Tools for data analyses in Cosmology

- Aula 12 -

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Observatório Nacional

June 20, 2017

TOPCAT

http://www.star.bristol.ac.uk/~mbt/topcat/

TOPCAT

Tool for OPerations on Catalogues And Tables

Does what you want with tables

Latest (see Version History for details)

Version 4.4 released 8 March 2017

New: **More visualisation options** 
New plot forms introduced: Grid can plot weighted 2-d histograms/density maps, Quantile can draw median lines through noisy data (and more), Gaussian can fit a Gaussian to histogram-like data.

New: **Free colour chooser** 
You can now choose any RGB colour using a flexible chooser widget.

New: **Better visualisation documentation**
All plot forms and shading modes are now documented with example screenshots.

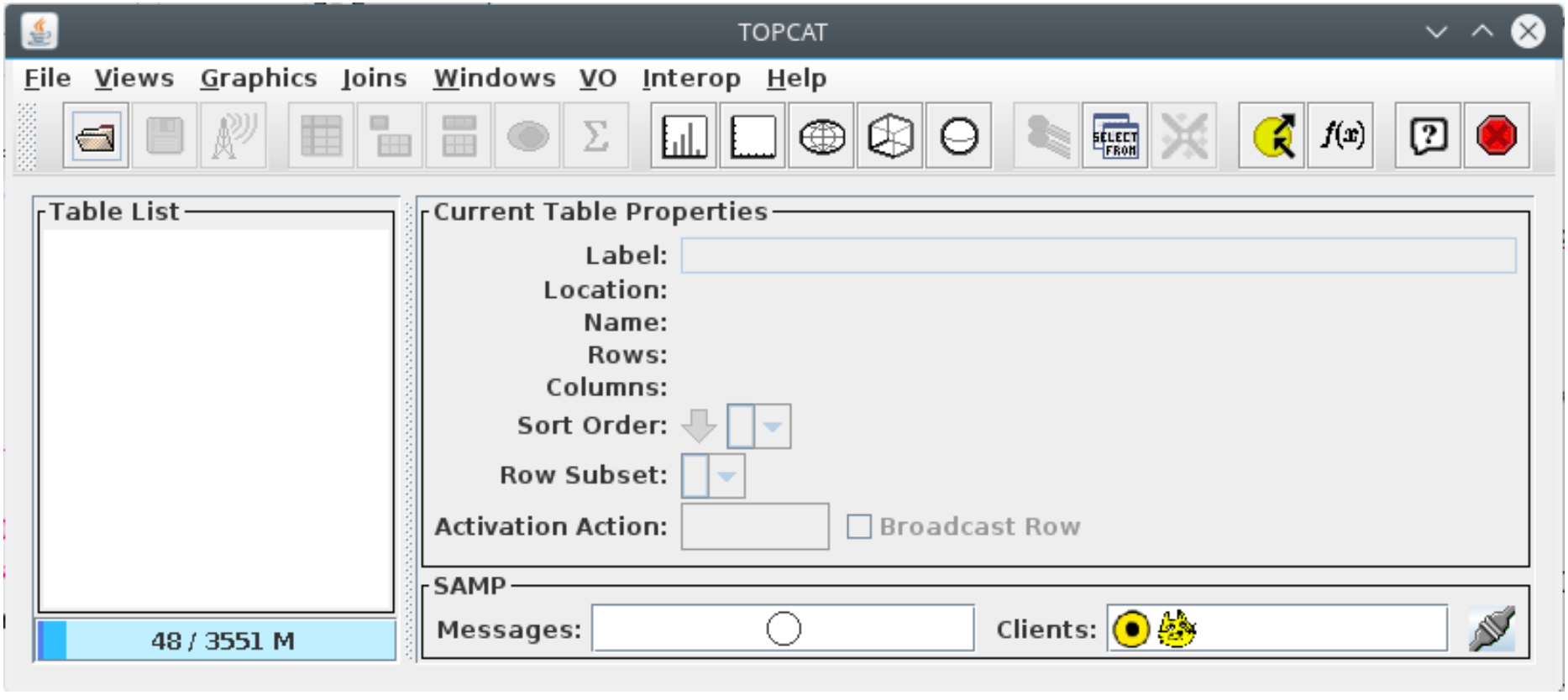
- What is TOPCAT?
- Features
- Screenshots
- Documentation
- Frequently Asked Questions
- Mailing Lists
- Downloads
  - Jar File

TOPCAT: Download and start using

- Download `topcat-full.jar` and `topcat` files into the same directory. [`Under Window, Mac, Linux and other Unix systems.`]
- In the terminal, enter the `TOPCAT` folder and use the command "`chmod +x topcat`".
- To open it just run the command: `./topcat`.

  [`Or:` you can add a command line like `export PATH=$PATH:/home/camila/Instalacoes/TopCat` in your `.bashrc` file!]

TOPCAT: Download and start using



TOPCAT: Main features

Supported table input formats include:

- FITS TABLE (ASCII table) or BINTABLE (binary table) extensions,
- VOTables in any of the format variants (TABLEDATA, FITS, BINARY, BINARY2) or versions,
- ASCII tables in a number of variations,
- CDF files,
- Comma-Separated Values,
- Results of SQL queries on relational databases,
- IPAC format,
- GBIN files.

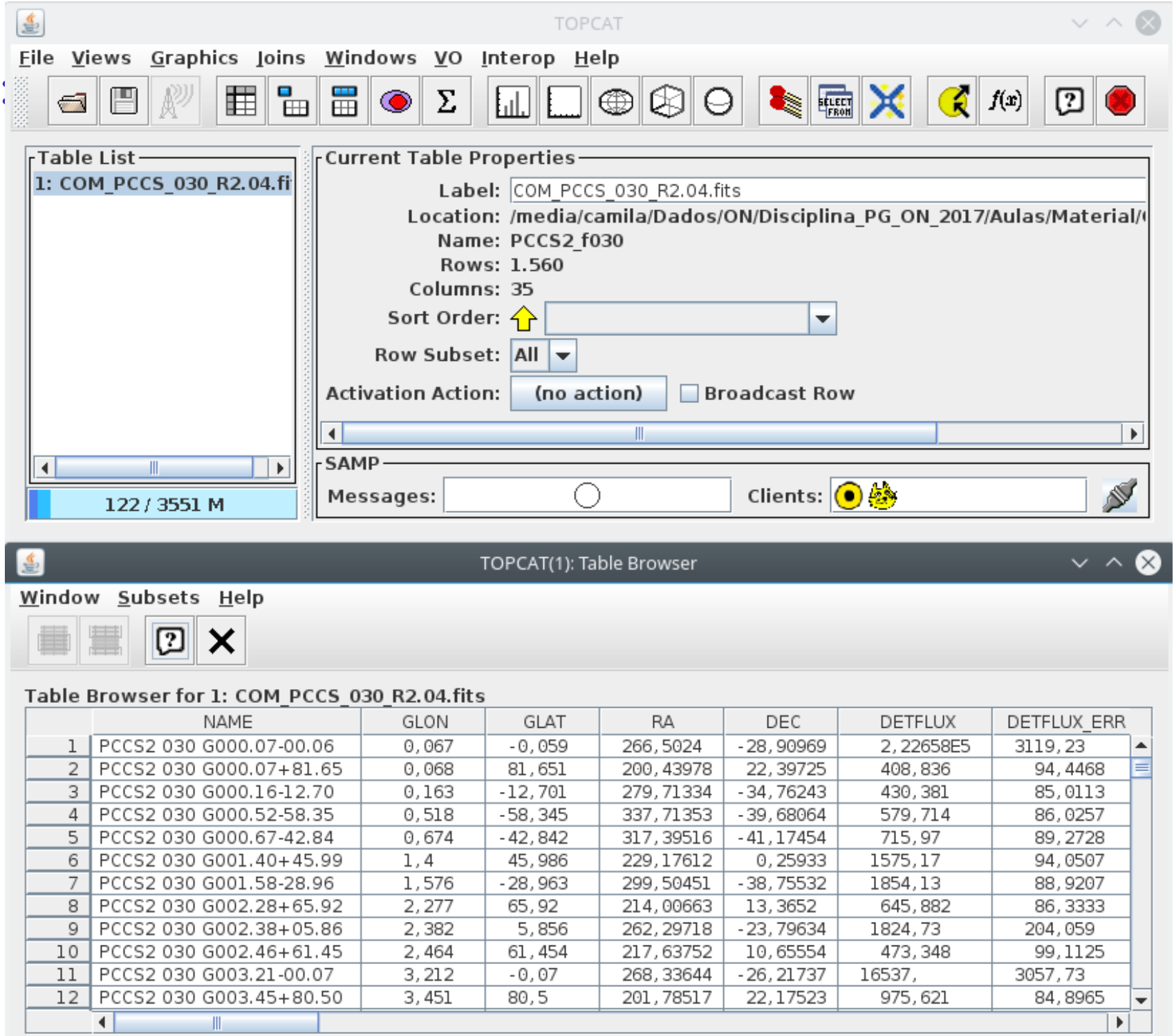
TOPCAT: Main features

Main capabilities:

- Fast access to large datasets (millions of rows/hundreds of columns),
- View/edit table and column metadata,
- Insert 'synthetic' columns defined by algebraic expression,
- Calculate statistics on each column for some or all rows,
- View interactively and export configurable plots of column-based quantities against each other distinguishing different data sets:
  - Plot types are histogram, plane, sky, cube, sphere, time,
  - Features include variable transparency, error bars, point labelling, colour axes, all-sky plots, configurable density shading, vectors, ellipses, contours, density maps, KDEs, analytic functions, plain text/LaTeX axis annotation, ...
- ...

Examples

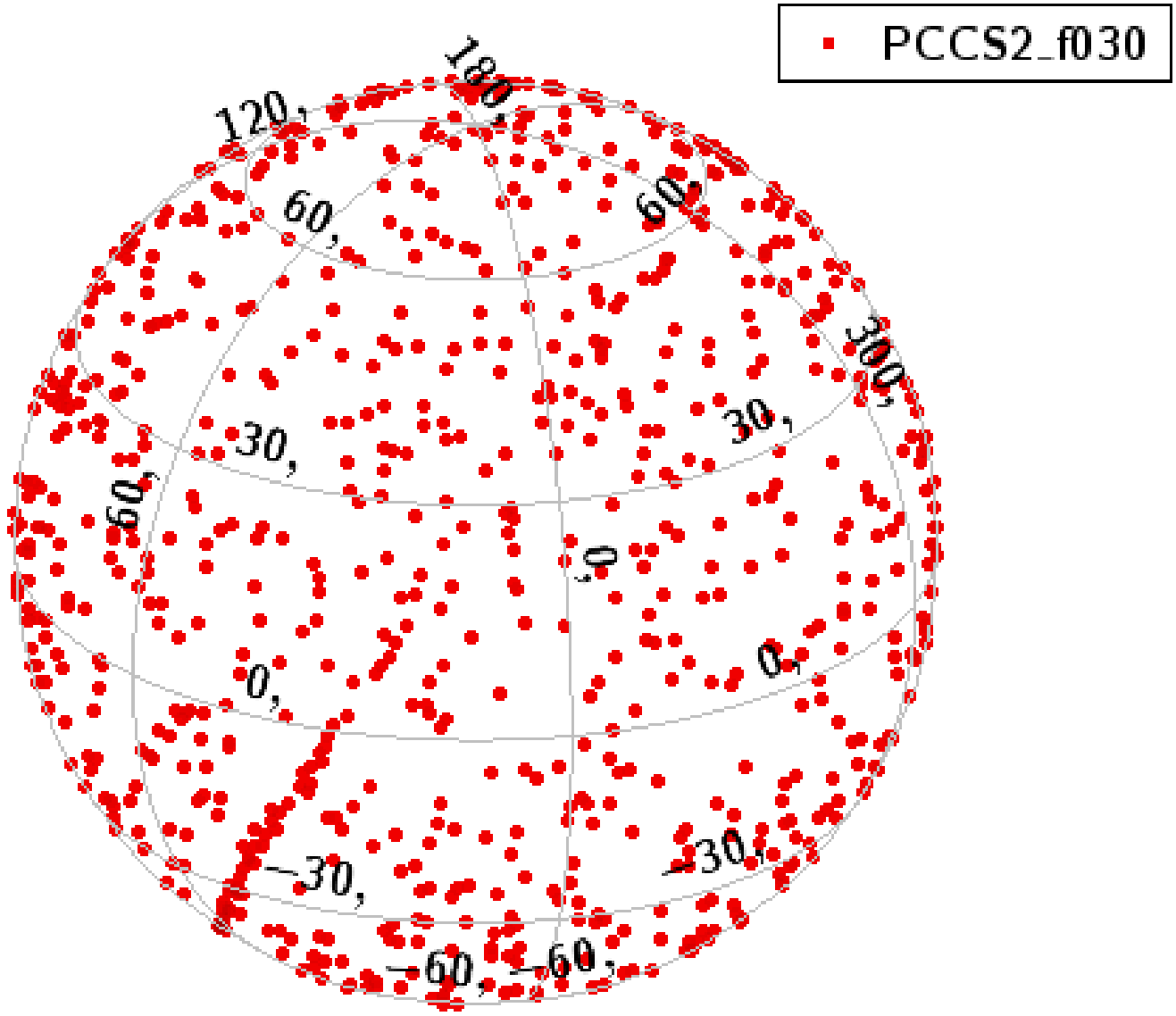
TOPCAT: access to data



	NAME	GLON	GLAT	RA	DEC	DETFLUX	DETFLUX_ERR
1	PCCS2 030 G000.07-00.06	0,067	-0,059	266,5024	-28,90969	2,22658E5	3119,23
2	PCCS2 030 G000.07+81.65	0,068	81,651	200,43978	22,39725	408,836	94,4468
3	PCCS2 030 G000.16-12.70	0,163	-12,701	279,71334	-34,76243	430,381	85,0113
4	PCCS2 030 G000.52-58.35	0,518	-58,345	337,71353	-39,68064	579,714	86,0257
5	PCCS2 030 G000.67-42.84	0,674	-42,842	317,39516	-41,17454	715,97	89,2728
6	PCCS2 030 G001.40+45.99	1,4	45,986	229,17612	0,25933	1575,17	94,0507
7	PCCS2 030 G001.58-28.96	1,576	-28,963	299,50451	-38,75532	1854,13	88,9207
8	PCCS2 030 G002.28+65.92	2,277	65,92	214,00663	13,3652	645,882	86,3333
9	PCCS2 030 G002.38+05.86	2,382	5,856	262,29718	-23,79634	1824,73	204,059
10	PCCS2 030 G002.46+61.45	2,464	61,454	217,63752	10,65554	473,348	99,1125
11	PCCS2 030 G003.21-00.07	3,212	-0,07	268,33644	-26,21737	16537,	3057,73
12	PCCS2 030 G003.45+80.50	3,451	80,5	201,78517	22,17523	975,621	84,8965

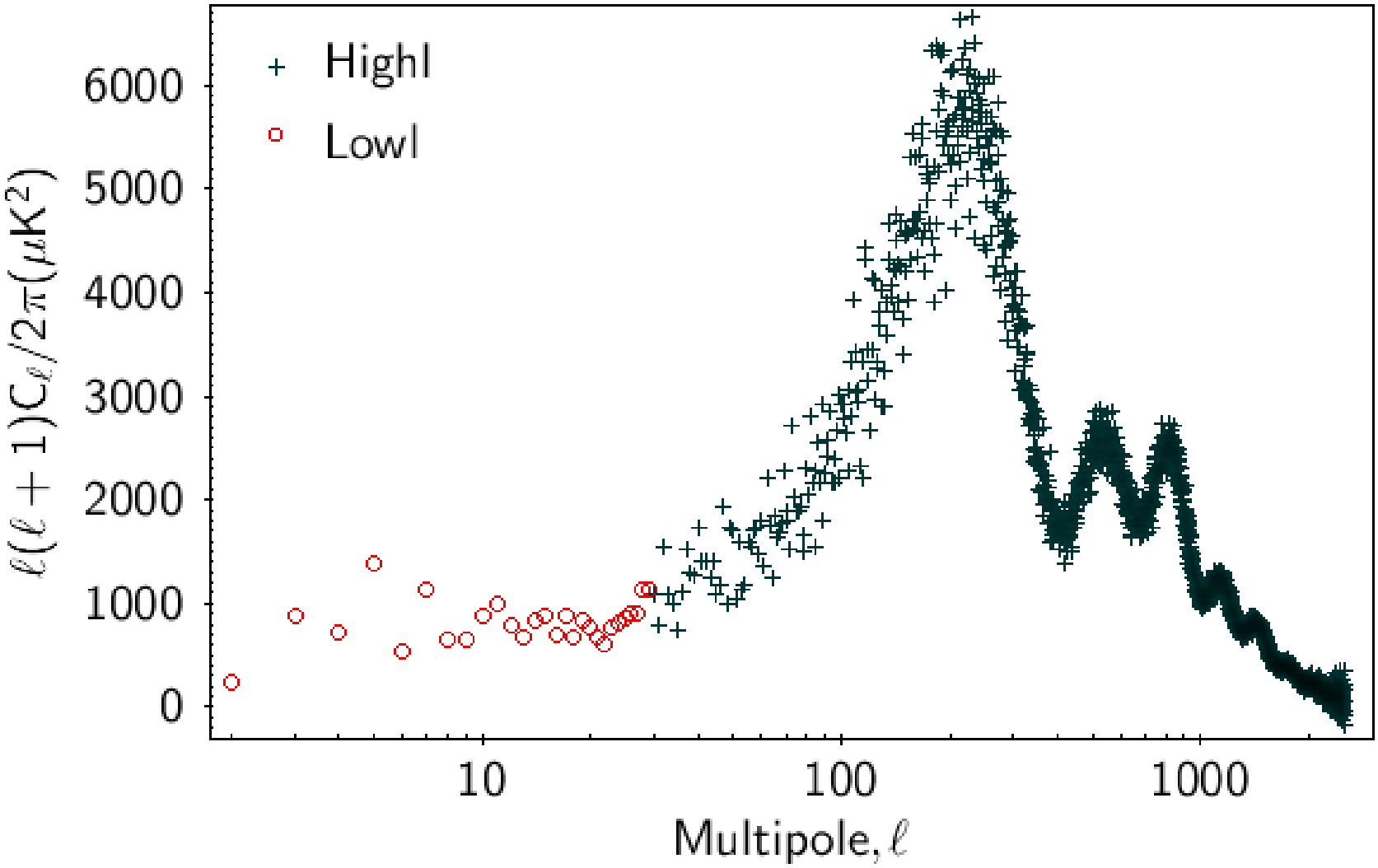
TOPCAT: Sky plot

"Planck Catalogue of Compact Sources"



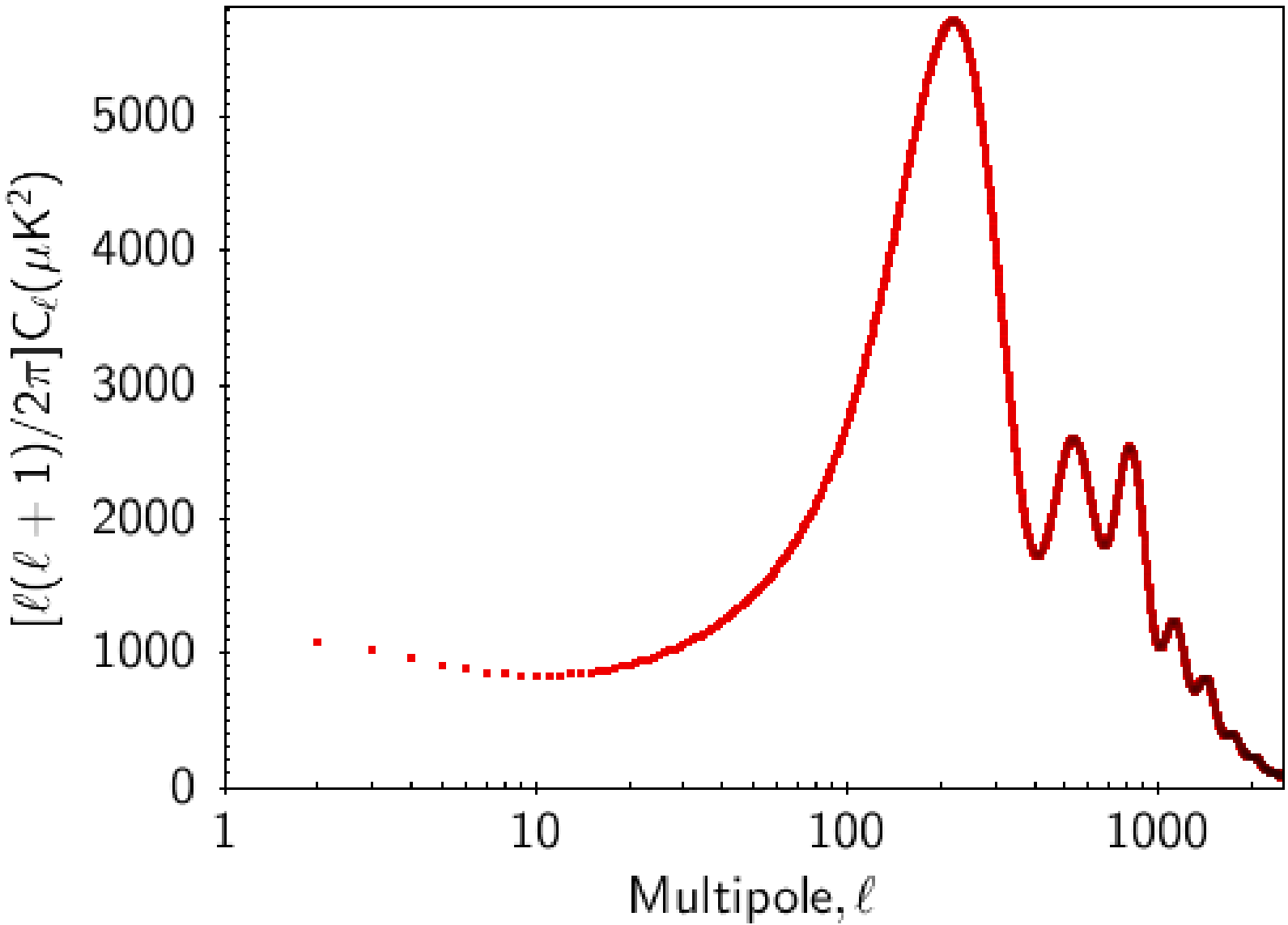
TOPCAT: Plain plot

"COM_PowerSpect_CMB_R2.02.fits"

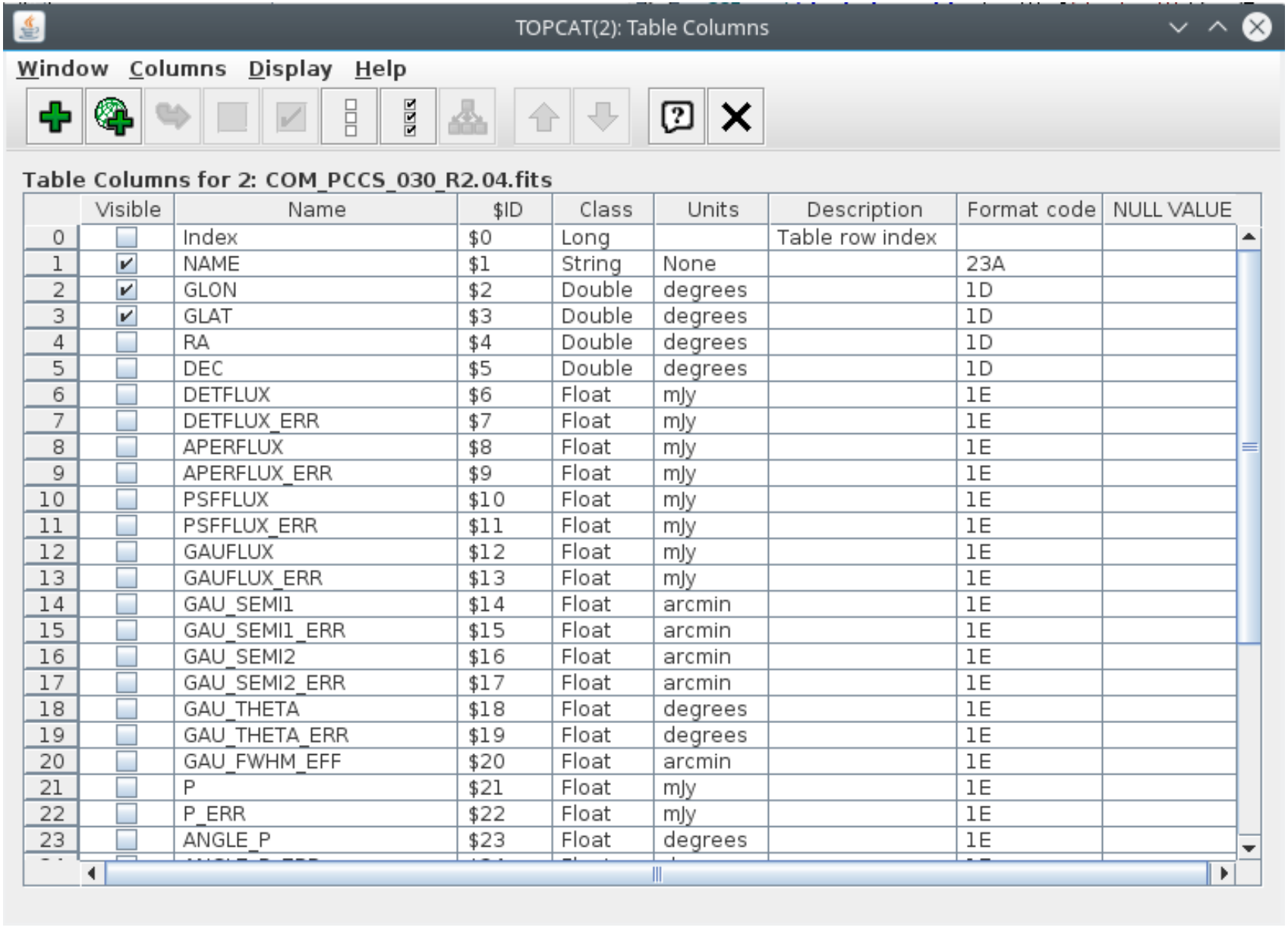


TOPCAT: Synthetic column and Algebraic expression

"APS best-fit"



TOPCAT: Write modified tables into original or different format file



	Visible	Name	$ID	Class	Units	Description	Format code	NULL VALUE
0	☐	Index	$0	Long		Table row index		
1	☑	NAME	$1	String	None		23A	
2	☑	GLON	$2	Double	degrees		1D	
3	☑	GLAT	$3	Double	degrees		1D	
4	☐	RA	$4	Double	degrees		1D	
5	☐	DEC	$5	Double	degrees		1D	
6	☐	DETFLUX	$6	Float	mJy		1E	
7	☐	DETFLUX_ERR	$7	Float	mJy		1E	
8	☐	APERFLUX	$8	Float	mJy		1E	
9	☐	APERFLUX_ERR	$9	Float	mJy		1E	
10	☐	PSFFLUX	$10	Float	mJy		1E	
11	☐	PSFFLUX_ERR	$11	Float	mJy		1E	
12	☐	GAUFLUX	$12	Float	mJy		1E	
13	☐	GAUFLUX_ERR	$13	Float	mJy		1E	
14	☐	GAU_SEMI1	$14	Float	arcmin		1E	
15	☐	GAU_SEMI1_ERR	$15	Float	arcmin		1E	
16	☐	GAU_SEMI2	$16	Float	arcmin		1E	
17	☐	GAU_SEMI2_ERR	$17	Float	arcmin		1E	
18	☐	GAU_THETA	$18	Float	degrees		1E	
19	☐	GAU_THETA_ERR	$19	Float	degrees		1E	
20	☐	GAU_FWHM_EFF	$20	Float	arcmin		1E	
21	☐	P	$21	Float	mJy		1E	
22	☐	P_ERR	$22	Float	mJy		1E	
23	☐	ANGLE_P	$23	Float	degrees		1E	

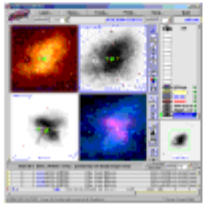
Aladin

http://aladin.u-strasbg.fr/

Aladin Sky Atlas

Overview

Aladin is an interactive sky atlas allowing the user to visualize digitized astronomical images or full surveys, superimpose entries from astronomical catalogues or databases, and interactively access related data and information from the *Simbad database*, the *VizieR service* and other archives for all known astronomical objects in the field.



Download
Aladin Desktop
on your machine

Preview with
Aladin Lite
In your browser

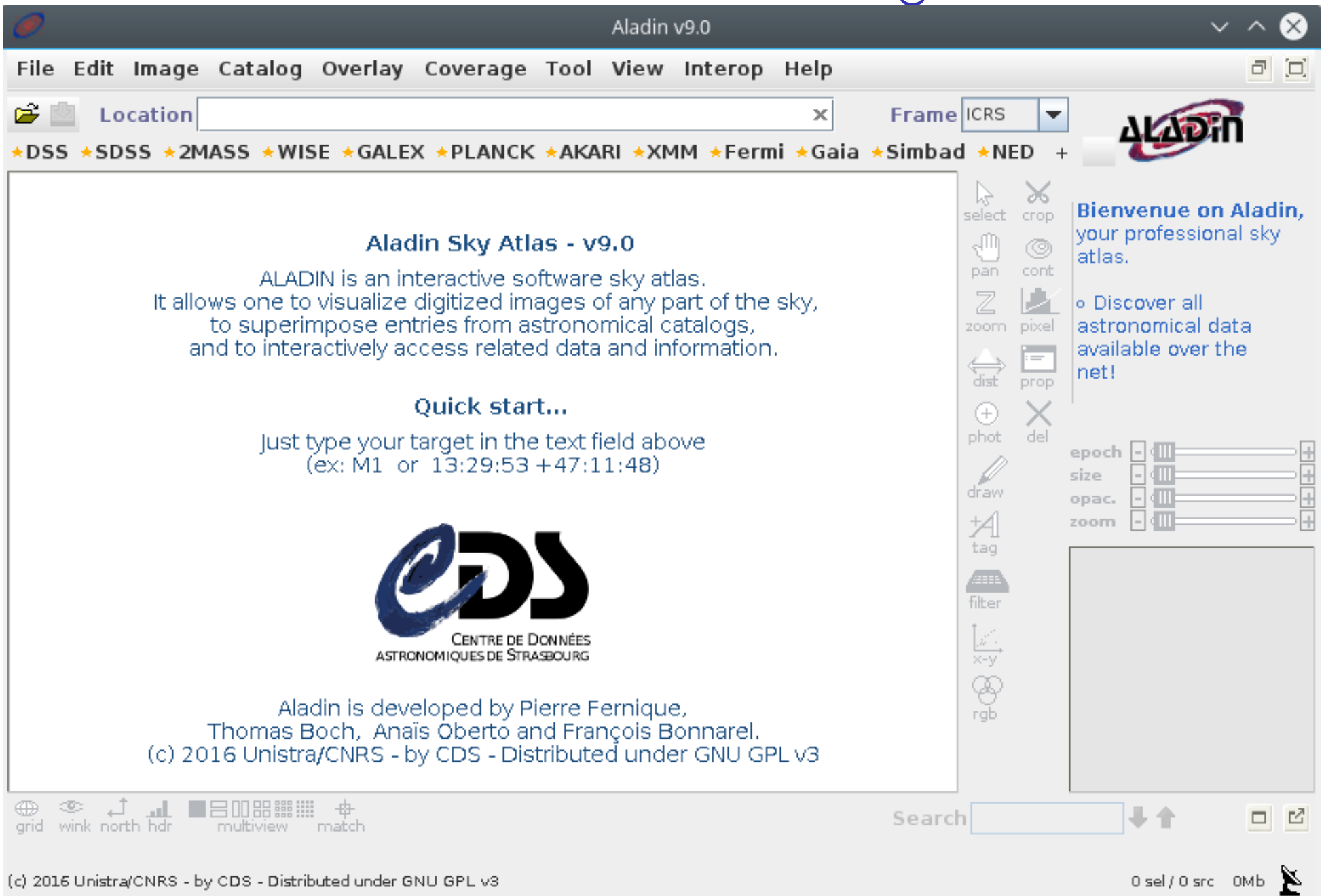
The *Aladin sky atlas* is available in two modes: *Aladin Desktop*, a regular application and *Aladin Lite* an HTML5 javascript web widget.

Aladin: Download and start using

- Download the `Aladin.tar` file and unpack it.
- To open it, enter the `Aladin` folder and run the command `./aladin`.

  [Again you can include a single command in the `.bashrc` file to open `Aladin` from anywhere.]

Aladin: Download and start using



Aladin: Main features

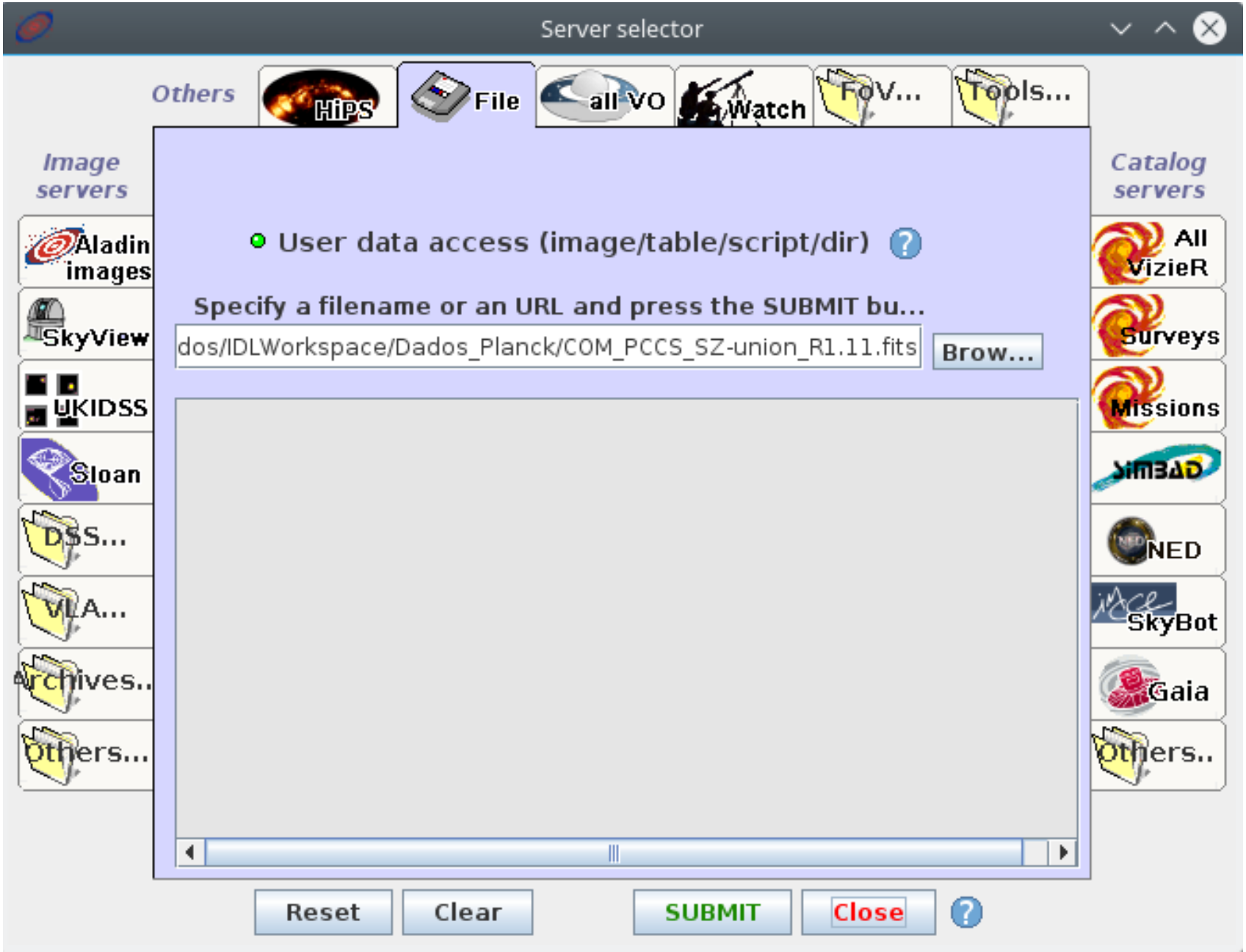
- Visualize and manipulate digitized astronomical images or full surveys
- Superimpose entries from astronomical catalogues or databases
- Interactively access related data and information from the Simbad database, the VizieR service and other archives for all known astronomical objects in the field.

Aladin: Main features

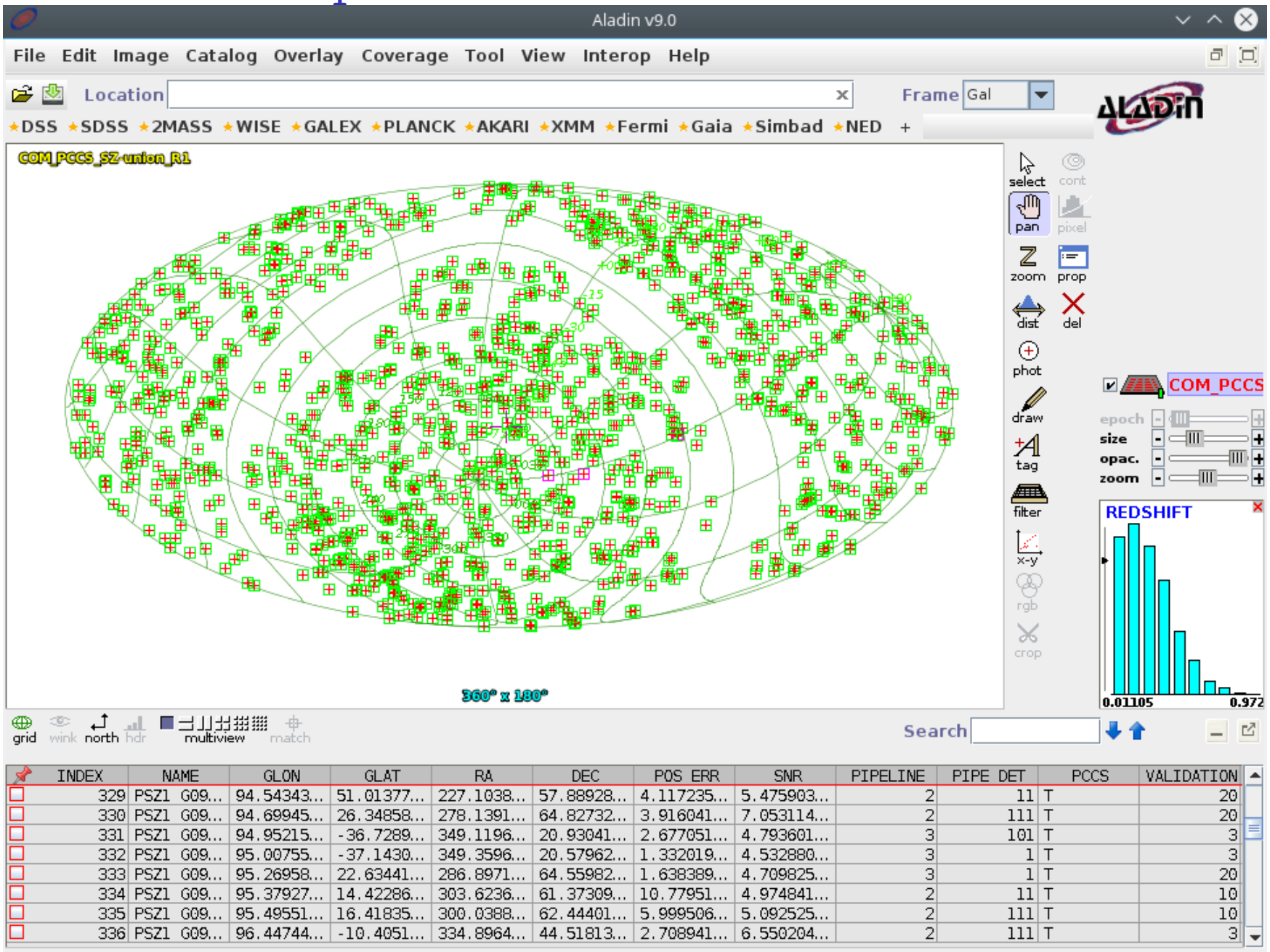
Specifically ...

- Zoom;
- Pan;
- Rotate;
- Overlays;
- Multi-views;
- Many projections (Sin, Tan, Aitoff, Mollweide, etc);
- Any coordinate systems (FK4, FK5, ICRS, GAL, SGAL, ECL);
- No image size limit;
- Million source overlays,
- Most of astronomical formats (images: HiPS, FITS, PDS, HEALPix map, JPEG, PNG; cubes (HiPS, FITS); tables: HiPS, FITS, VOTable, S-extractor, IPAC TBL, ASCII, etc; regions: XML, STC, DS9, IDL);
- Powerful tool boxes (images: color map, contours, crop, ..., etc; Catalogs: filter, split, merge, x-match, scatter plot, etc);
- ...

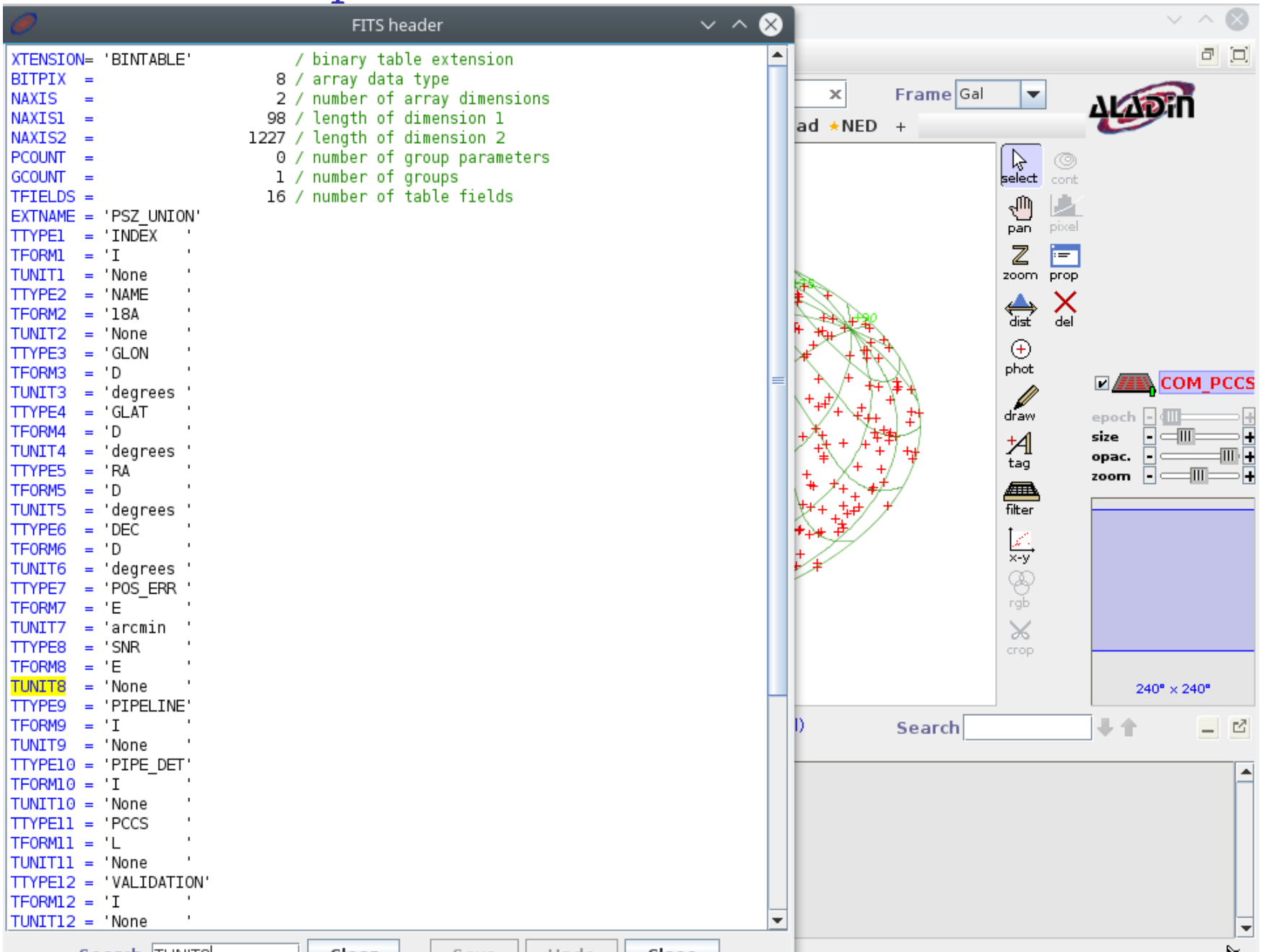
Aladin: Example



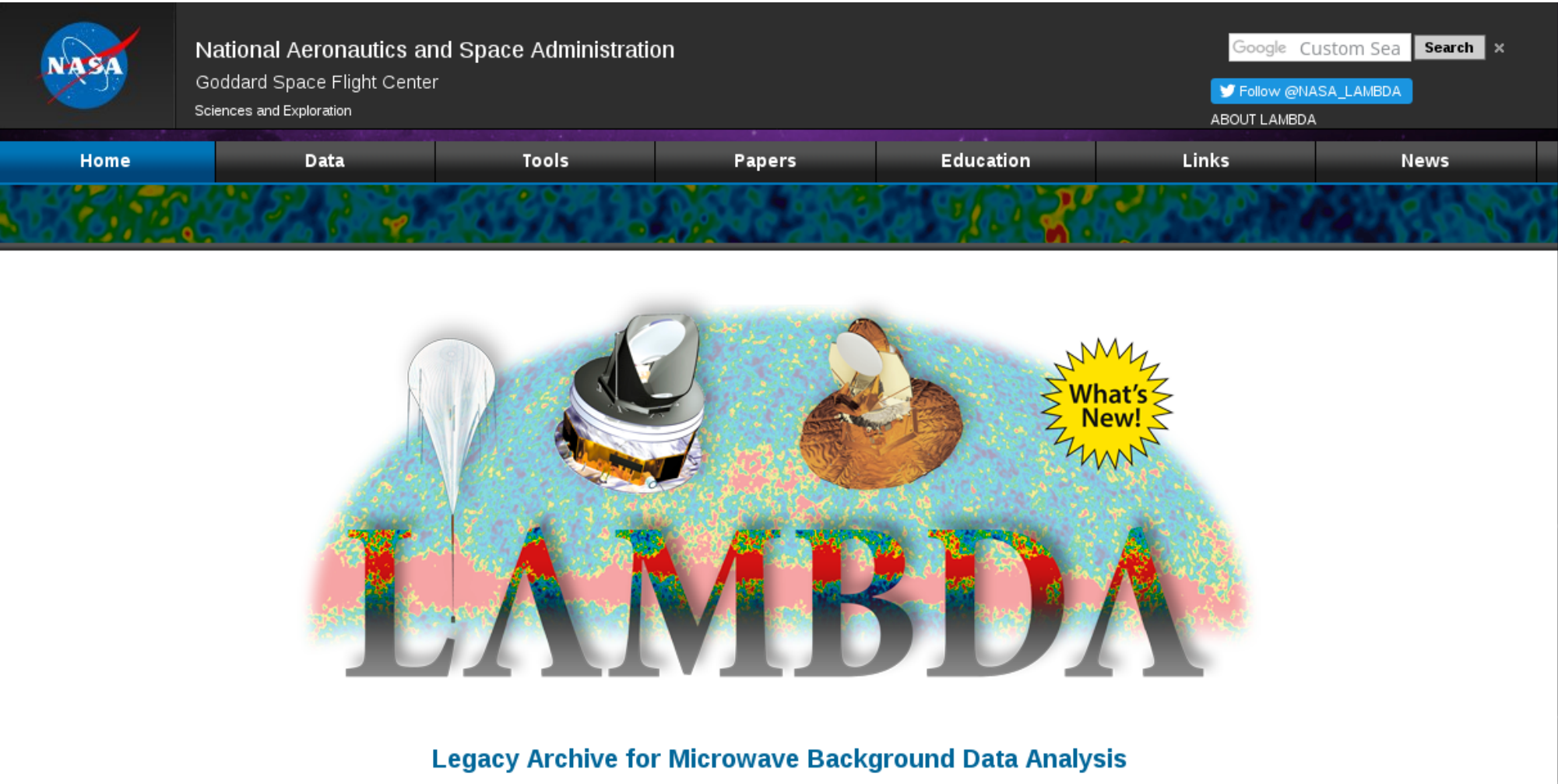
Aladin: Example



Aladin: Example



Some other ‘‘tips’’ ...



https://lambda.gsfc.nasa.gov/

CMB Tools

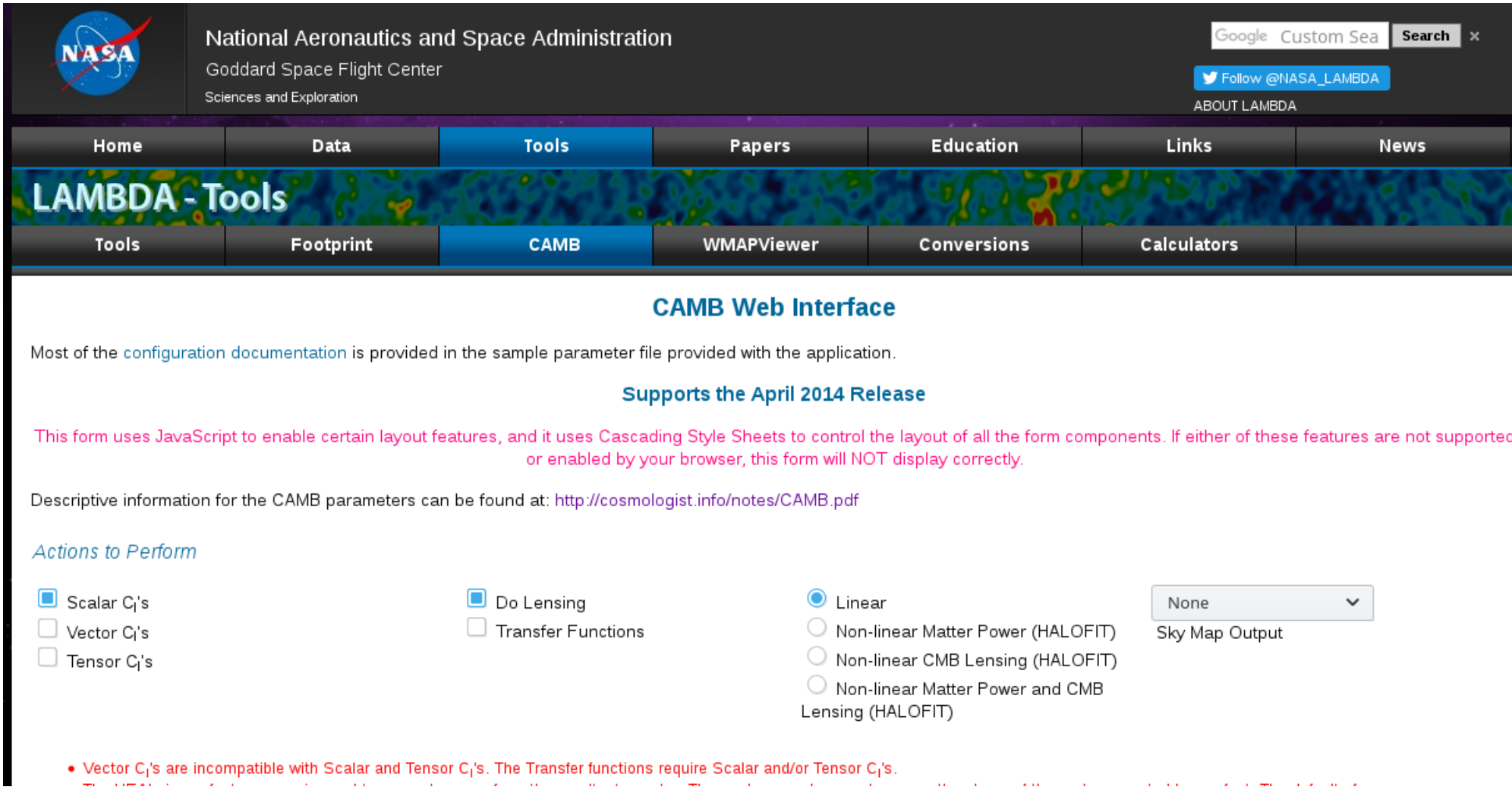
We provide links to a number of useful tools for CMB and Astronomy in general. Use these tools at your own risk; LAMBDA has not tested them and therefore can assume no responsibility for problems arising from their use.

LAMBDA Tools

- CMB polarization band-power plotting tool - an IDL tool and dataset for making summary plots of CMB polarization bandpowers. *Odegard*
- Cosmological Footprints Tool - a Python tool to visualize where many different CMB and large-scale structure survey regions. *Miller*
- A web-based interface for CAMB.
- CMB Simulations - High-resolution, full-sky microwave temperature simulations including secondary anisotropies.
- SkyViewer - A LAMBDA-developed OpenGL-based program to display HEALPix-based skymaps stored in FITS format files. *Phillips*
- Power Spectrum Simulator - A flash-based educational tool showing how the power spectrum varies with input parameters.
- WMAP Effective Frequency Calculator - A tool that calculates the effective frequencies of the five WMAP frequency bands.
- WMAP Likelihood Software - A software library used by the WMAP team to compute Fisher and Master matrices and to compute the likelihoods of various models. This is the same software found on the WMAP products list; more information may be found here.
- WMAPViewer - A LAMBDA-developed web-based CMB map viewing tool using a technology similar to that found on maps.google.com. *Phillips*

Likelihood Software

- SDSS LRG DR7 Likelihood Software - A software package that computes likelihoods for Luminous Red Galaxies (LRG) data from the seventh release of the Sloan Digital Sky Survey (SDSS).


National Aeronautics and Space Administration
Goddard Space Flight Center
Sciences and Exploration
Google Custom Sea
Search
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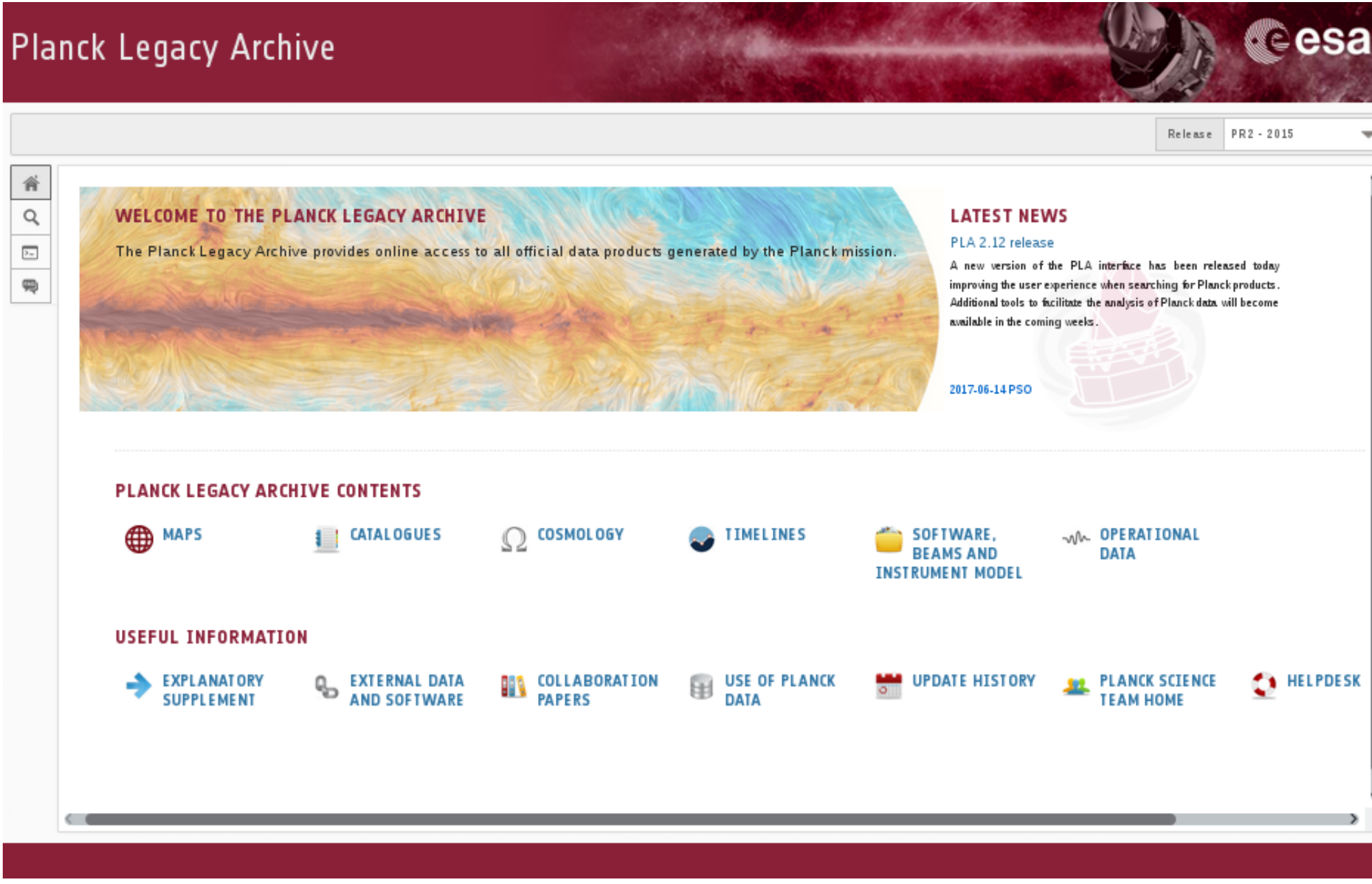
ABOUT LAMBDA
Home
Data
Tools
Papers
Education
Links
News
LAMBDA - Tools
Tools
Footprint
CAMB
WMAPViewer
Conversions
Calculators
CAMB Web Interface
Most of the configuration documentation is provided in the sample parameter file provided with the application.
Supports the April 2014 Release
This form uses JavaScript to enable certain layout features, and it uses Cascading Style Sheets to control the layout of all the form components. If either of these features are not supported or enabled by your browser, this form will NOT display correctly.
Descriptive information for the CAMB parameters can be found at: http://cosmologist.info/notes/CAMB.pdf
Actions to Perform
Scalar C_l's
Vector C_l's
Tensor C_l's
Do Lensing
Transfer Functions
Linear
Non-linear Matter Power (HALOFIT)
Non-linear CMB Lensing (HALOFIT)
Non-linear Matter Power and CMB Lensing (HALOFIT)
None
Sky Map Output
Vector C_l's are incompatible with Scalar and Tensor C_l's. The Transfer functions require Scalar and/or Tensor C_l's.



http://pla.esac.esa.int/pla/#home

News & Featured Updates - May 2017

- 650,000+ new objects with spectroscopic redshifts from SDSS DR13 added

Update: IPAC network activity planned for Tuesday, June 13 — Cancelled.

OBJECTS	DATA	LITERATURE	TOOLS	INFO
By Name	Images by Object Name Region	References by Object Name	Coordinate Transformation & Extinction Calculator	Introduction Latest News/Updates
Near Name	Photometry & SEDs	References by Author Name	Velocity Calculator	Features FAQ
Near Position	Spectra	Text Search	Cosmology Calculators	Brochure (pdf) Best Practices (pdf)
IAU Format	Redshifts	Knowledgebase	Extinction-Law Calculators	Source Nomenclature
By Parameters	Redshift-Independent Distances	Galaxy Distance Tabulations (NED-D)	Galaxy Environment by Precomputed Parameters Radial Velocity Constraint	Web Links New Interface
By Classifications *Types, Attributes*	Classifications by Object Name	Abstracts	X/Y offset to RA/DEC	Glossary & Lexicon
By Refcode	Positions		Batch Help	Team Users Committee
Object Notes	Diameters		Build Data Table from Input List By Name Near Name/Position (Cross-Matching)	Contact Us

NASA/IPAC EXTRAGALACTIC DATABASE

Search for Objects by Object Name

Help | Comment | NED Home

Select Cosmological Parameters for Derived Quantities

Submit Query | Reset

Input Parameters:

Object Name: VIRGO CLUSTER

Extended name search? ○ Yes ◉ No

Input Parameters for Distances and Cosmology-Corrected Quantities:

H_o 73 Ω_{matter} 0.27 Ω_{vacuum} 0.73 | NED Default/WMAP (Three-Year) | WMAP (Five-Year) Parameters

Correct Redshift: To the Reference Frame defined by the 3K CMB

as Input for Calculations of the Distances and Cosmology-Corrected Quantities

Output Format Specification:

System: Equatorial **Equinox:** J2000.0 | Set B1950.0 | Set J2000.0

Sort the output list by: RA or Longitude

Format tabular data as:

HTML Preformatted text (faster to display)

Velocity displayed as: lower limit(>) when it is above 30000.0 km/s.

If fewer than 5 objects found, list detailed information:

◉ **with** image preview, if available (slower response time)

○ **without** image preview (faster response time)

Submit Query | Reset

NASA/IPAC EXTRAGALACTIC DATABASE

Date and Time of the Query: 2017-06-19 T11:11:48 PDT

Help | Comment | NED Home

You have selected the following parameters to search on:

Parameters for Distances and Cosmology: H_o= 73.0; Ω_{matter} = 0.27; Ω_{vacuum} = 0.73;
Derived Quantities use a Redshift corrected to a Reference Frame defined by the 3K CMB

NED results for object VIRGO CLUSTER

1 objects found in NED.

SOURCE LIST

Row No.	Object Name (* => Essential Note)	EquJ2000.0 RA	DEC	Object Type	Velocity/Redshift km/s	z	Qual	Mag./ Filter	Separ. arcmin	Refs	Notes	Number of Phot	Posn	Vel/z	Diam	Assoc	Images	Spectra	Row No.
1	Virgo Cluster	12h30m47.3s	+12d20m13s	GClstr	1079	0.003600		...	...	1051	7	3	5	4	0	0	Retrieve	Retrieve	1

Detailed information for each object

Object No. 1 - Virgo Cluster

INDEX for Virgo Cluster

Essential Data (jump to sub-section of this query report):

Essential Note
Cross-IDs

Detailed Data (NED queries):

Spectra
Redshift-Independent Distances
1051 Reference(s)

Thank you!!!