

Tools for data analyses in Cosmology

- Aula 12 -

Camila Novaes

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.

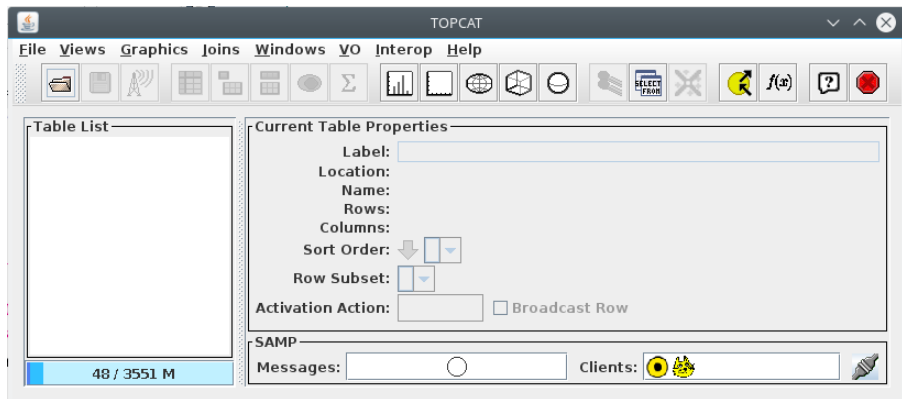
- [What is TOPCAT?](#)
- [Features](#)
- [Screenshots](#)
- [Documentation](#)
- [Frequently Asked Questions](#)
- [Mailing Lists](#)
- [Downloads](#)

• [Java 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, ...
- ...

TOPCAT: Main features

Examples

TOPCAT:
access
to
data

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

1: COM_PCCS_030_R2.04.fits

Current Table Properties


Label: COM_PCCS_030_R2.04.fits

Location: /media/camila/Dados/ON/Disciplina_PG_ON_2017/Aulas/Material/

Name: PCCS2_f030

Rows: 1.560



Columns: 35

Sort Order: 

Row Subset: All

Activation Action: (no action) ☐ Broadcast Row

SAMP

Messages: Clients:  

122 / 3551 M

TOPCAT(1): Table Browser

Window Subsets Help





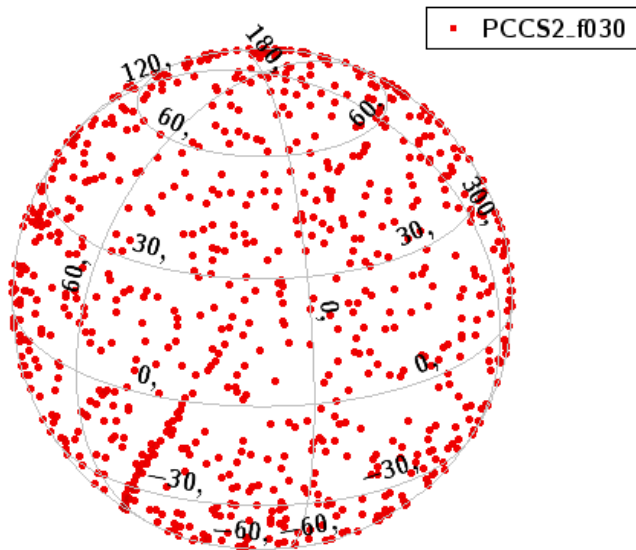
   

Table Browser for 1: COM_PCCS_030_R2.04.fits

	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

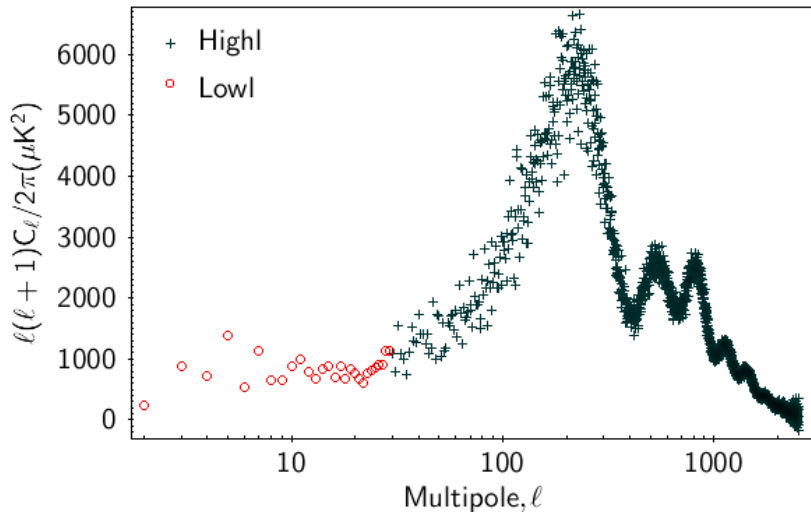
TOPCAT: Sky plot

“Planck Catalogue of Compact Sources”



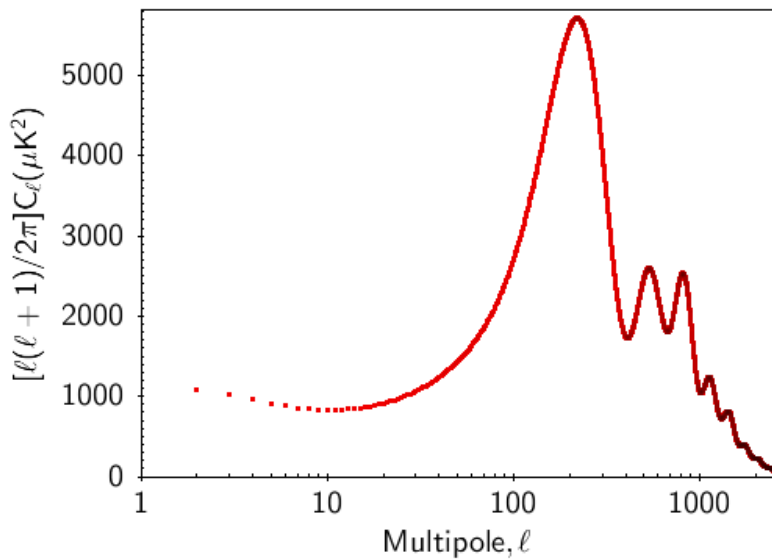
TOPCAT: Plain plot

“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

TOPCAT(2): Table Columns

Window Columns Display Help

Table Columns for 2: COM_PCCS_030_R2.04.fits

	Visible	Name	\$ID	Class	Units	Description	Format code	NULL VALUE
0	<input type="checkbox"/>	Index	\$0	Long		Table row index		
1	<input checked="" type="checkbox"/>	NAME	\$1	String	None		23A	
2	<input checked="" type="checkbox"/>	GLON	\$2	Double	degrees		1D	
3	<input checked="" type="checkbox"/>	GLAT	\$3	Double	degrees		1D	
4	<input type="checkbox"/>	RA	\$4	Double	degrees		1D	
5	<input type="checkbox"/>	DEC	\$5	Double	degrees		1D	
6	<input type="checkbox"/>	DETFLUX	\$6	Float	mJy		1E	
7	<input type="checkbox"/>	DETFLUX_ERR	\$7	Float	mJy		1E	
8	<input type="checkbox"/>	APERFLUX	\$8	Float	mJy		1E	
9	<input type="checkbox"/>	APERFLUX_ERR	\$9	Float	mJy		1E	
10	<input type="checkbox"/>	PSFFLUX	\$10	Float	mJy		1E	
11	<input type="checkbox"/>	PSFFLUX_ERR	\$11	Float	mJy		1E	
12	<input type="checkbox"/>	GAUFLUX	\$12	Float	mJy		1E	
13	<input type="checkbox"/>	GAUFLUX_ERR	\$13	Float	mJy		1E	
14	<input type="checkbox"/>	GAU_SEM1	\$14	Float	arcmin		1E	
15	<input type="checkbox"/>	GAU_SEM1_ERR	\$15	Float	arcmin		1E	
16	<input type="checkbox"/>	GAU_SEM2	\$16	Float	arcmin		1E	
17	<input type="checkbox"/>	GAU_SEM2_ERR	\$17	Float	arcmin		1E	
18	<input type="checkbox"/>	GAU_THETA	\$18	Float	degrees		1E	
19	<input type="checkbox"/>	GAU_THETA_ERR	\$19	Float	degrees		1E	
20	<input type="checkbox"/>	GAU_FWHM EFF	\$20	Float	arcmin		1E	
21	<input type="checkbox"/>	P	\$21	Float	mJy		1E	
22	<input type="checkbox"/>	P_ERR	\$22	Float	mJy		1E	
23	<input type="checkbox"/>	ANGLE_P	\$23	Float	degrees		1E	

Aladin

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

Aladin sky Atlas

[Overview](#)
[Aladin Desktop](#)
[Aladin Lite](#)
[Information](#)
[→ en français](#)

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 v9.0

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location Frame ICRS


★DSS ★SDSS ★2MASS ★WISE ★GALEX ★PLANCK ★AKARI ★XMM ★Fermi ★Gaia ★Simbad ★NED +

Aladin Sky Atlas - v9.0

ALADIN is an interactive software sky atlas.
It allows one to visualize digitized images of any part of the sky,
to superimpose entries from astronomical catalogs,
and to interactively access related data and information.

Quick start...

Just type your target in the text field above
(ex: M1 or 13:29:53 +47:11:48)


CENTRE DE DONNÉES
ASTRONOMIQUES DE STRASBOURG

Aladin is developed by Pierre Fernique,
Thomas Boch, Anaïs Oberto and François Bonnarel.
(c) 2016 Unistra/CNRS - by CDS - Distributed under GNU GPL v3

Bienvenue on Aladin,
your professional sky atlas.

- Discover all astronomical data available over the net!

select crop
pan cont
zoom pixel
dist prop
photo del
draw
tag
filter
x-y
rgb

epoch size opac. zoom

Search

Aladin: Main features

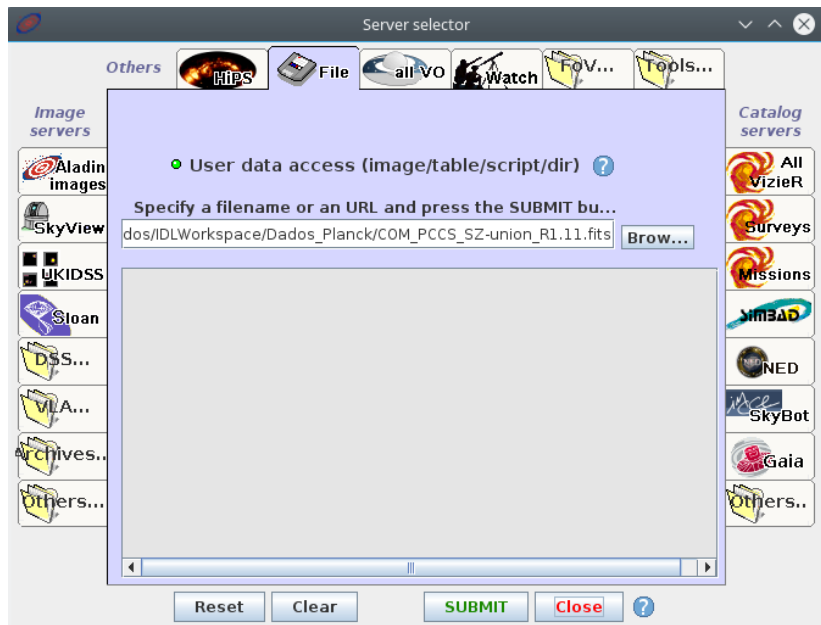
- Visualize and manipulate digitized astronomical images or full surveys
- Superimpose entries from astronomical catalogues or databases
- Interactively access related data and information from the Simbad database, the VizieR service and other archives for all known astronomical objects in the field.

Aladin: Main features

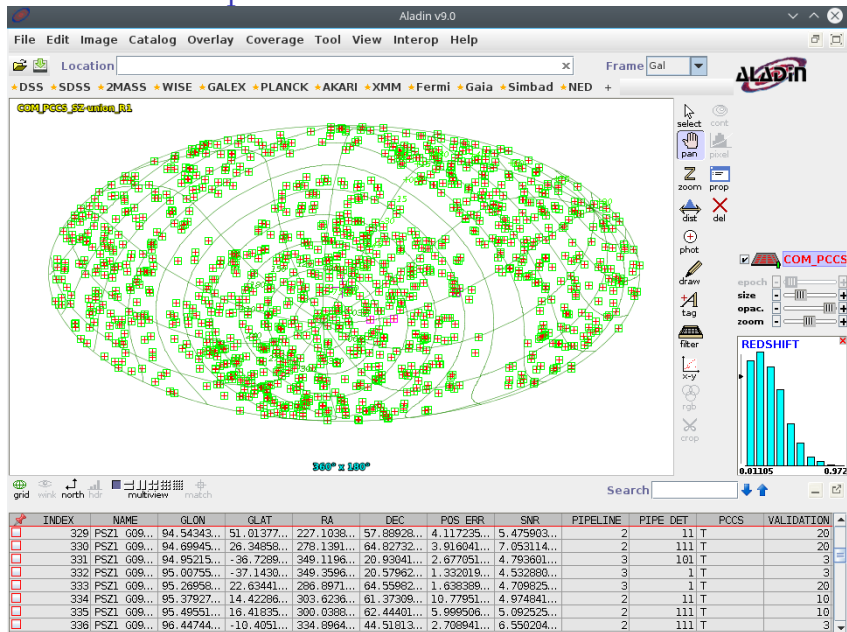
Specifically ...

- 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

The screenshot displays the Aladin software interface, which is used for astronomical data visualization. The interface is divided into several panels:

- FITS header editor (left panel):** This panel shows the metadata for a FITS file. The header is titled "FITS header" and contains the following information:
 - XTENSION= 'BINTABLE'** / binary table extension
 - BITPIX = 8** / array data type
 - NAXIS = 2** / number of array dimensions
 - NAXIS1 = 98** / length of dimension 1
 - NAXIS2 = 1227** / length of dimension 2
 - PCOUNT = 0** / number of group parameters
 - GCOUNT = 1** / number of groups
 - TFIELDS = 16** / number of table fields
 - EXTNAME = 'PSZ_UNION'**
 - TTYPE1 = 'INDEX'**
 - TFORM1 = 'I'**
 - TUNIT1 = 'None'**
 - TTYPE2 = 'NAME'**
 - TFORM2 = '18A'**
 - TUNIT2 = 'None'**
 - TTYPE3 = 'GLON'**
 - TFORM3 = 'D'**
 - TUNIT3 = 'degrees'**
 - TTYPE4 = 'GLAT'**
 - TFORM4 = 'D'**
 - TUNIT4 = 'degrees'**
 - TTYPE5 = 'RA'**
 - TFORM5 = 'D'**
 - TUNIT5 = 'degrees'**
 - TTYPE6 = 'DEC'**
 - TFORM6 = 'D'**
 - TUNIT6 = 'degrees'**
 - TTYPE7 = 'POS_ERR'**
 - TFORM7 = 'E'**
 - TUNIT7 = 'arcmin'**
 - TTYPE8 = 'SNR'**
 - TFORM8 = 'E'**
 - TUNIT8 = 'None'**
 - TTYPE9 = 'PIPELINE'**
 - TFORM9 = 'I'**
 - TUNIT9 = 'None'**
 - TTYPE10 = 'PIPE_DET'**
 - TFORM10 = 'I'**
 - TUNIT10 = 'None'**
 - TTYPE11 = 'PCCS'**
 - TFORM11 = 'L'**
 - TUNIT11 = 'None'**
 - TTYPE12 = 'VALIDATION'**
 - TFORM12 = 'I'**
 - TUNIT12 = 'None'**
- Main viewing window (center):** This panel displays a visualization of the data. It shows a green wireframe sphere with red crosses representing data points. The sphere is labeled "PSZ" and "UNION". The crosses are labeled "PCCS".
- Toolbar (right side):** This panel contains various tools for interacting with the data, including:
 - select** (mouse cursor icon)
 - cont** (contour icon)
 - pan** (hand icon)
 - pixel** (pixel icon)
 - zoom** (zoom icon)
 - prop** (properties icon)
 - dist** (distance icon)
 - del** (delete icon)
 - phot** (photometry icon)
 - draw** (draw icon)
 - tag** (tag icon)
 - filter** (filter icon)
 - x-y** (x-y icon)
 - rgb** (rgb icon)
 - crop** (crop icon)
- COM PCCS (bottom right):** This panel shows the results of a query. It includes a table with columns for **epoch**, **size**, **opac.**, and **zoom**. The table is currently empty.
- Search (bottom):** A search bar with a magnifying glass icon and a search button.

Some other ‘‘tips’’ ...



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Legacy Archive for Microwave Background Data Analysis

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



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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).





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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.





WELCOME TO THE PLANCK LEGACY ARCHIVE

The Planck Legacy Archive provides online access to all official data products generated by the Planck mission.

LATEST NEWS

[PLA 2.12 release](#)

A new version of the PLA interface has been released today improving the user experience when searching for Planck products. Additional tools to facilitate the analysis of Planck data will become available in the coming weeks.

2017-06-14 PSO



PLANCK LEGACY ARCHIVE CONTENTS



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[CATALOGUES](#)



[COSMOLOGY](#)



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

[HELPDESK](#)



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 <i>Types, Attributes</i>	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:

Extended name search? ☐ Yes ☒ No

Input Parameters for Distances and Cosmology-Corrected Quantities:


H_0 Ω_{matter} Ω_{vacuum}

Correct Redshift: 


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

Output Format Specification:

System:  Equinox:

Sort the output list by: 

Format tabular data as:



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

If fewer than 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: $H_0 = 73.0$; $\Omega_{\text{matter}} = 0.27$; $\Omega_{\text{vacuum}} = 0.73$;

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	Mag./ Filter	Separ. arcmin	Refs	Notes	Phot	Posn	Vel/z	Dian	Assoc	Images	Spectra	Row No.
1	Virgo Cluster	12h30m47.3s	+12d20m13s	GClsr	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 References](#)

Thank you!!!