cherenkov telescope array

an observatory for ground-based gamma-ray astronomy

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Structuring metadata for the Cherenkov Telescope Array

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ABSTRACT

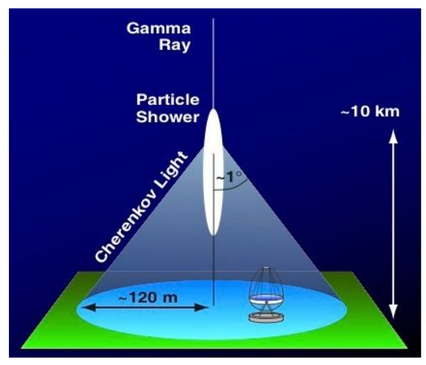
The landscape of ground-based gamma-ray astronomy is drastically changing with the perspective of the **Cherenkov Telescope Array (CTA)** composed of more than 100 Cherenkov telescopes. For the first time in this energy domain, CTA will be operated as an observatory **open** to the astronomy community. In this context, a structured **high level data model** is being developed to describe a CTA observation. The data model includes different classes of metadata on the project definition, the configuration of the instrument, the ambient conditions, the data acquisition and the data processing. This last part relies on the **Provenance Data Model** developed within the International Virtual Observatory Alliance (IVOA), for which CTA is one of the main use cases. The CTA data model should also be compatible with the Virtual Observatory (VO) for data diffusion. We have thus developed a web-based data diffusion prototype to test this requirement and ensure the compliance.

Objectives

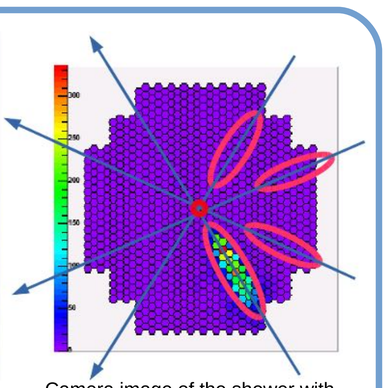
The high level data model diagram aims at defining **global terms** and their **relations**, in order to provide the complete description of a CTA data product. This data model or part of it is relevant to **various CTA working groups:** Proposal Handling, Array Control, Pipeline, Data Diffusion and Hardware Developments. It serves as a **global interface**.

Cherenkov Astronomy

The **Imaging Atmospheric Cherenkov Technique** (IACT) is a method to detect very high energy gamma-ray photons in the **50 GeV to 50 TeV** range. It works by imaging the very short flash of Cherenkov radiation generated by the cascade of relativistic charged particles (**shower**) produced when a very high-energy gamma-ray strikes the atmosphere.



Schema of the cone of Cherenkov light



Camera image of the shower with ellipses from other cameras overlayed

Proposals
Decomposed into
Targets

→ **Scheduler** →

Acquisition
Scheduling Blocks
and
Observation Blocks

← **Obs Config**
Pointing coordinates
Sub-Array used
Type of observation

← **Instrument Description**
Give the structure of the instrument:
Site, Array, Telescope, Camera, Pixel, Auxiliary instruments, ...

CTA High Level Data Model

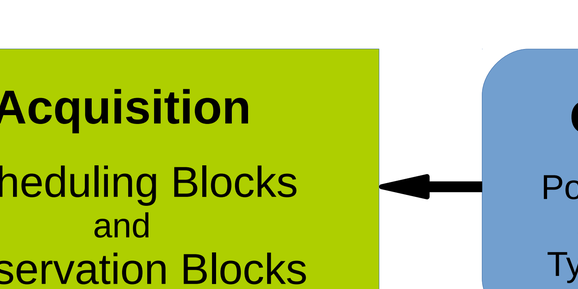
We show here the global structure only, without details on classes and attributes:

- **Proposals** are decomposed into **Targets** with their **requirements (**observing and pointing modes, ...), and **constraints** (e.g. night sky background, ...)
- The **Scheduler** then creates an observation program composed of blocks: **Scheduling Blocks** (sequence of observations planned for a given Target), made of **Observation Blocks** (effective start and stop times of acquisition with a given configuration)
- The **Obs Config** defines the coordinates, the **SubArray** (group of telescopes used), the **type** of observation, the strategy and the observing, pointing and trigger modes
- The **Instrument Description** is a separate database that contains the complete instrument description and its modifications
- **Raw Data** is produced during **Acquisition** and processed to higher **Data Levels**

Data
Data Levels (DL):
Raw, DL0-5

Pipeline stages for data processing

DL0 → **Calibration** (per telescope) → DL1 → **Reconstruction** (shower) → DL2 → **Analysis** science preparation → DL3 → **Data product generation** → DL4-5



IVOA ProvenanceDM

The **tracking** of **processing activities** will be done using the IVOA Provenance Data Model, based on the **W3C PROV** ontology (Entity-Activity-Agent relations).

This data model and its access layer are currently in development (see talks **O10.4** and **I10.1**).

VO Diffusion for CTA

One of the goal of the High Level Data Model is to make **CTA data products available and discoverable** through the Virtual Observatory (VO).

For example, the attributes contained in this data model can be mapped to the generic **IVOA ObsCore data model**, and exposed using the **IVOA Table Access Protocol** (TAP). This provides an **ObsTAP service** for the CTA Archive.

An **online prototype** has been developped to test the data model and adapt the VO protocols to Cherenkov Astronomy:

https://voparis-cta-test.obspm.fr

Next developments

This work is still **preliminary**. Most of the content of the data model is now defined but it still requires iterations with involved working groups to be completed.

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