



Data mining with TOPCAT and ADQL

Creating a target list

Max Pritzkeleit
Research workshop on evolved stars
27.08.2024

Overview



- Topcat
 - Basic overview
 - Table visualisation/manipulation
 - Visualisation tools
 - Crossmatching
- ADQL
 - Basic commands and hands-on exercise
- Exercise: cross-match with ATLAS – creating our target list for photometry
- Creating our target list for spectroscopy
 - Defining the region of interest
 - ADQL query
 - Observational constraints



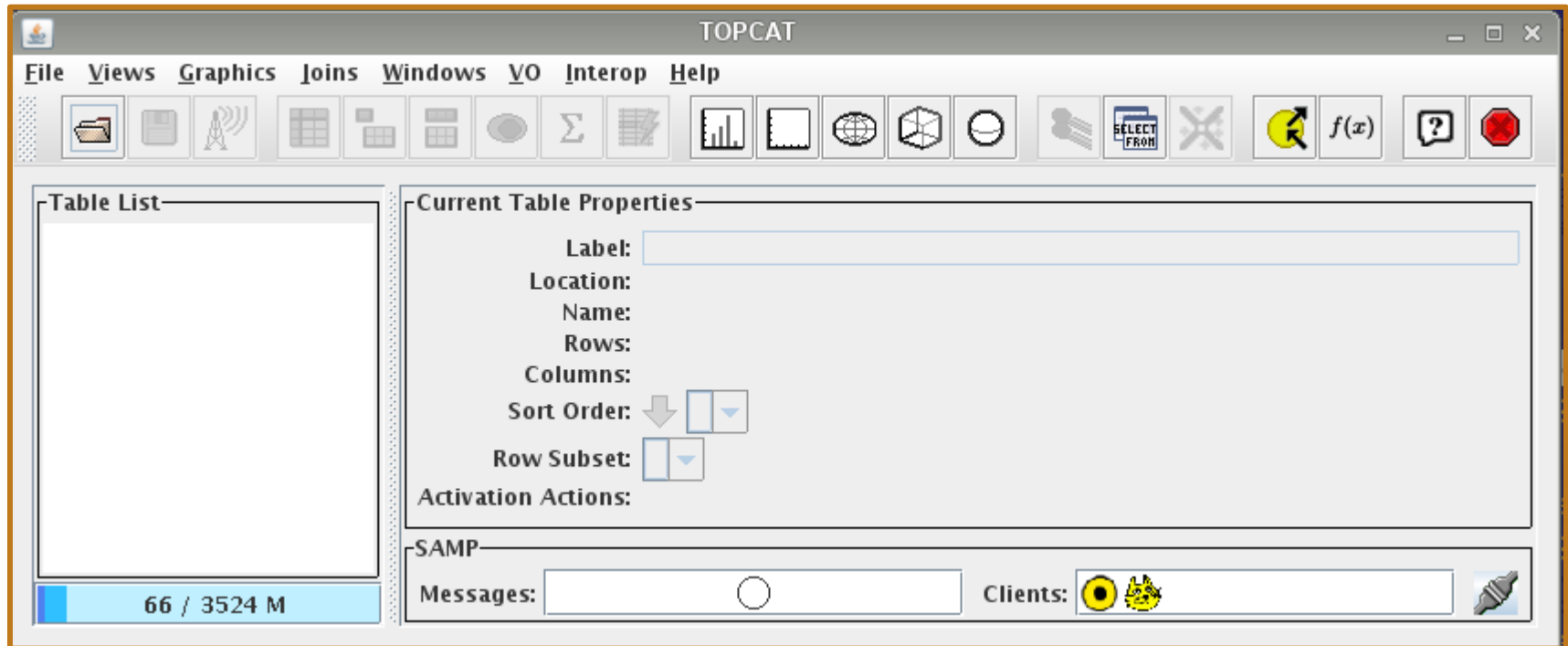
Tool for Operations on Catalogues And Tables

Does what you want with tables

- Website: <http://www.star.bristol.ac.uk/~mbt/topcat/>
- Manual: <http://www.starlink.ac.uk/topcat/sun253/>
- Why TOPCAT?
 - Easy to use
 - Easy to learn
 - Easy to investigate data — good for exploratory analysis
 - Simple things obvious, complicated things documented
 - Easy to install and run
 - Fast
 - Copes with large data sets

- What can we do with TOPCAT?
 - Read/write tables in multiple formats
 - View/edit data
 - View/edit metadata
 - Plot data
 - Crossmatch — efficient and very flexible
 - (Simple) Calculations
 - Access Virtual Observatory (VO) services
- What can't we do with TOPCAT?
 - Images and spectra (tables only!)
 - Do astronomy for you

TOPCAT - start window



TOPCAT - start window



Most important
button!

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

Current Table Properties

Label:

Location:

Name:

Rows:

Columns:

Sort Order:

Row Subset:

Activation Actions:

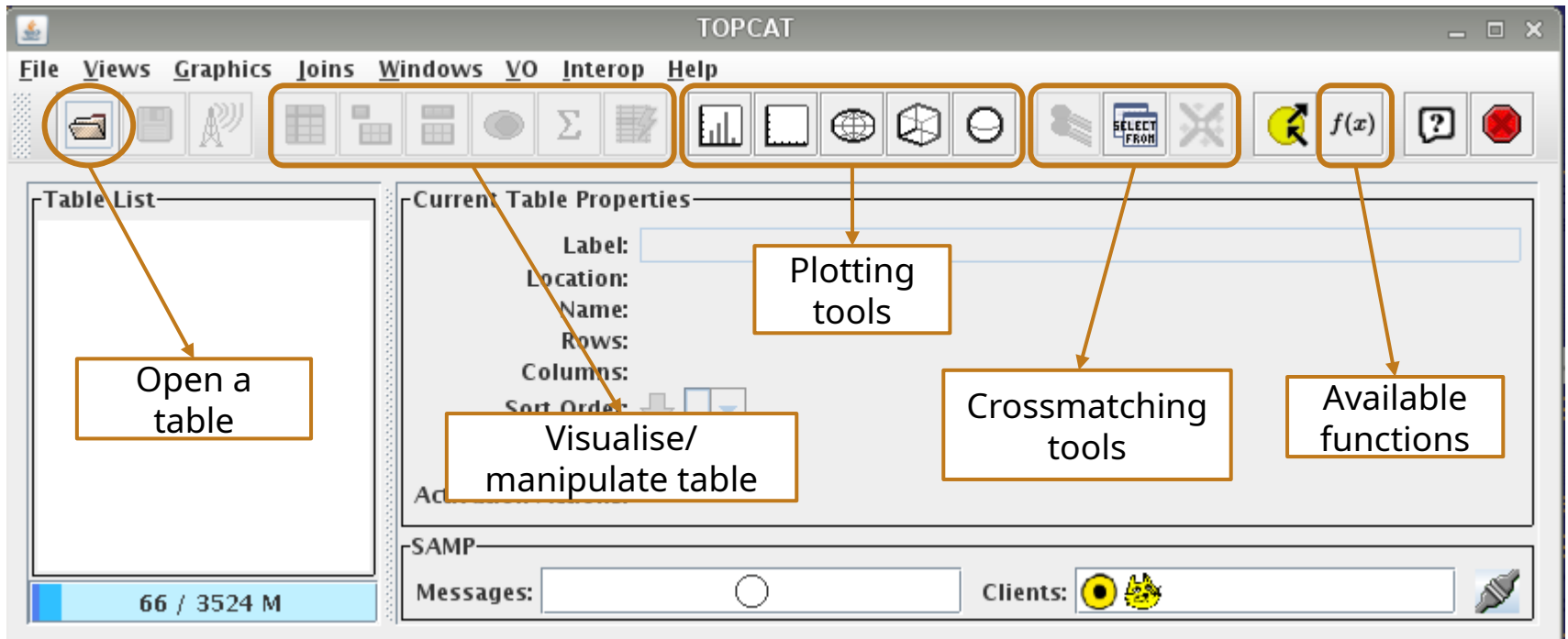
SAMP

Messages:

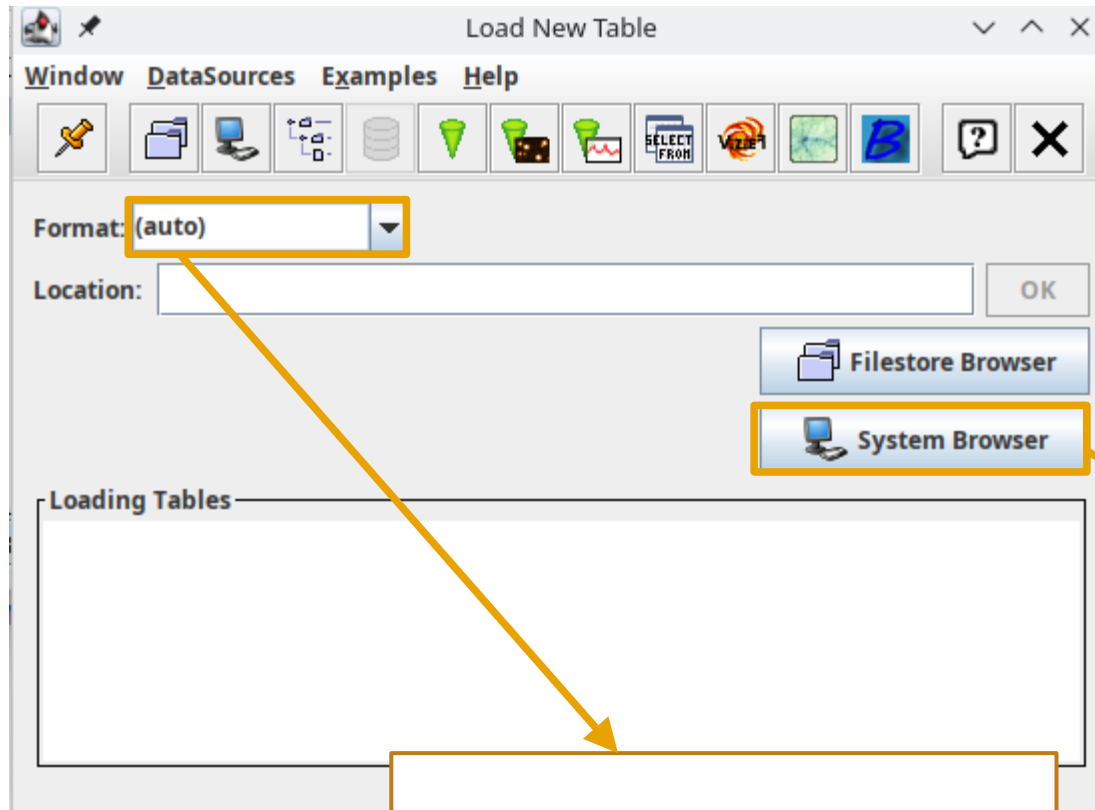
Clients:

66 / 3524 M

TOPCAT - start window



TOPCAT - open a table



You can keep "auto" here but it might fail sometimes and then you have to set the correct format of your table

Select path where table is located, e.g. your share folder

TOPCAT - tables

The screenshot displays the TOPCAT software interface. The window title is "TOPCAT". The menu bar includes "File", "Views", "Graphics", "Joins", "Windows", "VO", "Interop", and "Help". The toolbar contains various icons for file operations, data visualization, and analysis.

The interface is divided into several panels:

- Table List:** A list of tables with two entries:
 - 1: sd_catalogue_v44.csv
 - 2: SampleC.vot
- Current Table Properties:** A panel showing details for the selected table:
 - Label: sd_catalogue_v44.csv
 - Location: /home/octans/pelisoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
 - Name:
 - Rows: 5,613
 - Columns: 300
 - Sort Order:
 - Row Subset: All
 - Activation Actions: 1 / 2
- SAMP:** A status bar at the bottom showing "Messages: Clients:

A status bar at the bottom left indicates memory usage: 257 / 3524 M.

TOPCAT - browse table entries

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

Current Table Properties

Label: sd_catalogue_v44.csv
Location: /home/octans/pelisoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
Name:
Rows: 5,613
Columns: 300
Sort Order:
Row Subset: All
Activation Actions: 1 / 2

-SAMP-

Messages: Clients:

257 / 3524 M

TOPCAT(2): Table Browser

Window Subsets Help

Table Browser for 2: SampleC.vot

	source_id	ra	dec	parallax	pmra	pmdec	phot_g_me...	phot_bp_m...	phot_rp_m...	bp_rp	teff_val	radius_val	radial_velocity
1	5256215443991096192	147.86761	-61.24324	14.45812	12.03787	-69.37827	15.9087	17.5931	14.6429	2.9502	4061.37		
2	5256330686560451584	151.56722	-60.97767	11.94937	-22.95639	71.97418	16.0123	17.8669	14.7033	3.16366	3719.83		
3	5256385455986316288	151.27972	-60.70641	12.54169	31.90794	80.67874	8.88798	9.19604	8.46277	0.733274	5956.	1.07332	-7.42609
4	5253416396637155072	153.5164	-61.03644	12.63063	-105.39727	-45.1931	15.137	16.5149	13.956	2.55884	3806.61		
5	5253387156502079744	152.8841	-61.23938	10.00575	-104.01756	50.83406	7.99488	8.28995	7.58982	0.700138	6150.75	1.89712	78.49139
6	5256366489408398336	150.23835	-60.96456	13.98831	-94.56353	119.33368	15.208	16.8438	13.9581	2.88572	3942.28		
7	5251098523021221376	144.83717	-61.32796	15.20927	-42.29215	19.4506	4.43662	4.46872	4.54535	-0.076632	9450.		
8	5257162462774509440	145.37644	-60.51155	19.26591	-186.61478	102.95347	11.6907	12.6408	10.7458	1.89492	4121.07	0.501863	15.92912
9	5258941648688757888	153.40699	-57.19364	13.69926	-19.40082	84.64139	15.0713	16.5366	13.8802	2.6564	3866.73		
10	5258898488554176384	151.62451	-57.25991	32.36492	48.46716	-62.36505	12.7897	14.1319	11.6591	2.47282	3764.82		
11	5259661897522690688	151.14651	-57.02871	11.71382	-114.0676	60.93288	14.3115	15.8704	13.0872	2.78321	3683.46		
12	5258429379357599232	152.07547	-58.19864	14.42705	-4.00739	-13.83841	6.47879	6.80914	6.04574	0.763399	6011.5	2.77469	-10.38242
13	5255092876977182976	153.85899	-59.60026	15.49247	-59.49346	11.34791	16.459	18.0891	15.1948	2.89426	4120.11		

TOPCAT - table metadata

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

Current Table Properties

Label: sd_catalogue_v44.csv

Location: /home/octans/pelisolini/Documents/sdOR_catalogue/sd_catalogue_v44.csv

257 / 3524 M

TOPCAT(2): Table Parameters

Window Parameters Display Help

Table Parameters for 2: SampleC.vot

Name	Value	Description
Name	result_1547025393811	Table name
Column Count	13	Number of columns
Row Count	242582	Number of rows
QUERY_STATUS	OK	
PROVIDER	ARI (Astronomisches Rechen Institut - Heidelberg, Germany)	ARI's TAP access to the Gaia Archive.
QUERY	SELECT source_id, ra, dec, g.parallax, pmra, pmdec, g.phot_g_...	

Name: QUERY

Class: String

Shape:

Units:

Description:

UCD:

Utype:

Value: SELECT source_id, ra, dec, g.parallax, pmra, pmdec, g.phot_g_mean_mag, phot_bp_mean_mag, radius_val, radial_velocity FROM gaiadr2.gaia_source AS g JOIN TAP_UPLOAD.t1.USING (source_id)

TOPCAT - column metadata

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

Current Table Properties

Label: sd_catalogue_v44.csv
 Location: /home/octans/pelisola/Documents/sdOB_catalogue/sd_catalogue_v44.csv
 Name:
 Rows: 5,613
 Columns: 300
 Sort Order: ↑
 Row Subset: All
 Activation Actions: 1, 2

SAMP

Messages: Clients:

257 / 3524 M

TOPCAT(2): Table Columns

Window Columns Display Help

Table Columns for 2: SampleC.vot

Δ	Index	Visible	Name	\$ID	Class	Units	Description	UCD	Datatype	VOTable ID
0		<input type="checkbox"/>	Index	\$0	Long		Table row index			
1	1	<input checked="" type="checkbox"/>	source_id	\$1	Long				long	col_0
2	2	<input checked="" type="checkbox"/>	ra	\$2	Double	deg	Right ascension	pos.eq.ra;meta.main	double	col_1
3	3	<input checked="" type="checkbox"/>	dec	\$3	Double	deg	Declination	pos.eq.dec;meta.main	double	col_2
4	4	<input checked="" type="checkbox"/>	parallax	\$4	Double	mas	Parallax	pos.parallax	double	col_3
5	5	<input checked="" type="checkbox"/>	pmra	\$5	Double	mas/yr	Proper motion in right ascension direction	pos.pm;pos.eq.ra	double	col_4
6	6	<input checked="" type="checkbox"/>	pmdec	\$6	Double	mas/yr	Proper motion in declination direction	pos.pm;pos.eq.dec	double	col_5
7	7	<input checked="" type="checkbox"/>	phot_g_mean_mag	\$7	Float	mag	G-band mean magnitude	phot.mag;stat.mean;em.opt	float	col_6
8	8	<input checked="" type="checkbox"/>	phot_bp_mean_mag	\$8	Float	mag	Integrated BP mean magnitude	phot.mag;stat.mean	float	col_7
9	9	<input checked="" type="checkbox"/>	phot_rp_mean_mag	\$9	Float	mag	Integrated RP mean magnitude	phot.mag;stat.mean	float	col_8
10	10	<input checked="" type="checkbox"/>	bp_rp	\$10	Float	mag	BP - RP colour	phot.color	float	col_9
11	11	<input checked="" type="checkbox"/>	teff_val	\$11	Float	K	Stellar effective temperature	phys.temperature.effective	float	col_10
12	12	<input checked="" type="checkbox"/>	radius_val	\$12	Float	solRad	Stellar radius	phys.size.radius	float	col_11
13	13	<input checked="" type="checkbox"/>	radial_velocity	\$13	Double	km/s	Radial velocity	spect.dopplerVeloc.opt	double	col_12

TOPCAT - create new column

Define Synthetic Column

Window Help

f(x) ? X

? Name: pm

Expression: $\sqrt{\text{pow}(\text{pmra},2) + \text{pow}(\text{pmdec},2)}$

Units: mas/yr

Description: Total proper motion

UCD: POS_PM
Proper Motion (non-equatorial) and related quantities

Index: 14

OK Cancel

Column names become variables

Column names should not contain mathematical operators and spaces!

TOPCAT(2): Table Columns

Window Columns Display Help

Table Columns for 2: SampleC.vot

Δ	Index	Visible	Name	ID	Class	Units	Description	UCD	Datatype	VOTable ID
0		<input type="checkbox"/>	Index	\$0	Long		Table row index			
1	1	<input checked="" type="checkbox"/>	source_id	\$1	Long				long	col_0
2	2	<input checked="" type="checkbox"/>	ra	\$2	Double	deg	Right ascension	pos.eq.ra;meta.main	double	col_1
3	3	<input checked="" type="checkbox"/>	dec	\$3	Double	deg	Declination	pos.eq.dec;meta.main	double	col_2
4	4	<input checked="" type="checkbox"/>	parallax	\$4	Double	mas	Parallax	pos.parallax	double	col_3
5	5	<input checked="" type="checkbox"/>	pmra	\$5	Double	mas/yr	Proper motion in right ascension direction	pos.pm;pos.eq.ra	double	col_4
6	6	<input checked="" type="checkbox"/>	pmdec	\$6	Double	mas/yr	Proper motion in declination direction	pos.pm;pos.eq.dec	double	col_5
7	7	<input checked="" type="checkbox"/>	phot_g_mean_mag	\$7	Float	mag	G-band mean magnitude	phot.mag;stat.mean;em.opt	float	col_6
8	8	<input checked="" type="checkbox"/>	phot_bp_mean_mag	\$8	Float	mag	Integrated BP mean magnitude	phot.mag;stat.mean	float	col_7
9	9	<input checked="" type="checkbox"/>	phot_rp_mean_mag	\$9	Float	mag	Integrated RP mean magnitude	phot.mag;stat.mean	float	col_8
10	10	<input checked="" type="checkbox"/>	bp_rp	\$10	Float	mag	BP - RP colour	phot.color	float	col_9
11	11	<input checked="" type="checkbox"/>	teff_val	\$11	Float	K	Stellar effective temperature	phys.temperature.effective	float	col_10
12	12	<input checked="" type="checkbox"/>	radius_val	\$12	Float	solRad	Stellar radius	phys.size.radius	float	col_11
13	13	<input checked="" type="checkbox"/>	radial_velocity	\$13	Double	km/s	Radial velocity	spect.dopplerVeloc.opt	double	col_12

TOPCAT - most important math operators



Real	Expression in TOPCAT
+	+
-	-
*	*
/	/
$\log(5)$	<code>log10(5)</code>
$\sqrt{5}$	<code>sqrt(5)</code>
10^5	<code>pow(10,5)</code>

TOPCAT - create subsets

TOPCAT(1): Row Subsets

Window Subsets Display Interop Help

Row Subsets for 1: sd_catalogue_v44.csv

ID	Name	Size	Fraction	Expression
.1	All	5613	100%	

Define Row Subset

Window Help

Simple expression

Subset Name: bright

Expression: G_Gaia < 10

OK Cancel

Define Row Subset

Window Help

Use of functions

Subset Name: fast

Expression: abs(RV) > 400

OK Cancel

Define Row Subset

Window Help

Missing values = empty table entries

Subset Name: noRVdata

Expression: NULL_RV

OK Cancel

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Table List

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

Current Table Properties

Label: sd_catalogue_v44.csv

Location: /home/octans/pelisoli/Documents/sdOB_catalogue/s

Name:

Rows: 5,613

Columns: 300

Sort Order: ↑

Row Subset: All

Activation Actions: 1 / 2

SAMP

Messages: ○ Clients: ☀ 🐛

257 / 3524 M

TOPCAT - create column based on subset

Define Synthetic Column

Window Help

f(x) ? X If statement

? Name: Observe?

Expression: (fast && bright) ? "yes" : "no"

Units:

Description:

UCD: no UCD

Index: 301

OK Cancel

TOPCAT(2): Table Columns

Window Columns Display Help

+ + ↶ □ ✓ ☰ ☷ ⏶ ⏷ ? X

Table Columns for 2: SampleC.vot

Δ	Index	Visible	Name	\$ID	Class	Units	Description	UCD	Datatype	VOTable ID
0		<input type="checkbox"/>	Index	\$0	Long		Table row index			
1	1	<input checked="" type="checkbox"/>	source_id	\$1	Long				long	col_0
2	2	<input checked="" type="checkbox"/>	ra	\$2	Double	deg	Right ascension	pos.eq.ra;meta.main	double	col_1
3	3	<input checked="" type="checkbox"/>	dec	\$3	Double	deg	Declination	pos.eq.dec;meta.main	double	col_2
4	4	<input checked="" type="checkbox"/>	parallax	\$4	Double	mas	Parallax	pos.parallax	double	col_3
5	5	<input checked="" type="checkbox"/>	pmra	\$5	Double	mas/yr	Proper motion in right ascension direction	pos.pm;pos.eq.ra	double	col_4
6	6	<input checked="" type="checkbox"/>	pmdec	\$6	Double	mas/yr	Proper motion in declination direction	pos.pm;pos.eq.dec	double	col_5
7	7	<input checked="" type="checkbox"/>	phot_g_mean_mag	\$7	Float	mag	G-band mean magnitude	phot.mag;stat.mean;em.opt	float	col_6
8	8	<input checked="" type="checkbox"/>	phot_bp_mean_mag	\$8	Float	mag	Integrated BP mean magnitude	phot.mag;stat.mean	float	col_7
9	9	<input checked="" type="checkbox"/>	phot_rp_mean_mag	\$9	Float	mag	Integrated RP mean magnitude	phot.mag;stat.mean	float	col_8
10	10	<input checked="" type="checkbox"/>	bp_rp	\$10	Float	mag	BP - RP colour	phot.color	float	col_9
11	11	<input checked="" type="checkbox"/>	teff_val	\$11	Float	K	Stellar effective temperature	phys.temperature.effective	float	col_10
12	12	<input checked="" type="checkbox"/>	radius_val	\$12	Float	solRad	Stellar radius	phys.size.radius	float	col_11
13	13	<input checked="" type="checkbox"/>	radial_velocity	\$13	Double	km/s	Radial velocity	spect.dopplerVeloc.opt	double	col_12

TOPCAT - Visualisation tools

The image displays the TOPCAT software interface. On the left, the 'Current Table Properties' panel shows the file 'sd_catalogue_v44.csv' with 5,613 rows and 300 columns. A red box highlights the histogram icon in the toolbar, with an arrow pointing to the 'Histogram Plot' window. The histogram window shows a distribution of 'C_Gaia' values, with a legend for '1: All' (red), '1: bright' (green), and '1: fast' (blue). The x-axis ranges from 8 to 21, and the y-axis shows counts up to 600. Below the plot, the 'Position' and 'Subsets' panels are visible, with 'Table: 1: sd_catalogue_v44.csv' and 'X: C_Gaia' selected. A red box highlights the 'Add function' button in the 'Subsets' panel, with an arrow pointing to a text box that says 'Add function (e.g. Gaussian)'. Another red box highlights the 'Add another histogram' button in the 'Subsets' panel, with an arrow pointing to a text box that says 'Add another histogram'. The status bar at the bottom shows 'Count: 5,596 / 5,613'.

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Current Table Properties

Label: sd_catalogue_v44.csv
Location: /home/ortans/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
Name:
Rows: 5,613
Columns: 300
Sort Order:
Row Subset: All
Activation Actions: 1 / 2

Messages:
SAMP

Table List

1: sd_catalogue_v44.csv
2: SampleC.vot

257 / 3524 M

Histogram Plot

Window Layers Subsets Plot Export Help

1: All
1: bright
1: fast

600
500
400
300
200
100
0

8 9 10 11 12 13 14 15 16 17 18 19 20 21

C_Gaia

Frame
Legend
Axes
Bins
STILTS

Position Subsets Form

Table: 1: sd_catalogue_v44.csv
X: C_Gaia
Weight:

1: sd_cat

Add function (e.g. Gaussian)

Add another histogram

Position: Count: 5,596 / 5,613

TOPCAT - Visualisation tools

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Current Table Properties

Label: sd_catalogue_v44.csv
Location: /home/octan/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
Name:
Rows: 5,613
Columns: 300
Sort Order:
Row Subset: All
Activation Actions: 1 / 2

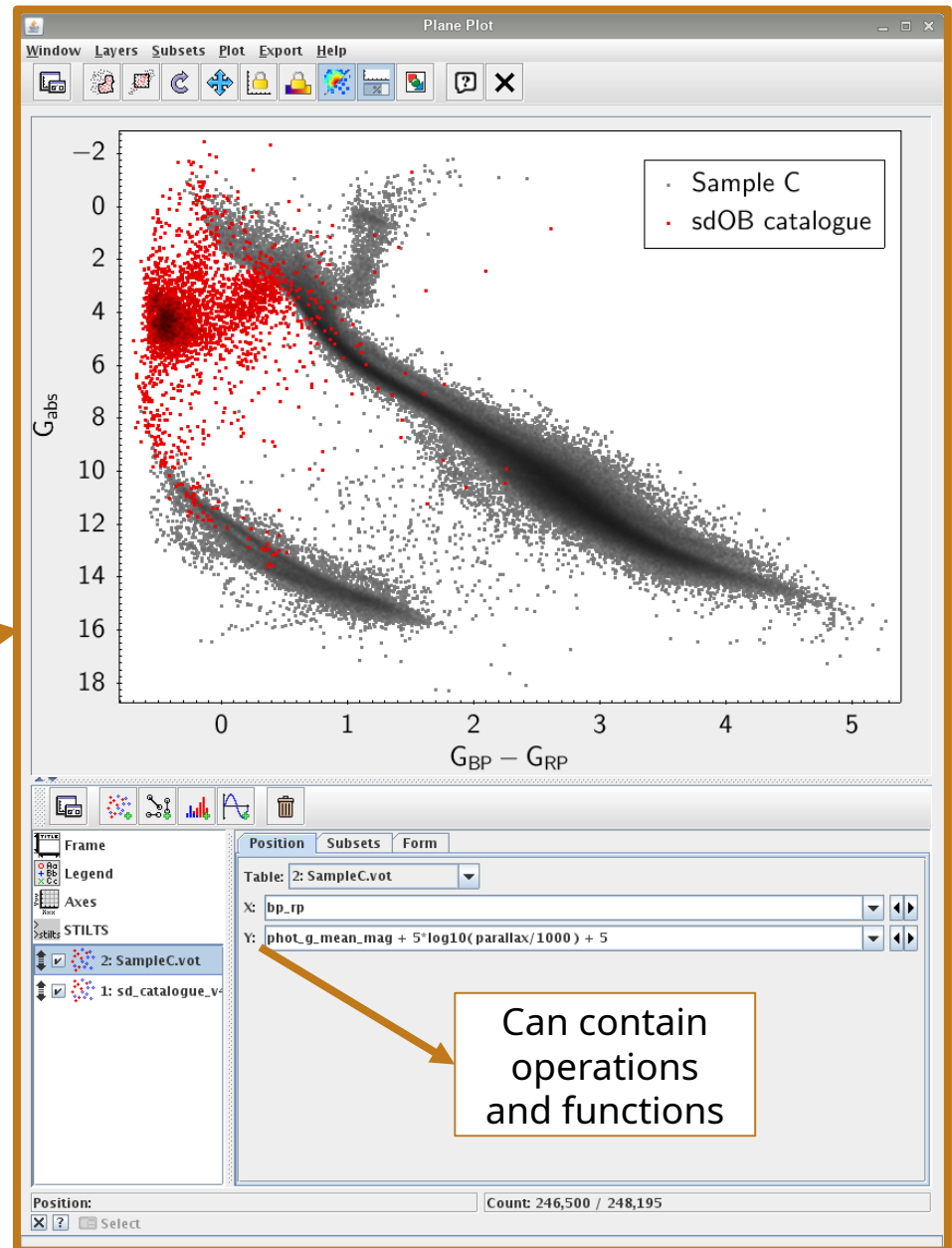
Messages: SAMP

Table List

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

257 / 3524 M

Plane plot



Can contain operations and functions

TOPCAT - Visualisation tools

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Current Table Properties

Label: sd_catalogue_v44.csv
Location: /home/octan/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
Name:
Rows: 5,613
Columns: 300
Sort Order:
Row Subset: All
Activation Actions: 1 / 2

Messages:

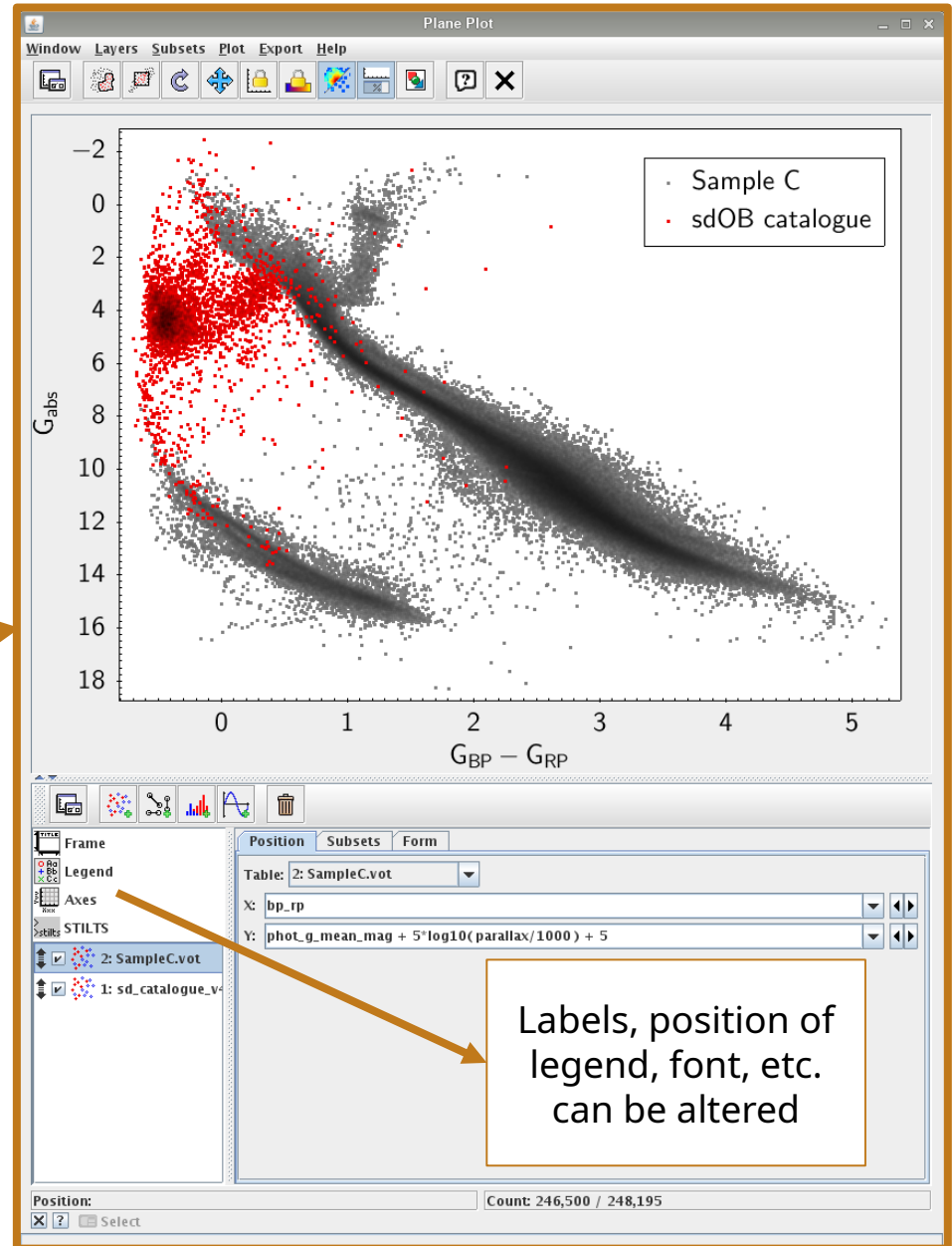
SAMP

Table List

1: sd_catalogue_v44.csv
2: SampleC.vot

257 / 3524 M

Plane plot



TOPCAT - Visualisation tools

The screenshot shows the TOPCAT main interface. On the left is a vertical toolbar with various icons. The main area is divided into two panels. The top panel, 'Current Table Properties', displays the following information: Label: sd_catalogue_v44.csv, Location: /home/octan/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv, Name: (empty), Rows: 5,613, Columns: 300, Sort Order: (empty), Row Subset: All, and Row Activation Actions: 1 / 2. The bottom panel, 'Table List', shows a list of tables: 1: sd_catalogue_v44.csv and 2: SampleC.vot. A blue bar at the bottom right indicates '257 / 3524 M'.

Plane plot

The screenshot shows the 'Plane Plot' window. The main plot area displays a scatter plot with 'Gabs' on the vertical axis (ranging from -2 to 18) and 'GBP - GRP' on the horizontal axis (ranging from 0 to 5). The plot contains two data series: 'Sample C' (represented by grey dots) and 'sdOB catalogue' (represented by red dots). A legend in the top right corner identifies these series. Below the plot is a configuration panel with tabs for 'Position', 'Subsets', and 'Form'. The 'Position' tab is active, showing 'Table: 2: SampleC.vot' and the following axis definitions: X: bp_rp and Y: $\text{pinet_g_mean_mag} + 5 * \log_{10}(\text{parallax}/1000) + 5$. A legend below the axes shows '2: SampleC.vot' and '1: sd_catalogue_v'. A text box with an arrow pointing to the legend area contains the text 'Add another table'. At the bottom of the window, the 'Position' section shows 'Count: 246,500 / 248,195'.

TOPCAT - Visualisation tools

TOPCAT

File Views Graphics Joins Windows VO Interop Help

Current Table Properties

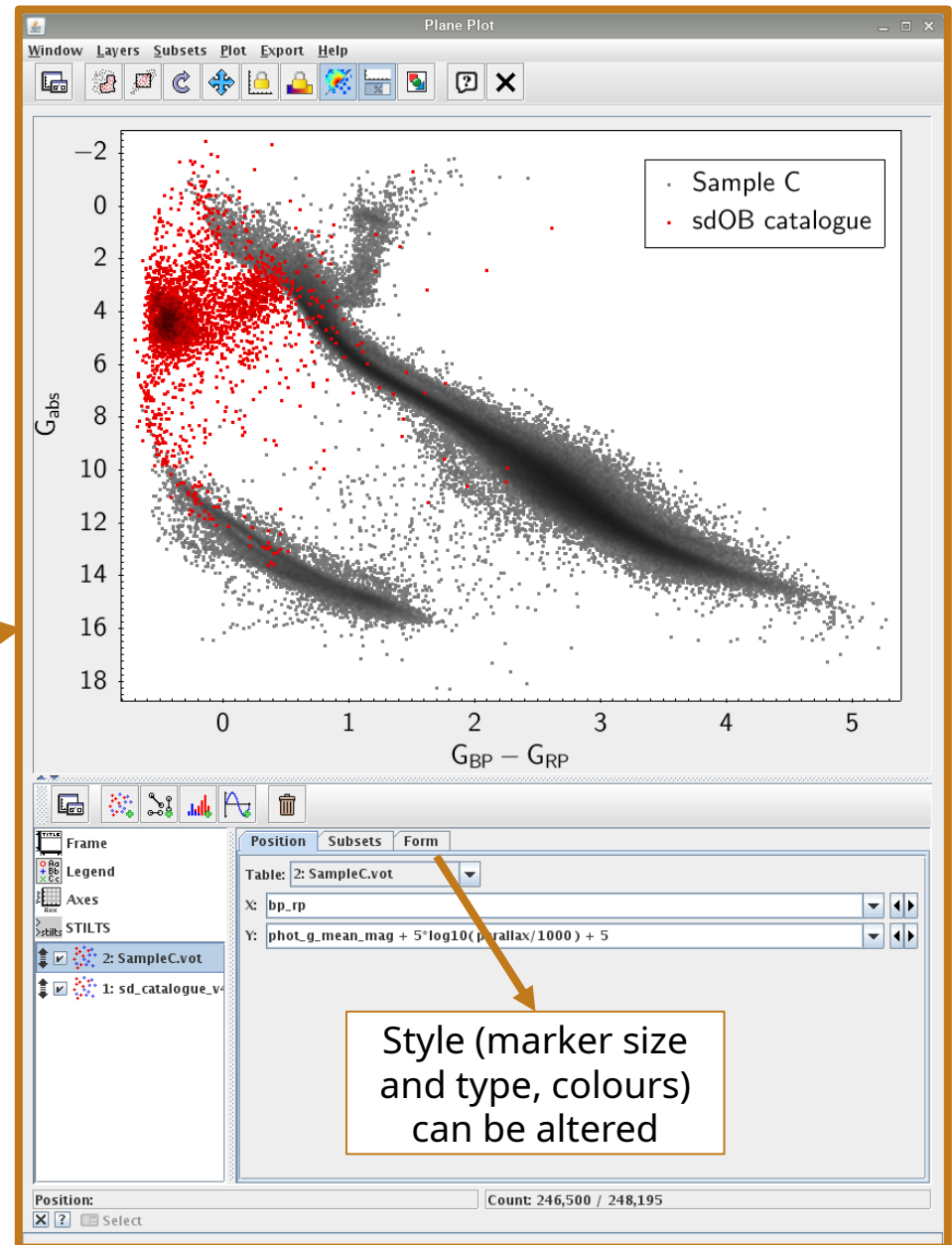
Label: sd_catalogue_v44.csv
Location: /home/octan/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
Name:
Rows: 5,613
Columns: 300
Sort Order:
Row Subset: All
Row Activation Actions: 1 / 2

Table List

1: sd_catalogue_v44.csv
2: SampleC.vot

257 / 3524 M

Plane plot



TOPCAT - Visualisation tools

The screenshot shows the TOPCAT software interface. The 'Current Table Properties' panel displays the following information:

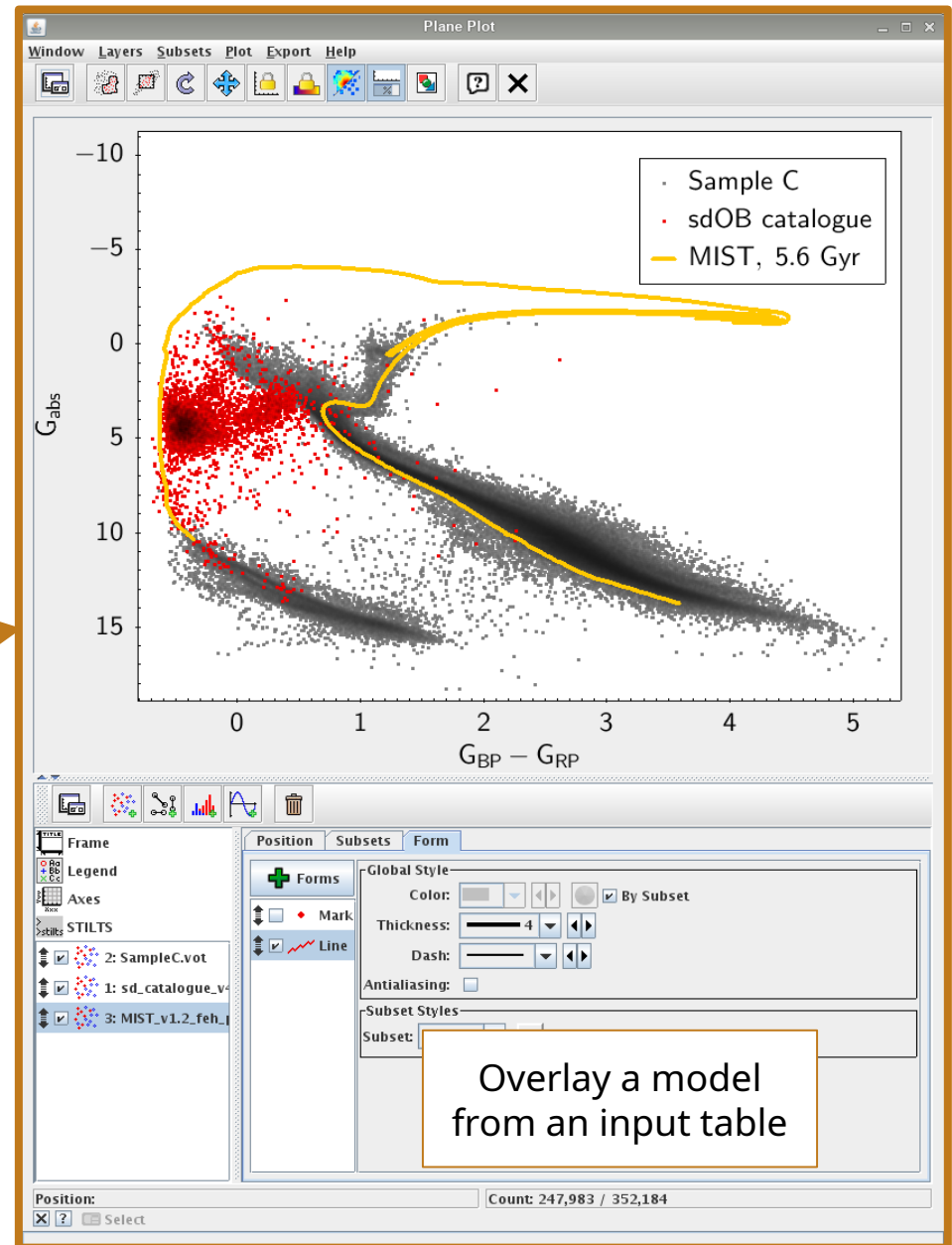
- Label: sd_catalogue_v44.csv
- Location: /home/octan/pelissoli/Documents/sdOB_catalogue/sd_catalogue_v44.csv
- Name: sd_catalogue_v44.csv
- Rows: 5,613
- Columns: 300
- Sort Order: All
- Row Subset: All
- Activation Actions: 1 / 2

The 'Table List' panel shows:

- 1: sd_catalogue_v44.csv
- 2: SampleC.vot

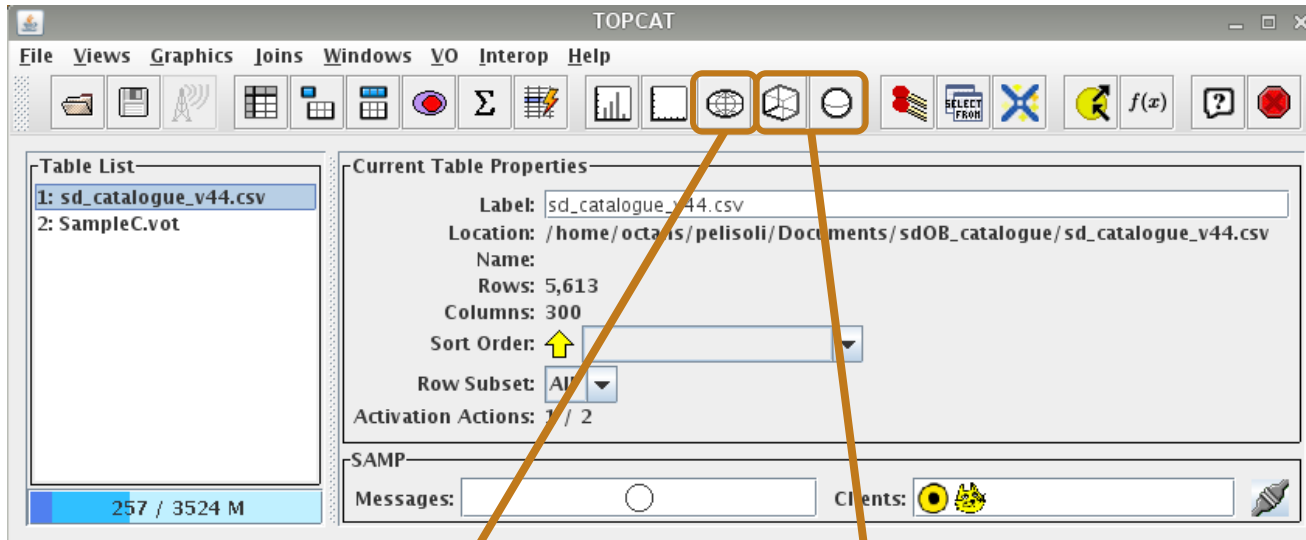
An orange arrow points from the 'Plane plot' icon in the toolbar to the main plot window.

Plane plot

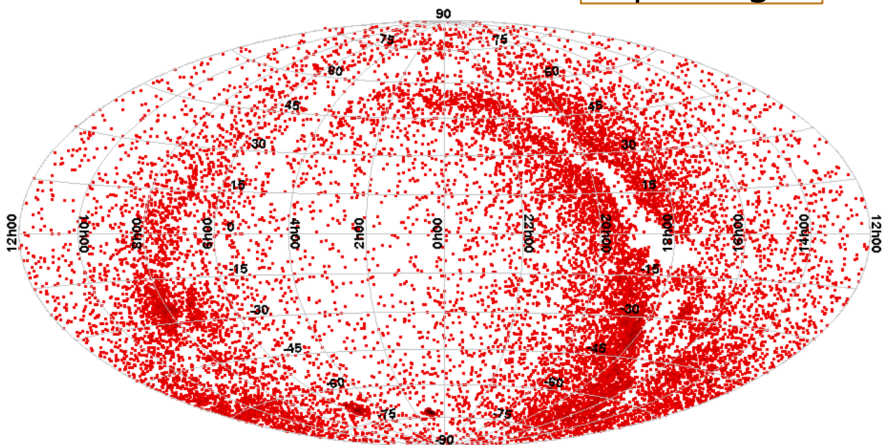


Overlay a model from an input table

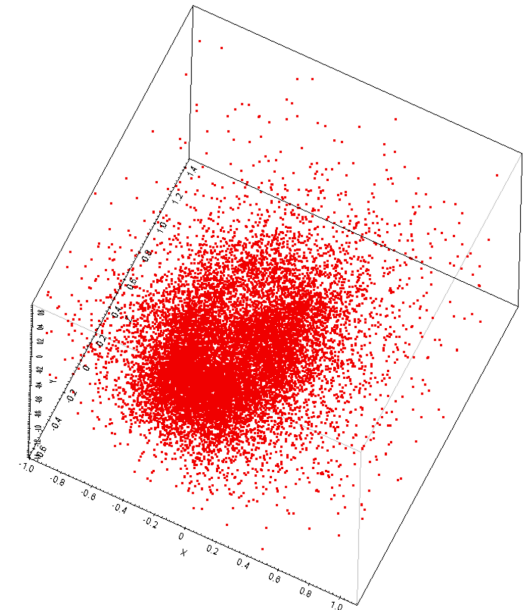
TOPCAT - Visualisation tools



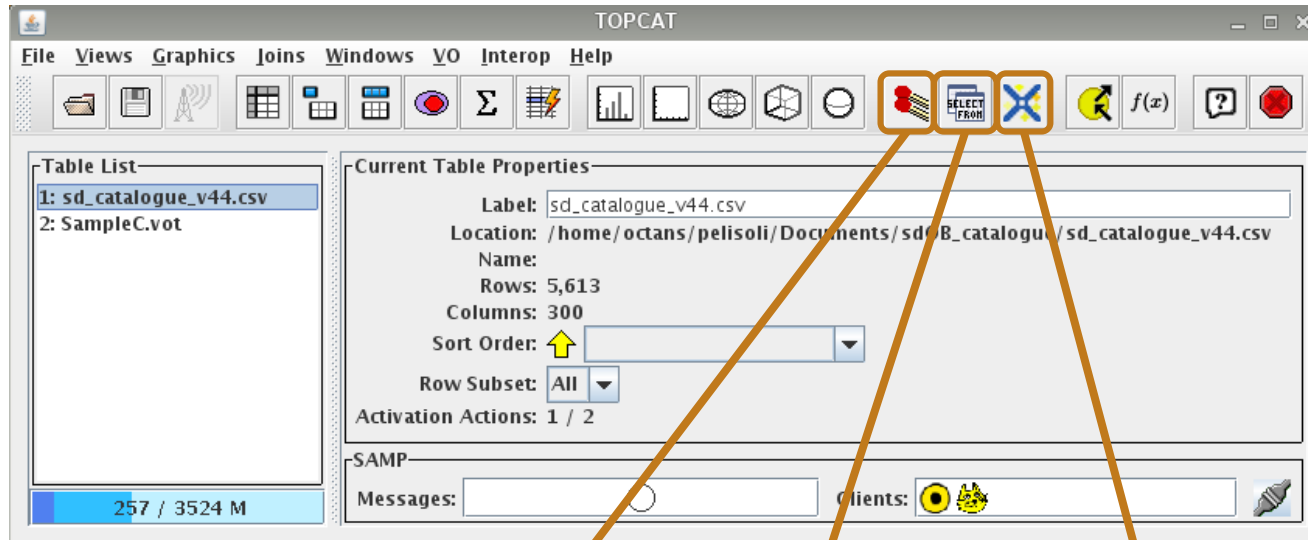
Sky plotting



3D plotting



TOPCAT – Crossmatching



Match two
local tables

Query
using
ADQL

Match local
table to survey
(e.g. SDSS,
Gaia...)

ADQL queries

Table Access Protocol (TAP) Query

Window TAP Registry Edit Interop Help

Select Service Use Service Resume Job Running Jobs

Locate TAP Service

By Table Properties By Service Properties

Keywords: And

Match Fields: Table Name Table Description Service

Cancel Find Services

All TAP services (123)

- TAPVizier (58170) - ivo://cds.vizier/tap
- VSA TAP (2900) - ivo://wfau.roe.ac.uk/vsa-tap
- WSA TAP (2162) - ivo://wfau.roe.ac.uk/wsa-tap
- HEASARC (1023) - ivo://nasa.heasarc/services/xamin
- IRSA TAP (944) - ivo://irsa.ipac/tap
- WFAU OSA TAP (799) - ivo://wfau.roe.ac.uk/osa-tap
- SSA (652) - ivo://wfau.roe.ac.uk/ssa-tap
- GAVO DC TAP (254) - ivo://irg.gavo.dc/tap
- GAIA (246) - ivo://esavo/gaia/tap**
- PDS-PPI TAP (209) - ivo://pds-ppi/tap
- ARI-Gaia (203) - ivo://uni-heidelberg.de/gaia/tap
- Gaia@AIP TAP Service (203) - ivo://gaia.aip.de/tap
- ESASky (120) - ivo://esavo/esasky/tap
- ESASky Legacy (119) - ivo://esavo/esaskylegacy/tap
- ESO TAP_CAT (106) - ivo://eso.org/tap_cat
- SkyMapper TAP (95) - ivo://nci.org.au/skymapper/tap
- APPLAUSE (Archives of Photographic Plates for Astronomical USE) TAP Service (83) - ivo://www.plate-archiv
- YouCat (71) - ivo://cadc.nrc.ca/youcat
- PS1DR2 TAP (69) - ivo://archive.stsci.edu/ps1dr2tap

Selected TAP Service

TAP URL:

Use Service

Run Query

Table Access Protocol (TAP) Query

Window TAP Registry Edit Interop Help

Select Service Use Service Resume Job Running Jobs

Metadata

Find:

Name Descrip Or

Service	Schema	Table
gaia3		gaia_source

Name: gaia3
Tables: 91
Description: Gaia Data Release 3

Service Capabilities

Query Language: ADQL-2.0 Max Rows: 3000000 (default) Uploads: 100Mb

ADQL Text

Mode: Synchronous

1

Examples

Run Query

Provides simple queries that can be adapted

Here goes query

Spectroscopy group will use this catalogue

ADQL queries



Table Access Protocol (TAP) Query

Window TAP Registry Edit Interop Help

Select Service Use Service Resume Job Running Jobs

Metadata

Find:

Columns FKeys Hints

Service Schema Table

Name Descrip

gaiaadr3.commanded_scan_law
gaiaadr3.dr2_neighbourhood
gaiaadr3.frame_rotator_source
gaiaadr3.gaia_crf3_xm
gaiaadr3.gaia_source
gaiaadr3.gaia_source_lite
gaiaadr3.gaia_source_simulation
gaiaadr3.gaia_universe_model
gaiaadr3.galaxy_candidates
gaiaadr3.galaxy_catalogue_name
gaiaadr3.gold_sample_carbon_stars
gaiaadr3.gold_sample_fgkm_stars
gaiaadr3.gold_sample_obv_stars
gaiaadr3.gold_sample_obv_catalogue

Name: gaiaadr3
Tables: 91
Description: Gaia Data Release 3

Service Capabilities

Query Language: ADQL-2.0 Max Rows: 3000000 (default) Uploads: 100Mb

ADQL Text

Mode: Synchronous

Run Query

Select this to see names of columns

Set to Asynchronous if query times out

ADQL queries

- ADQL = Astronomical Data Query Language
- Useful tutorial <http://docs.g-vo.org/adql-gaia/html/>
- A dialect of SQL

Column names

Very basic summary of a query:

```
SELECT [TOP1 (number of rows)] [source table index].(variables you need)
FROM (table you're querying) [AS (table index)]
[WHERE (condition 1) AND (condition 2) OR (condition 3)]
[ORDER BY (variable)]
```

1

Instead of **TOP** a ***** can be used to select everything that fulfills criteria or until maximum number of entries is reached

ADQL queries – SELECT: ORDER BY



- Useful to select brightest, fastest, etc. from a table
- E.g.: 50 brightest stars in Gaia DR2

- E.g.: 20 highest proper motion stars in Tycho

ADQL queries – SELECT: ORDER BY

- Useful to select brightest, fastest, etc. from a table
- E.g.: 50 brightest stars in Gaia DR2

```
SELECT TOP 50 source_id, phot_g_mean_mag, parallax, bp_rp  
FROM gaiadr3.gaia_source  
ORDER BY phot_g_mean_mag
```

- E.g.: 20 highest proper motion stars in Tycho

```
SELECT TOP 20 source_id, parallax, phot_g_mean_mag,  
              SQRT(POW(pmra,2)+POW(pmdec,2)) AS pm  
FROM gaiadr1.tgas_source  
ORDER BY pm DESC
```

ADQL queries – SELECT: WHERE clause



- **WHERE** introduces a logical expression, in a similar way to other languages, with operators **AND** and **OR**.
- E.g.: stars brighter than 12, closer than 50 pc.

ADQL queries – SELECT: WHERE clause

- **WHERE** introduces a logical expression, in a similar way to other languages, with operators **AND** and **OR**.
- E.g.: stars brighter than 12, closer than 50 pc.

```
SELECT source_id, phot_g_mean_mag, parallax, bp_rp  
FROM gaiadr3.gaia_source  
WHERE phot_g_mean_mag < 12.0 AND parallax > 20.0
```

ADQL queries – SELECT: JOIN USING



- For joining two tables with a same column
- E.g.: get Gaia DR2 proper motions for stars with known source_id

ADQL queries - SELECT: JOIN USING

- For joining two tables with a same column
- E.g.: get Gaia DR2 proper motions for stars with known source_id

```
SELECT source_id, a.phot_g_mean_mag, a.parallax,  
       a.bp_rp, b.pmra, b.pmdec  
FROM TAP_UPLOAD.t6 AS a  
JOIN gaiadr3.gaia_source AS b USING(source_id)
```

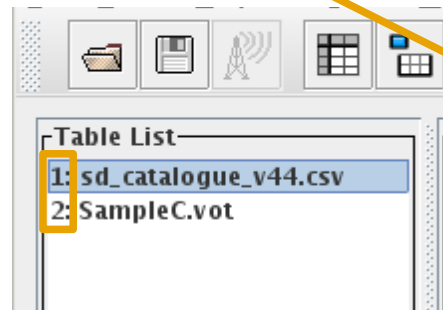


Table List	
1:	sd_catalogue_v44.csv
2:	SampleC.vot

You can find this number in your table list

ADQL queries – Exercise: variable sources in Gaia

Select variable sources in Gaia and crossmatch the result with the catalogue of known hot subluminous stars.

- Variability index:
$$V_G = \frac{\sigma_G}{\langle G \rangle} \times \sqrt{n_{\text{obs},G}}$$
- `phot_g_mean_flux_error/phot_g_mean_flux*sqrt(phot_g_n_obs)`

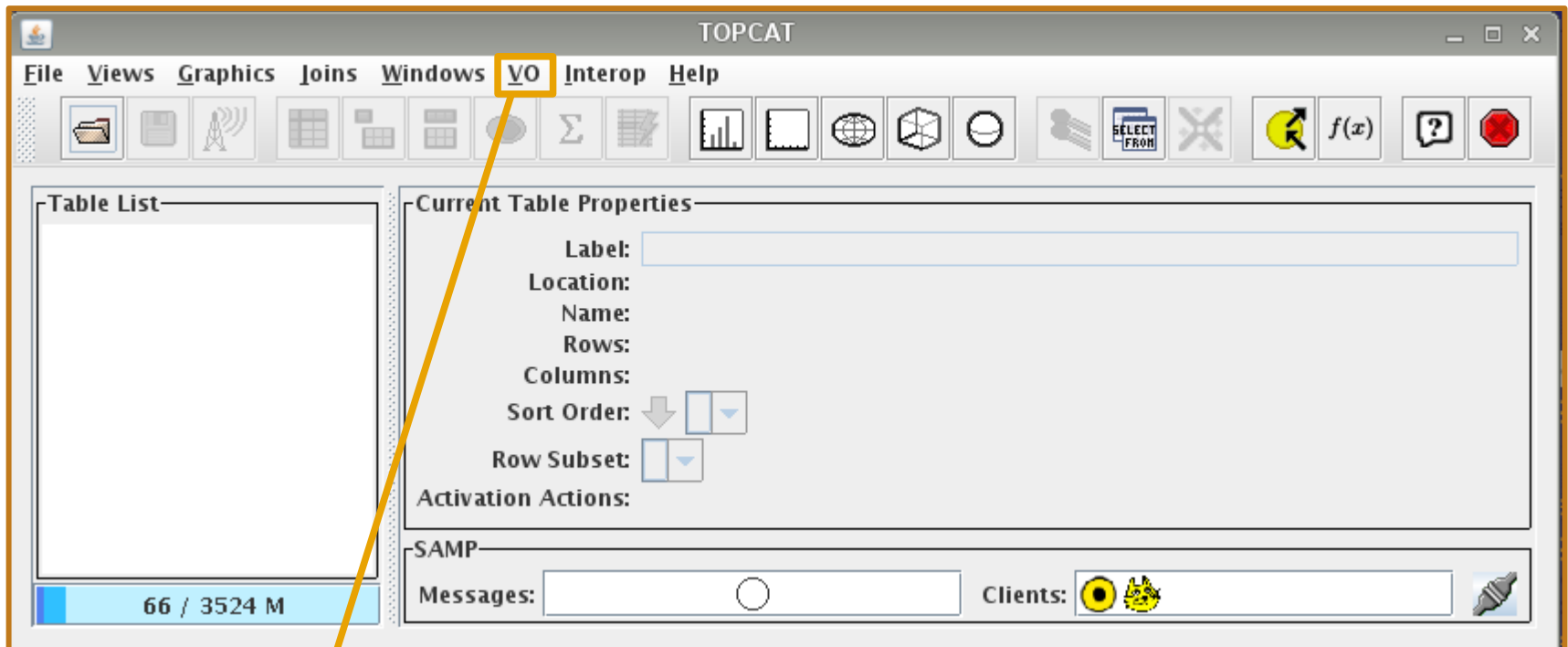
1. Select all stars that fulfill the following conditions:

```
Parallax >= 0.1  
parallax_error/parallax<=0.3  
phot_g_mean_mag<16  
bp_rp<0  
Varindex>0.1
```

Should result in 109 objects

ADQL queries - Exercise: variable sources in Gaia

2. Download the catalogue of hot subluminoous stars and crossmatch this with the table from the query



Select VizieR catalogue service

ADQL queries - Excercise: variable sources in Gaia

This will give you two catalogues:
_knownhsd and _hotsd. Use
_knownhsd for the crossmatch

VizieR Catalogue Service

Window Help

VizieR Server
Server:

Row Selection

Cone Selection

Object Name: Resolve

RA: degrees (J2000)

Dec: degrees (J2000)

Radius: degrees

All Rows

Maximum Row Count:

Column Selection

Output Columns:

Catalogue Selection

By Category | By Keyword | Surveys | Missions

Keywords:

Sub-Table Details Include Obsolete Tables

ity	Density	Description
69	0	Catalogues of Blue Horizontal Branch Stars (Culpan+, 2021)
76	0	Hot subdwarf stars studied with Gaia (Culpan+, 2022)
90	0	Blue Horizontal Branch stars catalog (Culpan+, 2024)
65	0	Hot subluminoous stars 500pc volume-limited sample (Dawson+, 2024)

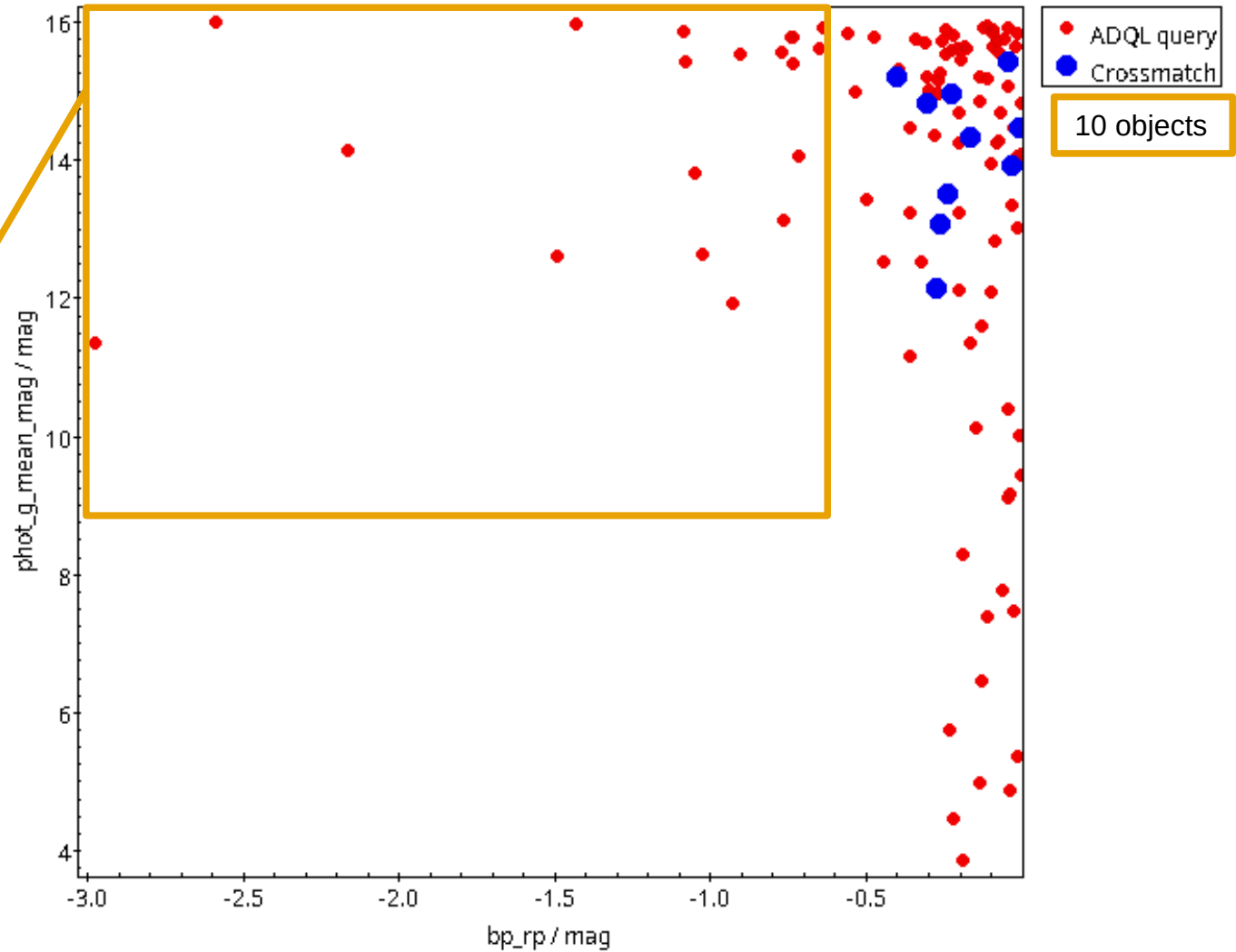
Select these settings



ADQL queries – Exercise: variable sources in Gaia

3. Plot a Colour Magnitude Diagram (CMD) of the stars in the ADQL query table and the targets from the crossmatch. Use the columns `bp_rp` and `phot_g_mean_mag`

ADQL queries – Exercise: variable sources in Gaia





Now create the target lists for your projects

Spectroscopic selection

Selection
criteria

Parallax \geq 0.1
Absolute magnitude \leq 3.7
bp_rp \leq 0.05
phot_g_mean_mag \leq 11
Tangential velocity \geq 100

Quality cuts

phot_bp_rp_excess_factor \geq 1.0+0.015*bp_rp²
visibility_periods_used \geq 8
phot_g_mean_flux_over_error \geq 50
phot_bp_mean_flux_over_error \geq 20
phot_rp_mean_flux_over_error \geq 20
4.74*pm/(parallax+parallax_error) \geq 30
Ruwe \leq 1.4