group

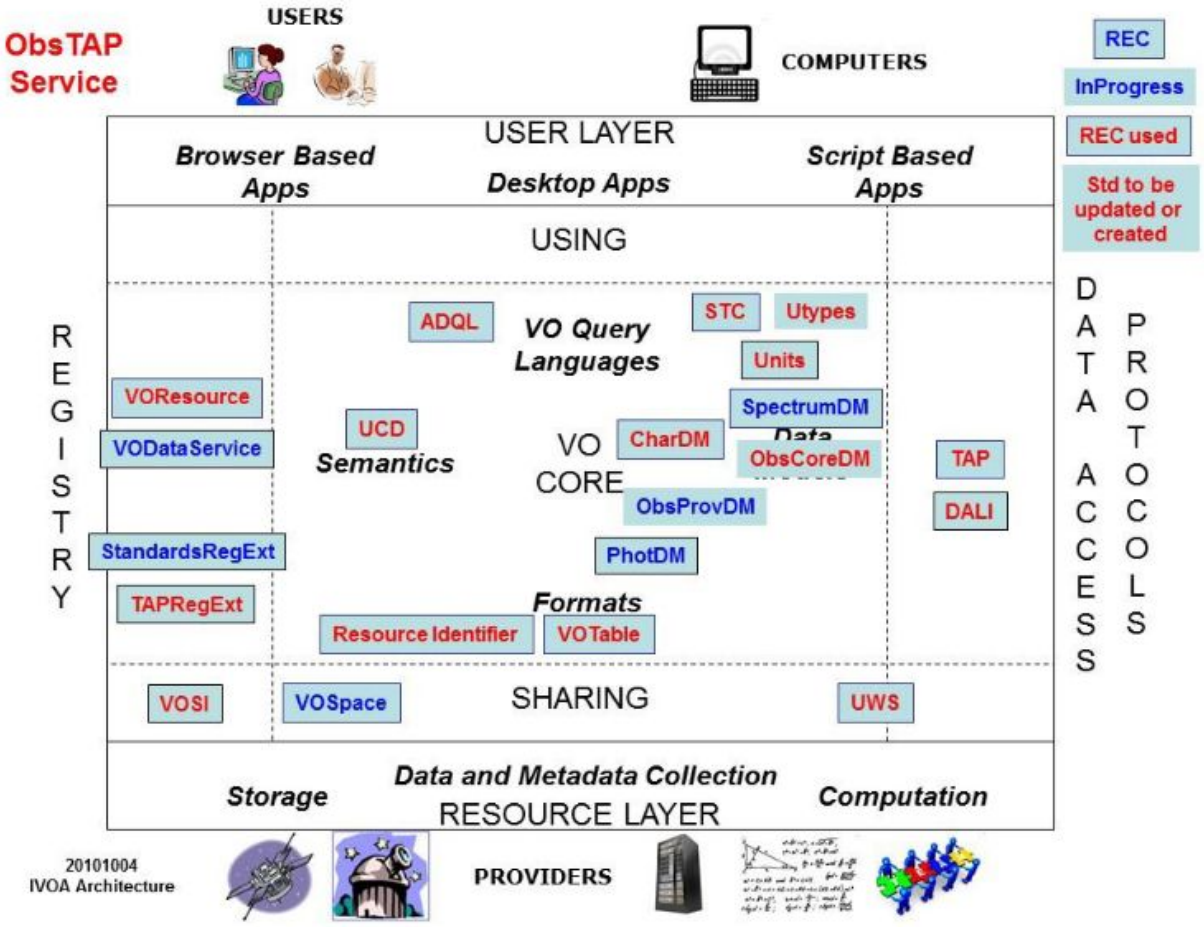
- Definition of a HE event in the VO
- ObsCore description of an event list
- Event list context data model & use of Datalink

The note and proposed topics

Established standards

Relevant IVOA protocols

- ObsCore and TAP
  - identification of relevant observations (by “type”==”event”?) and retrieval as table (Table Access Protocol)
- DataLink
  - link complex digital objects to table rows + description
- Storing sky survey data (HiPS, Hierarchical Progressive Survey), and producing Multi-Order coverage maps (MOCs
- VOTable and MIVOT
  - Storing data in tables and annotating them
- Provenance
- VOEvent
  - handling of alerts
- Measurements
  - for error handling

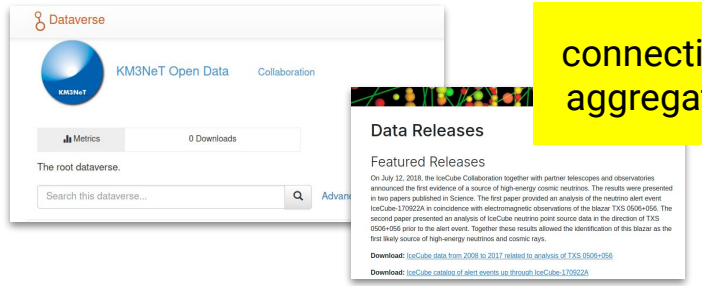


Input to the IVOA 1

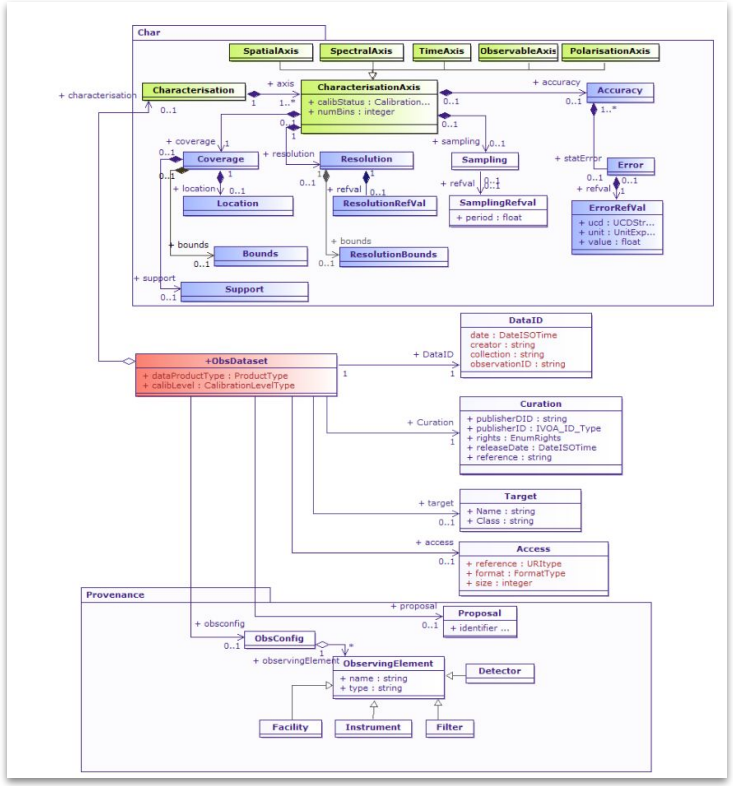
Making data discoverable

- How does your project make their data discoverable?
- Are data from your project in the IVOA registry?
- Are there problems in the IVOA ObsCore definition preventing or limiting it?

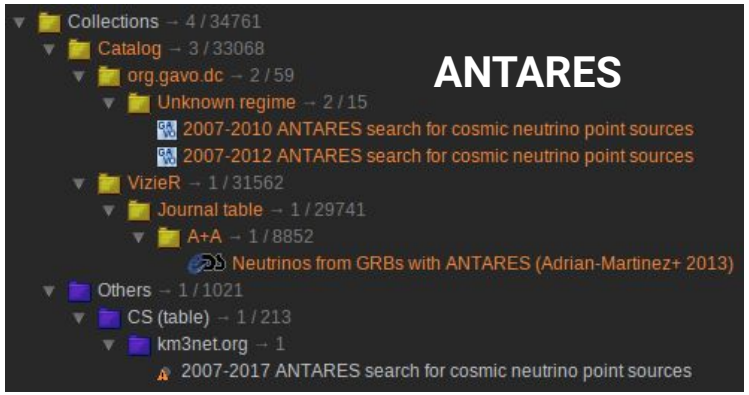
https://icecube.wisc.edu/science/data-releases/
https://opendata.km3net.de/



connection to aggregators?



IceCube



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Input to the IVOA 2

Relevant data products

- What data products are used in your data analysis?
- Are they interoperable with data from other projects?
- Do you use a data model?

not really?

Event lists
simulation -> instrument responses

On case-by-case basis

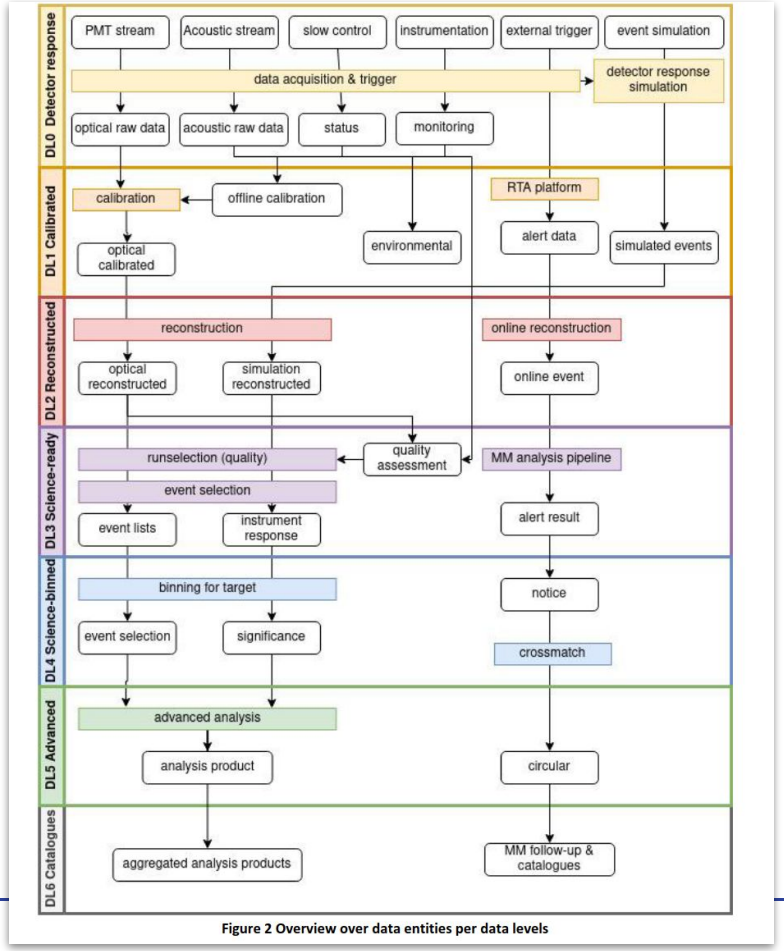
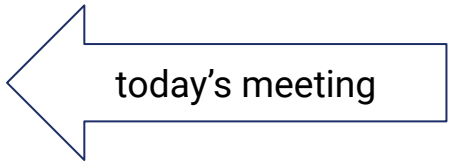


Figure 2 Overview over data entities per data levels

Input to the IVOA 3

Alert system

- What do you use for an alert system?
- Do you use VOevent, and if not, can you address the issues you see?



Input to the IVOA 4

Follow-ups and coordination

- How do you coordinate rapid follow up observations currently?
- Are the Observing plan of your project/mission available externally and is there coordination of your project/mission among the HE projects?
- Are you familiar with the IVOA ObsLocTAP protocol and ObjObsSAP working draft of the IVOA?

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Let's do science together
&
Thank you for your attention!