CTA Data Model

The Cherenkov Telescope Array

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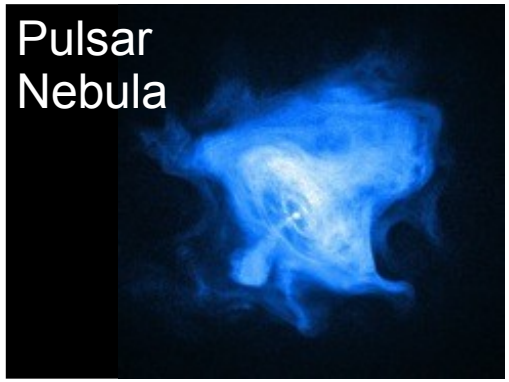
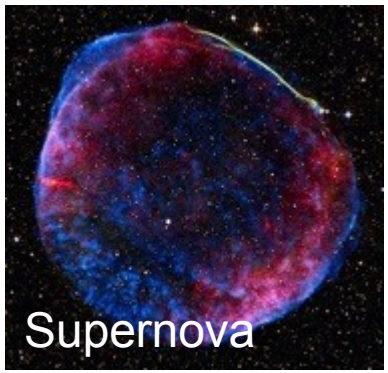
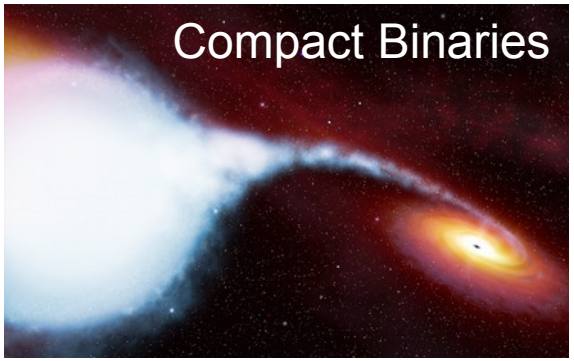
VO-Paris Data Center

High Energy Astrophysics



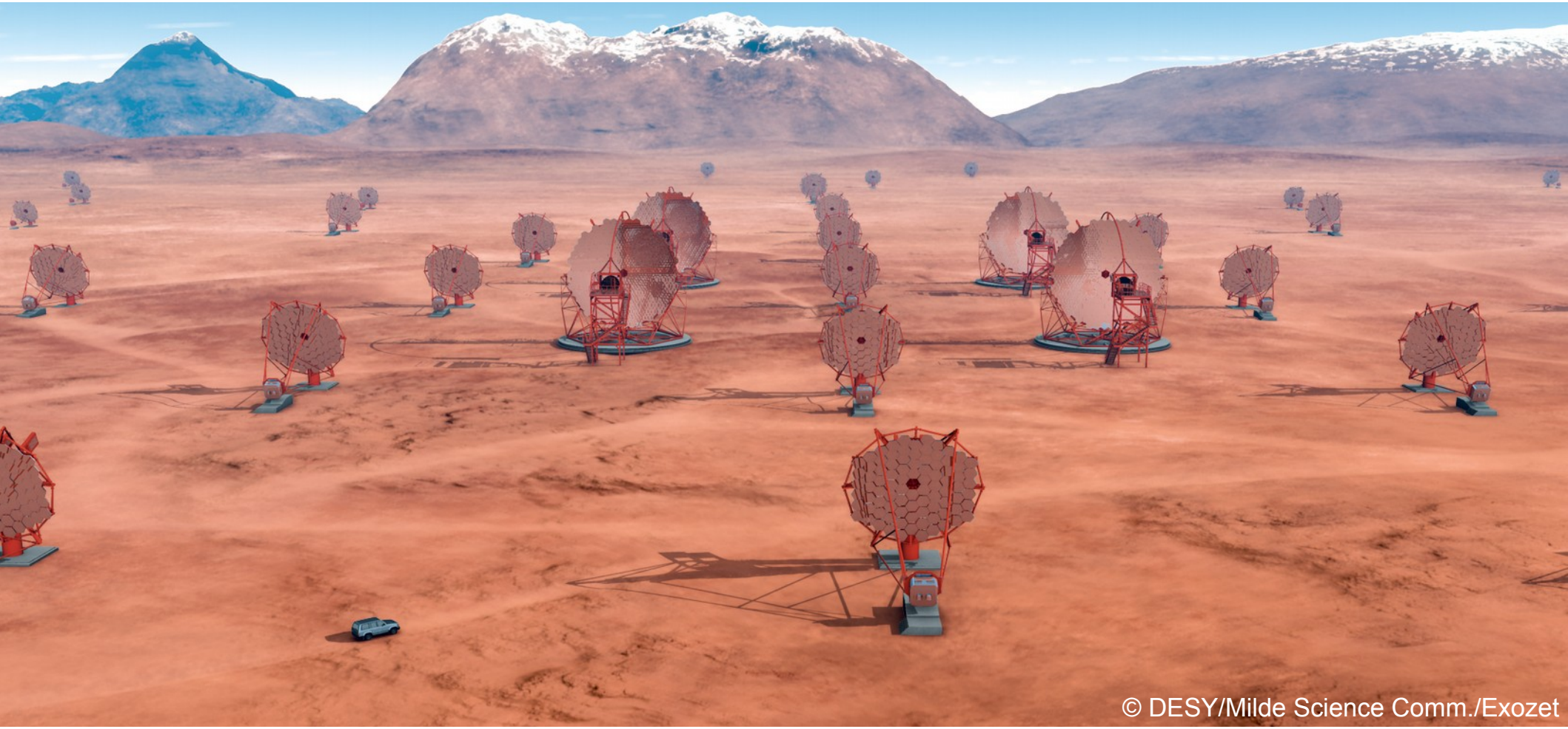


- Violent, transient, non-thermal phenomena
- Matter under extreme conditions
- Particle Acceleration
- Fundamental Physics
- Role of Black Holes in the structuration of the Universe



Observatory

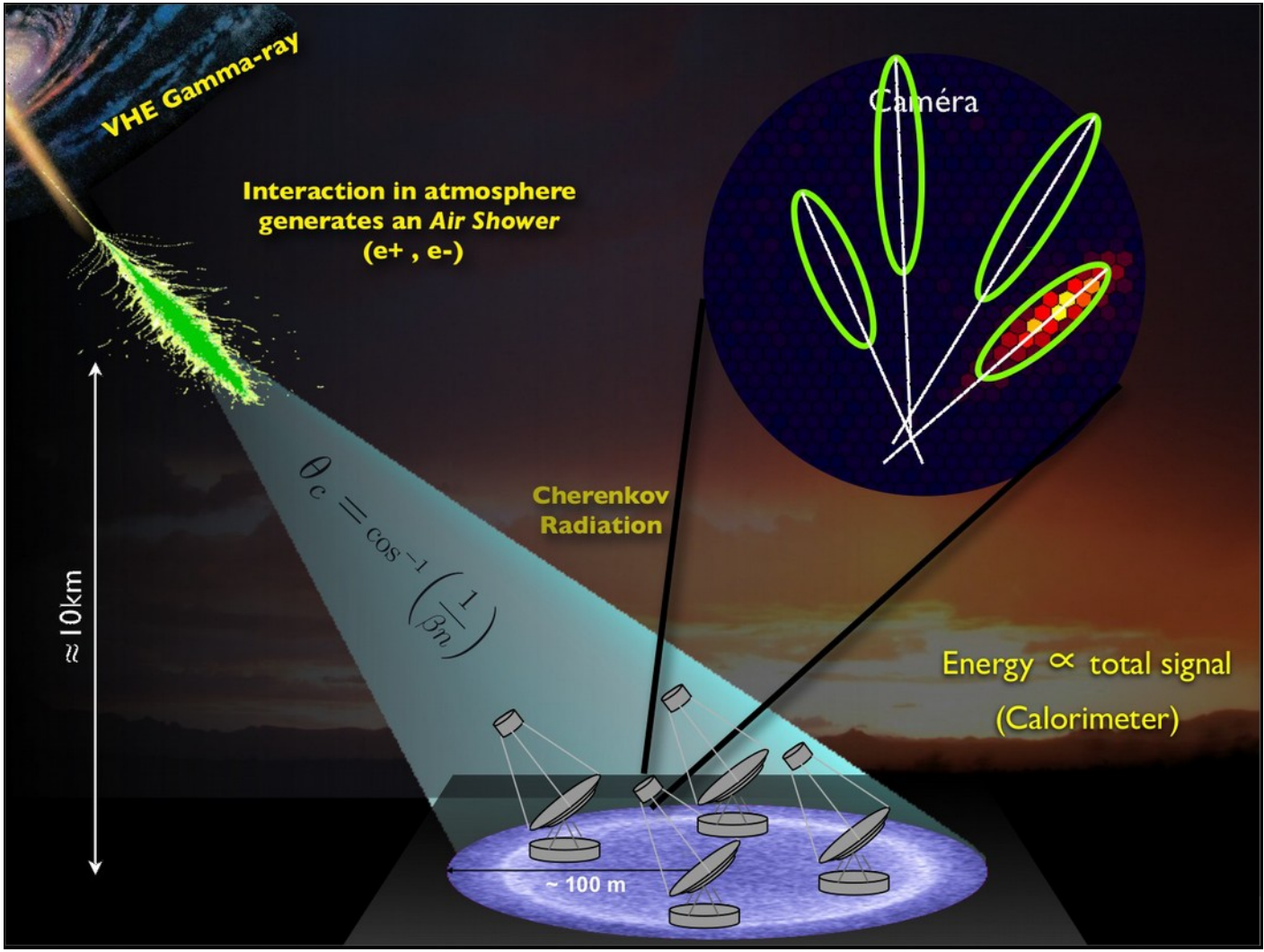
- Two arrays of **100 (South)** et **20 (North)** Cherenkov telescopes (4, 12 et 24 m in diametre)
- End of 2015: Site Selection, Namibia or Chile (under negociations)
- 2016: Construction
- Current experiments: H.E.S.S., MAGIC, VERITAS
  H.E.S.S.: experiment with 4+1 telescopes (4 x 12 m + 1 x 28 m)

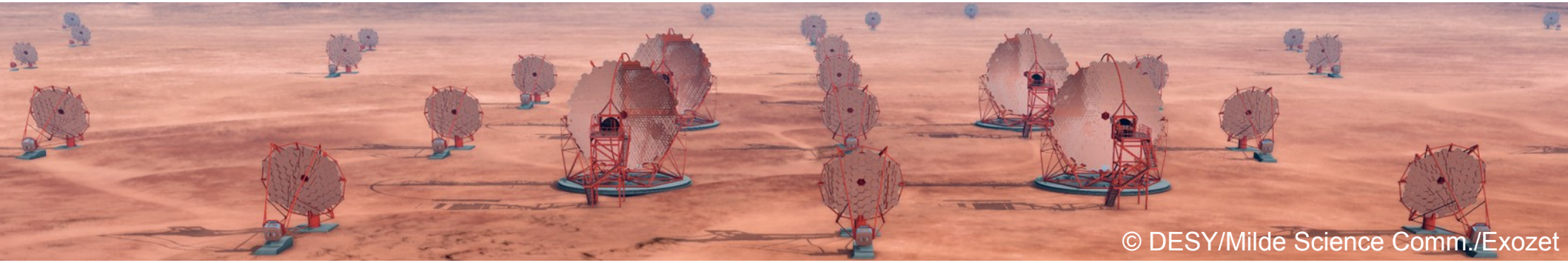


cherenkov telescope array

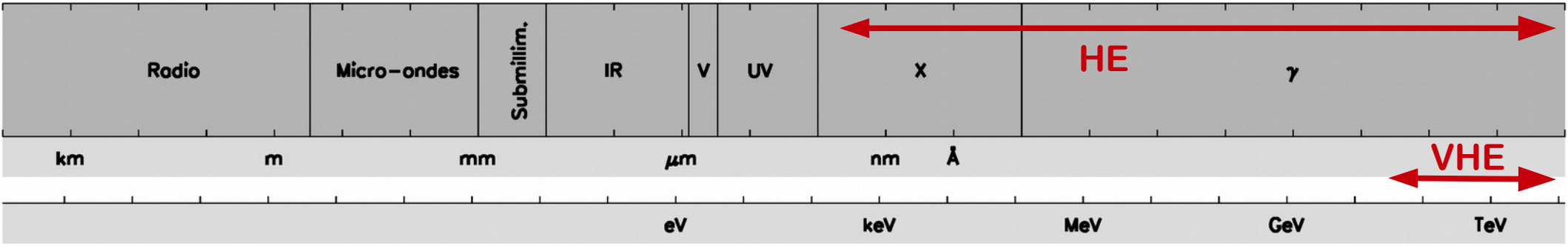
Observatory

- Event Reconstruction: photon, particle shower, Cherenkov light (faint, few nanoseconds)
- Atmosphere = calorimetre Simulations, assumptions
- Complex Metada, need to be structured

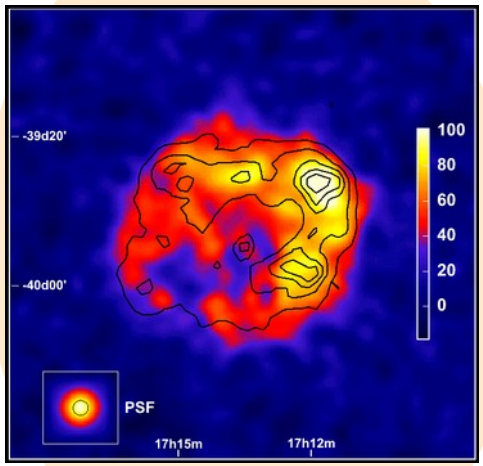




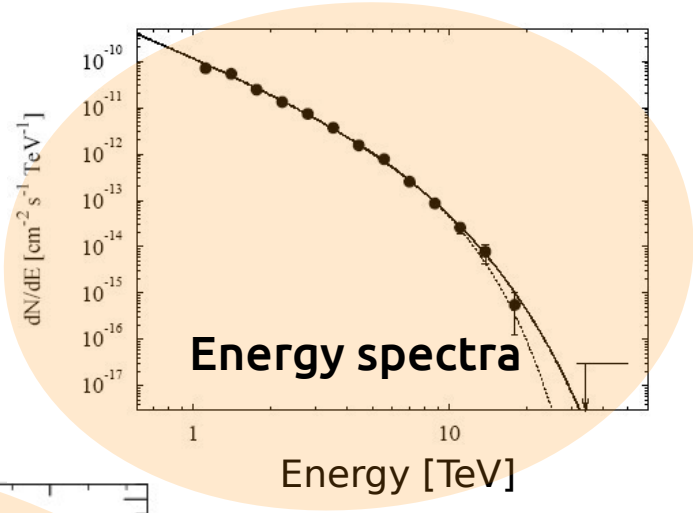
Very high energy data

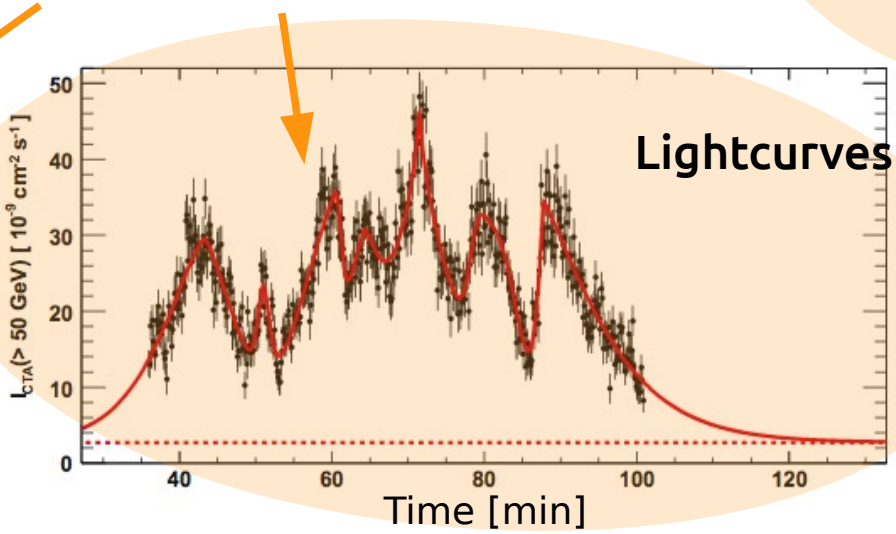


- Several orders of magnitude
- Photon counting
- Low count statistics, high background
- **Event lists**
  (coordinates, time, energy)



Images



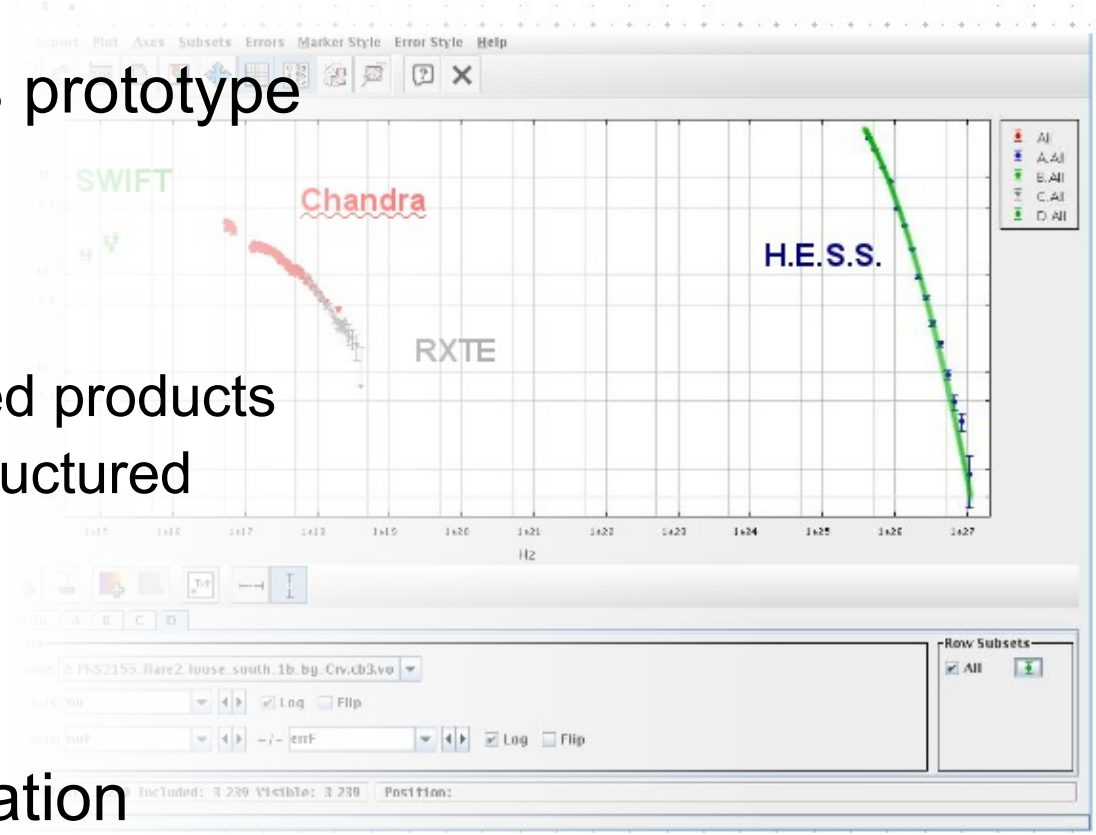


CTA Data Access at Observatoire de Paris

Knowledge in Very High Energies and VO

- H.E.S.S. experiment
- High level **VO data access** prototype
  http://hess.obspm.fr/

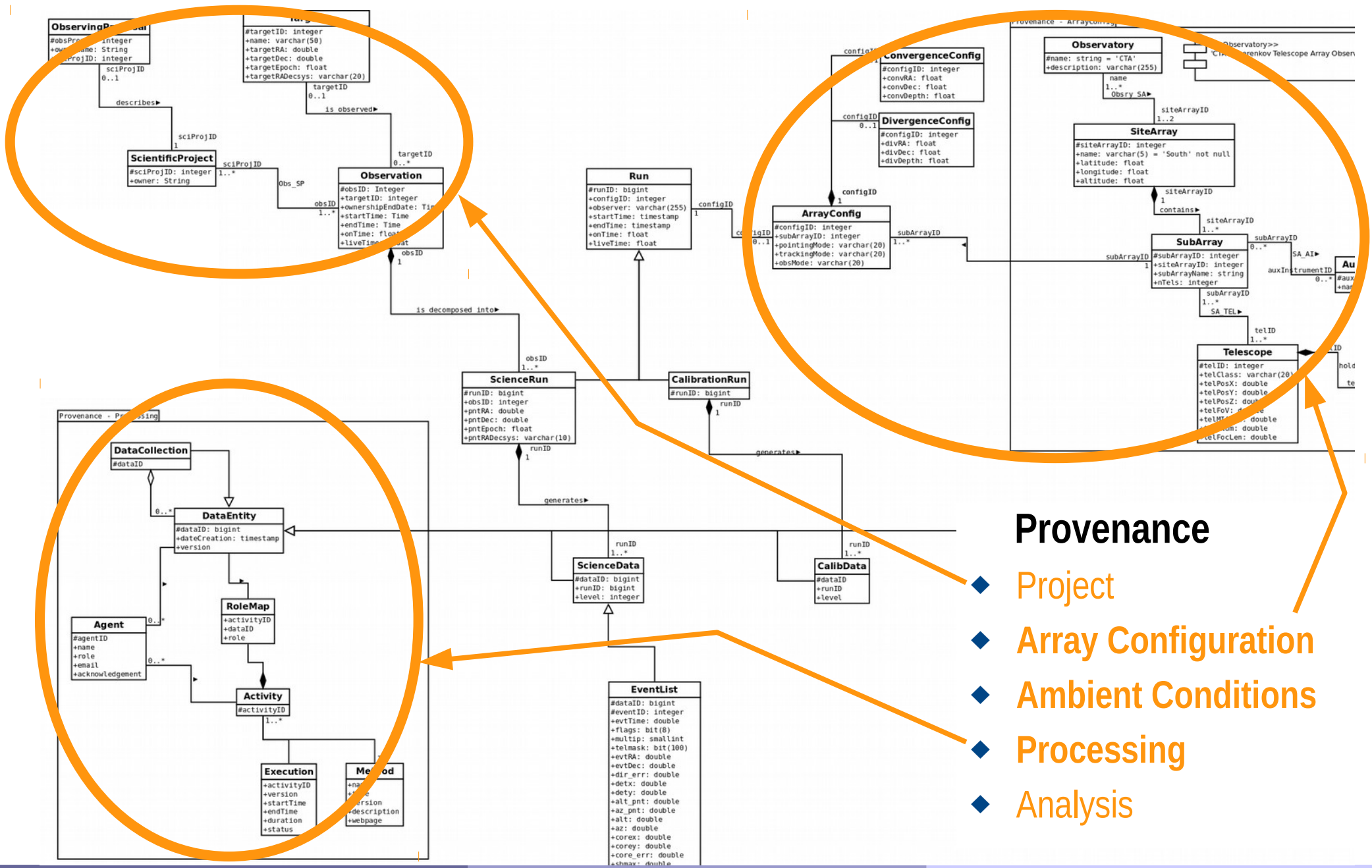
- VO standards vs VHE?
  - Complex **hierarchy** of related products
  - Complex **metadata** to be structured
  - **Queryable** metadata ?



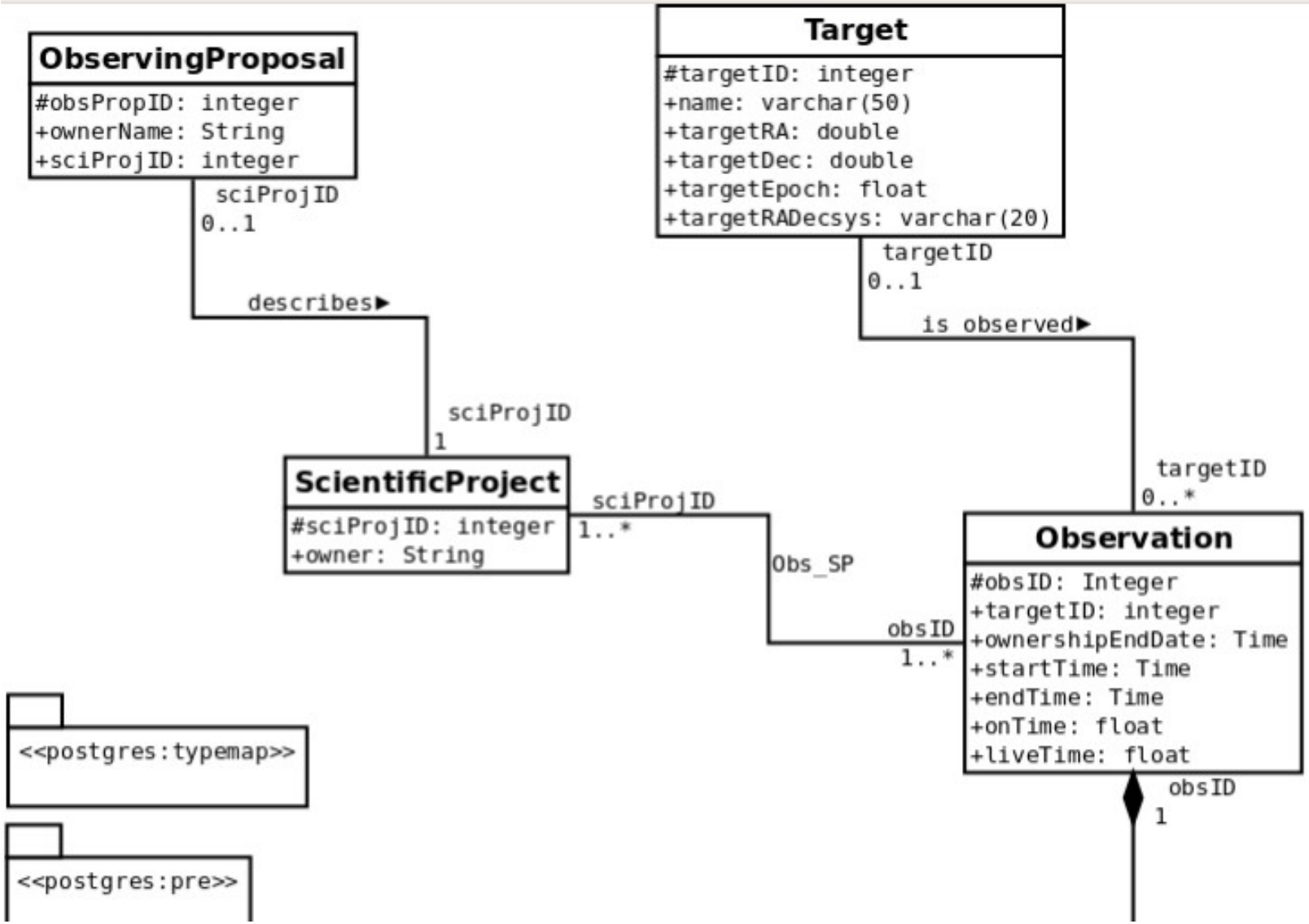
CTA data access prototype

- CTA **data model** implemetation
- Test VO compliance
  http://voparis-cta-client.obspm.fr

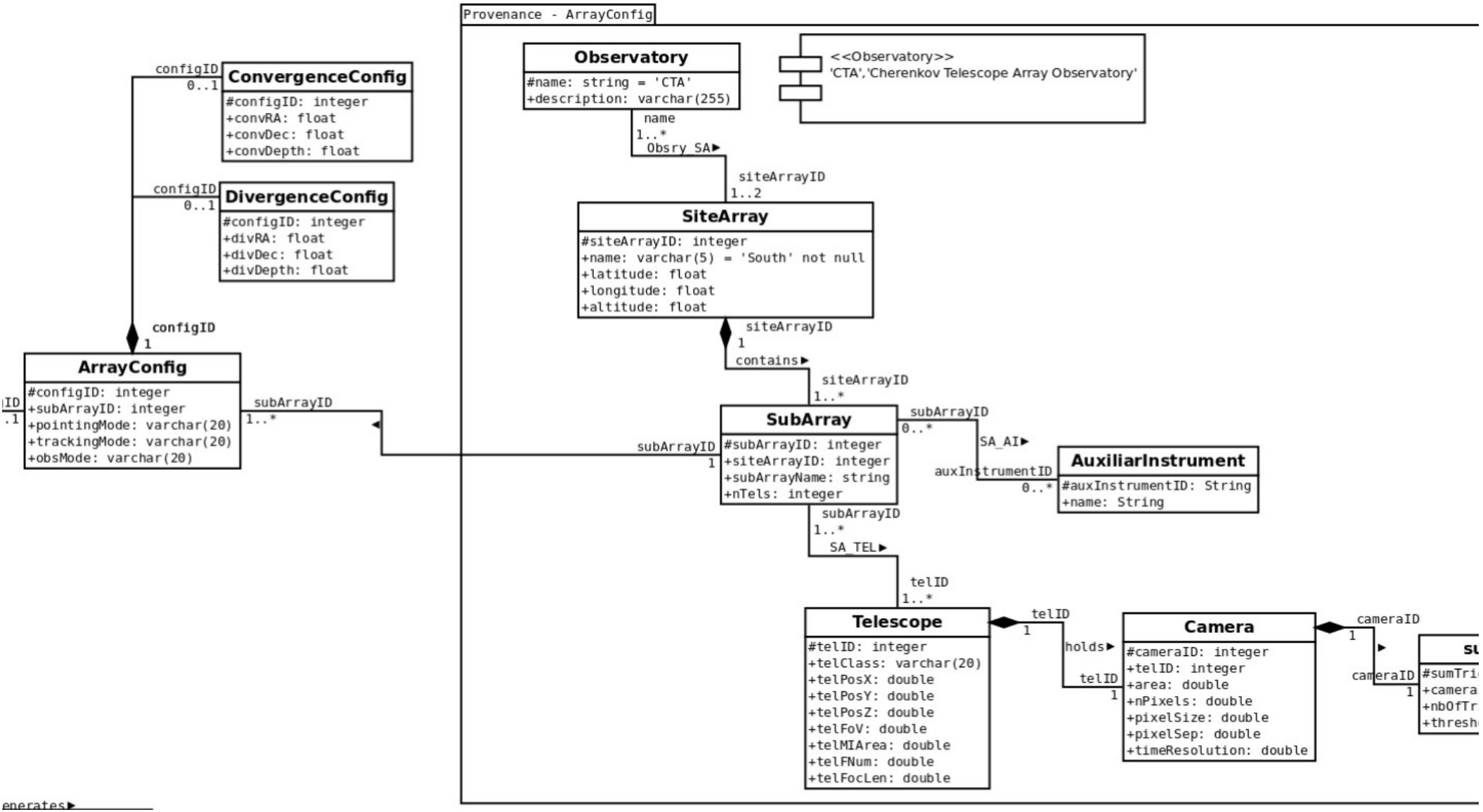
CTA Data Model



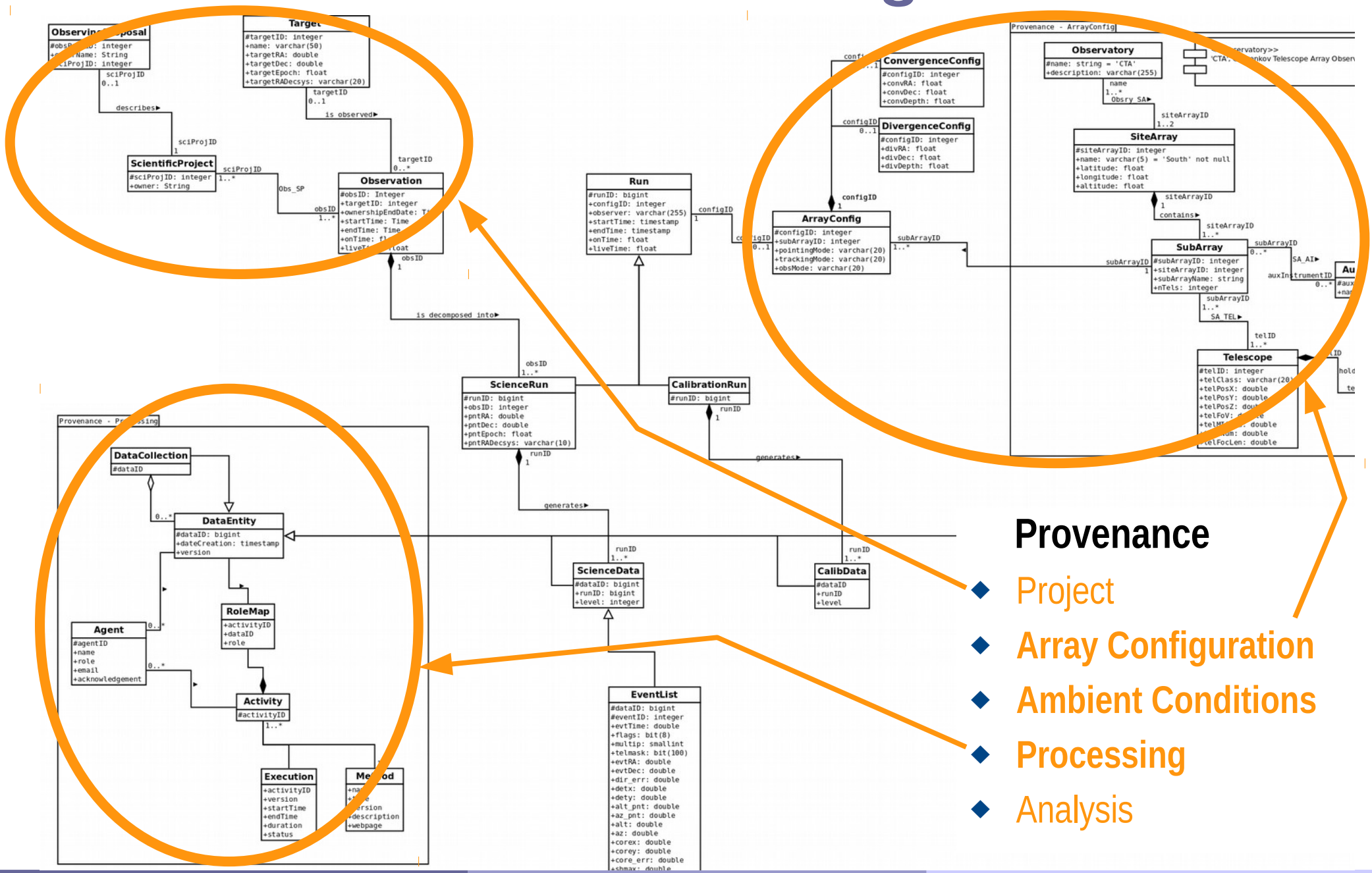
CTA DM - Project



CTA DM - ArrayConfig



CTA Data Model – Processing Provenance?

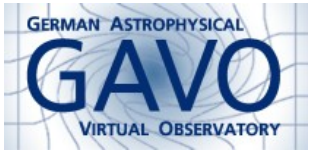


Provenance

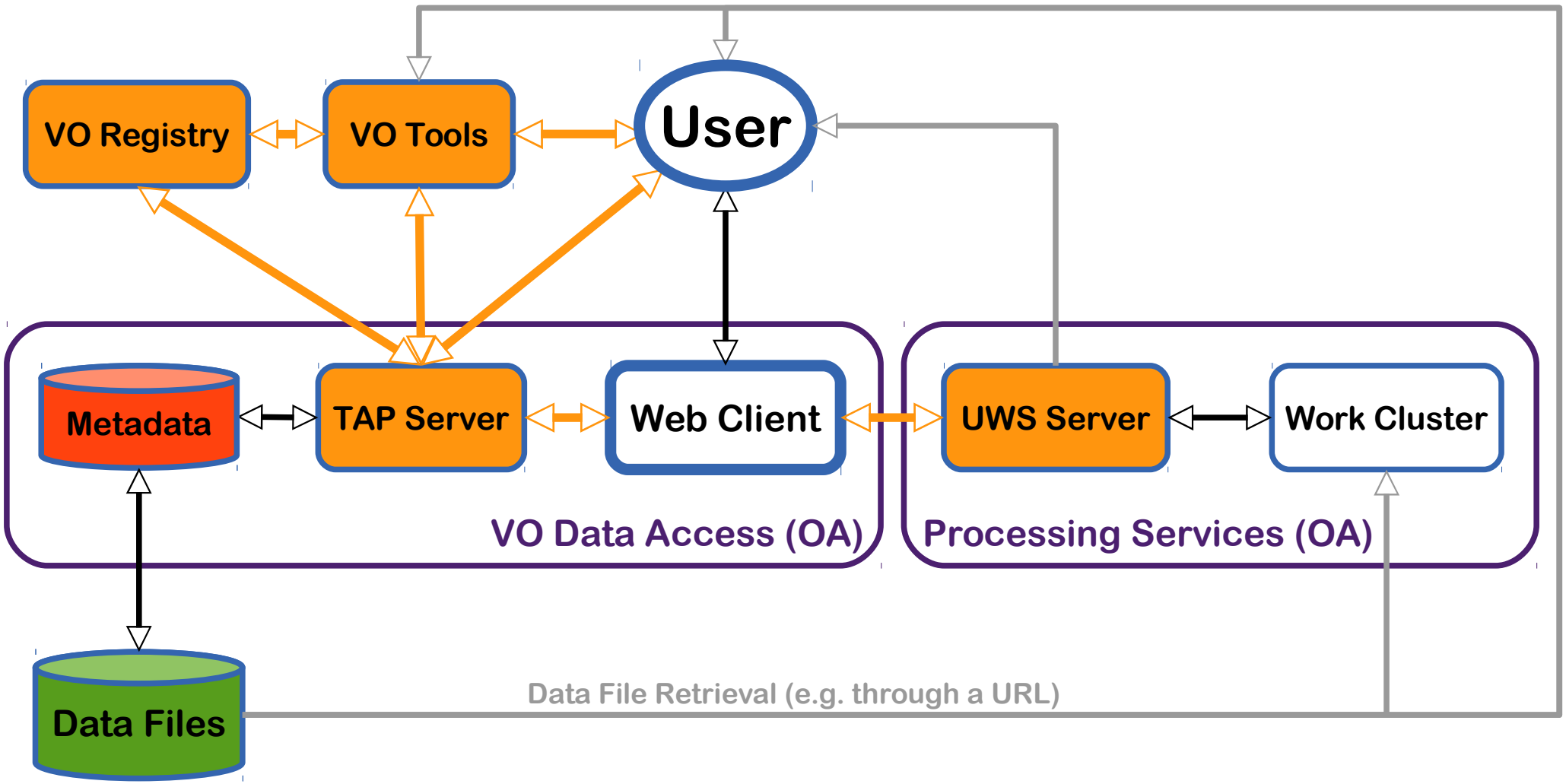
- Project
- Array Configuration
- Ambient Conditions
- Processing
- Analysis

CTA VO data access prototype

- **CTA Data Model** (not complete, still evolving)
  - **Automatic** Conversion UML to SQL
  - Relational database implemented (PostgreSQL)
- **Data Ingestion**: CTA 1DC data/metadata
- **VO Compliance**
  - ObsCore Data Model
  - GAVO DaCHS server: TAP, ADQL
- **Web Client** (Django, jQuery, BootStrap)
- **Online Analysis**: UWS, SAMP
- **Single Sign On** with SAML2/Shibboleth



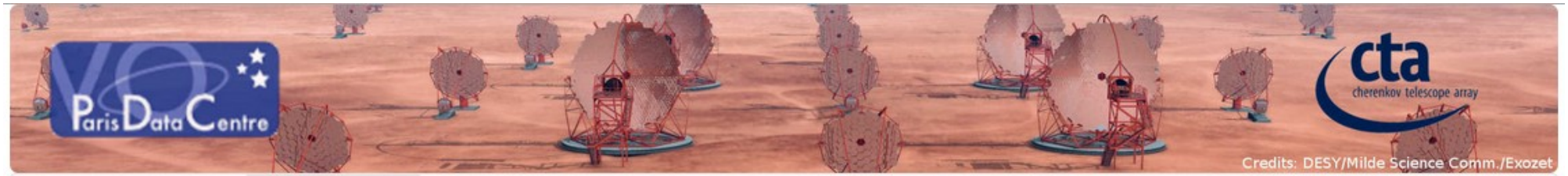
► Complete solution based on VO standards/protocols



VO compliant Service
VO protocol
Database
CTA Data Model
CTA Archive
OA CTA Observer Access

Web Client

http://voparis-cta-client.obspm.fr



CTA Data Distiller | Search Form | Job List | Sign out **user**

Cone Search

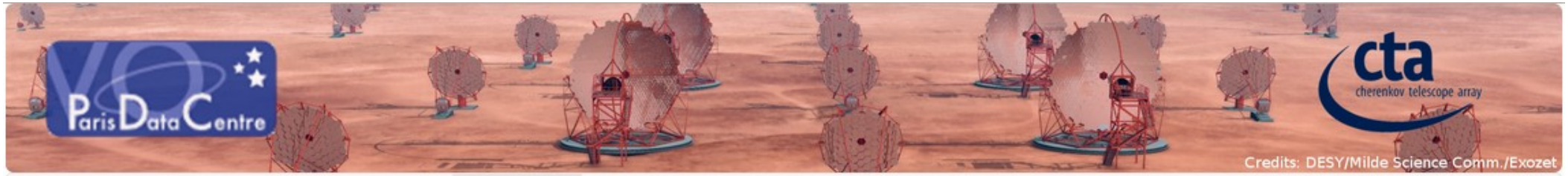
Target Name	Crab Nebula
Source RA (deg)	83.633
Source Dec (deg)	22.514
Search radius (deg)	0.001

Submit | Reset

- Django, jQuery, BootStrap3
- Name resolver
  Simbad through Sesame
- Builds and Sends the ADQL query

ObsCore Search

proposal_id		Proposal ID
dataproduct_type	Nothing selected	Data product (file content) primary type
dataproduct_level	Nothing selected	DL0-5



CTA Data Distiller | Search Datasets | Results | Job List | Selected Job | JS9 | Authentication: Sign out **user**

Search | Analyse | Visualisation

SAMP

Interop (SAMP)
- Send Result Table
- Send Selected Data

Results

show/hide query

```
SELECT * FROM cta.vo_obscore as o WHERE 1 = intersects(o.s_region, circle('ICRS', 83.63308333, 22.0145, 0.001))
```

ADQL query

Send

ObsCore fields

Search

	dataproduct_type	obs_collection	obs_id	target_name	s_ra (deg)	s_dec (deg)
☐	eventlist	1	23592	Crab Nebula	82.01333618164062	22.01444435119629
☐	eventlist	1	23559	Crab Nebula	85.25333404541016	22.01444435119629
☐	eventlist	1	23526	Crab Nebula	83.63333129882812	22.51444435119629
☐	eventlist	1	23523	Crab Nebula	83.63333129882812	21.51444435119629
☐	eventlist	3	5003499	CrabNebula	83.28087615966797	21.784133911132812

UWS

Analysis tools
- Create Count Map(s)
- Extract Spectrum

Plotting tools
- TOPCAT
- Aladin
- VOSpec
- SPLAT

Showing 1 to 5 of 10 rows 5 records per page

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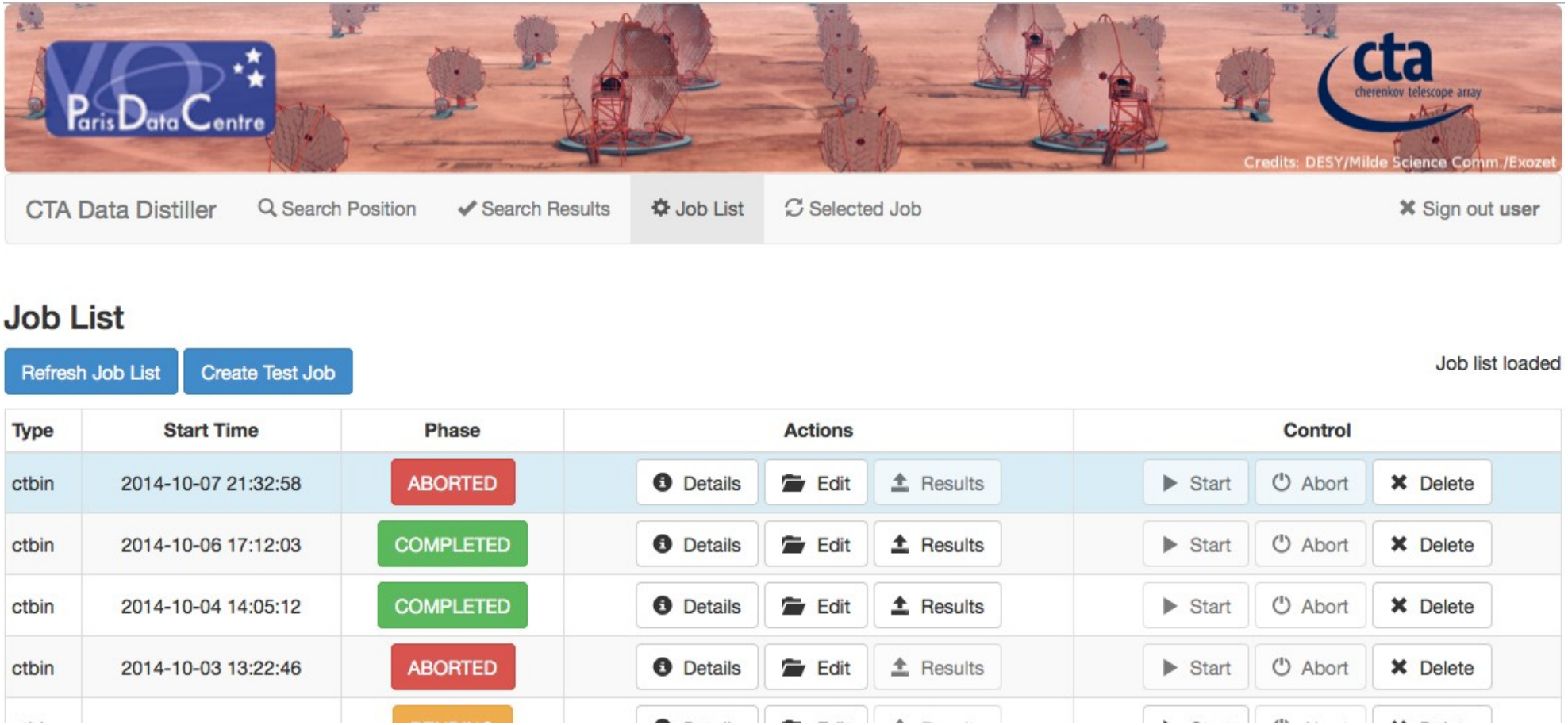
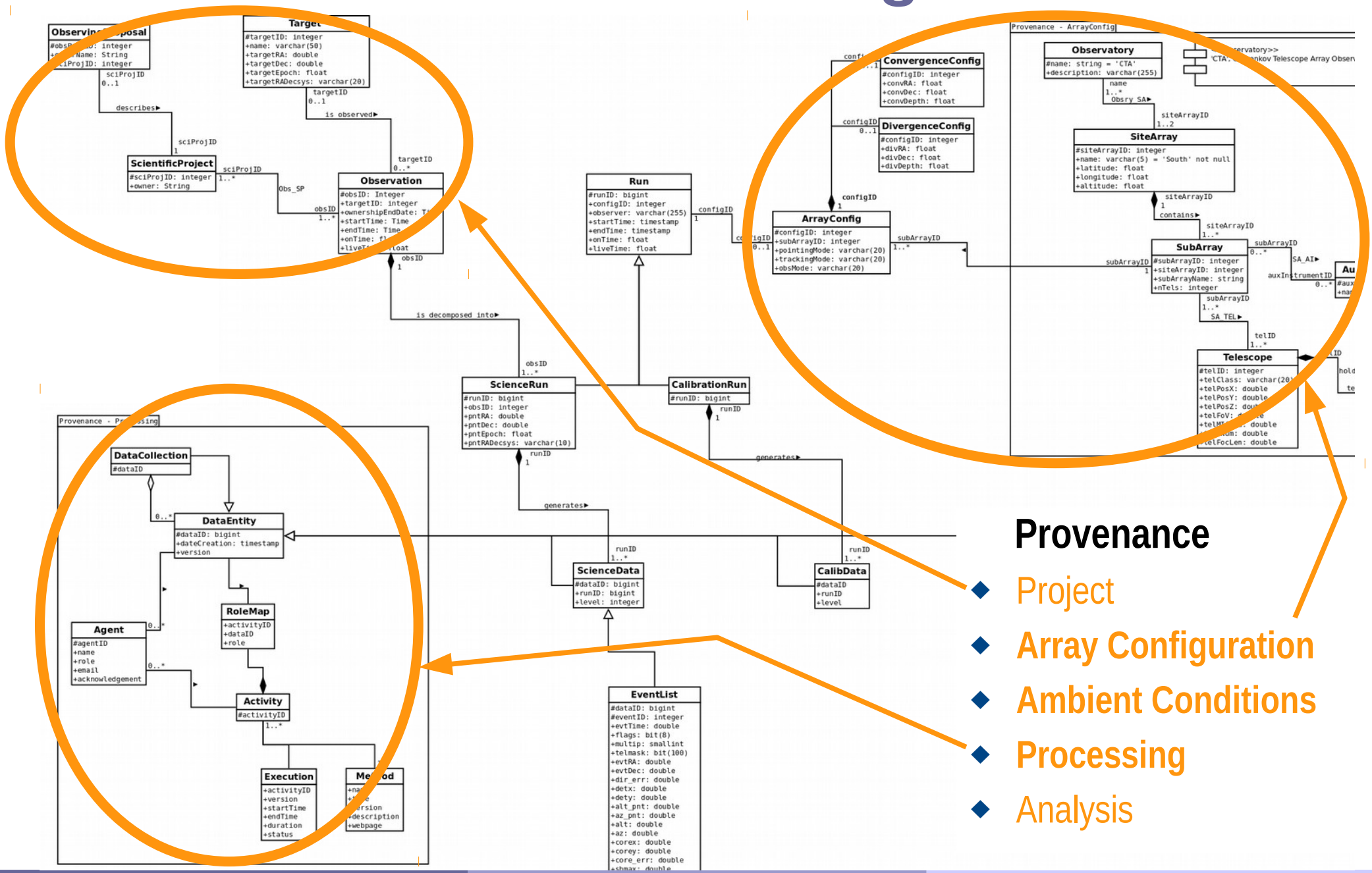
Web Client – Job List



- « ctbin » processes DL3 data to create an image
- However Provenance / Data links have been lost

CTA Data Model – Processing Provenance?



Provenance

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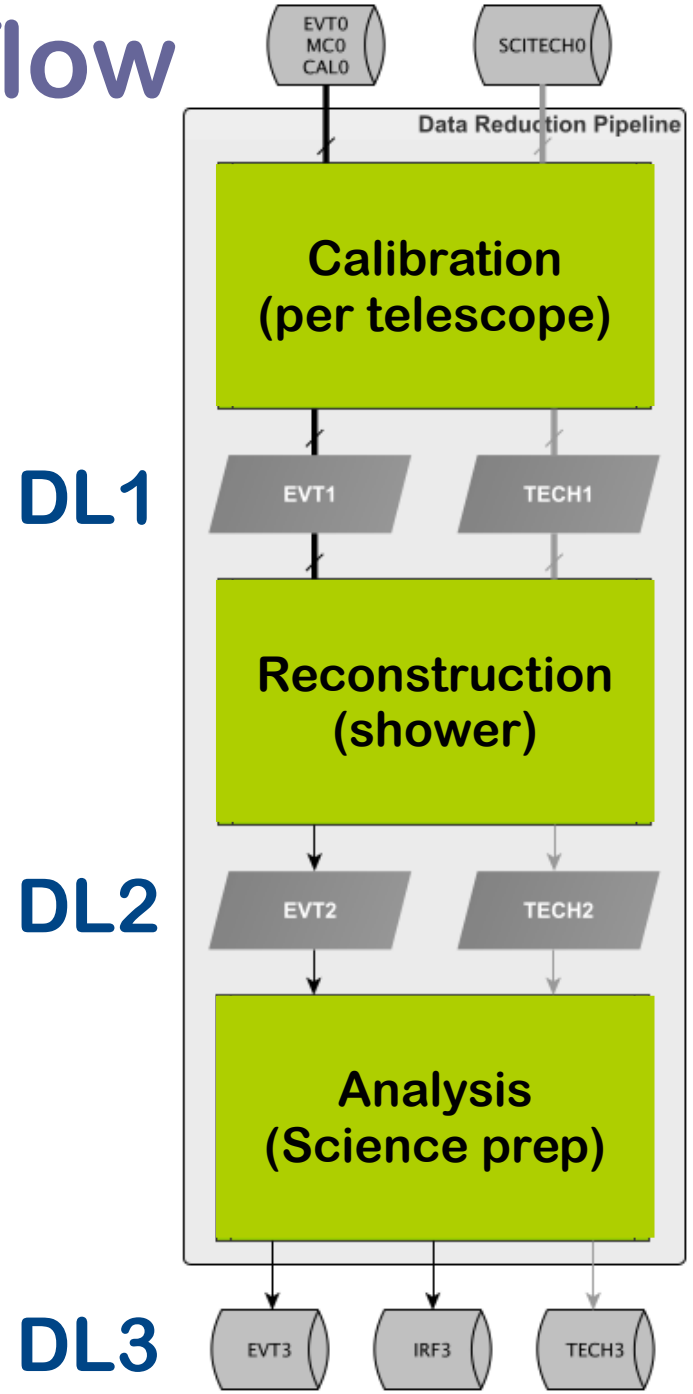
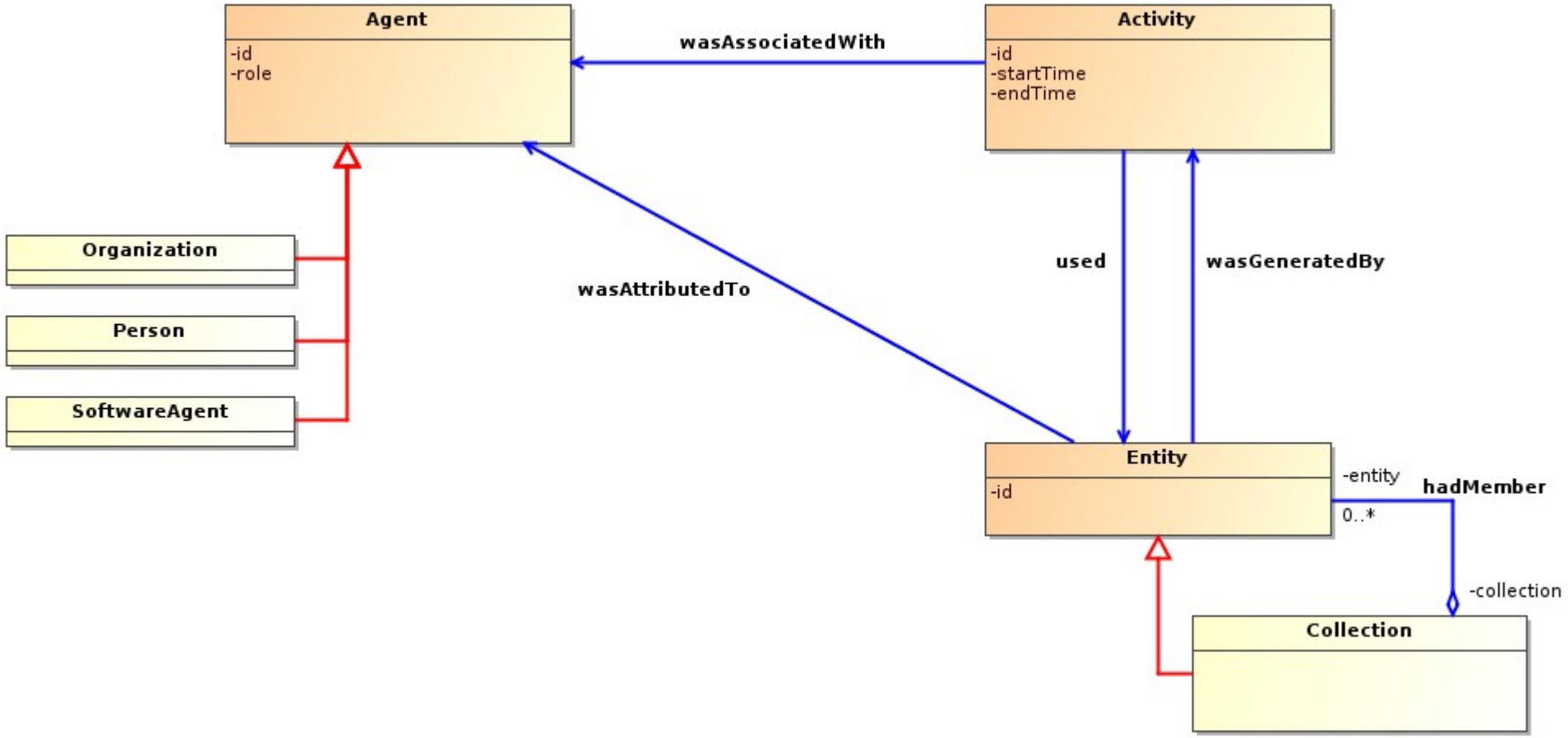
CTA data levels and workflow

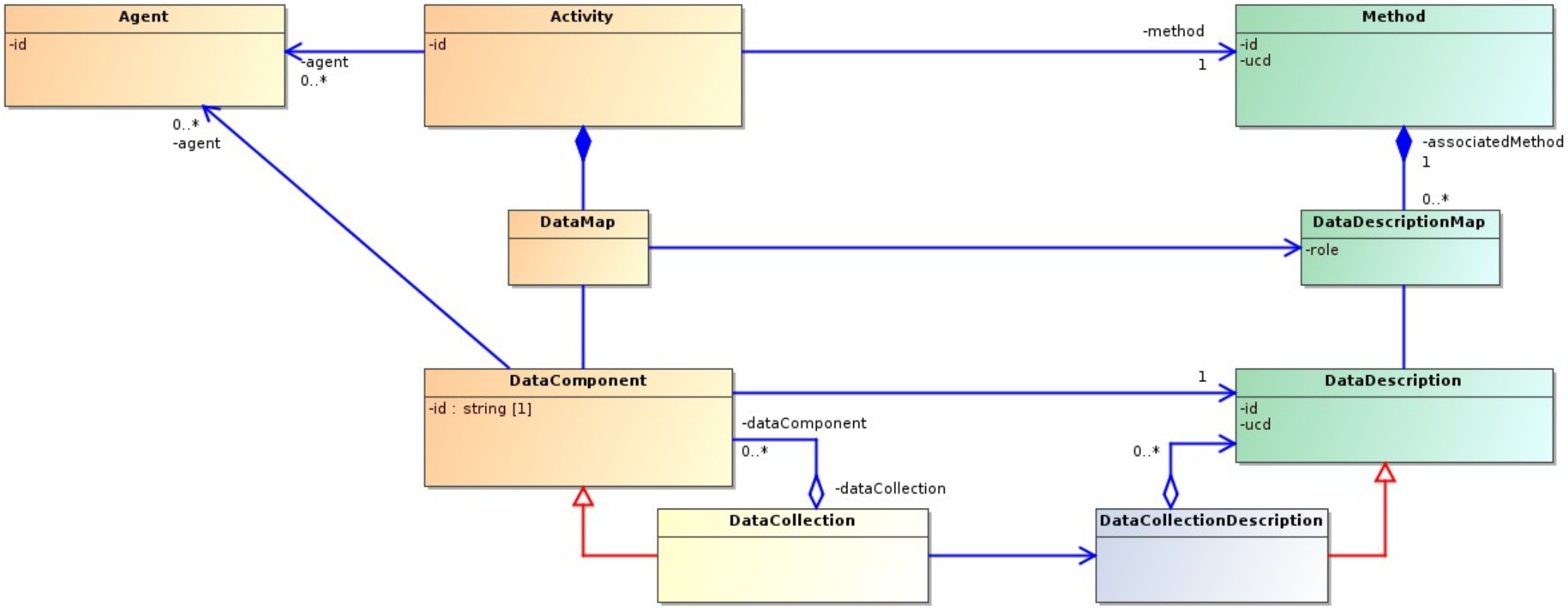
Data Level	Short Name	Description
Level 0 (DL0)	DAQ-RAW	Data from the Data Acquisition hardware/software.
Level 1 (DL1)	CALIBRATED	Physical quantities measured in each separate camera: photons, arrival times, etc., and per-telescope parameters derived from those quantities.
Level 2 (DL2)	RECONSTRUCTED	Reconstructed shower parameters (per event, no longer per-telescope) such as energy, direction, particle ID, and related signal discrimination parameters.
Level 3 (DL3)	REDUCED	Sets of selected (e.g. gamma-ray-candidate) events, along with associated instrumental response characterizations and any technical data needed for science analysis.
Level 4 (DL4)	SCIENCE	High Level binned data products like spectra, sky maps, or light curves.
Level 5 (DL5)	OBSERVATORY	Legacy observatory data, such as CTA survey sky maps or the CTA source catalog.



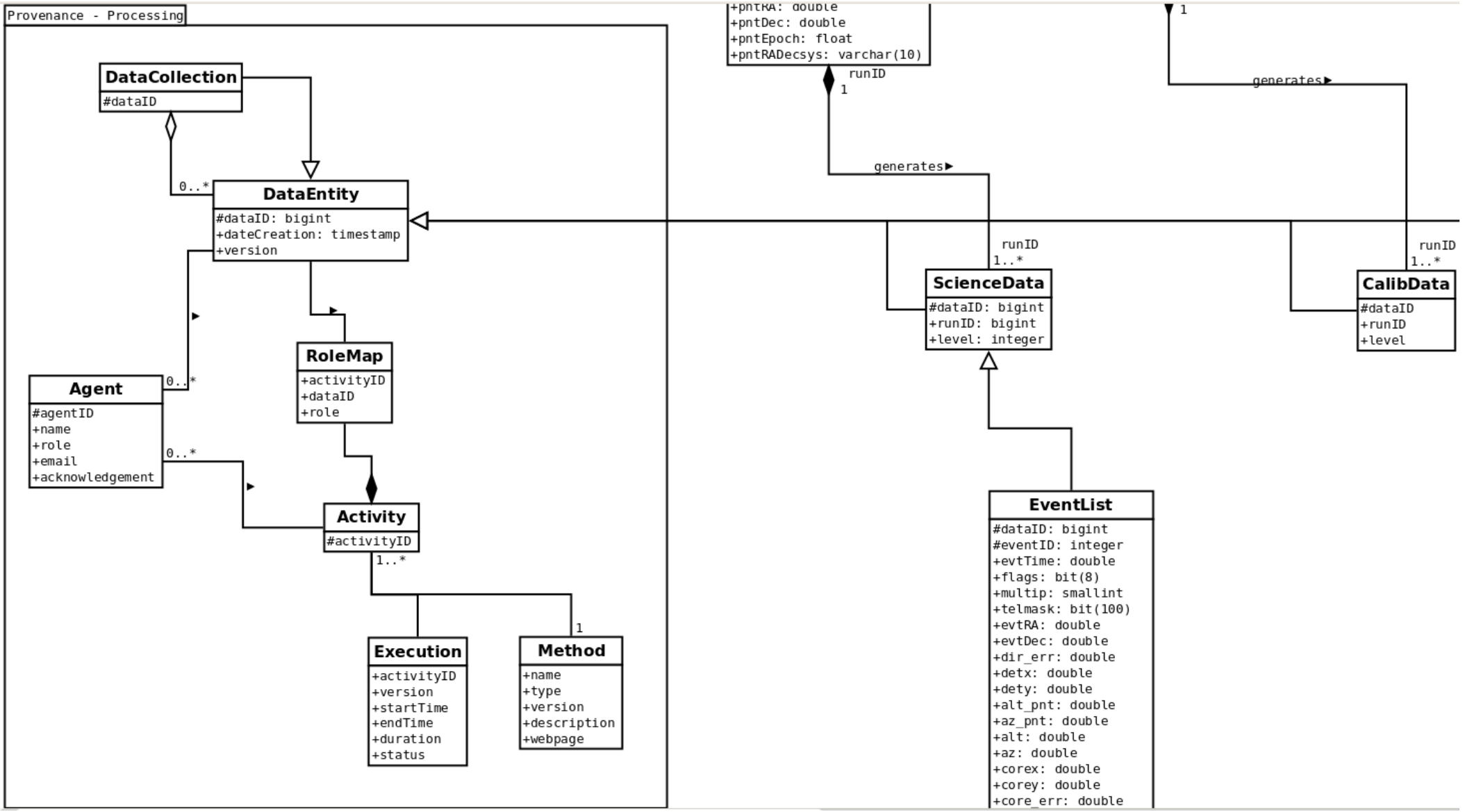
IVOA Provenance DM (based on W3C)



IVOA Provenance DM (with prototypes)



CTA DM – Processing Provenance



Use Cases

- Users:
  - astronomer, quality control, database managers
- Examples :
  - Create an image (DL3 → DL4)
  - All datasets with run_id = …
  - From DL4 image, go back to DL3 and redo
  - All products using Pipeline version ...
- Questions :
  - Metadata propagation
  - Access to Provenance (Obscore fields, DataLink)