Archivage des données de H.E.S.S. à l'usage des astronomes.

> 50 sources, nbr croissant + HESS-2

PKS2155-304 2006 campaign / plan galactique

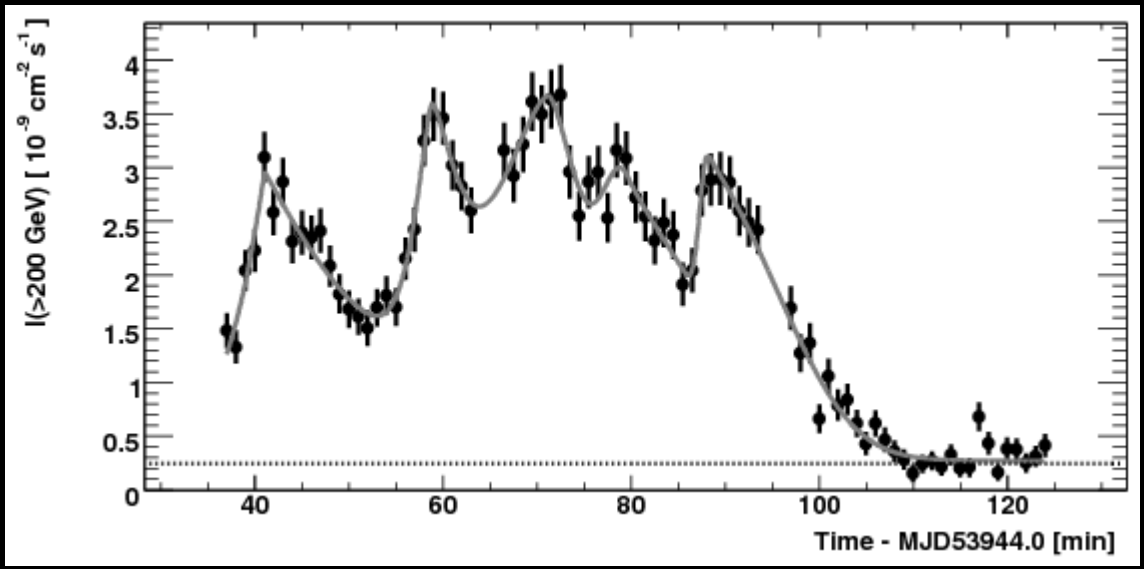
Spectres et même courbes de lumières au TeV

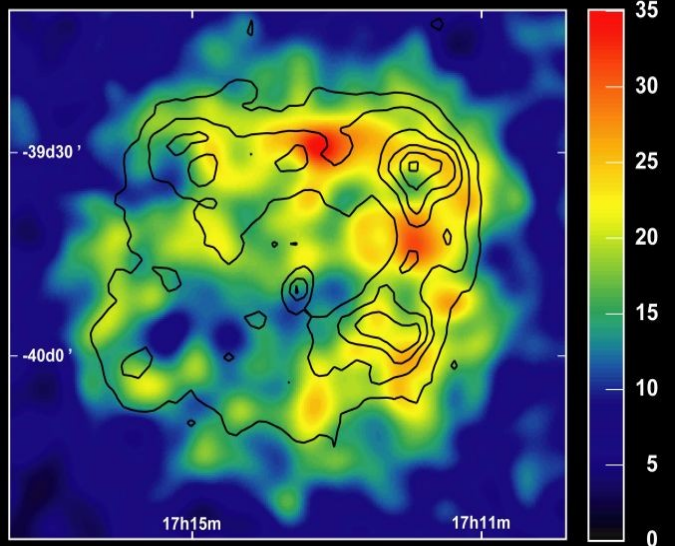
Cartographie

l'Observatoire de Paris — LUTH
Laboratoire de l'Univers et de ses Théories

Données brutes gamma de nature très particulière, nécessitant un traitement sophistiqué et évolutif d'analyse des gerbes, généralement conduits sous la responsabilité de physiciens des particules.

Pour un transfert efficace d'information vers communauté des astronomes, il faut améliorer les interfaces de toute la chaîne d'analyse et parvenir à un archivage utile, une vision multi-lambda, structurés autour des besoins propres des astrophysiciens.

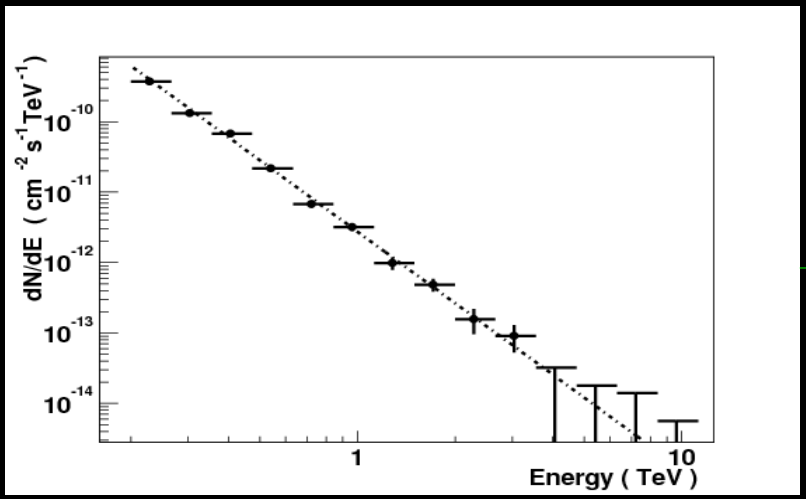


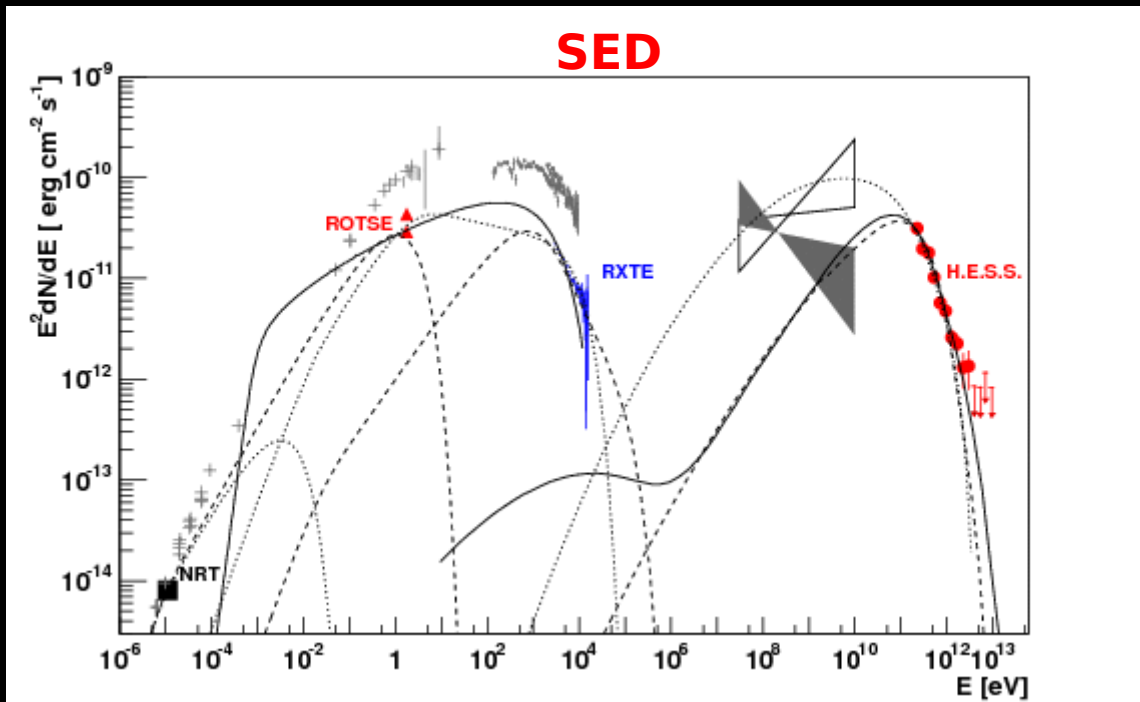


Courbes de lumière

Cartographie

Spectres: moyennés dans le temps ou non





Description d'un spectre:

```
!#
!# Spectrum             : PKS 2155-304 – date d'observation
!#
!# Total Live Time      : 5.2676 h
!# Mean Zenith Angle    : 30.0161
!#
!# Mean Energy Threshold : 0.2637 TeV
!# F_int(E_thresh)      : 6.9371e-10
!#                      : 373.26 % Crab
!#
!# Gamma(PL)            : 3.1511e+00 ± 1.2547e-02
!# Phi_0(PL)            : 8.4854e-11 ± 1.1328e-12
!# chi^{2}/d.o.f.(PL)   : 5.2814e+02 / 14
!# Prob(PL)             : 0.0000e+00
!# NGamma(PL)           : 11356.6
!#
!#BinCenter Corr.  Width/2. Flux        FluxErr     UL (FC 99.9%)   On      Off     Gamma   Sign
!#   0.2201  0.2180  0.0212  7.39162e-09 2.61640e-10 0.00000e+00 853.000 133.000 826.400  48.220
     0.2667  0.2641  0.0256  4.56230e-09 1.33507e-10 0.00000e+00 1243.000 184.000 1206.200 58.519
     0.3231  0.3200  0.0310  2.96929e-09 7.68810e-11 0.00000e+00 1563.000 178.000 1527.400 67.208
     0.3915  0.3876  0.0376  2.09156e-09 5.05102e-11 0.00000e+00 1786.000 179.000 1750.200 72.571
     0.4743  0.4696  0.0456  1.21041e-09 3.08324e-11 0.00000e+00 1605.000 156.000 1573.800 68.953
     0.5746  0.5690  0.0552  5.90055e-10 1.70600e-11 0.00000e+00 1272.000 171.000 1237.800 59.752
     0.6961  0.6893  0.0669  3.22060e-10 1.02938e-11 0.00000e+00 1043.000 153.000 1012.400 53.653

   ...
```

caractéristiques obs.

Paramètres globaux

Modèle

EGRET 3D catalog: PKS2155-304

```
SIMPLE  =                    T / file does conform to FITS standard
BITPIX  =                    8 / number of bits per data pixel
NAXIS   =                    1 / number of data axes
NAXIS1  =                    1 / length of data axis   1
EXTEND  =                    T / FITS dataset may contain extensions
DATE    = '01/03/00'           / FITS file creation date (dd/mm/yy)
USERNAME= 'dlb     '           / who
COMMENT   SPECTRAL output file
MODEL   =                    1 / model number
FORM    = 'simple power law'   /
PHASE11 =          0.000000E+00 / start src phase
PHASE12 =          1.000000E+00 / end src phase
PHASE21 =          0.000000E+00 / start BG phase
PHASE22 =          0.000000E+00 / end BG phase
ALPHA1  =          2.347586E+00 / slope 1
ALPHERR1=          2.592137E-01 / slope error 1
ENORM   =          2.178128E+02 / standard energy
ALPHA2  =          2.347586E+00 / slope 2
ALPHERR2=          2.592137E-01 / error 2
FNORM   =          3.701761E-10 / inst flux @ enorm
FNORMERR=          7.926732E-11 / flux error
CHISQ   =          1.576053E+00 / reduced chi sq
NDOF    =                    8 / degrees of freedom
CORREL  =          3.522234E-07 / correlation
NLINES  =                    0 / # of lines
NCHAN   =                   10 / energy channels
XTENSION= 'TABLE   '           / ASCII table extension
BITPIX  =                    8 / 8-bit ASCII characters
NAXIS   =                    2 / 2-dimensional ASCII table
NAXIS1  =                   80 / width of table in characters
NAXIS2  =                   10 / number of rows in table
PCOUNT  =                    0 / no group parameters (required keyword)
GCOUNT  =                    1 / one data group (required)
TFIELDS =                    7 / number of fields in each row
TTYPE1  = 'chan    '           / label for field   1
TBCOL1  =                    1 / beginning column of field   1
TFORM1  = 'I3      '           / Fortran-77 format of field
```

Hillas Recommended Standard Cuts

a 5/10 cleaning (set_hillas_name)

a charge cut at 80 pe (set_chargemin)

a nominal distance cut at 2 degrees (set_maxnomdistance)

a Mean Scaled Width between -2 and 0.9 (ref run_analysis)

a Mean Scaled Length between -2 and 2 (set_msclmin and set_msclmax)

a Theta^2 cut of 0.0125 for point-like source

Hillas Recommended Hard Cuts

For fainter sources, it is recommended to use harder cuts:

a 5/10 cleaning (set_hillas_name)

a charge cut at 200 pe (set_chargemin)

a nominal distance cut at 2 degrees (set_maxnomdistance)

a Mean Scaled Width between -2 and 0.7 (run_analysis)

a Mean Scaled Length between -2 and 2 (set_msclmin and set_msclmax)

a Theta^2 cut of 0.01 for point-like source

et aussi loose cuts et quelques autres...

La statistique peut augmenter avec le temps!

Table 1. Results of the HESS observations of PG 1553+113.

Dark Period	MJD First	MJD Last	Time [h]	On	Off	α	Excess	Sig [σ]	I(>300 GeV)[a] [10^{-12} cm^{-2} s^{-1}]	Crab[b] %	χ^2, NDF[c]	P(χ^2)
04/2005	53492	53507	4.9	1210	8154	0.125	191	5.5	4.78 ± 1.18	3.5	2.7 , 4	0.61
08/2005	53609	53614	2.7	491	3462	0.125	58	2.5	10.19 ± 5.46	7.5	4.9 , 2	0.09
04/2006	53849	53860	7.1	1811	12742	0.125	218	5.0	4.08 ± 1.10	3.0	5.3 , 8	0.72
07/2006	53938	53943	10.1	2236	15341	0.125	318	6.7	4.33 ± 0.94	3.2	3.1 , 5	0.68
2005	53492	53614	7.6	1701	11616	0.125	249	6.0	5.44 ± 1.23	4.0	0.9 , 1	0.33
2006	53849	53943	17.2	4047	28083	0.125	536	8.3	4.22 ± 0.72	3.1	0.03 , 1	0.86
Total	53492	53943	24.8	5748	39699	0.125	785	10.2	4.56 ± 0.62	3.4	0.7 , 1	0.39

Table 2. Results of the best χ^2 fit to the annual and overall spectra of PG 1553+113 measured by HESS.

Epoch	E_{min} [TeV]	E_{max} [TeV]	Γ	I_0 [10^{-11} cm^{-2} s^{-1} TeV^{-1}]	χ^2	NDF	P(χ^2)
2005 (AH06)[a]	0.185	0.585	$3.98 \pm 0.63_{stat} \pm 0.10_{syst}$	$2.59 \pm 0.47_{stat} \pm 0.52_{syst}$	1.7	2	0.42
2005[b]	0.225	1.265	$4.01 \pm 0.60_{stat} \pm 0.10_{syst}$	$5.92 \pm 1.19_{stat} \pm 1.18_{syst}$	2.1	5	0.84
2006	0.225	0.534	$4.45 \pm 0.48_{stat} \pm 0.10_{syst}$	$4.35 \pm 0.54_{stat} \pm 0.87_{syst}$	8.5	2	0.014
Total	0.225	1.265	$4.46 \pm 0.34_{stat} \pm 0.10_{syst}$	$4.68 \pm 0.49_{stat} \pm 0.94_{syst}$	8.4	5	0.13

Besoin de représenter un spectre avec suffisamment de détail pour comprendre la différences entre 2 spectres d'objets différents.

Besoin de représenter séries temporelles de beaucoup de points pour le même objet à différents temps.

Finalement, besoin de représenter associations de spectres = SED, donc besoin d'être compatible avec autres fréquences.

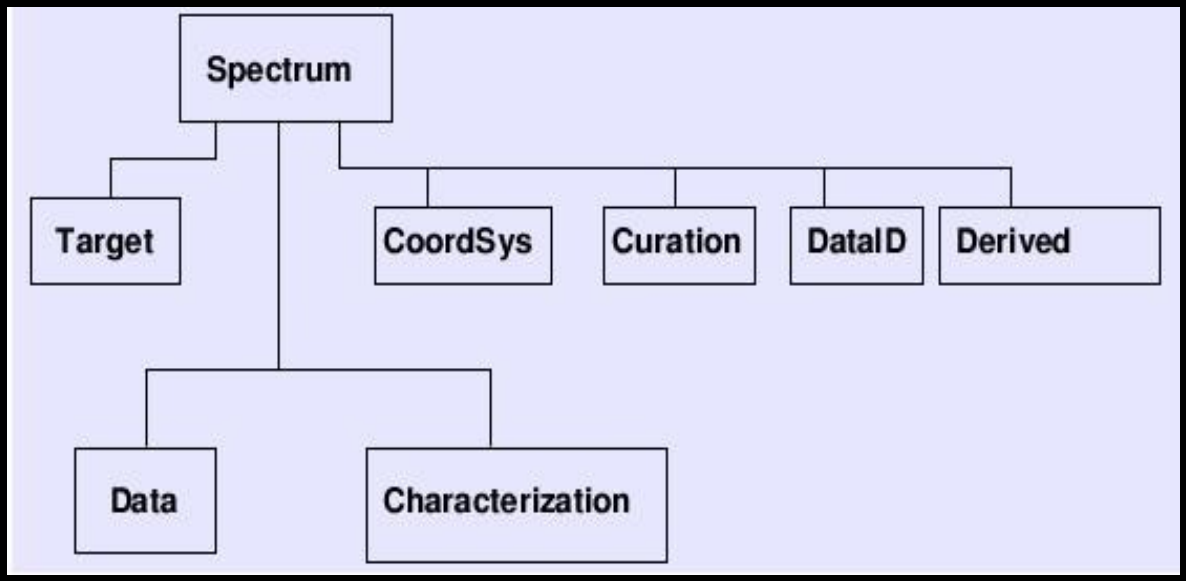
Besoin d'un DATA MODEL spécifique aux obs. gamma.

Uniform Content Descriptor: UCD

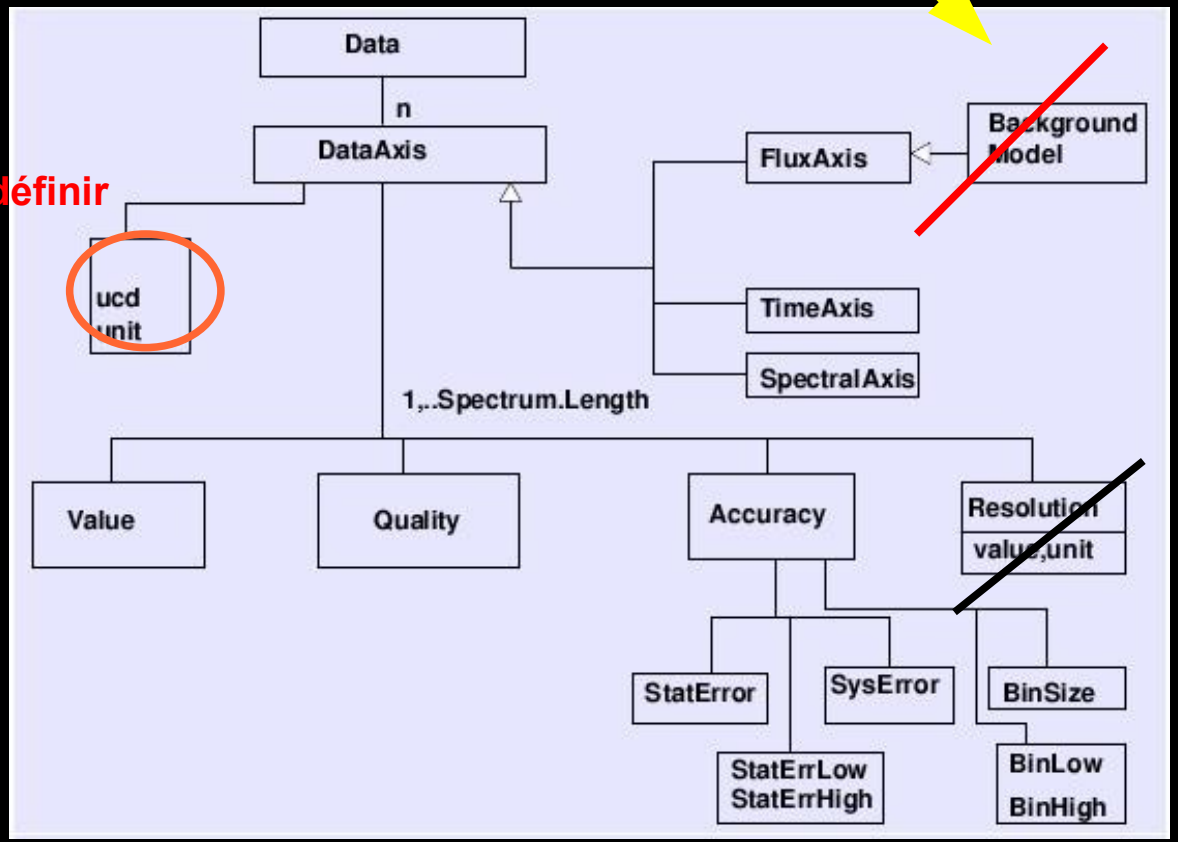
standardized vocabulary for astronomical concepts

S	em.opt.B	Optical band between 400 and 500 nm
S	em.opt.V	Optical band between 500 and 600 nm
S	em.opt.R	Optical band between 600 and 750 nm
S	em.opt.I	Optical band between 750 and 1000 nm
S	em.UV	Ultraviolet part of the spectrum
S	em.UV.10-50nm	Ultraviolet between 10 and 50 nm
S	em.UV.50-100nm	Ultraviolet between 50 and 100 nm
S	em.UV.100-200nm	Ultraviolet between 100 and 200 nm
S	em.UV.200-300nm	Ultraviolet between 200 and 300 nm
S	em.UV.FUV	Far-Ultraviolet
S	em.X-ray	X-ray part of the spectrum
S	em.X-ray.soft	Soft X-ray (0.12 - 2 keV)
S	em.X-ray.medium	Medium X-ray (2 - 12 keV)
S	em.X-ray.hard	Hard X-ray (12 - 120 keV)
S	em.gamma	Gamma rays part of the spectrum
S	em.gamma.soft	Soft gamma ray (120 - 500 keV)
S	em.gamma.hard	Hard gamma ray (>500 keV)
S	em.line	Designation of major atomic lines
S	em.line.Brgamma	Brackett gamma line
S	em.line.HI	21cm hydrogen line
S	em.line.Halpha	H-alpha line
S	em.line.Hbeta	H-beta line
S	em.line.Hgamma	H-gamma line
S	em.line.Hdelta	H-delta line
S	em.line.Lyalpha	Hydrogen Lyman alpha line
S	em.line.OIII	[OIII] line whose rest wl is 500.7 nm
S	em.line.CO	CO radio line, e.g. 12CO(1-0) at 115GHz
Q	em.bin	Channel / instrumental spectral bin coordinate (bin number)
Q	em.energy	Energy value in the em frame

...



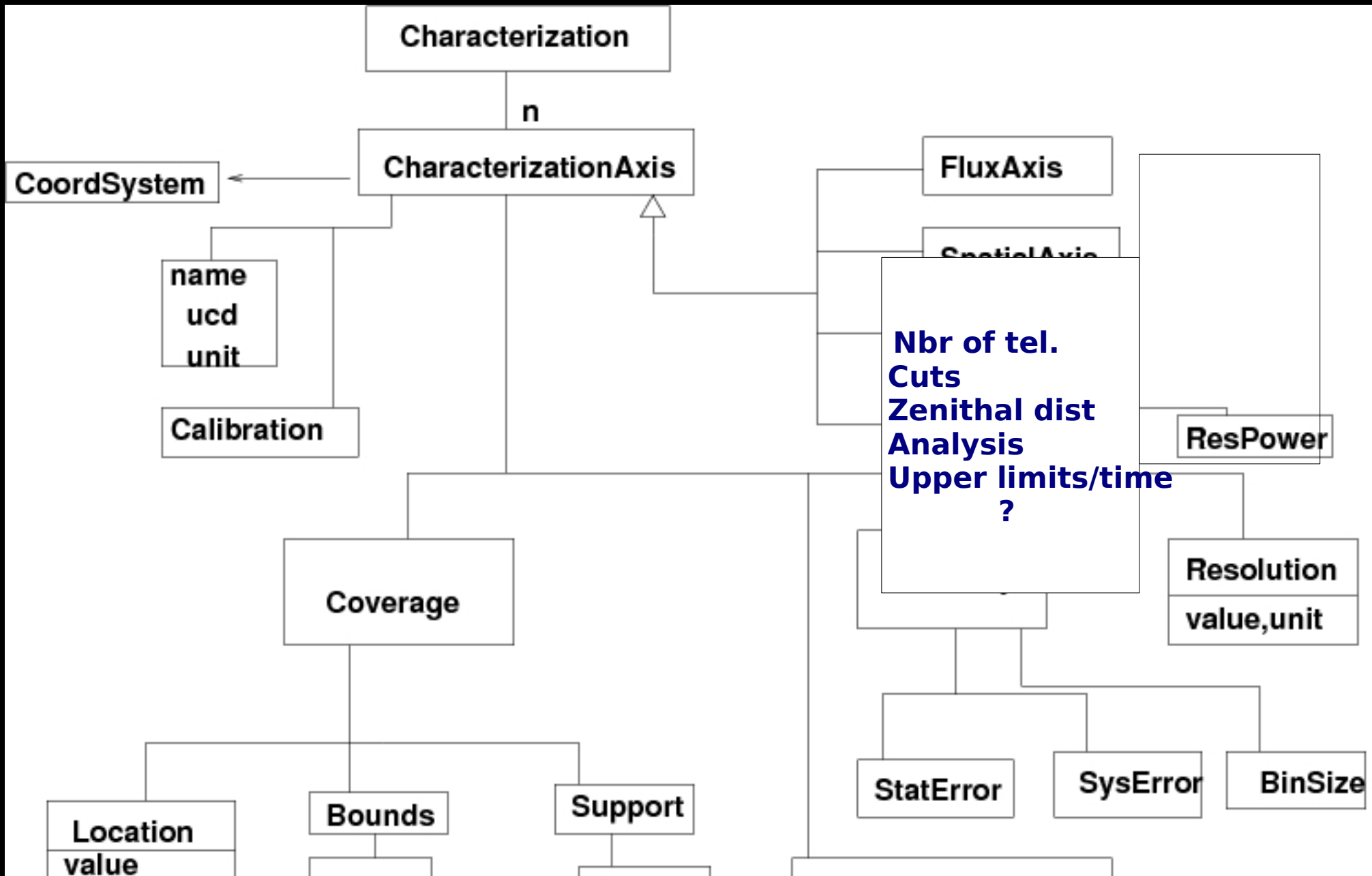
cuts, nbr télescopes?



Cuts
Zenithal dist
Nbr of telescopes
Analysis
Upper limits
Time (instant, period)

?

Characterization object



Test

Data in Table: VOTABLE_RESOURCE_TABLE

Coord	Flux	ErrorLow	ErrorHigh
TeV	cm**(-2) s**(-1) TeV**(-1)	cm**(-2) s**(-1) TeV**(-1)	cm**(-2) s**(-1) TeV**(-1)
0.179200	1423.817508	38.111442	38.111442
0.225200	855.398596	14.876714	14.876714
0.283200	447.970194	7.227353	7.227353
0.356000	254.754373	3.816387	3.816387
0.447600	107.626064	2.077244	2.077244
0.562800	56.993532	1.162983	1.162983
0.707600	25.394986	0.657388	0.657388
0.889600	10.572162	0.378106	0.378106
1.118500	5.065939	0.219477	0.219477
1.406200	2.203313	0.130008	0.130008
1.768000	1.072874	0.077212	0.077212
2.222800	0.409715	0.046633	0.046633
2.794700	0.168205	0.027958	0.027958
3.513600	0.085220	0.016904	0.016904
4.417600	0.018993	0.010471	0.010471

Fields in Table: VOTABLE_RESOURCE_TABLE

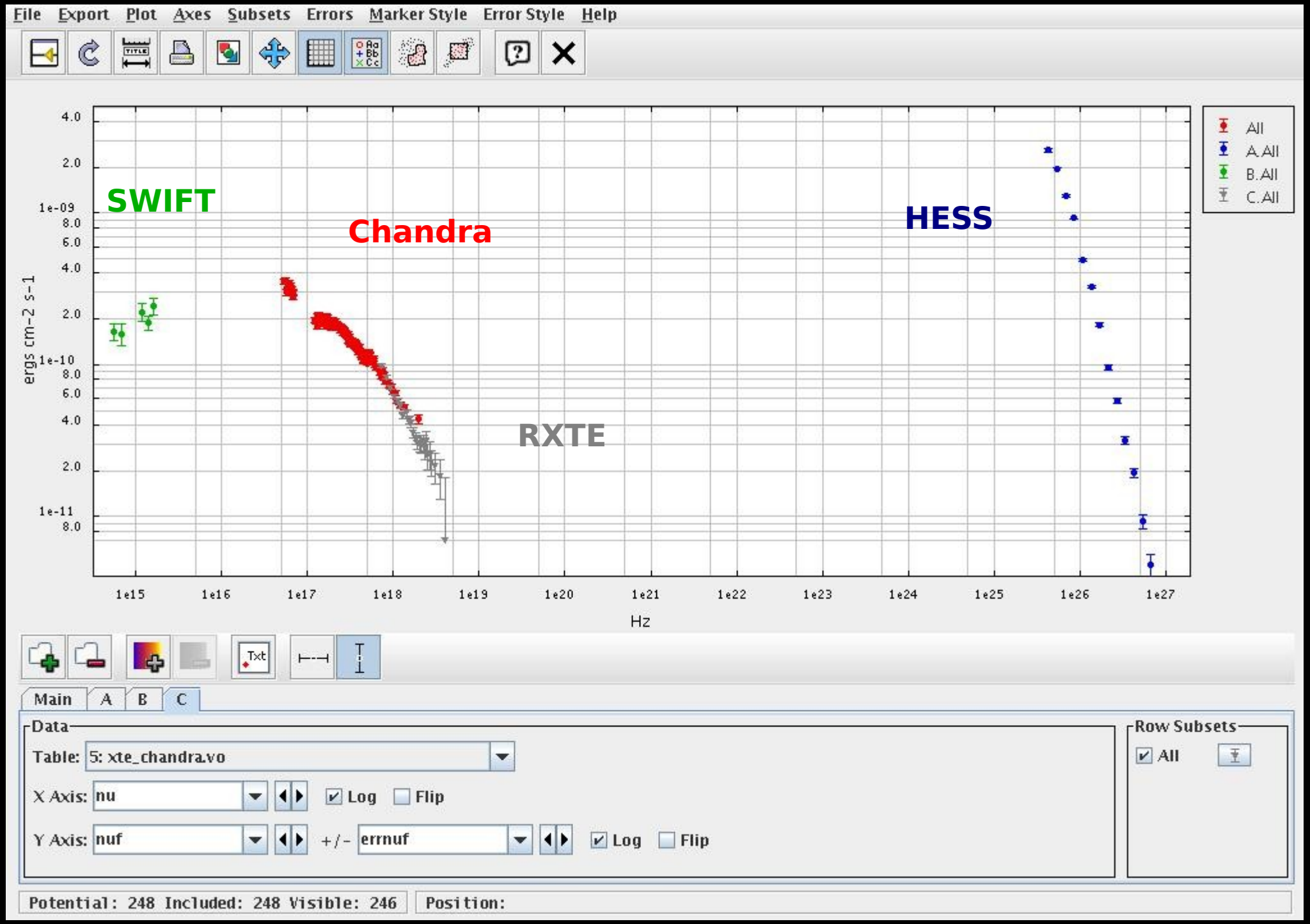
ID	name	datatype	unit	precision	width	ref	ucd	
Coord	Coord	double	TeV				em.gamma.hard	spec:Data.Spect
Flux1	Flux	double	cm**(-2) s**(-1) TeV**(-1)				phot.flux.density;em.gamma.hard	spec:Data.FluxA
ErrorLow	ErrorLow	double	cm**(-2) s**(-1) TeV**(-1)					spec:Data.FluxA
ErrorHigh	ErrorHigh	double	cm**(-2) s**(-1) TeV**(-1)					spec:Data.FluxA

Parameters for Table: VOTABLE_RESOURCE_TABLE

ID	name	value	datatype	unit	precision	width	ref	ucd	utype	arraysize	Description	Li
	Segtype	Spectrum	char					meta.code	spec:SegmentType	*		

Groups Defined in Table: VOTABLE_RESOURCE_TABLE

Group Name					
Attributes	ID	name	ref	ucd	utype
					spec:Targ
PARAMETERS					
ID	name	value	datatype	unit	precisi
	Target	PKS2155-304	char		
	TargetPos	329.7169379 -30.2255883	double	deg	
	z	0.117	float		
Group Name	CoordSys				
Attributes	ID	name	ref	ucd	utype
		CoordSys			spec:Coor
Group Name					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SWIFT
Chandra
RXTE
HESS
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A.All
B.All
C.All
ergs cm-2 s-1
Hz
1e15 1e16 1e17 1e18 1e19 1e20 1e21 1e22 1e23 1e24 1e25 1e26 1e27
Main A B C
Data
Table: 5: xte_chandra.vo
X Axis: nu Log Flip
Y Axis: nuf +/- errnuf Log Flip
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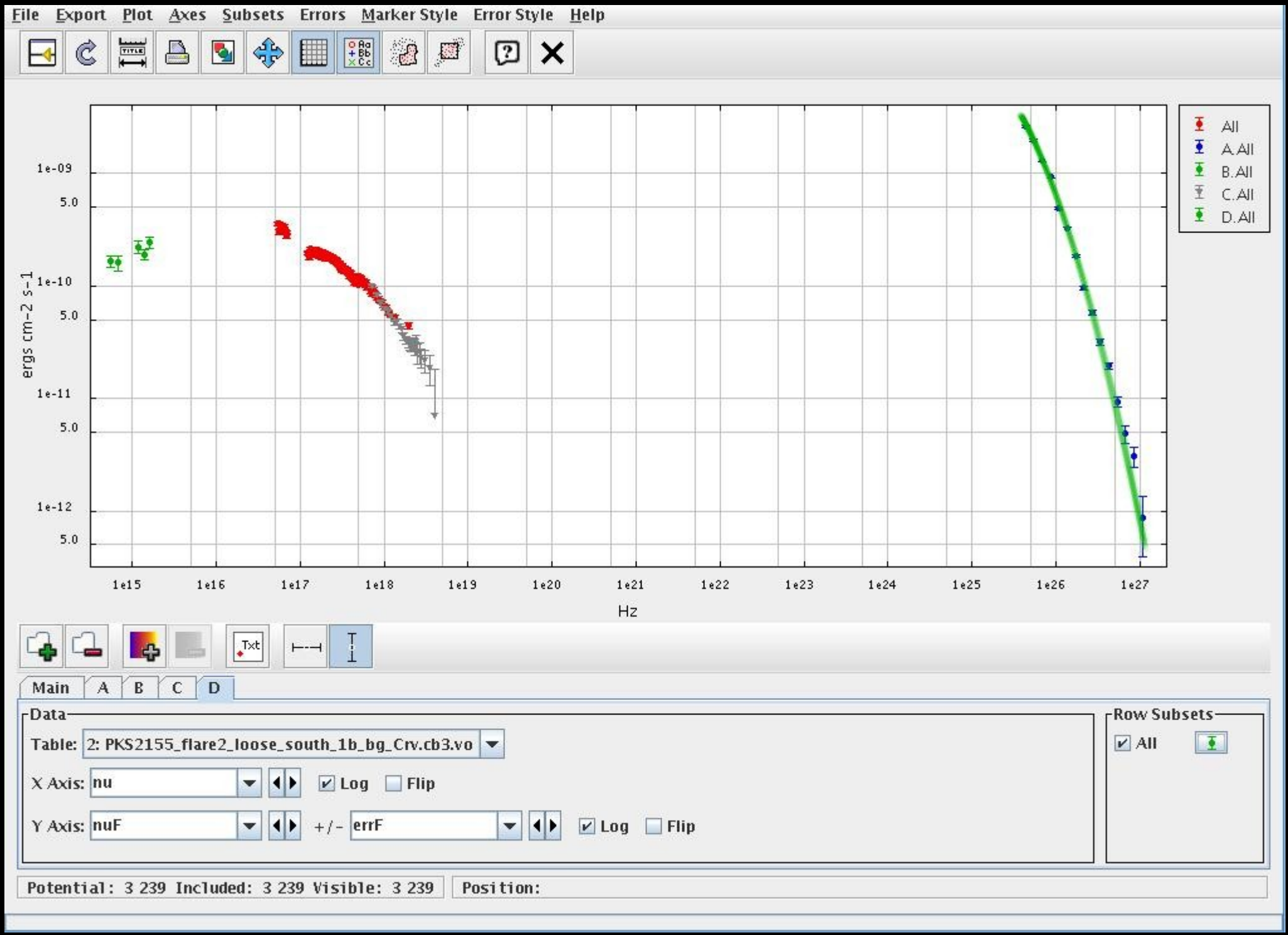
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1e22
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1e24
1e25
1e26
1e27
Hz
Txt
Main
A
B
C
D
Data
Table: 2: PKS2155_flare2_loose_south_1b_bg_Crv.cb3.vo
X Axis: nu
Log
Flip
Y Axis: nuF
+/- errF
Log
Flip
Row Subsets
All
Potential: 3 239 Included: 3 239 Visible: 3 239
Position:

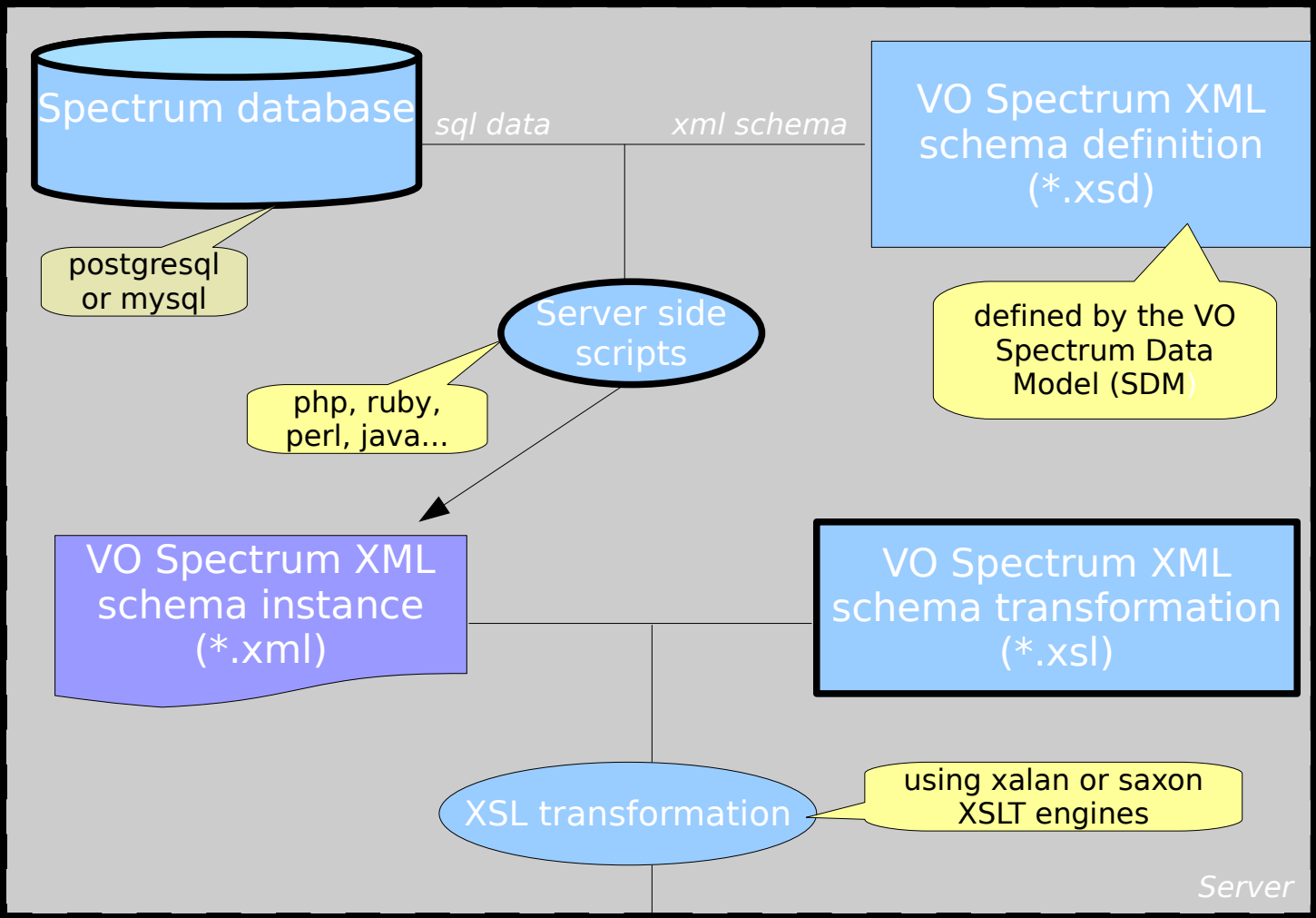
Conclusion

VHE astrophysics is becoming a mainstream energy window, by analogy to the X-ray astronomy in the 70's, it would be time to make the data more generally available.

For the 2006 campaign on PKS2155-304, we have started collecting the data in a uniform format for use by a wider community.

Now need to work on the 'standards' and define in great detail typical DATA MODEL for VHE experiments.

Coordination avec les autres projets: MAGIC, VERITAS?



Fits file (*.fits)

VO Table (*.xml)

Ascii file (*.txt)

HTML file (*.html)

can be handled by VO local Tools

can interact with VO compliant distant services