Archiving data from a software telescope

An astronomer perspective
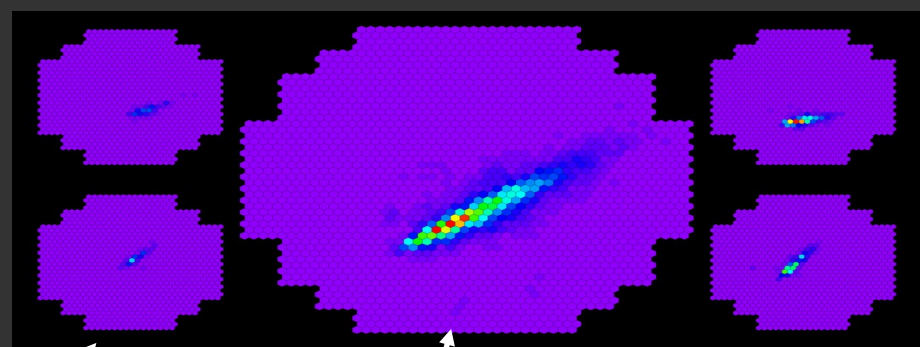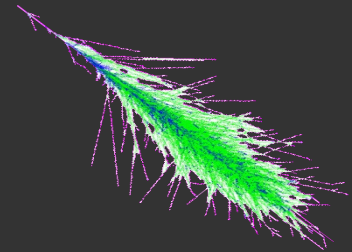
Catherine Boisson
ASTERICS OBELICS PyGamma19, Heidelberg 2019

Dark nights → small duty cycle

Event reconstruction :

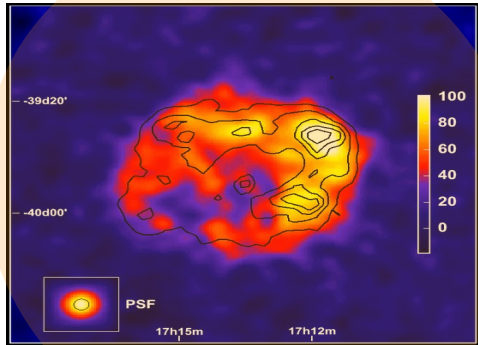photon, particle shower, Cherenkov light (faint, few nanoseconds)

Atmosphere = **calorimeter**
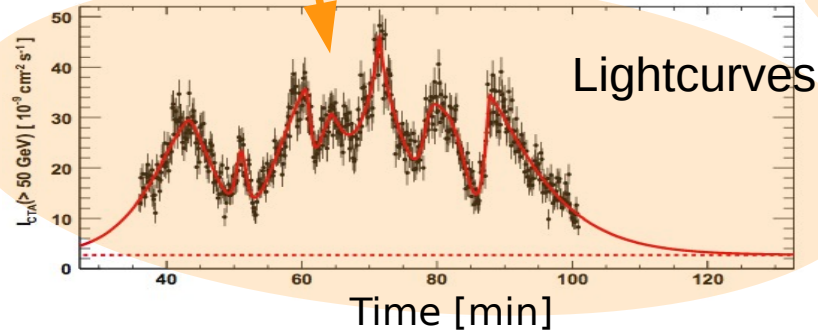Simulations, assumptions
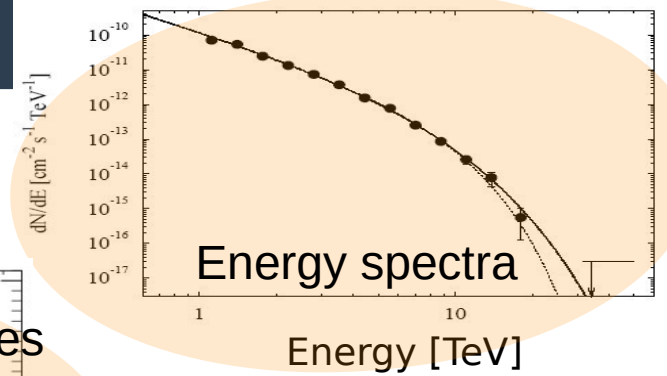
Complex metadata : need to be structured

©Matthias Lorentz

Multi-wavelength analysis

Event lists
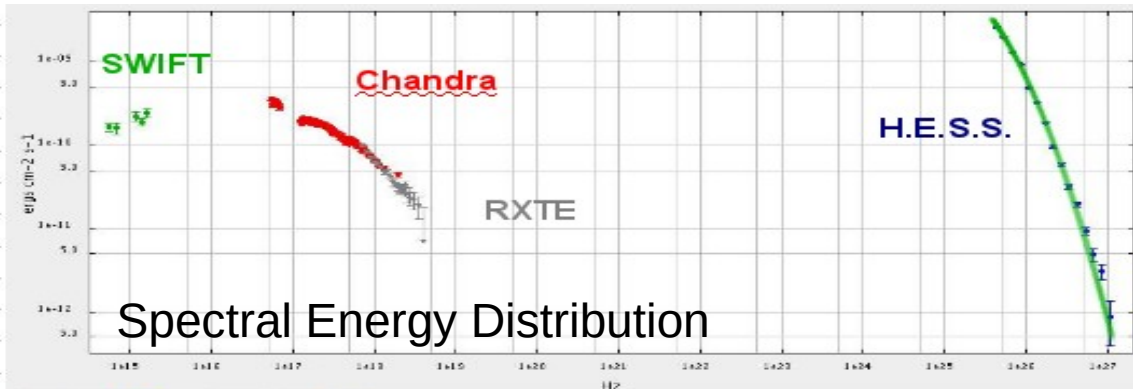(coordinates, time, energy)

Energy spectra

Energy [TeV]

Lightcurves

Time [min]

Images

Spectral Energy Distribution

**Compatible data
at other wavelength?**

**Simultaneous
Calibrated
Specific Processing?
Context?**

Only a few hours of useful data summed over a long time

Not pixels but asymetric energy bins

optimization

☑ HESS J0152+017

Observation

name	comments	pointing alpha	pointing alpha sys	pointing alpha stat	pointing delta	pointing delta sys	pointing delta stat	publisher
HESS J0152+017	October to November 2007 summed data; significance of 6.6 sigma	1:52:33.500	1.3	8.3	1:46:40.300	20	107	VO-Paris

Curation

curation date	version	rights	contact name	contact email	title	creator	creation date	creation type
02-08-2008	1.0	Public	C. Boisson	catherine.boisson@obspm.fr	Extragalactic	C. Boisson	28-07-2008	Archival

Time Axis

bounds start	bounds stop	livetime
52412.075	53504.895	14.7

Spectral Axis

energy threshold
3

Spectral Data (E in TeV) / Flux Data (dN/dE in cm-2.s-1.TeV-1)

| value	value	stat error
0.308	2.03399e-11	6.674 e-12
0.484509		1.63425e-12
0.760992	1.20326e-12	5.01844e-13
1.19525	3.12378e-13	2.16144e-13
1.87731	1.18592e-13	8.50016e-14
2.9486	4.0974e-14	3.51122e-14

Segment

length	data type	imgfile	comments	background	hypothesis power law	hypothesis gamma	hypothesis ngamma	hypothesis chi2	hypothesis dof
6	Spectrum		Aharonian et al., A&A 481 (2008) L103	Reflected model	Single	2.95	173	2.16	4

Quality

mean zenith angle
26.9

Cuts

name	description
Hillas soft cuts	Soft Cuts: as standard cuts but optimized for a 1% Crab flux (>100 GeV) source with a photon index of 5.0. * a 5/10 cleaning * a charge cut at 40 p.e. * a nominal distance cut at 2 degrees * a Mean Scaled Width between -2 and 0.9 * a Mean Scaled Length between -2 and 1.3 * a Theta^2 cut of 0.02

Background

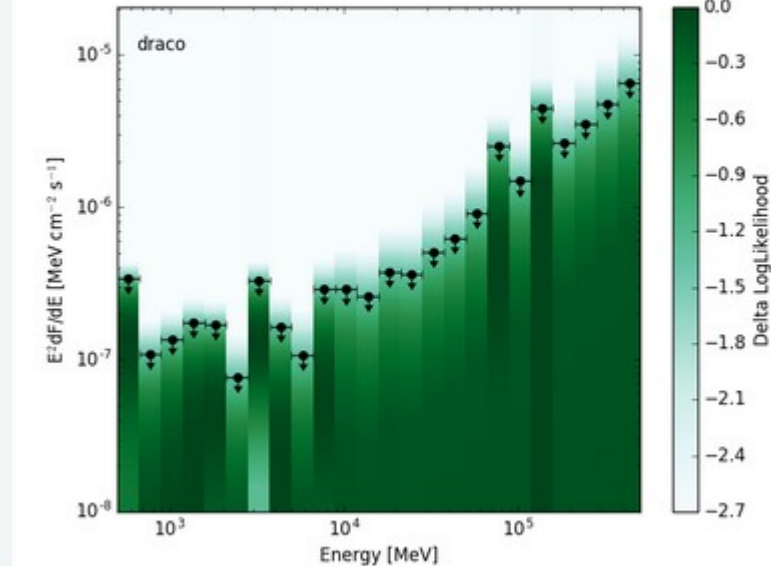| name	description
Reflected model	Technique used in standard wobble observation mode. See Aharonian et al. (H.E.S.S. Collaboration), A&A 457, 899 (2006)

Spectral Fit

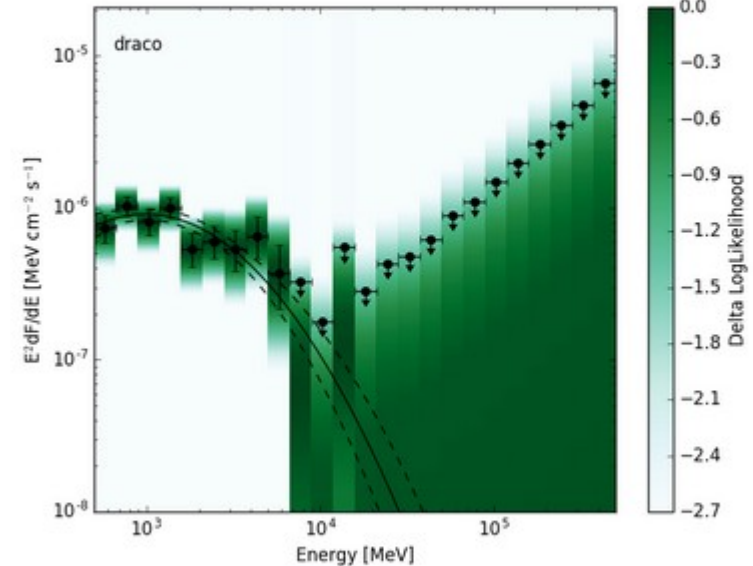Bin-by-bin fluxes + broadband fit envelope   3FGL catalog
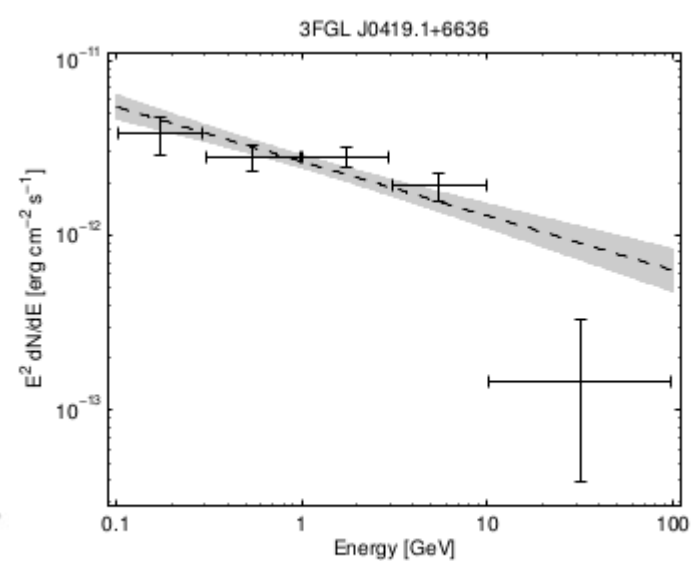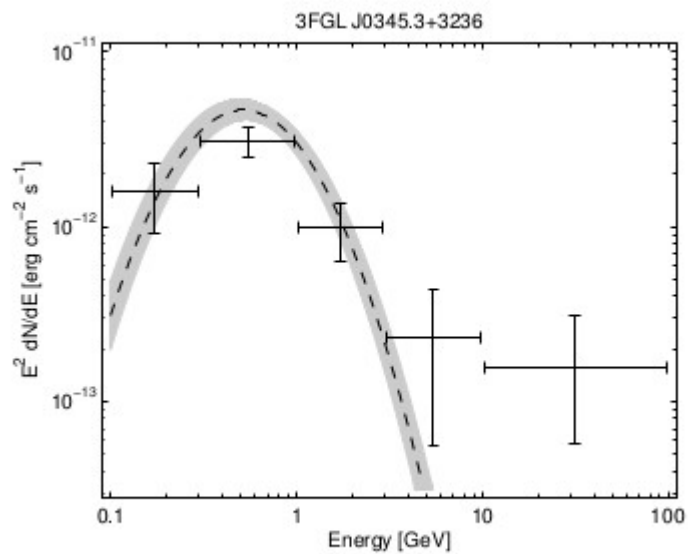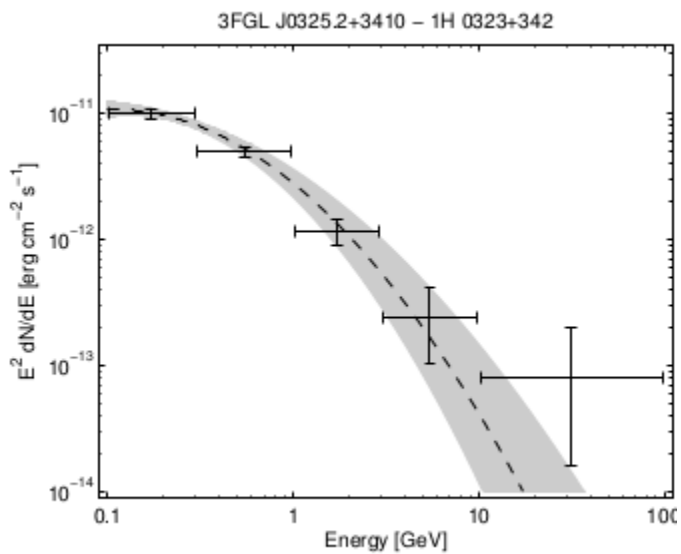
Format for complete likelihood curve

https://gamma-astro-data-formats.readthedocs.io/en/latest/spectra/binned_likelihoods/index.html

see Eric Charles's presentation

Data from publications, catalogs...

CTA & Virtual Observatory

- Virtual Observatory (VO) standards and framework explored for several CTA use cases
  - Identify how a data was produced → Provenance
  - Identify what detailed options were used → Configuration

- IVOA Provenance data model
  - See Mathieu Servillat's presentation

- Link Master Configuration Data Model / Provenance Data Model

- Extension of tools (e.g. ctapipe, gammapy) to include access to provenance information
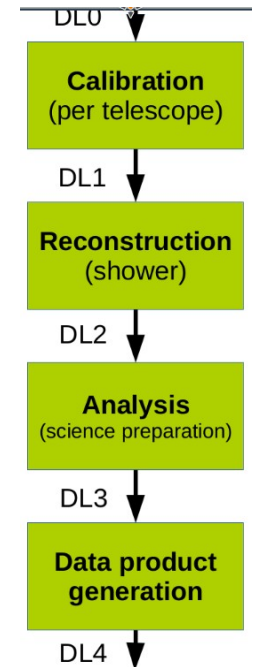
Science Archive in the VO framework

CTA Data Access
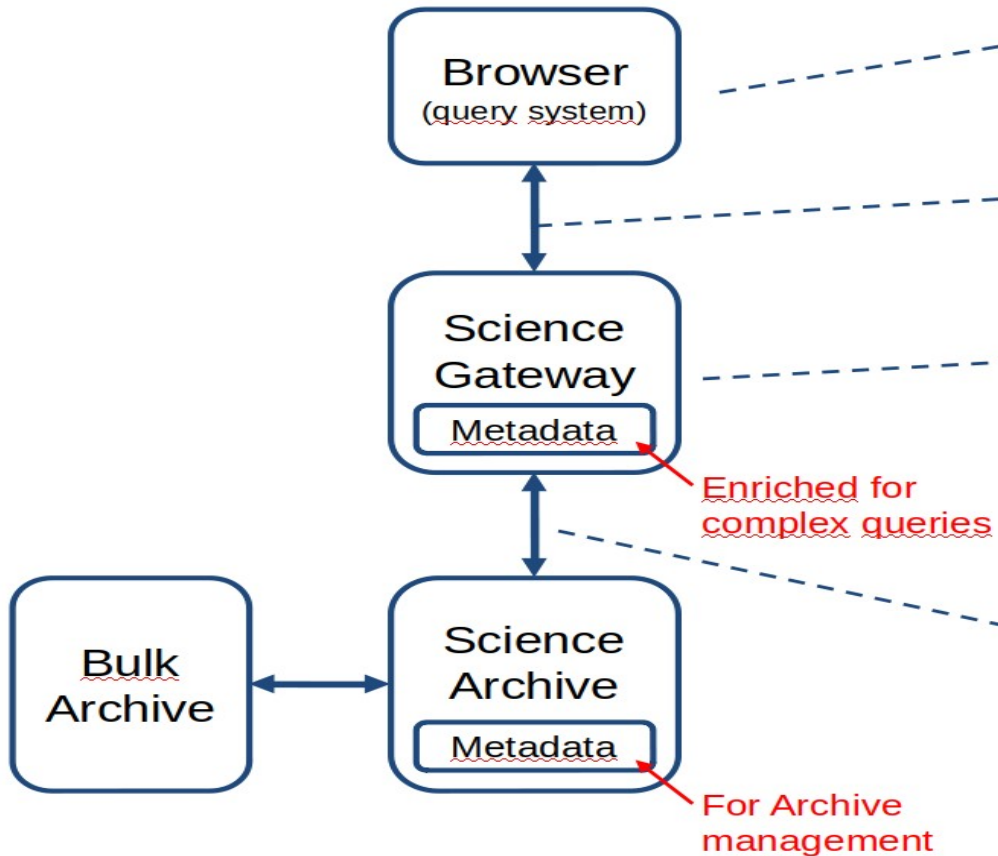
In the VO Framework

Client: submits a query
- **VO tools** (Topcat, Aladin, scripts...)
- Dedicated **Web Client**

Protocol: standard for query exchange
- **ADQL** (Astronomical Data Query Language)
- **TAP** (Table Access Protocol)

Server: computes query results
- **TAP** Service
- VO **Data Models** (ObsCore, DataSet, ...)
  - RA → s_ra
  - Dec → s_dec
  - obs_id, t_min, t_max, access_url, ...
- ⇒ **ObsTAP** Service

Retrieval System:
- VO ObsCore **access_url** + **DataLink**
- Any service at the **access_url**
  - FTP, HTTP server
  - VO Space
- e.g. https://archive.cta.org/retrieve?id=###

CTA Data Distiller

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

CTA Data Distiller   🔍 Search Form   ✔ Results   👤 Sign in

☑ Cone Search

Target Name	PKS 2155-304	Used to query Simbad with Sesame and set RA/Dec.
Source RA (deg)	329.717	Right Ascension.
Source Dec (deg)	-30.226	Declination.
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

HESS DL3 data release exposed using VO protocols

Computing and workflow management

- **OPUS** (Observatoire de Paris UWS Server)

  - a light **job controller** for the Paris Observatory **work cluster** developped in Python
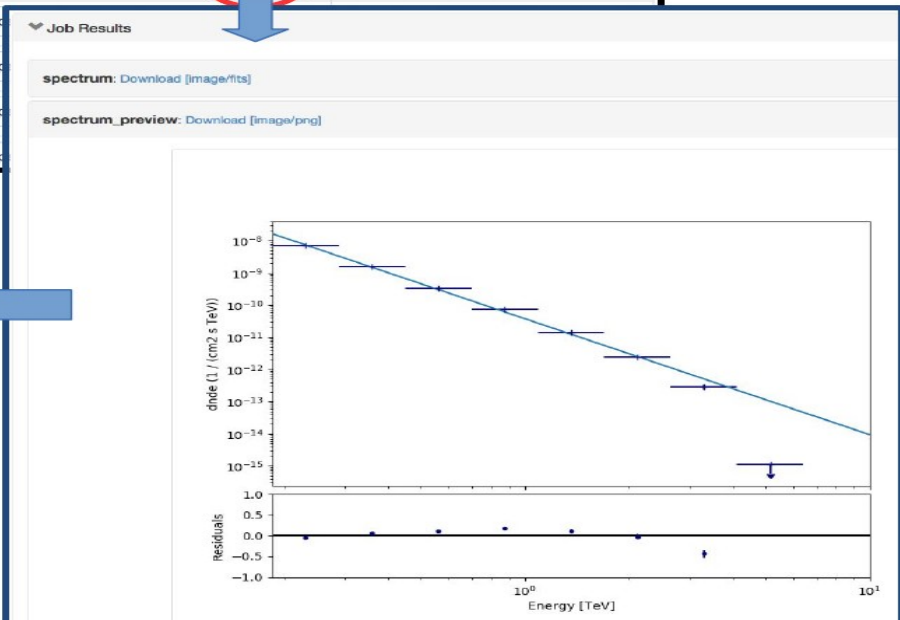   https://uws-server.readthedocs.io/en/latest/

- Follows the **IVOA UWS pattern**
- REST web service
- Job definition editor
- Job manager
  - Stores job **properties** (start, stop time…)
  - **Parameter** also kept
  - Access to **results**
  - **Visualization of logs and Provenance information**

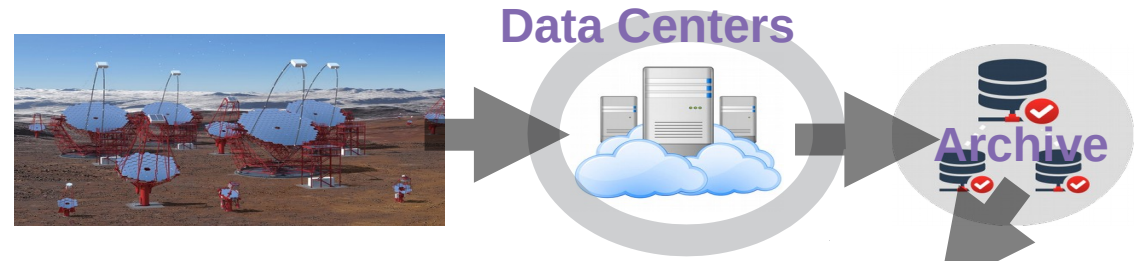# Web client working prototype - DL3+

Science Archive & Science Gateway

- Conception of a CTA Master **Configuration Data Model**

- Containing detailed **Provenance** metadata stored in the **Archive**

- Compatibility with **Virtual Observatory** standards

- **Science Gateway** = collection of **interconnected** web services with common **Authentication/ Authorization** system