Data mining with TOPCAT and ADQL

Creating a target list

Harry Dawson
Research workshop on evolved stars
07.09.2021

Overview

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

TOPCAT

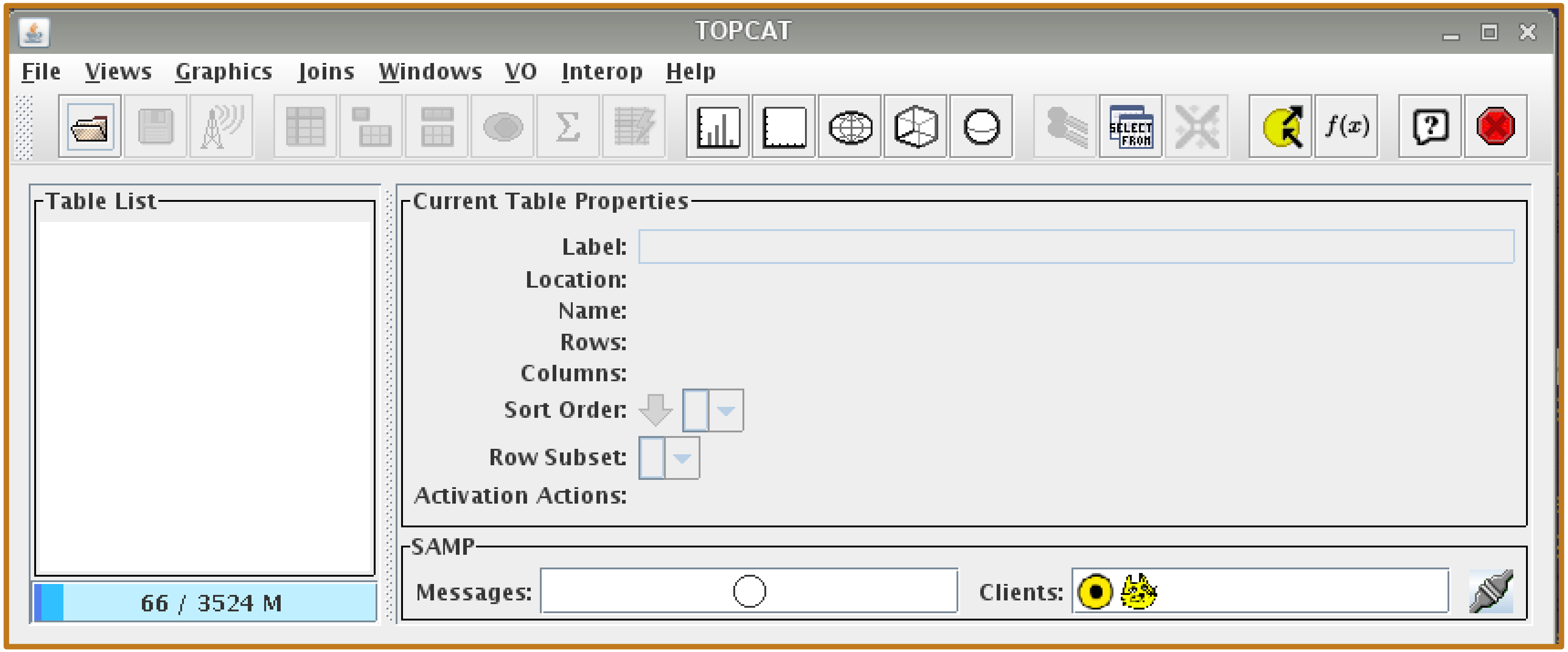
Tool for OPerations on Catalogues And Tables

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

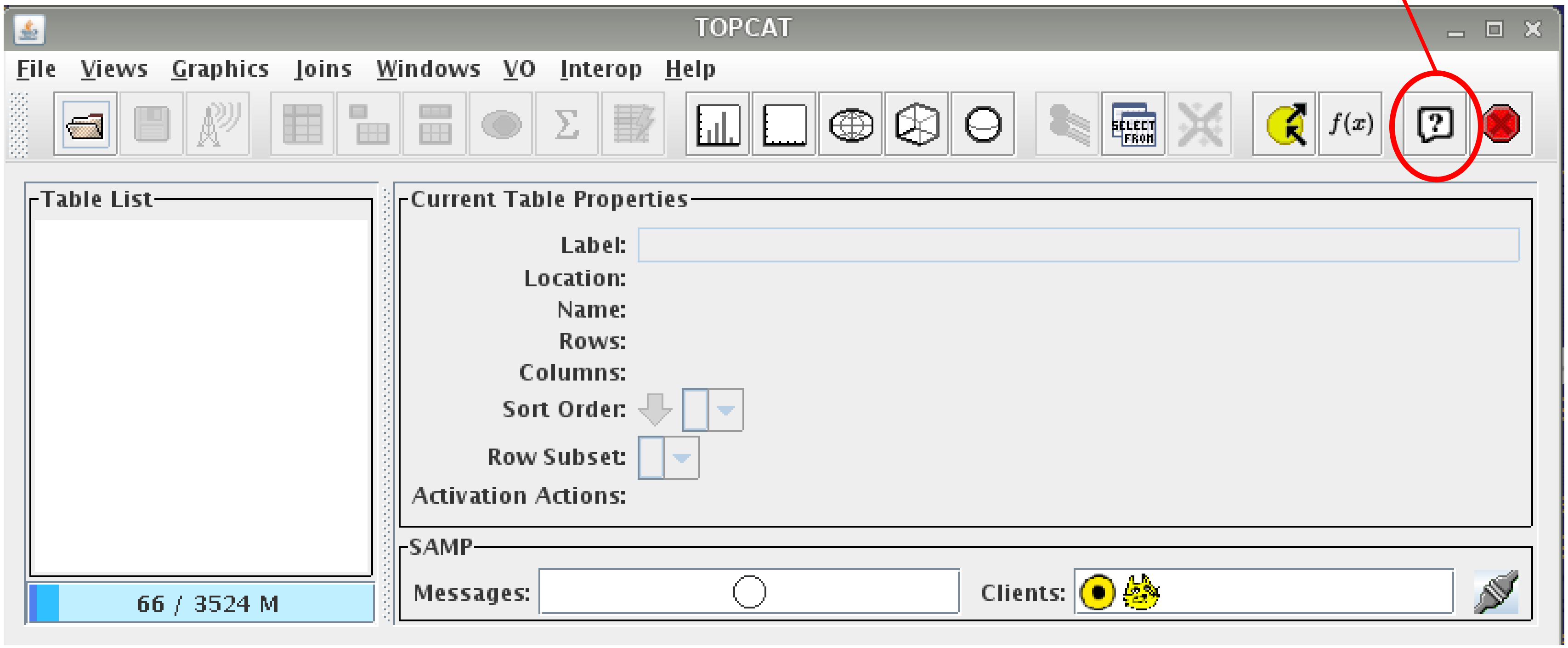
- What can we do with TOPCAT?
    - Read/write tables in multiple formats
    - View/edit data
    - View/edit metadata
    - Plot data
    - Crossmatch — efficient and very flexible
    - (Simple) Calculations
    - Access Virtual Observatory (VO) services

TOPCAT – start window

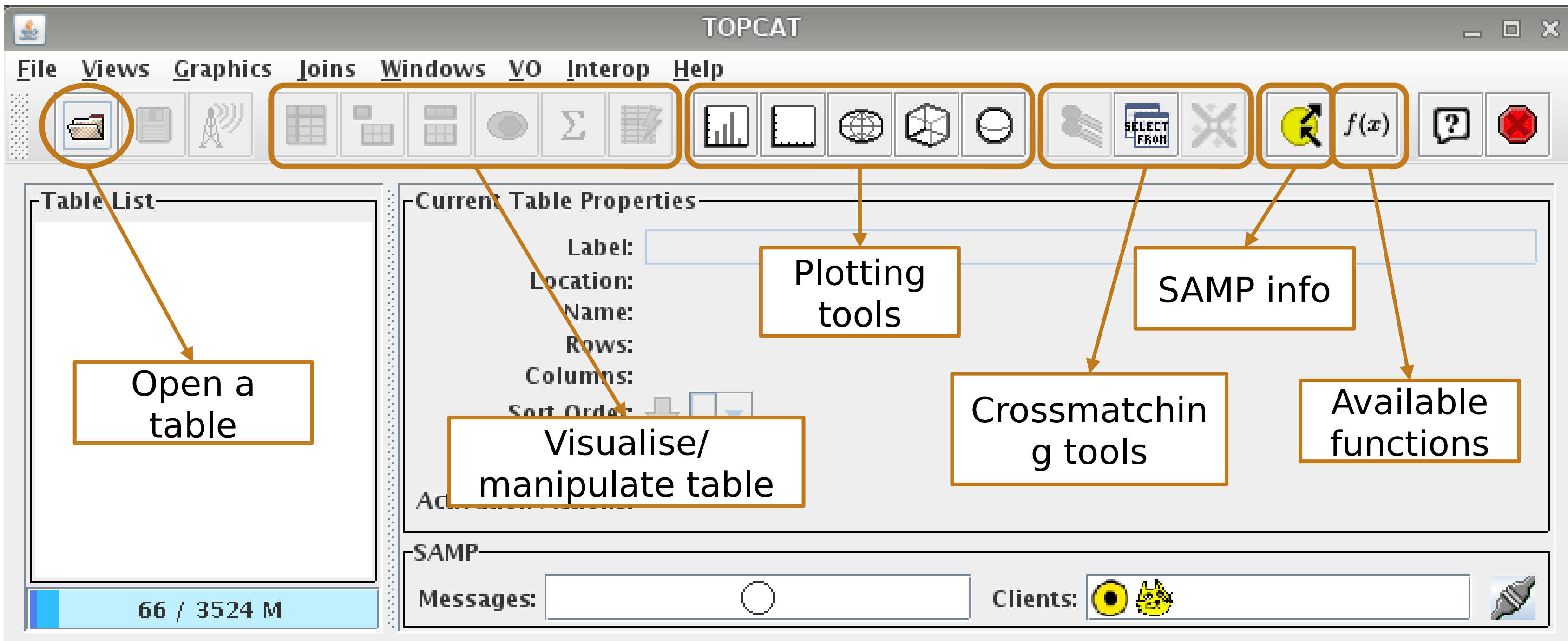


TOPCAT – start window

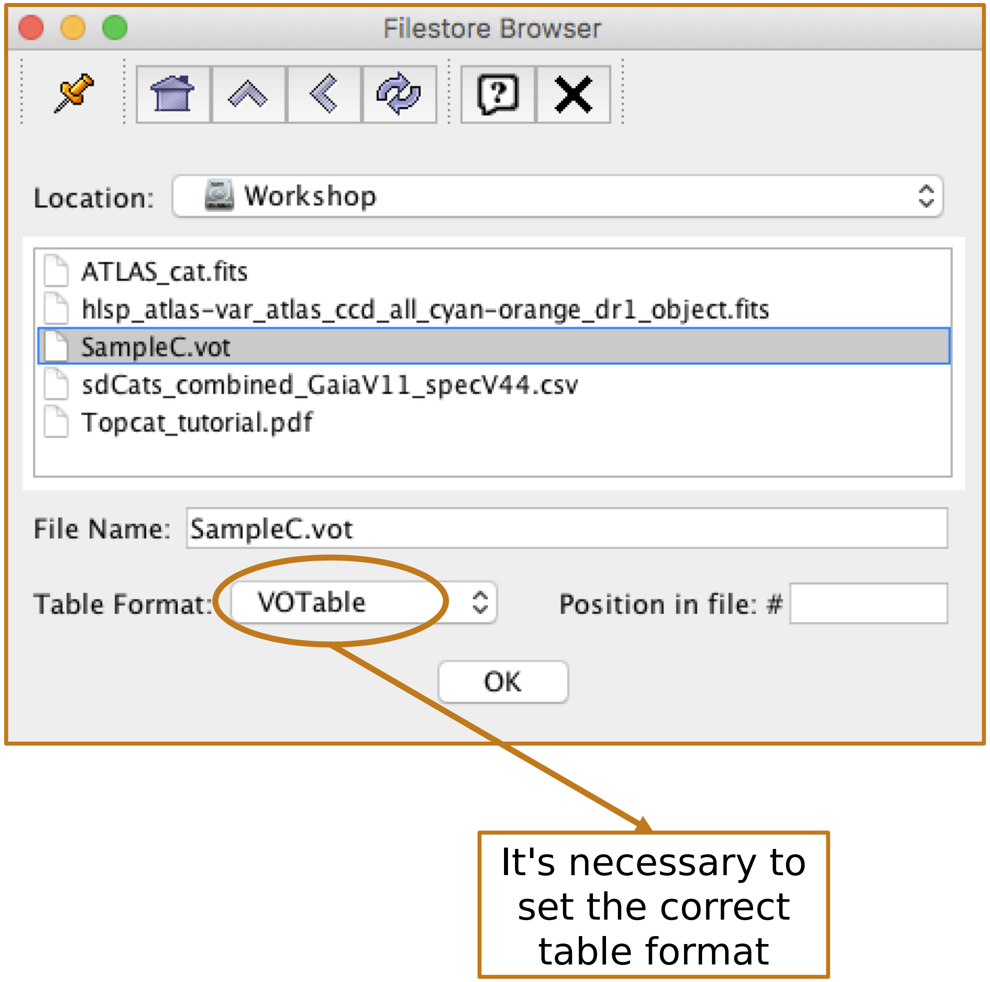
Most important button!



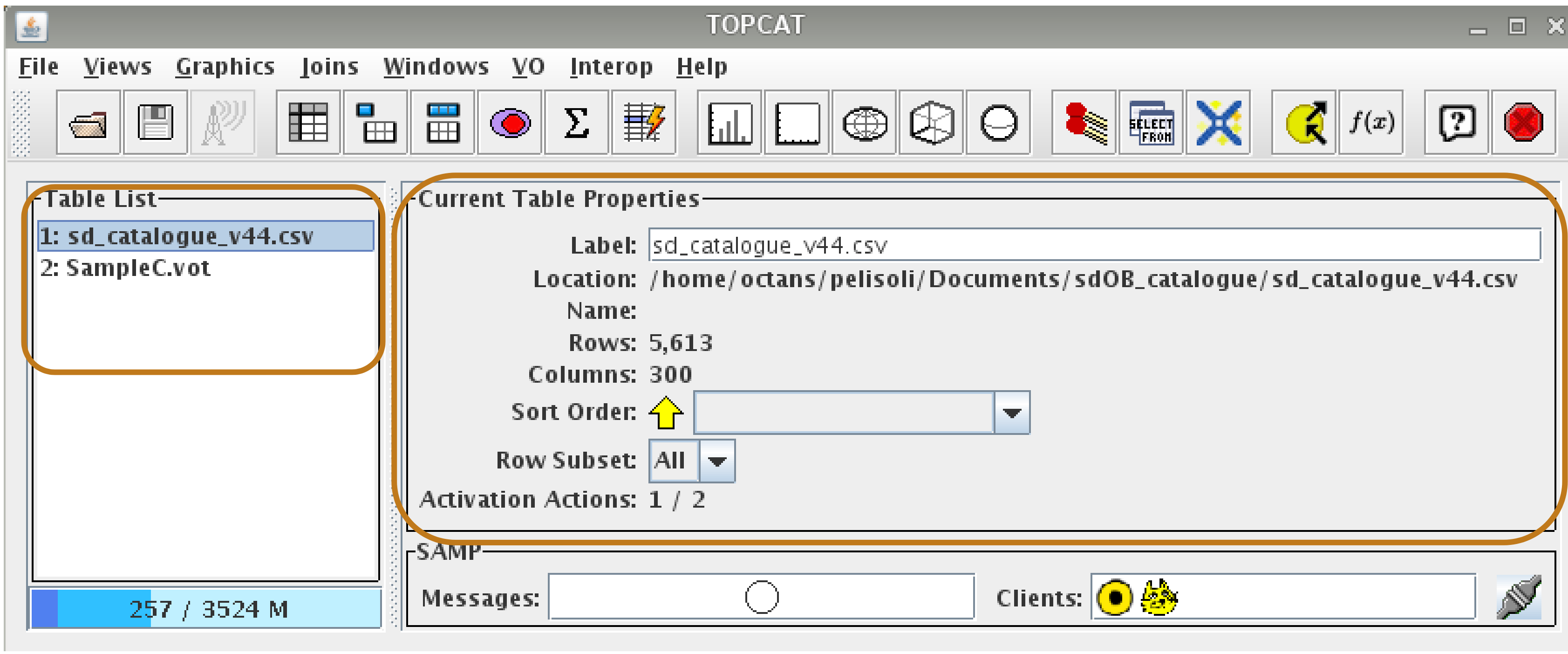
TOPCAT – start window



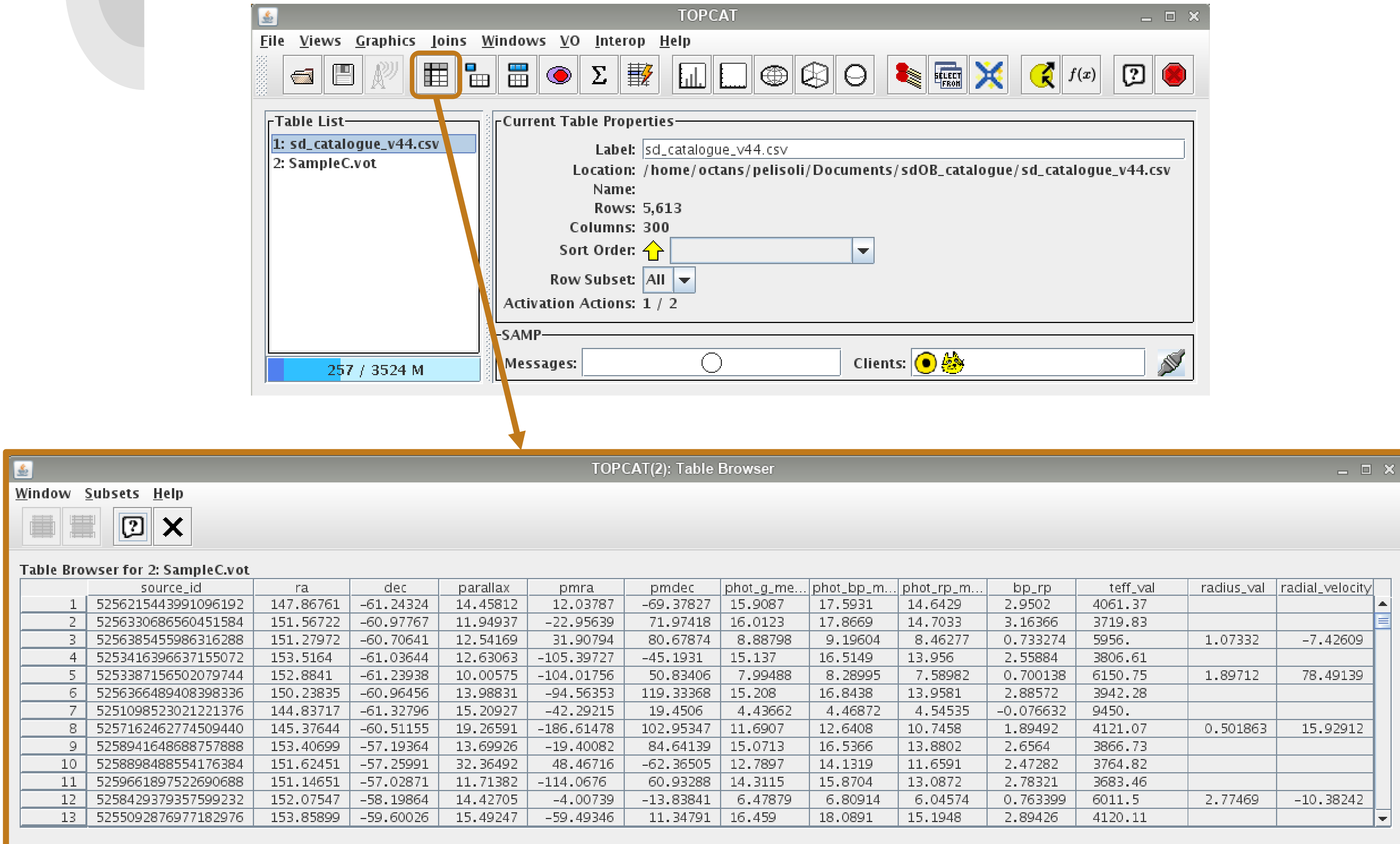
TOPCAT – open a table



TOPCAT – tables

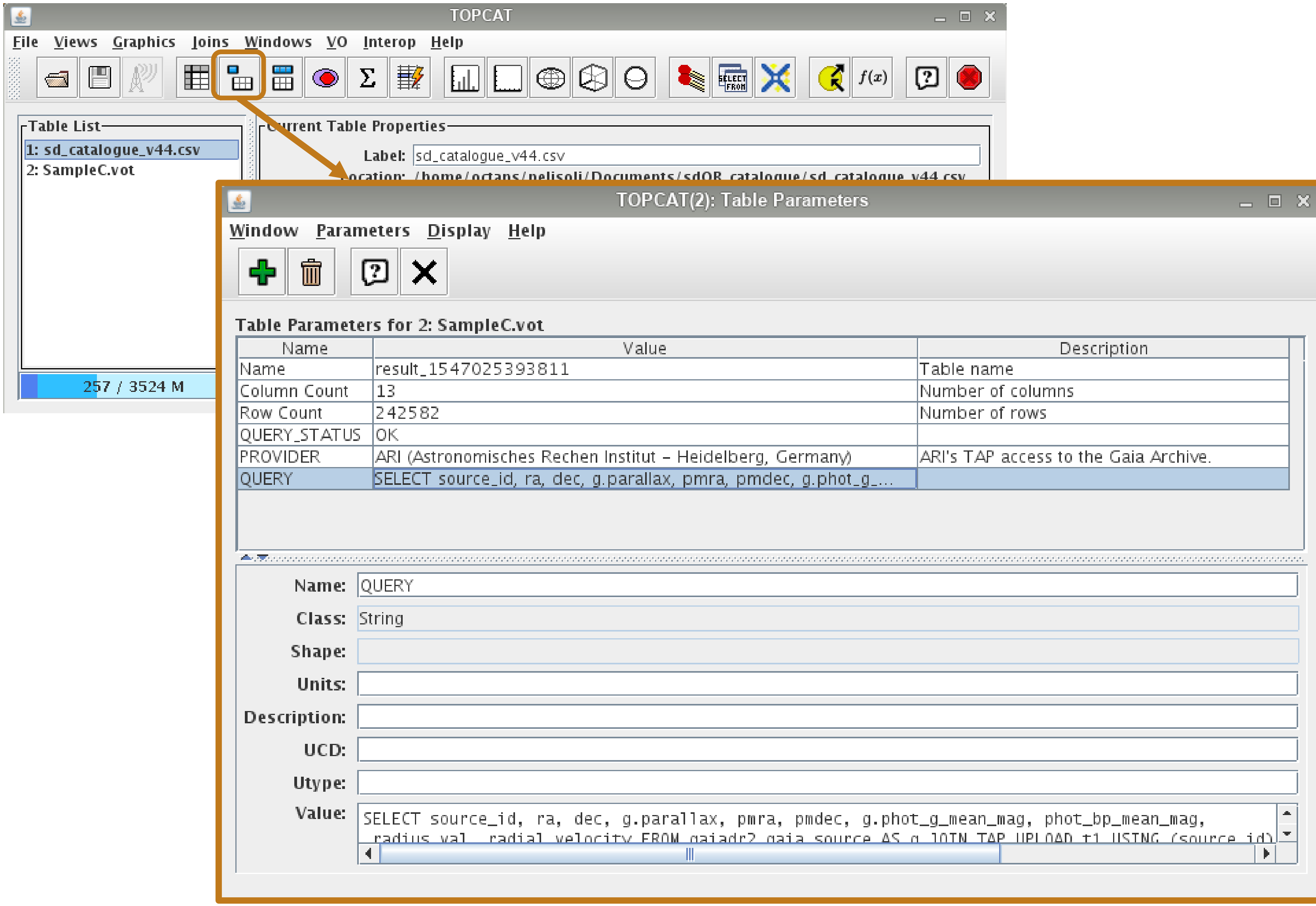


TOPCAT – browse a table

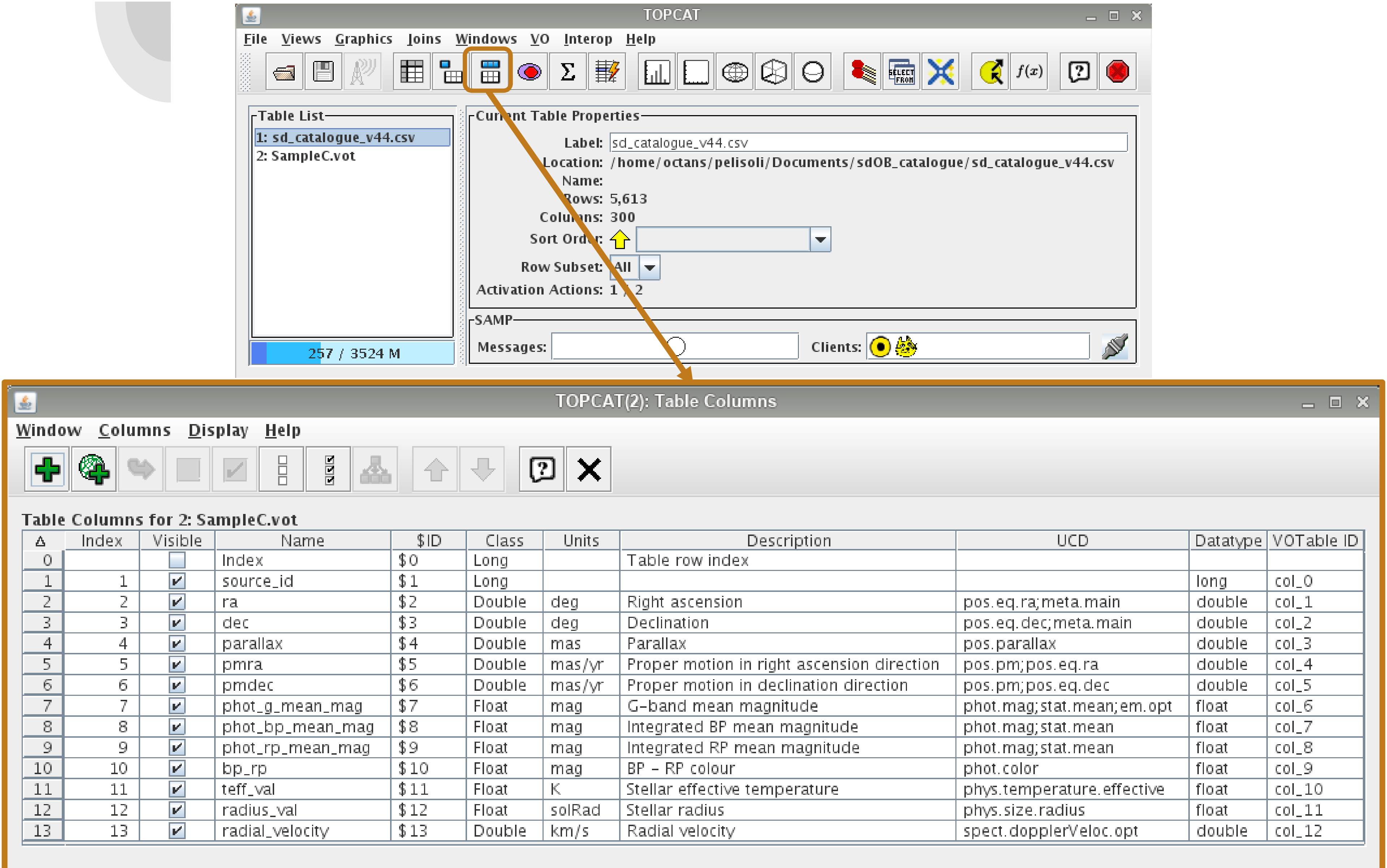


	source_id	ra	dec	parallax	pmra	pmdec	phot_g_me...	phot_bp_m...	phot_rp_m...	bp_rp	teff_val	radius_val	radial_velocity
1	5256215443991096192	147.86761	-61.24324	14.45812	12.03787	-69.37827	15.9087	17.5931	14.6429	2.9502	4061.37		
2	5256330686560451584	151.56722	-60.97767	11.94937	-22.95639	71.97418	16.0123	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

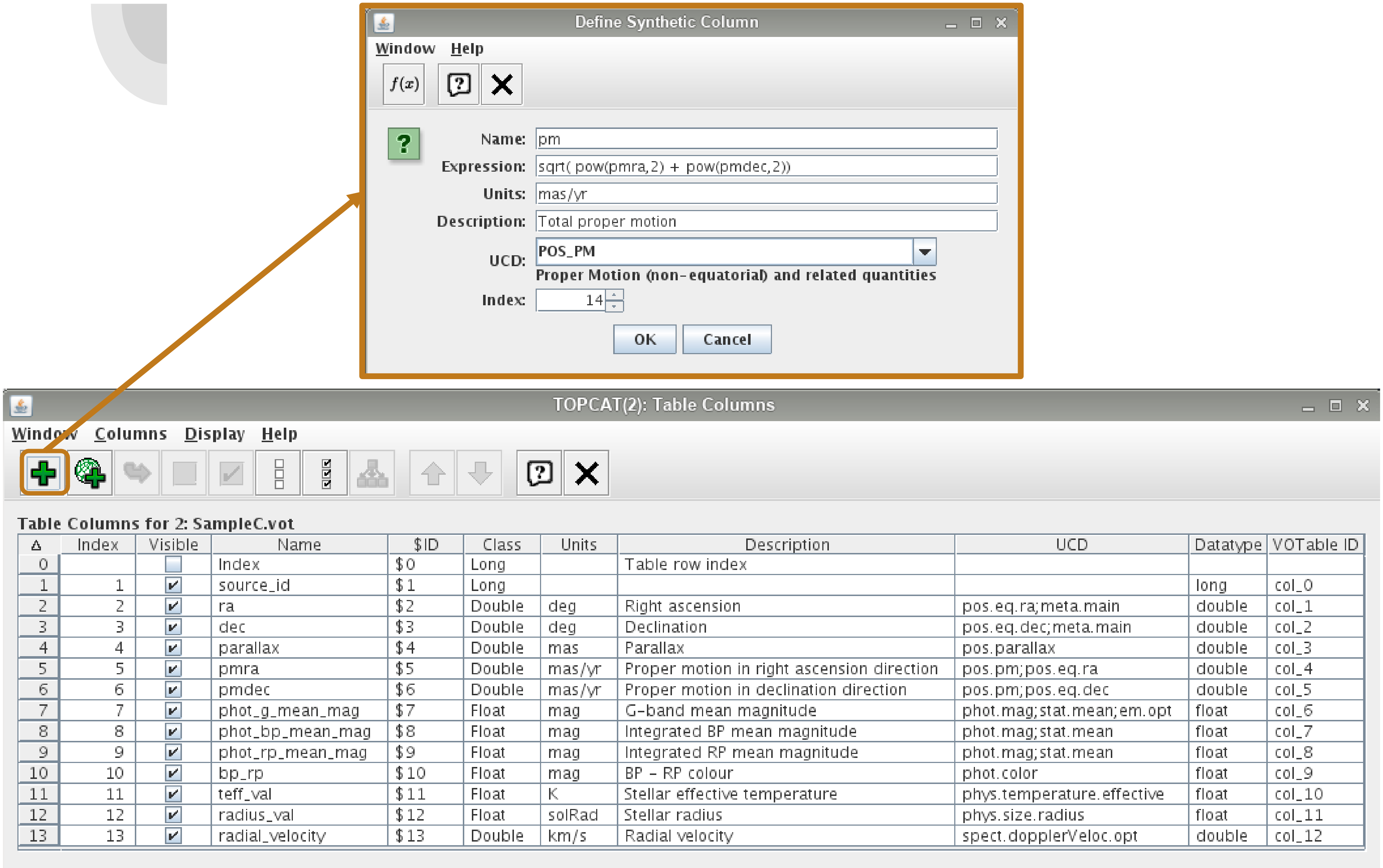


TOPCAT – column metadata



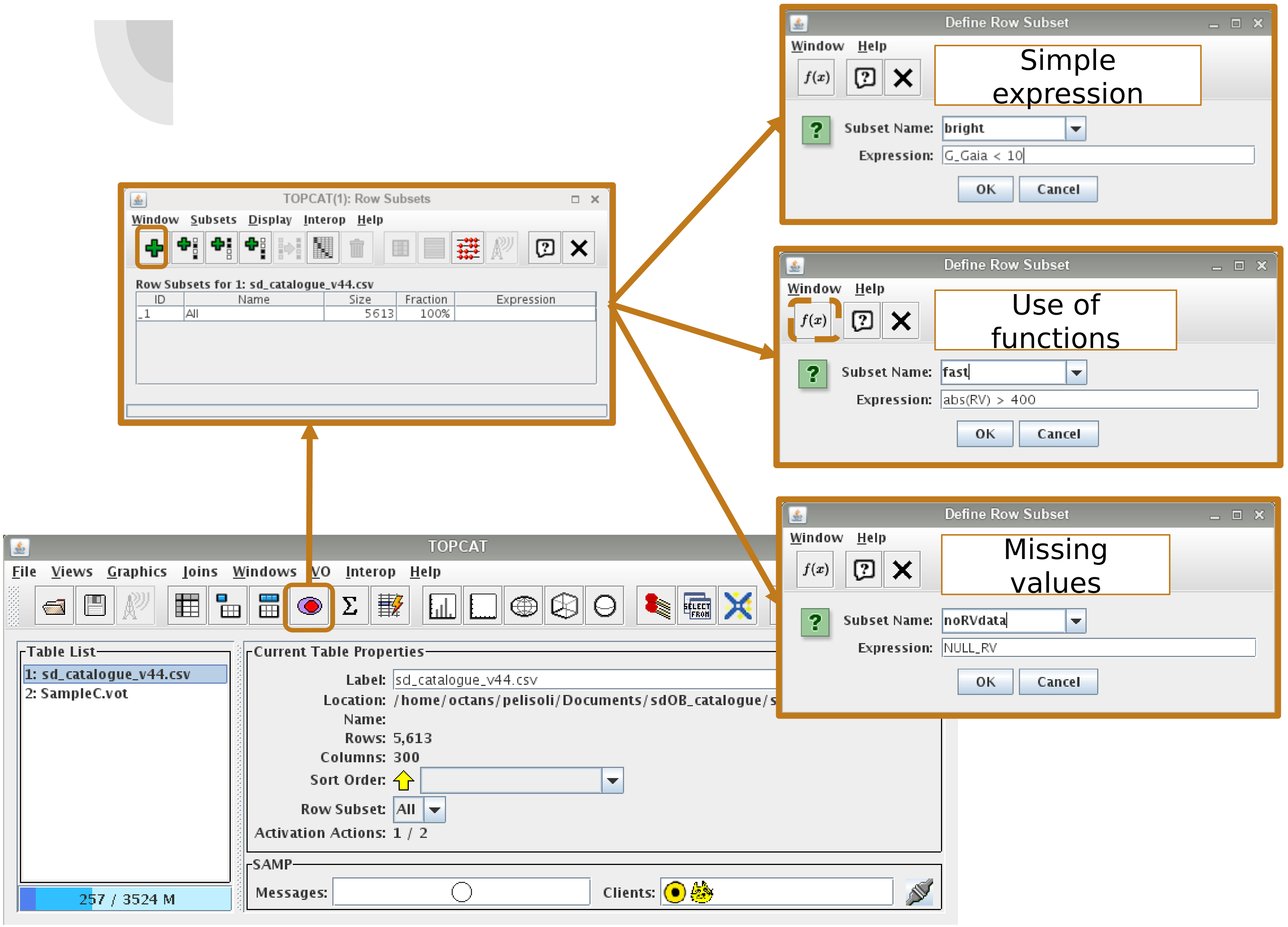
Δ	Index	Visible	Name	$ID	Class	Units	Description	UCD	Datatype	VOTable ID
0		☐	Index	$0	Long		Table row index			
1	1	☑	source_id	$1	Long				long	col_0
2	2	☑	ra	$2	Double	deg	Right ascension	pos.eq.ra;meta.main	double	col_1
3	3	☑	dec	$3	Double	deg	Declination	pos.eq.dec;meta.main	double	col_2
4	4	☑	parallax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

TOPCAT – create new column

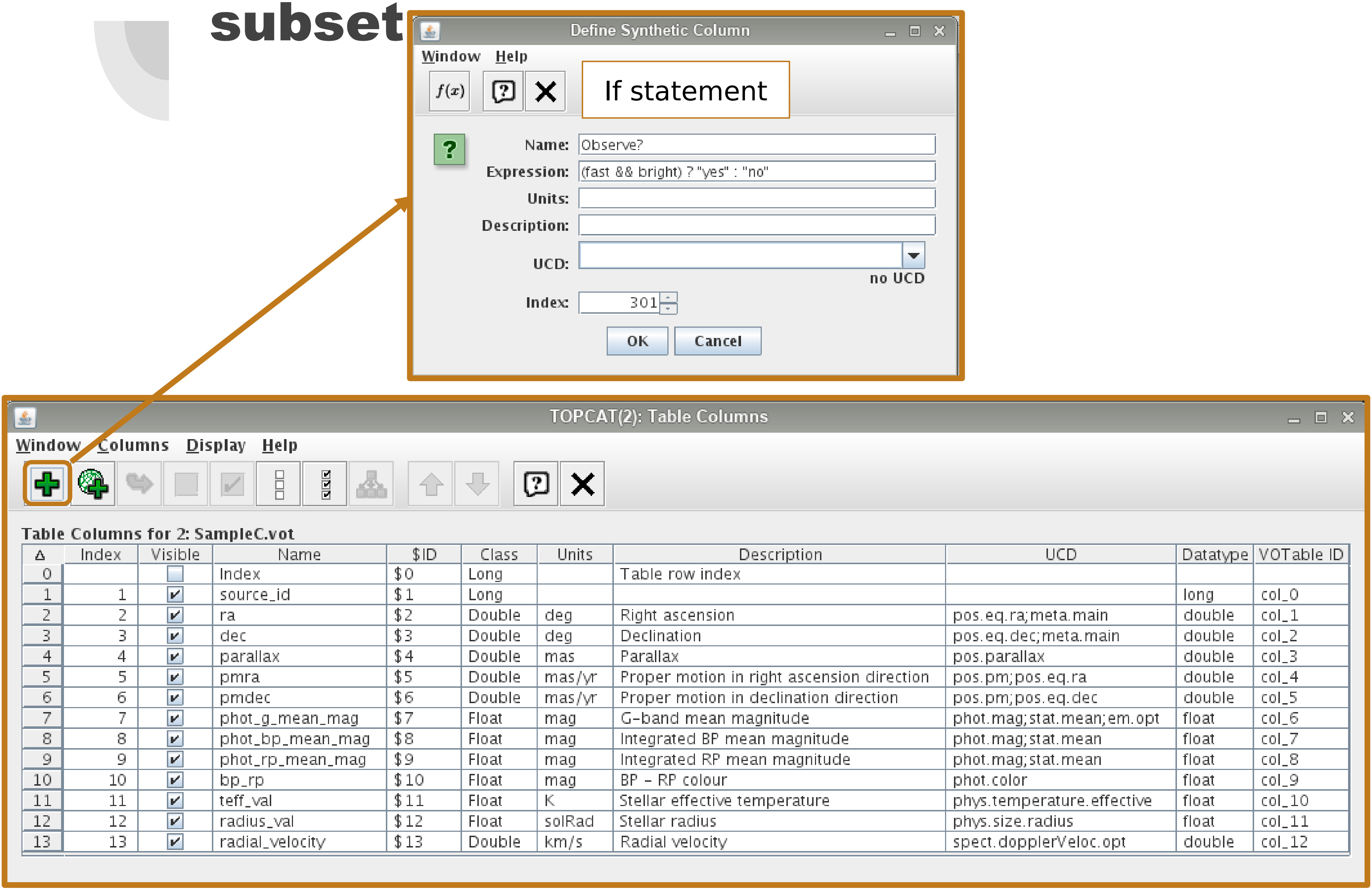


Δ	Index	Visible	Name	$ID	Class	Units	Description	UCD	Datatype	VOTable ID
0		☐	Index	$0	Long		Table row index			
1	1	☑	source_id	$1	Long				long	col_0
2	2	☑	ra	$2	Double	deg	Right ascension	pos.eq.ra;meta.main	double	col_1
3	3	☑	dec	$3	Double	deg	Declination	pos.eq.dec;meta.main	double	col_2
4	4	☑	parallax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

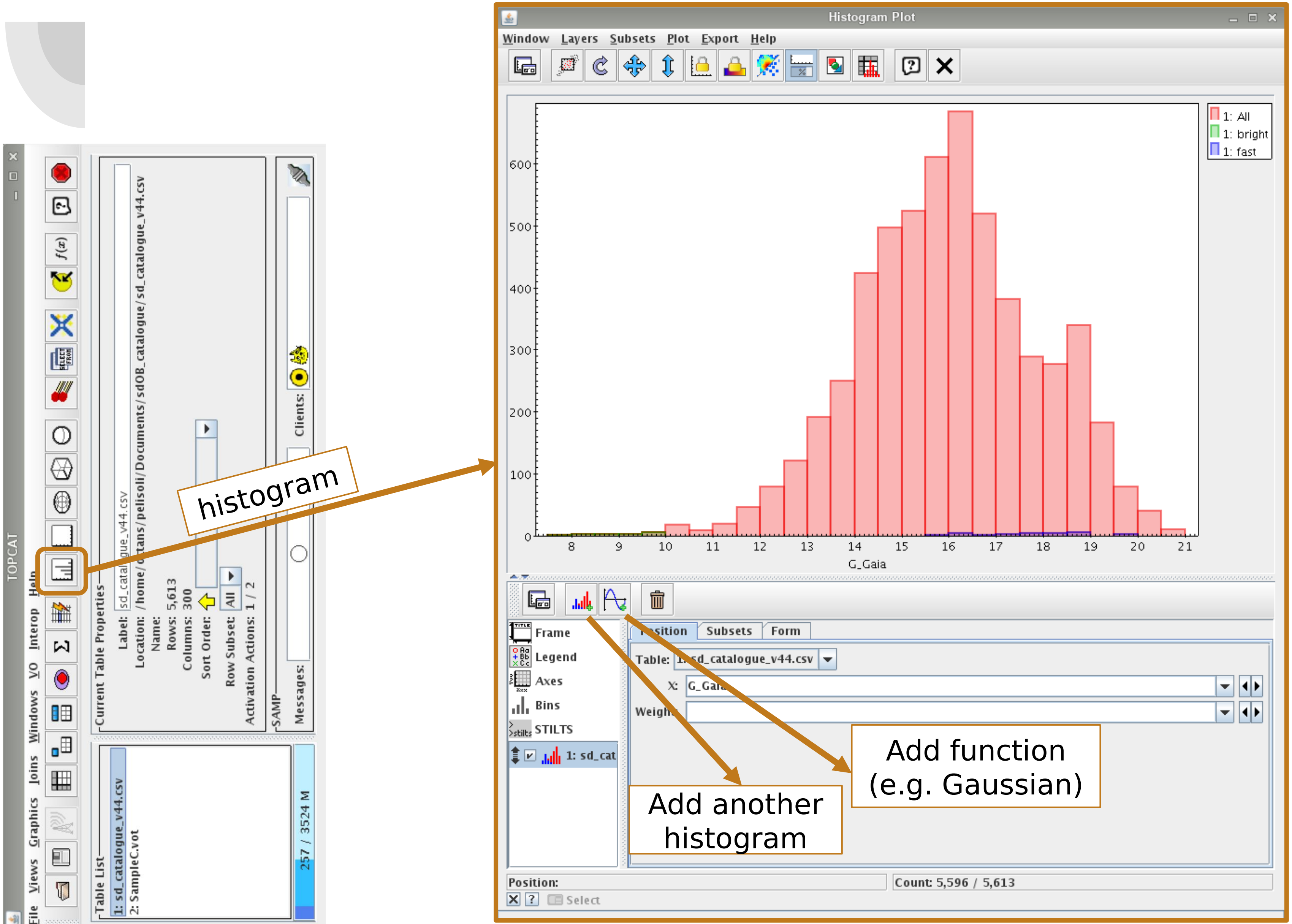
TOPCAT – create subsets



TOPCAT – create column based on subset



TOPCAT – Visualisation tools



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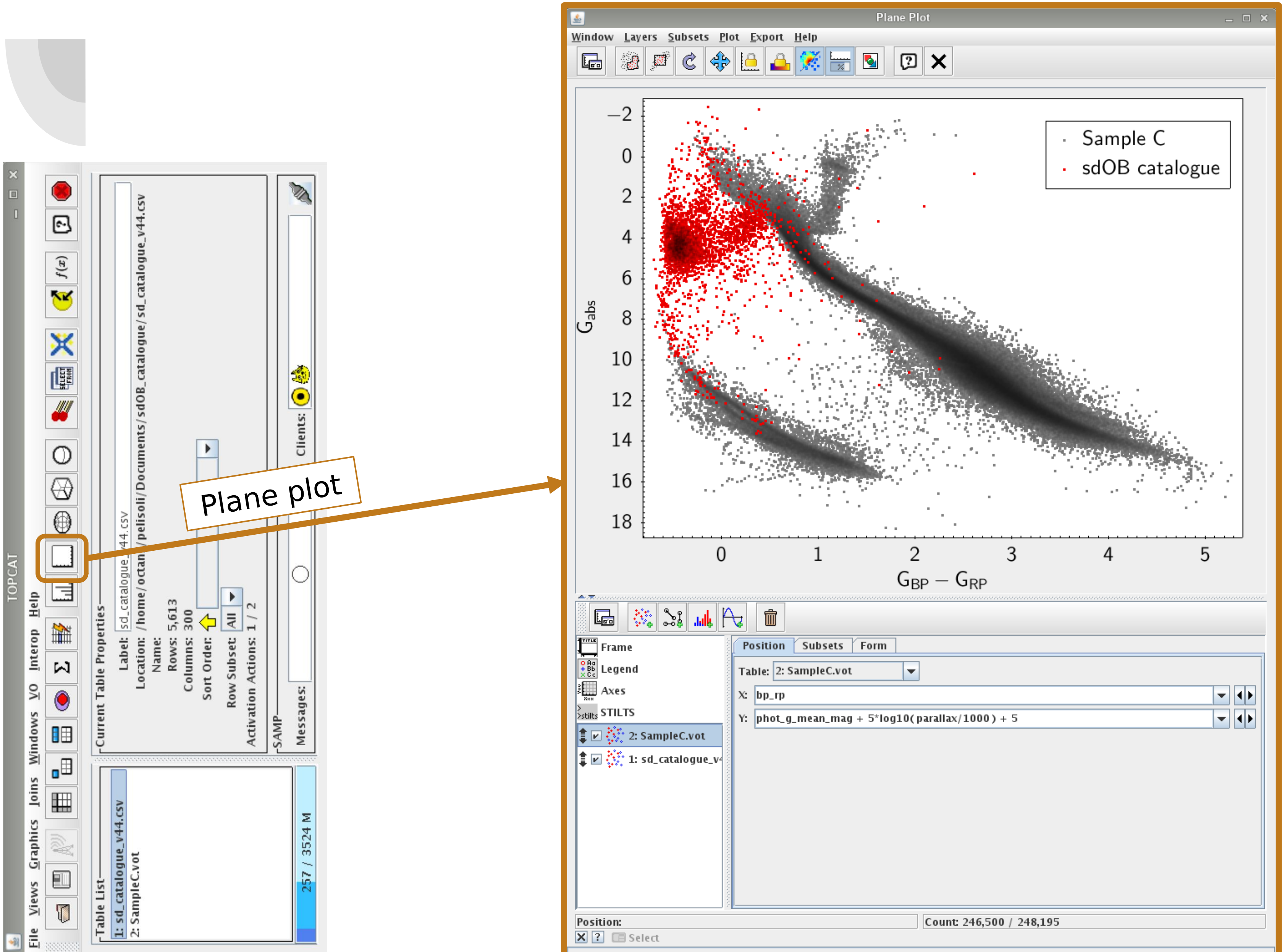

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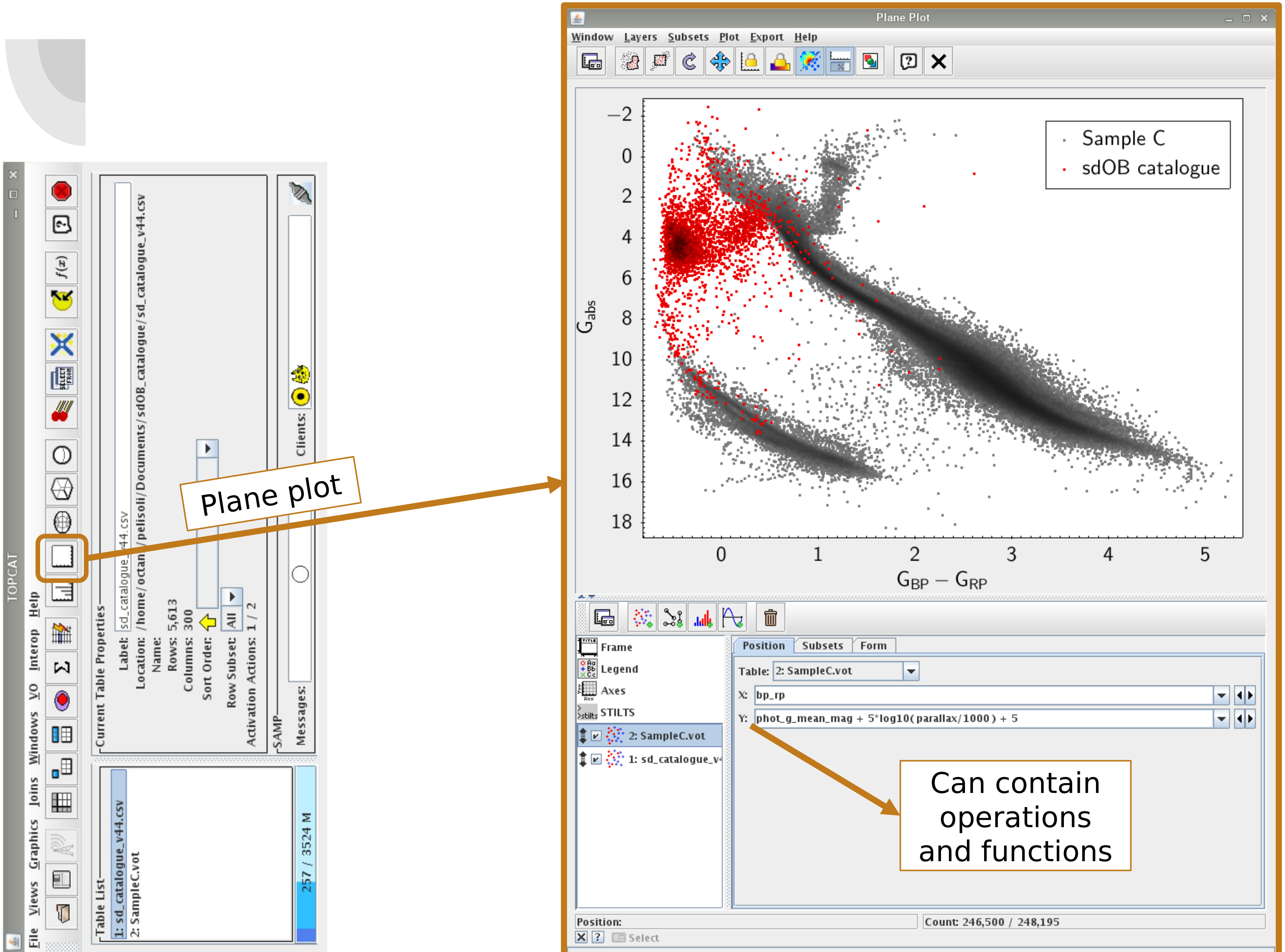

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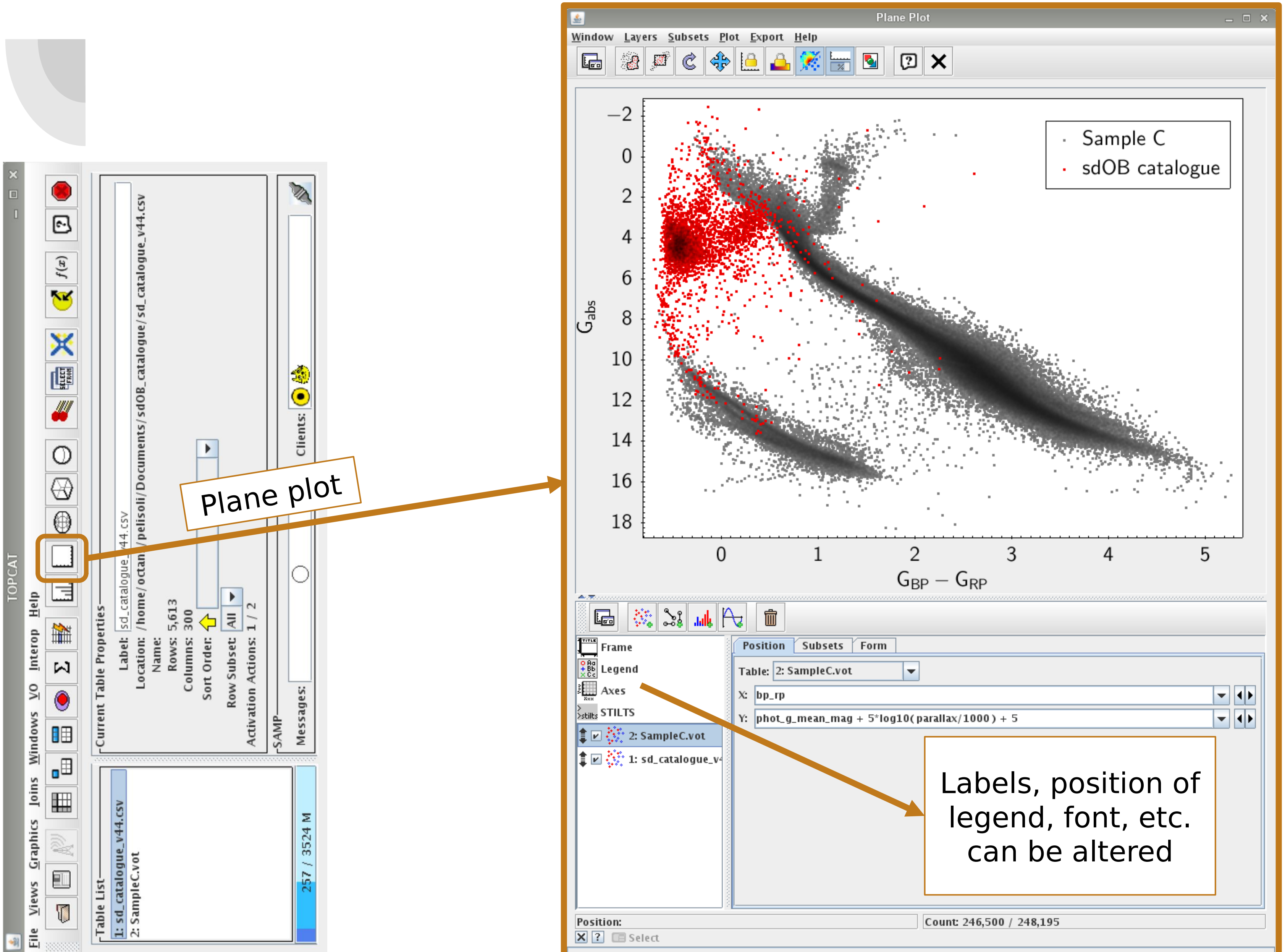
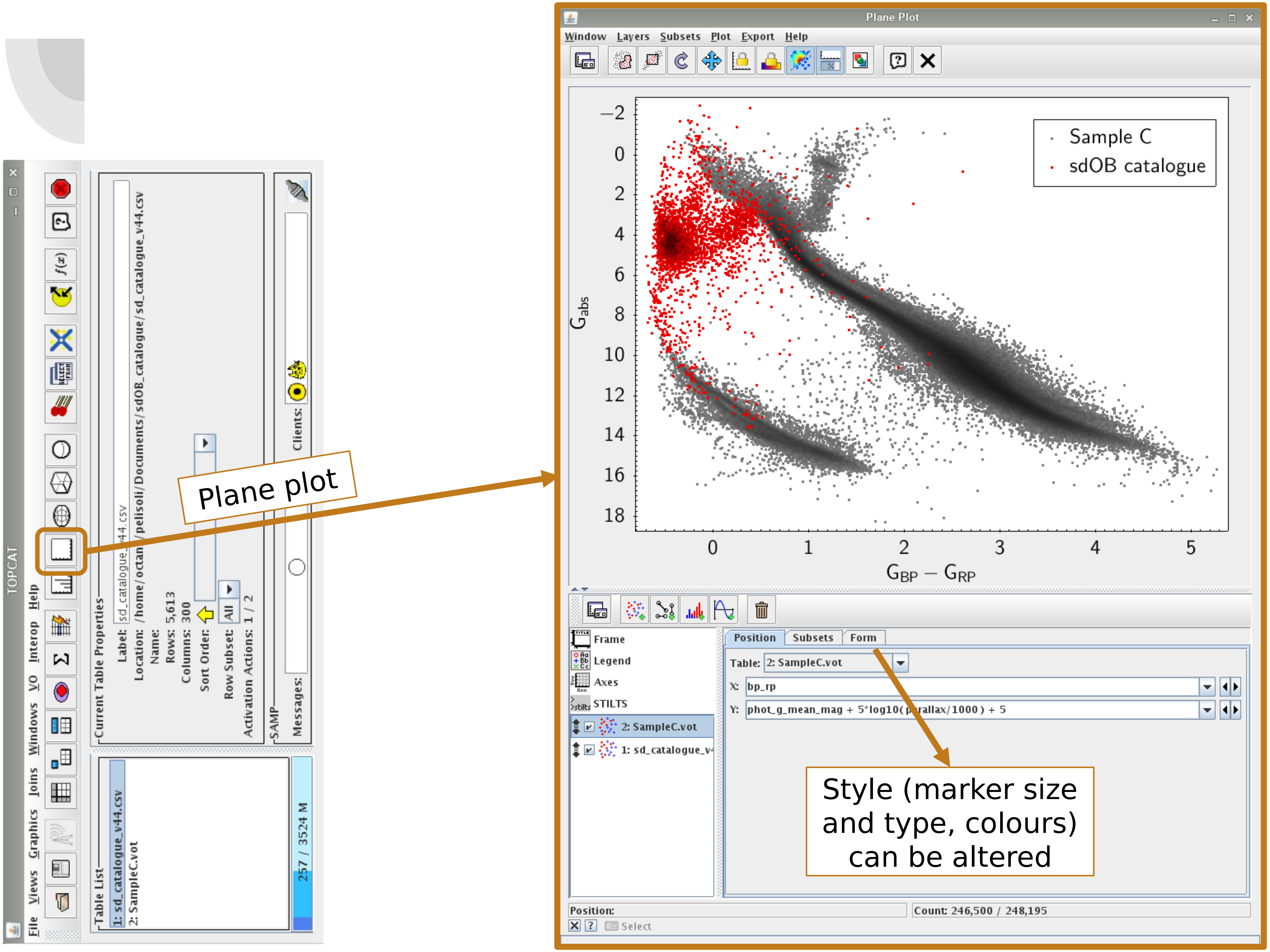
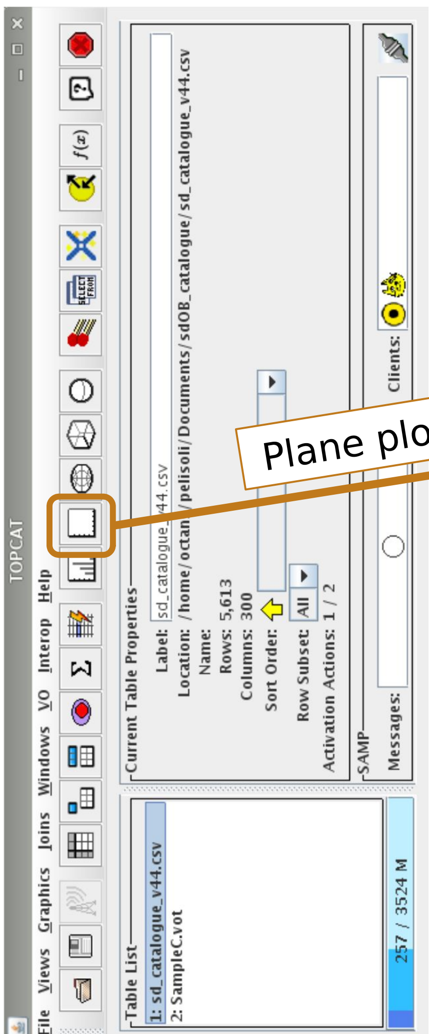


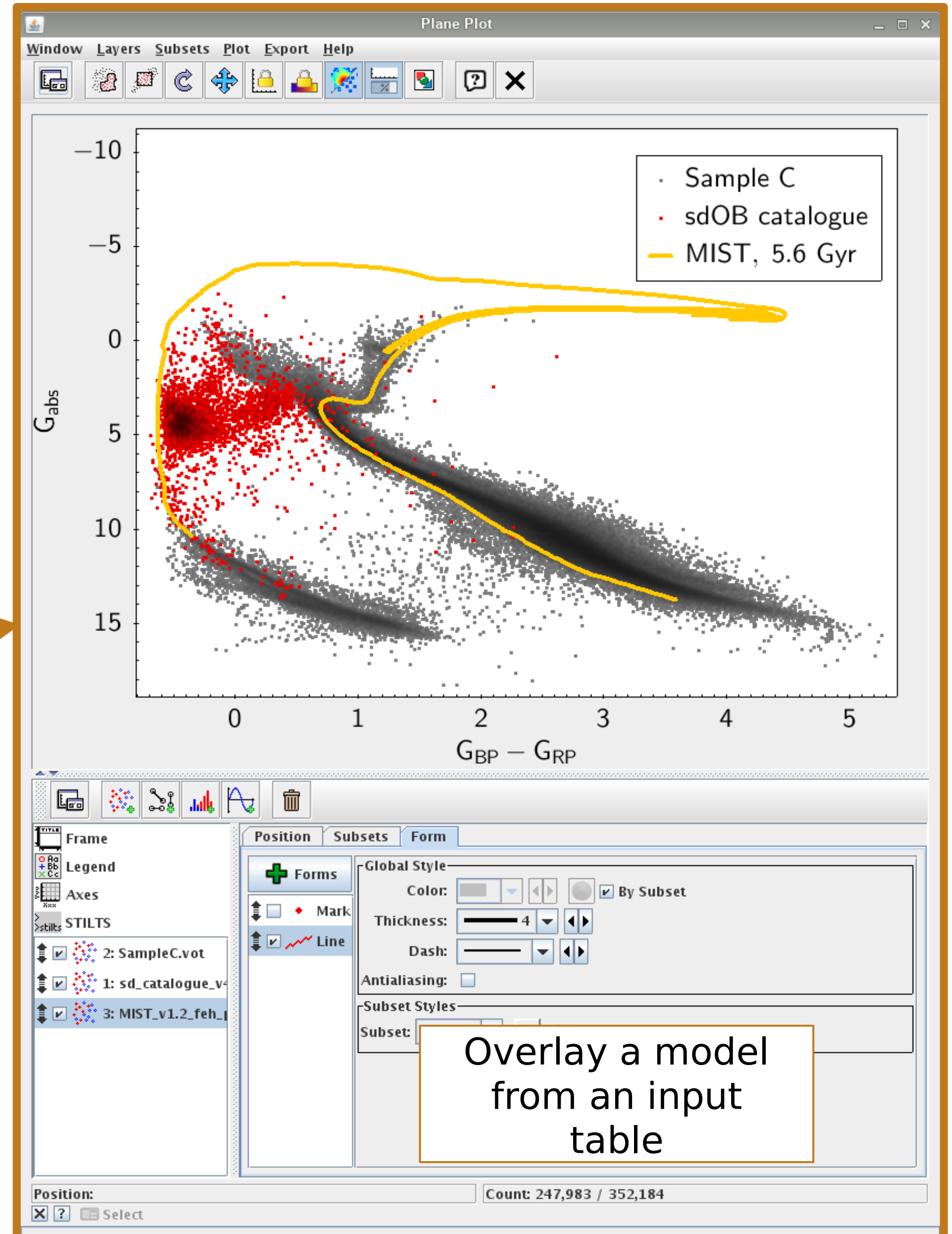
TOPCAT – Visualisation tools



TOPCAT – Visualisation tools

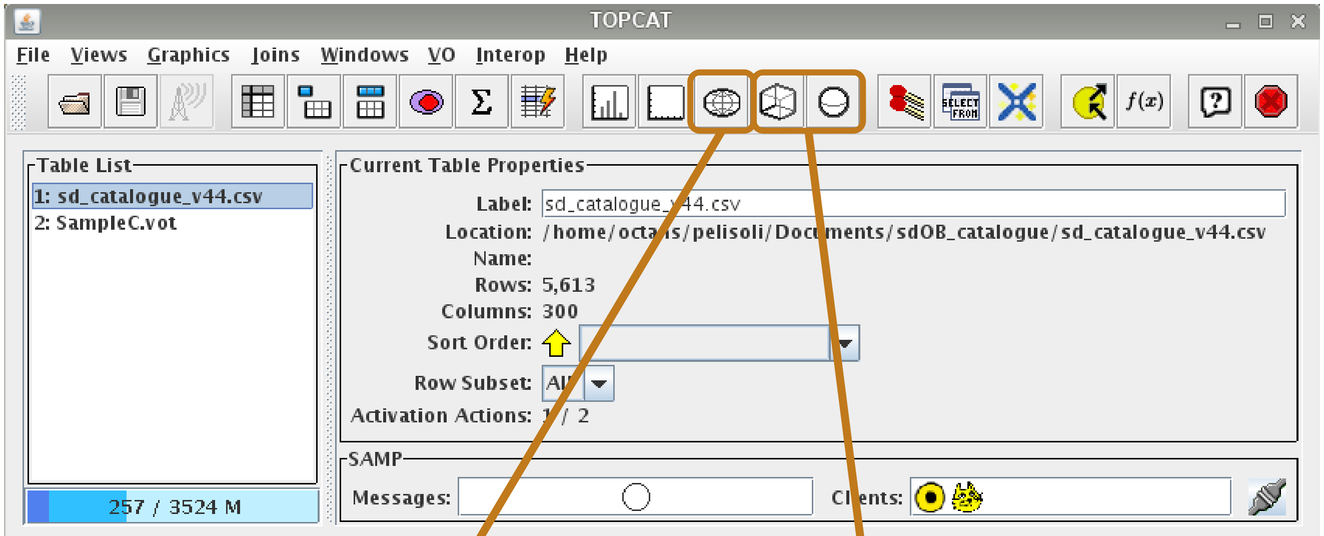


Plane plot



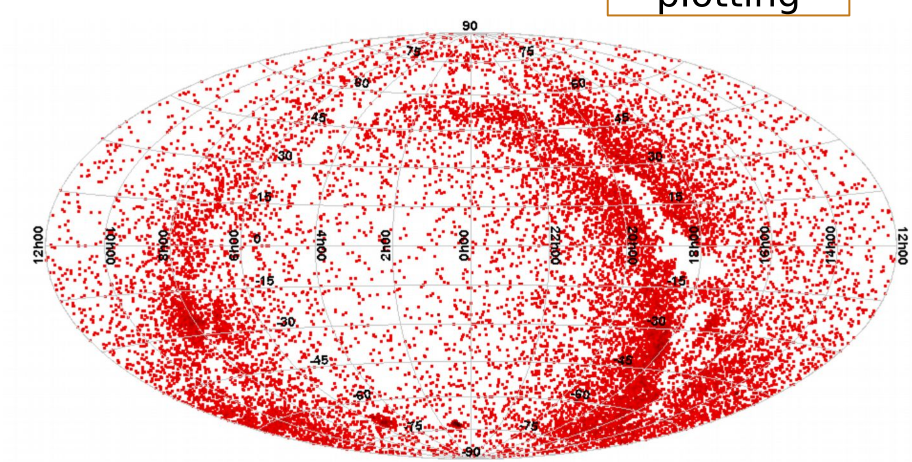
Overlay a model from an input table

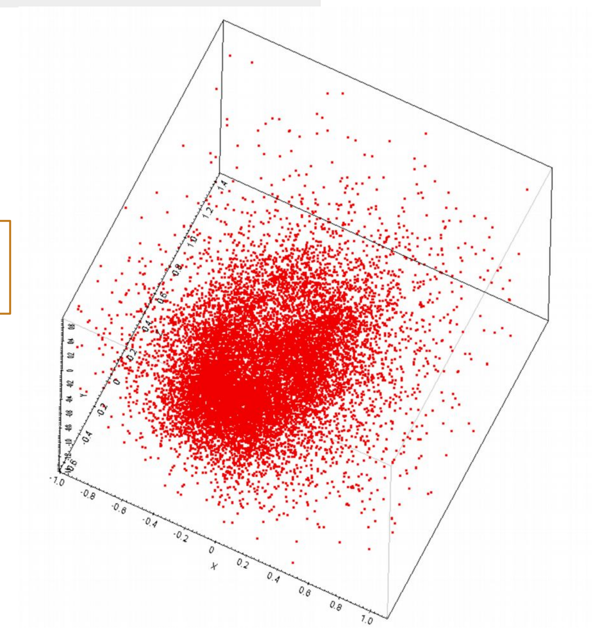
TOPCAT – Visualisation tools



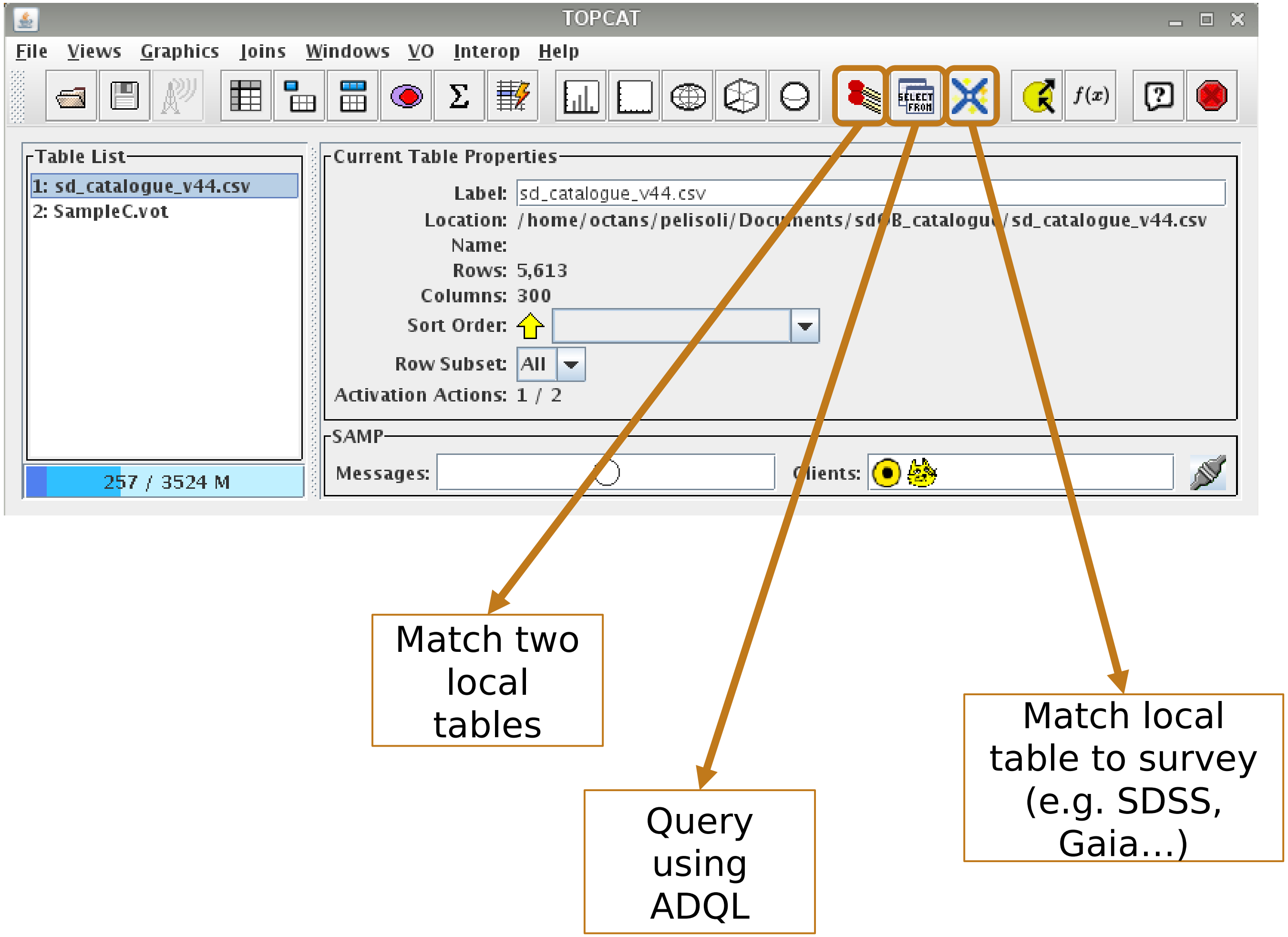
Sky plotting

3D plotting





TOPCAT – Crossmatching



ADQL queries

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

Very basic summary of a query:

```
SELECT [TOP (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)]
```

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

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```
SELECT TOP 50 source_id, phot_g_mean_mag, parallax, bp_rp
FROM gaiadr2.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(POWER(pmra,2)+POWER(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

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```
SELECT source_id, phot_g_mean_mag, parallax, bp_rp
FROM gaiadr2.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`

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```
SELECT source_id, a.phot_g_mean_mag, a.parallax,
       a.bp_rp, b.pmra, b.pmdec
FROM TAP_UPLOAD.t6 AS a
JOIN gaiadr2.gaia_source AS b USING(source_id)
```

Exercise: Pleiades

(Credit: Niall Deacon, Hawaii)

From the tutorial at
http://andromeda.star.bris.ac.uk/topcat/tutorial/

- Open the VizieR load dialog () **(click on "VO" at the top bar menu)**
- Search for all the objects within 3 degrees of the Pleiades in the Tycho-2 catalogue:
  - Check **Cone Selection** button
  - Object name `Pleiades`, **Resolve**
  - Radius 3 degrees
  - Catalogue Selection **Surveys** tab
  - Click on row Tycho-2 (Name column is ordered alphabetically)
  - Click **OK**
  - Loads 2 tables (2 tables in VizieR under that heading) - pick the one with most rows
- Visualise proper motions:
  - Open a scatter plot window
  - X = pmRA, Y = pmDE
  - Zoom in to find a cluster with non-zero motion
  - Draw a blob round it to create a new subset (click ; drag out the cluster region, click again)
- Draw colour-magnitude diagram:
  - Open a different scatter plot window
  - X = VTmag - BTmag, Y = VTmag, flip Y
  - See where the new cluster subset you identified sit in colour-magnitude space (main sequence?).
- Save the cluster identification:
  - Go to the Subsets window
  - Select the row corresponding to the cluster subset
  - Create a new boolean table corresponding to this subset by clicking the **To Column** toolbar button
  - Save the table.

Creating our photometric target list

- Now that you have familiarised yourself with TOPCAT, we can create a list of targets for photometry!
- We want to observe hot subdwarf stars with suspected variability.
- We are going to use a table containing 40,000+ hot subdwarf and candidates:

http://www.astro.physik.uni-potsdam.de/~pelisoli/AstroWorkshop/sdCats_combined_GaiaV11_specV44.csv

http://www.astro.physik.uni-potsdam.de/~hdawson/AstroWorkshop/asCats_combined_GaiaV11_specV54.csv

- To identify candidate variables, we will use the ATLAS catalogue:

https://archive.stsci.edu/prepds/atlas-var/

(The "Object Table")

* This table is 7GB in size! Instead, here we will use the compressed version:

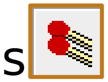
http://www.astro.physik.uni-potsdam.de/~pelisoli/AstroWorkshop/ATLAS_cat.fits

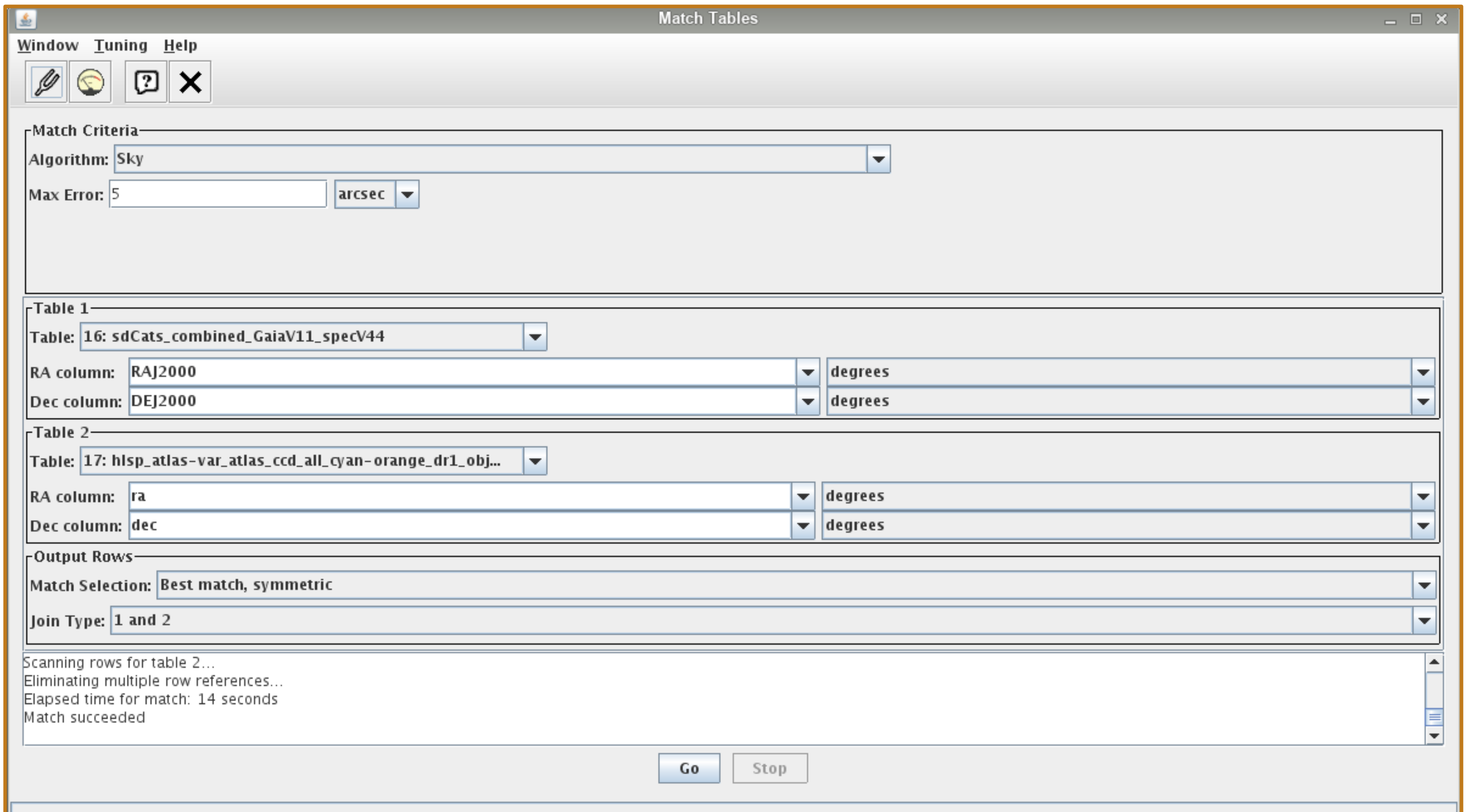
Creating our photometric target list

- **Step 1:** import both tables to TOPCAT.
- **Step 2:** select only relevant columns from the ATLAS table.
  - There are 197 (!) columns in the full table – they describe many parameters in the variability search algorithm run by ATLAS.
  - Using the column metadata shortcut, all columns but the following are deselected:
    - ATO_ID
    - ra and dec (we need those to do a crossmatch)
    - fp_period
    - fp_fitrms
    - fp_fitchi
    - CLASS (this is the type of variation ATLAS identified)

We are interested in short period binaries. These parameters describe the fitted period, root-mean-square, and chi-square of the short-period algorithm in ATLAS.

Creating our photometric target list

- **Step 3:** cross-match both tables 



Creating our photometric target list

- **Step 4:** create a subset with objects worth observing for our science case, taking into account the time and site constraints (for Ondřejov).
  - You can use staralt: http://catserver.ing.iac.es/staralt/index.php

    (Ondřejov location: 14.46ºE 49.54ºN 32m, UT-offset +2)
  - We want objects that do have a short period determined.
  - Preferably objects whose period can be covered in one night.

Creating our photometric target list

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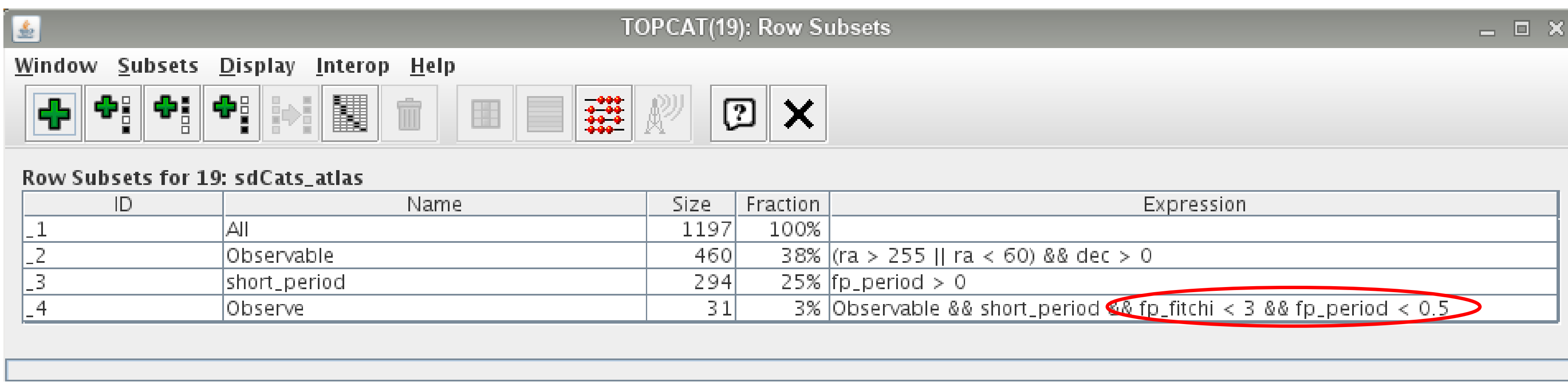


ID	Name	Size	Fraction	Expression
_1	All	1197	100%	
_2	Observable	460	38%	(ra > 255 || ra < 60) && dec > 0
_3	short_period	294	25%	fp_period > 0
_4	Observe	31	3%	Observable && short_period && fp_fitchi < 3 && fp_period < 0.5

Creating our photometric target list

TOPCAT(19): Table Browser

Window Subsets Help

Table Browser for 19: sdCats_atlas

	NAME_SDCAT	RAJ2000	DEJ2000	SPEC_SDCAT	phot_g_mea...	ATO_ID	fp_period	fp_fitrms	fp_fitchi	CLASS
1073		331.33941	35.55149		15.80169	J331.3394+35.5514	0.08587	0.03249	1.20774	NSINE
943		299.98457	50.61615		17.09661	J299.9845+50.6161	0.09119	0.07073	1.26616	dubious
997		307.21987	6.16752		14.81179	J307.2199+06.1675	0.09422	0.02025	1.56105	NSINE
971		303.32853	42.42771		15.61423	J303.3285+42.4276	0.09526	0.03289	2.42345	dubious
754		267.15569	9.16338		16.71258	J267.1556+09.1633	0.09646	0.07756	1.39432	SINE
758		267.90184	14.73861		16.94822	J267.9018+14.7386	0.09951	0.07587	1.65196	dubious
257		30.59676	51.89702		15.11298	J030.5967+51.8970	0.1008	0.02152	1.25241	NSINE
1102		343.38397	47.69991		16.41222	J343.3839+47.6999	0.1055	0.03974	0.8814	NSINE
1026		316.00593	34.61008		17.47401	J316.0059+34.6100	0.11855	0.08564	1.9227	dubious
1105		344.33419	49.65927		17.56062	J344.3341+49.6592	0.12966	0.08458	1.2062	dubious
189	HS2035+0418	309.50381	4.48565	sdB	14.77305	J309.5037+04.4856	0.13103	0.0249	1.46974	dubious
164	KeplerJ184307+425918	280.77823	42.98835	sdB+WD	15.58791	J280.7782+42.9883	0.13726	0.0395	2.02105	dubious
1024		315.11791	59.65741		16.3627	J315.1179+59.6574	0.13772	0.05055	1.28395	NSINE
1129	SDSSJ012458.96+475640.9	21.24568	47.94472	sd	16.92145	J021.2457+47.9447	0.14013	0.07384	1.13479	CBF
792		274.57916	6.89912		17.27594	J274.5791+06.8991	0.14707	0.10659	1.93357	NSINE
226		0.63041	42.88611		14.33737	J000.6304+42.8861	0.15578	0.02251	1.6455	SINE
1077		333.07139	52.02175		17.46384	J333.0713+52.0217	0.16019	0.10316	1.74243	dubious
212	PG2259+134	345.44094	13.64374	sdB	14.51706	J345.4409+13.6437	0.16346	0.02577	1.8531	NSINE
817		280.39493	38.99883		15.85566	J280.3949+38.9988	0.1655	0.04998	2.95899	SINE
1184	SDSSJ192059.78+372220.0	290.24908	37.37222	sdB+dM	15.77123	J290.2490+37.3722	0.16896	0.03841	1.64564	SINE
215	FBS2304+440	346.62686	44.31354	sdB	14.30496	J346.6269+44.3135	0.17589	0.03356	2.88013	CBF
1115		352.34433	32.23316		16.92967	J352.3443+32.2331	0.17644	0.07152	1.09889	NSINE
219	Pn23I1-18	351.71858	12.50608	sdB	14.3078	J351.7186+12.5060	0.21191	0.02353	2.7015	IRR
975		304.26974	53.71505		16.33385	J304.2697+53.7150	0.21286	0.04614	1.39473	SINE
1074		331.66585	32.72679		16.962	J331.6658+32.7267	0.22041	0.06343	1.14331	NSINE
229		4.23059	51.23049		16.35795	J004.2305+51.2304	0.27096	0.04629	1.17926	NSINE
842		284.85281	7.85064		15.80786	J284.8528+07.8506	0.29756	0.05785	2.25908	SINE
245		18.47086	50.08699		14.97042	J018.4708+50.0870	0.31029	0.0239	1.37276	NSINE
211	GALEXJ22392+1819	339.80672	18.3295	sdB	14.07094	J339.8067+18.3294	0.36676	0.01961	1.88989	PULSE
1018		312.41318	30.08182		13.5045	J312.4131+30.0818	0.42977	0.02234	2.12267	SINE
925		296.70749	39.99371		14.39431	J296.7074+39.9936	0.45116	0.02622	2.38232	SINE

Creating our photometric target list

- To determine the best targets, you can also inspect the light curves and perform a period search.
- At http://www.astro.physik.uni-potsdam.de/~pelisoli/lightcurves/ATLAS/
  dat/ you can find a Jupyter notebook containing instructions, as well as the code, to perform a Lomb-Scargle periodogram and phase-fold the data.

The data is available in this same directory.

Exercise – ADQL queries in TOPCAT

- Draw the Gaia DR2 HR diagram
  (absolute magnitude $M_G = G - 5 \log(d[pc]) + 5$
  as a function of colour $G_{BP} - G_{RP}$)
  for 100.000 stars closer than 100 pc.
  - Which variables do you need to select?
  - From which table?
  - How to limit this for 100.000 stars?
  - How to limit this to $d < 100$ pc? Hint: use WHERE
- Inspect this diagram. Is there something odd with it? Why?

Exercise – ADQL queries in TOPCAT

- Retrieve the variables `parallax_over_error`, `phot_bp_mean_flux_over_error`, `phot_rp_mean_flux_over_error`, `phot_bp_rp_excess_factor`, `astrometric_chi2_al`, `astrometric_n_good_obs_al`, and `astrometric_excess_noise` for the stars in the table resulting from your previous query. Hint: use JOIN USING
- Create a subset with objects showing `parallax_over_error < 5`.

  How does the HR-diagram look like with only these objects?

- Now you know how important quality control parameters are!
- Use the following conditions to further improve your HR-diagram:

parallax_over_error > 10

astrometric_excess_noise < 1.0

phot_bp_mean_flux_over_error > 10

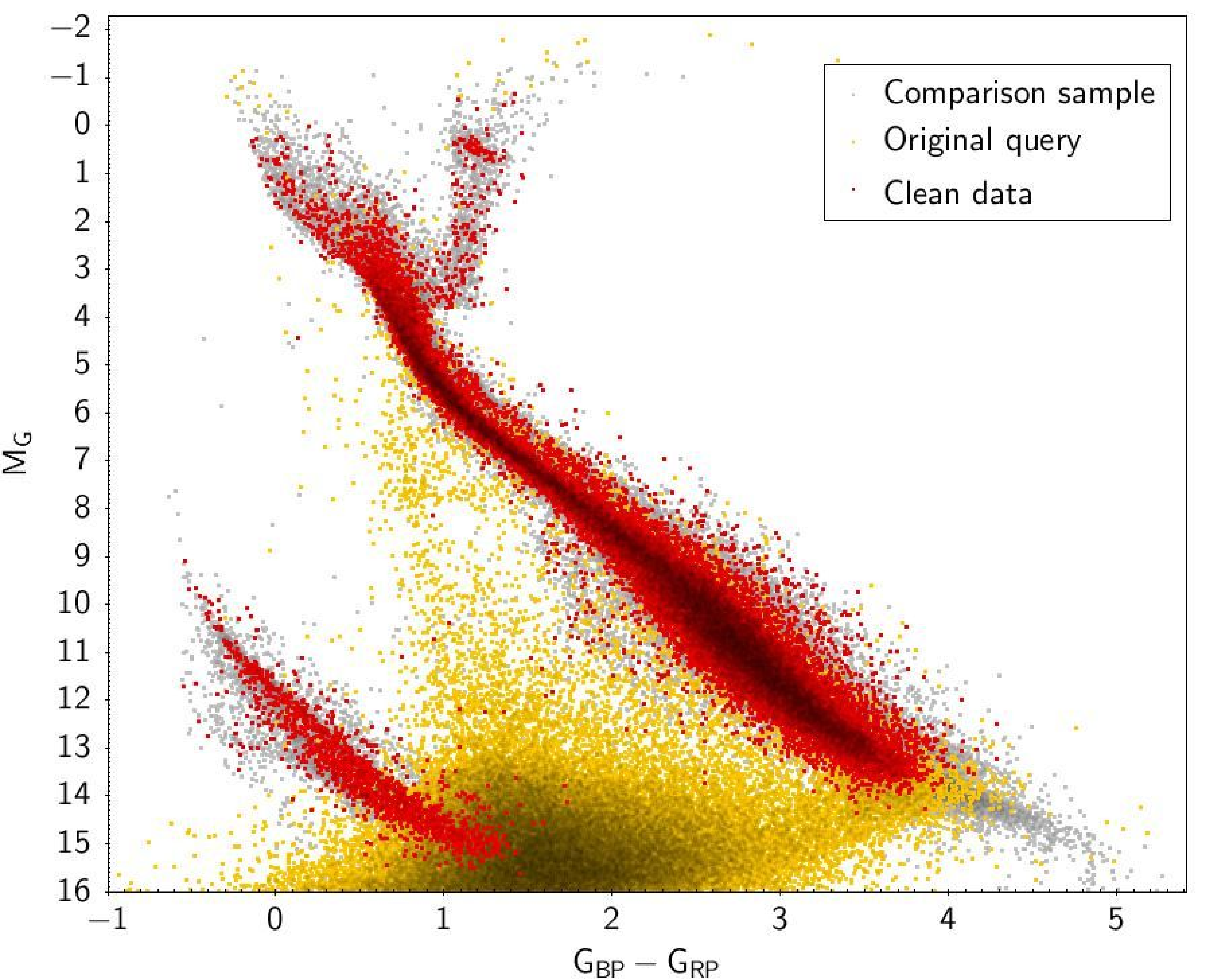
phot_rp_mean_flux_over_error > 10

phot_bp_rp_excess_factor < 1.3+0.06*power(bp_rp,2)

phot_bp_rp_excess_factor > 1.0+0.015*power(bp_rp,2)

astrometric_chi2_al/(astrometric_n_good_obs_al-5)
< 1.44*max(1, exp(-0.4*(phot_g_mean_mag-19.5)))

Check out this paper: https://arxiv.org/abs/1804.09366 if you want to understand more about where all of these parameters come from.



Comparison sample
Original query
Clean data
M_G
$G_{BP} - G_{RP}$
−2
−1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
−1
0
1
2
3
4
5

Creating our spectroscopic target list

- Now that you have familiarised yourself with TOPCAT, ADQL, and some Gaia parameters, it is time to create our list of targets for spectroscopy!
- We want to perform high-res, multi-epoch observations of hot subdwarf and blue horizontal branch stars.

  Step 1: identify the position of these stars in the HR-diagram.

  Step 2: define a colour-cut.

  Step 3: do a query in *Gaia* recovering stars within your colour cut, also using quality control parameters.

  Step 4: validate your query. Does the result make sense?

  Step 5: observational constraints (brightness, RA and DEC).

Creating our target list - STEP 1

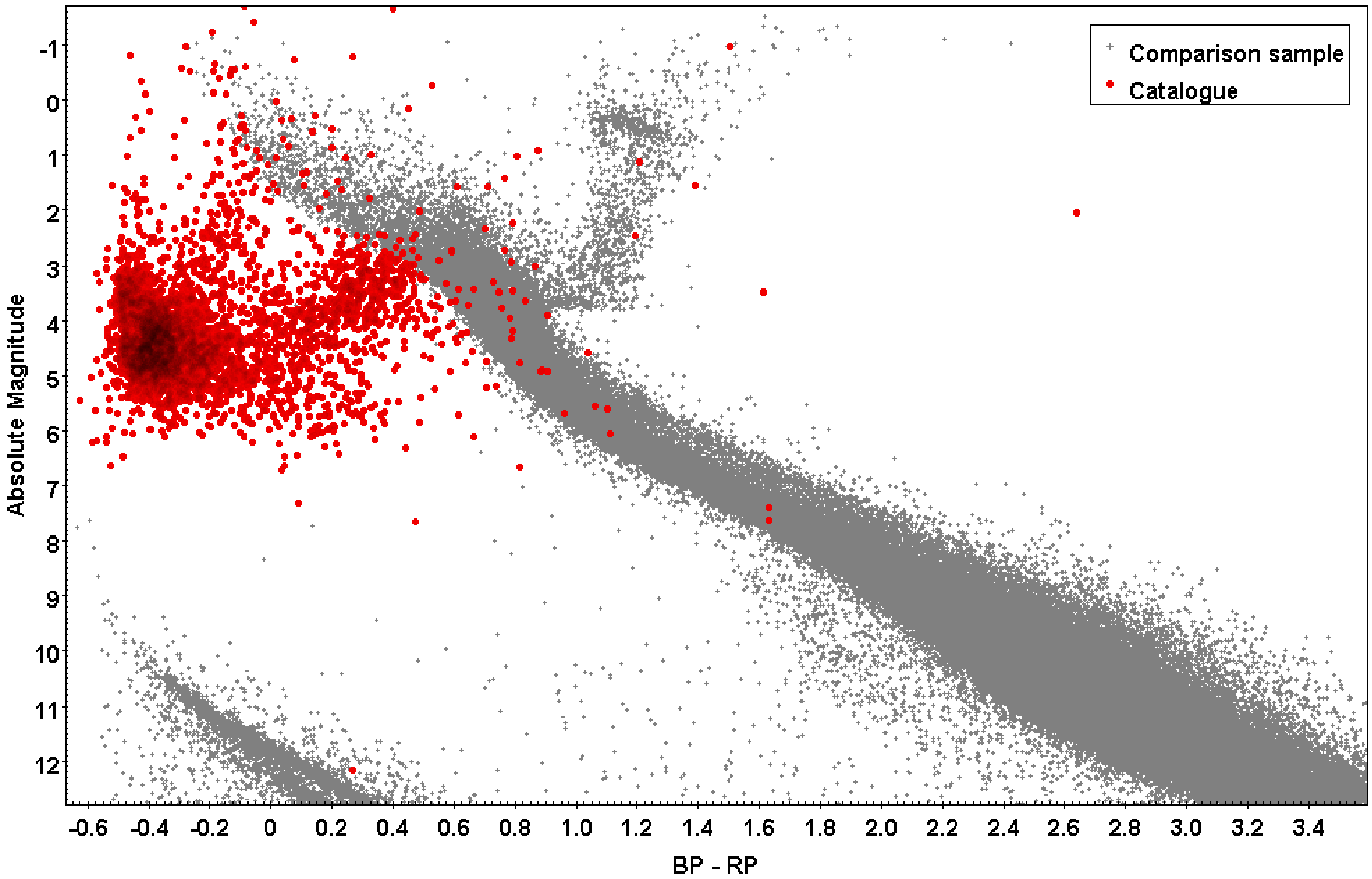
- Plot the HR-diagram for the comparison sample

  Sample C:
  http://www.astro.physik.uni-potsdam.de/~pelisoli/AstroWorkshop/SampleC.vot

- Overplot the known hot subdwarfs from Prof. Geier's catalogue:

  http://www.astro.physik.uni-potsdam.de/~hdawson/AstroWorkshop/sd_catalogue_v54.csv

Creating our target list - STEP 1

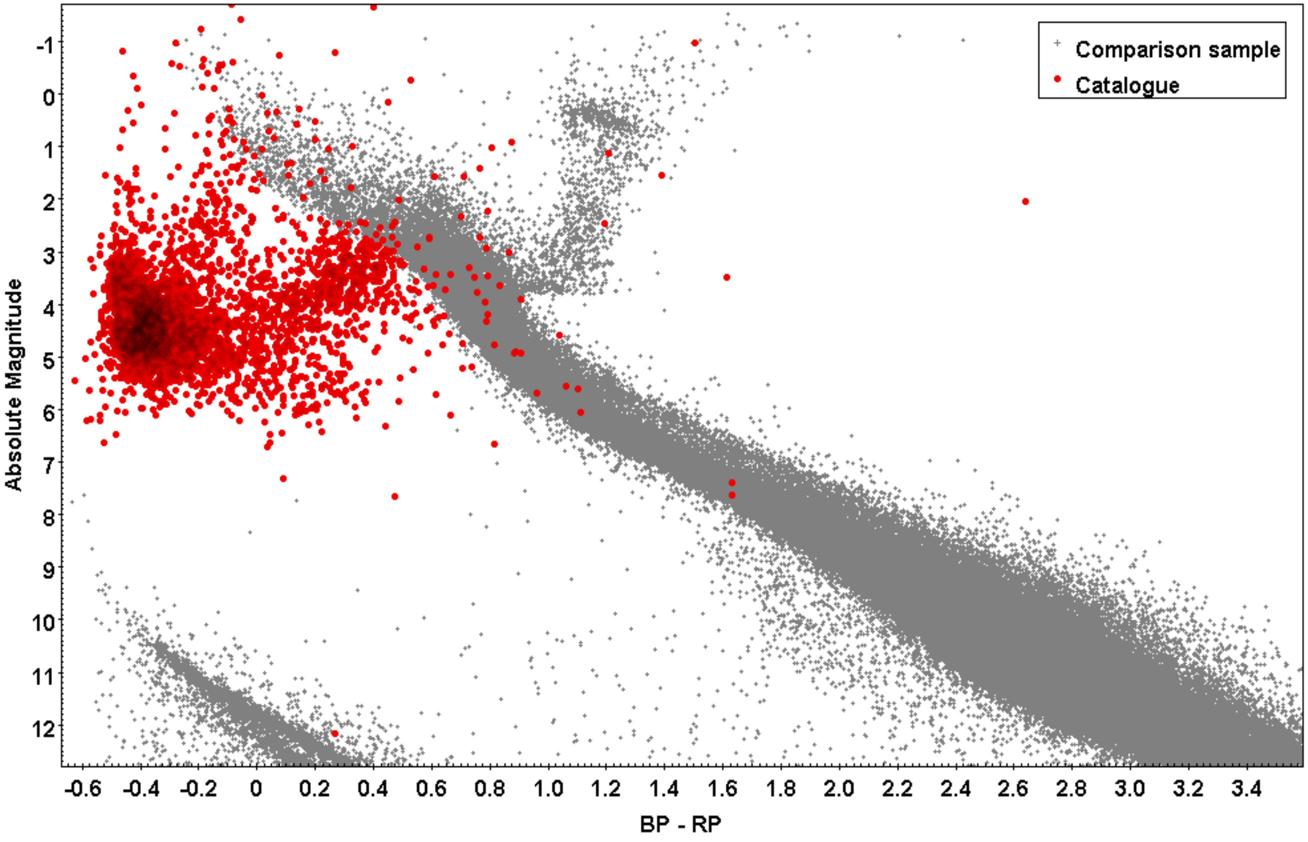


Creating our target list - STEP 2

- Define a colour-cut. Where do these stars concentrate?

$$?? < M_G < ??$$

$$?? < G_{BP} - G_{RP} < ??$$



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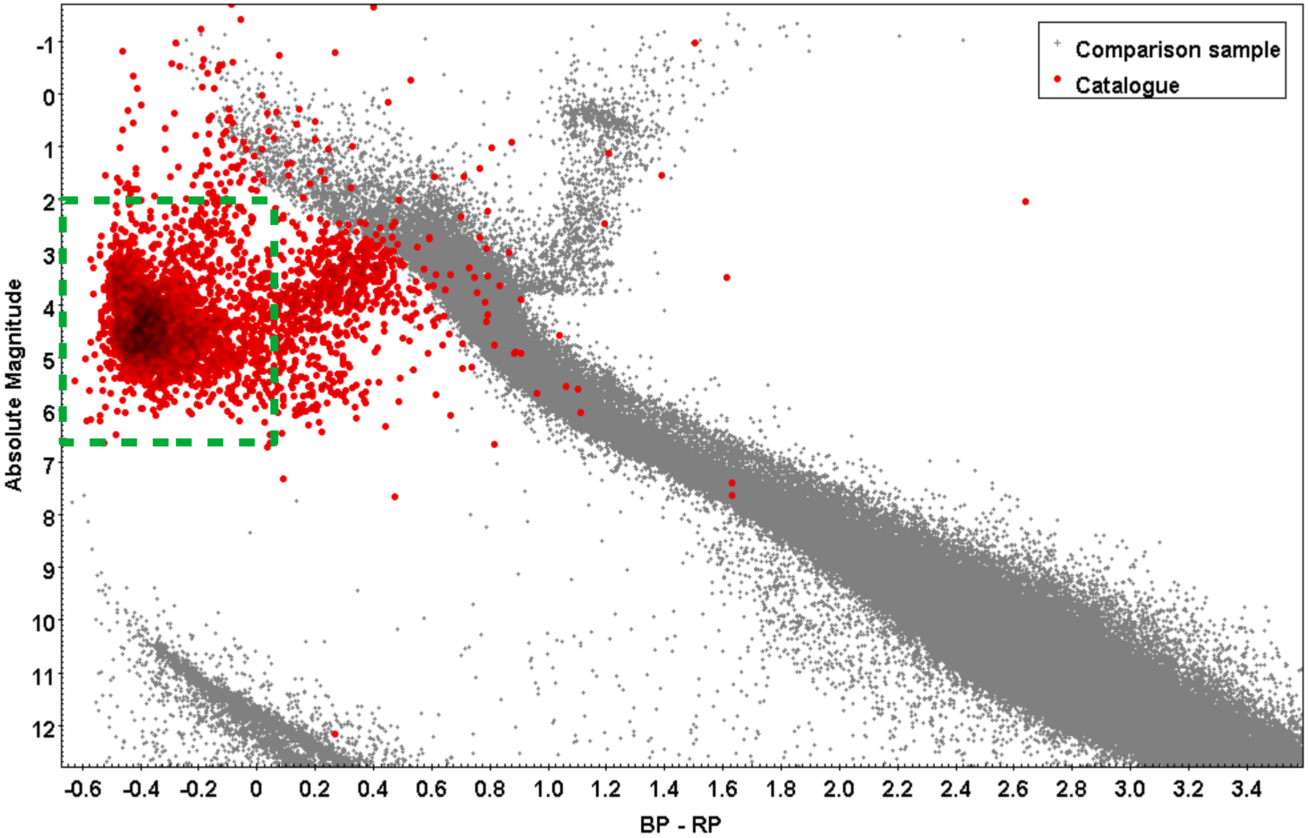
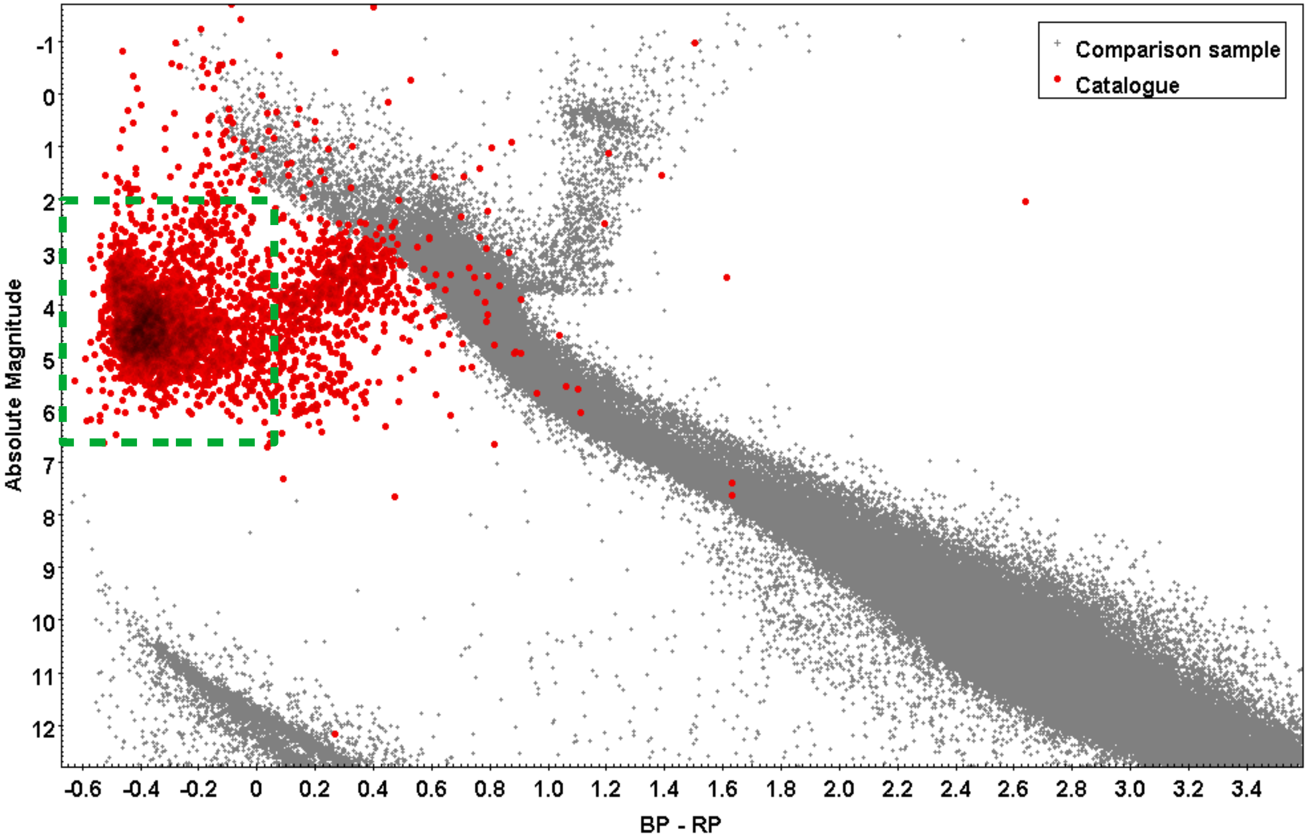


Creating our target list - STEP 2

- Define a colour-cut. Where do these stars concentrate?

$$2 < M_G < 6.5$$

$$-0.7 < G_{BP} - G_{RP} < 0.05$$



Creating our target list - STEP 3

- Write an ADQL query in *Gaia* recovering stars within your colour cut, also using quality control parameters:

parallax_over_error > 5

astrometric_excess_noise < 1.0

phot_bp_mean_flux_over_error > 10

phot_rp_mean_flux_over_error > 10

phot_bp_rp_excess_factor < 1.3+0.06*power(bp_rp,2)

phot_bp_rp_excess_factor > 1.0+0.015*power(bp_rp,2)

astrometric_chi2_al/(astrometric_n_good_obs_al-5)

  < 1.44*max(1, exp(-0.4*(phot_g_mean_mag-19.5)))

If TOPCAT ‘times out’, go directly to the Gaia archive: https://gea.esac.esa.int/archive/

Creating our target list - STEP 3

- Write an ADQL query in *Gaia* recovering stars within your colour cut, also using quality control parameters.

```
SELECT source_id, ra, dec, parallax, phot_g_mean_mag, bp_rp
FROM gaiadr2.gaia_source
WHERE parallax_over_error > 5
AND phot_bp_mean_flux_over_error>10
AND phot_rp_mean_flux_over_error>10
AND phot_bp_rp_excess_factor < 1.3+0.06*power(phot_bp_mean_mag-phot_rp_mean_mag,2)
AND phot_bp_rp_excess_factor > 1.0+0.015*power(phot_bp_mean_mag-phot_rp_mean_mag,2)
AND ( astrometric_chi2_al/(astrometric_n_good_obs_al-5)<1.44
    OR astrometric_chi2_al/(astrometric_n_good_obs_al-5)<1.44*exp(-0.4*(phot_g_mean_mag-
19.5)) )
AND bp_rp > -0.7 AND bp_rp < 0.05
AND 5+5*log10(parallax/1000)+phot_g_mean_mag < 6.5 and
5+5*log10(parallax/1000)+phot_g_mean_mag > 2.0
```

If TOPCAT ‘times out’, go directly to the Gaia archive: https://gea.esac.esa.int/archive/

Creating our target list - STEP 4

- Overplot the result of your query on the HR-diagram. Is everything where it is supposed to be?

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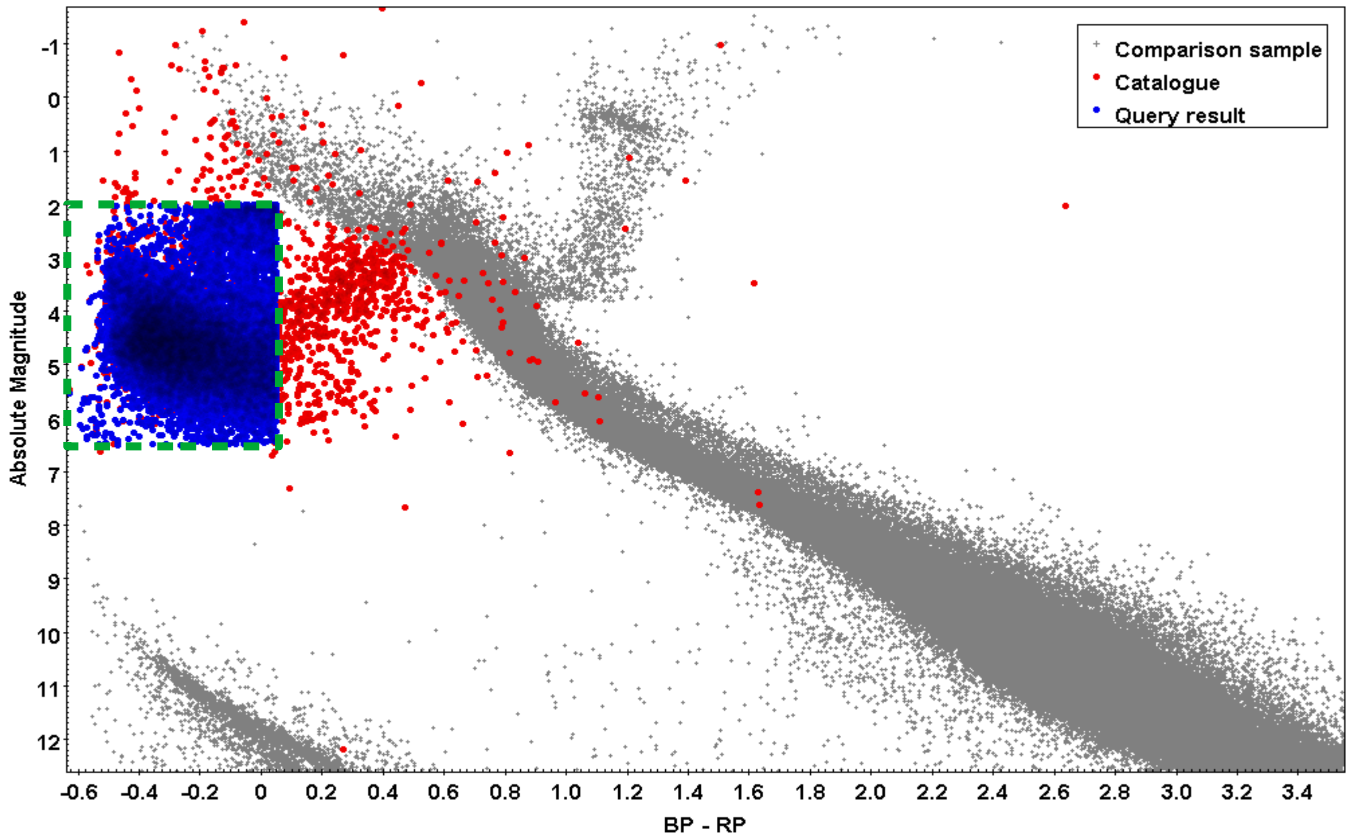

Creating our target list - STEP 4

- Make a sky-plot of the objects in your query. Anything weird?

Creating our target list - STEP 4

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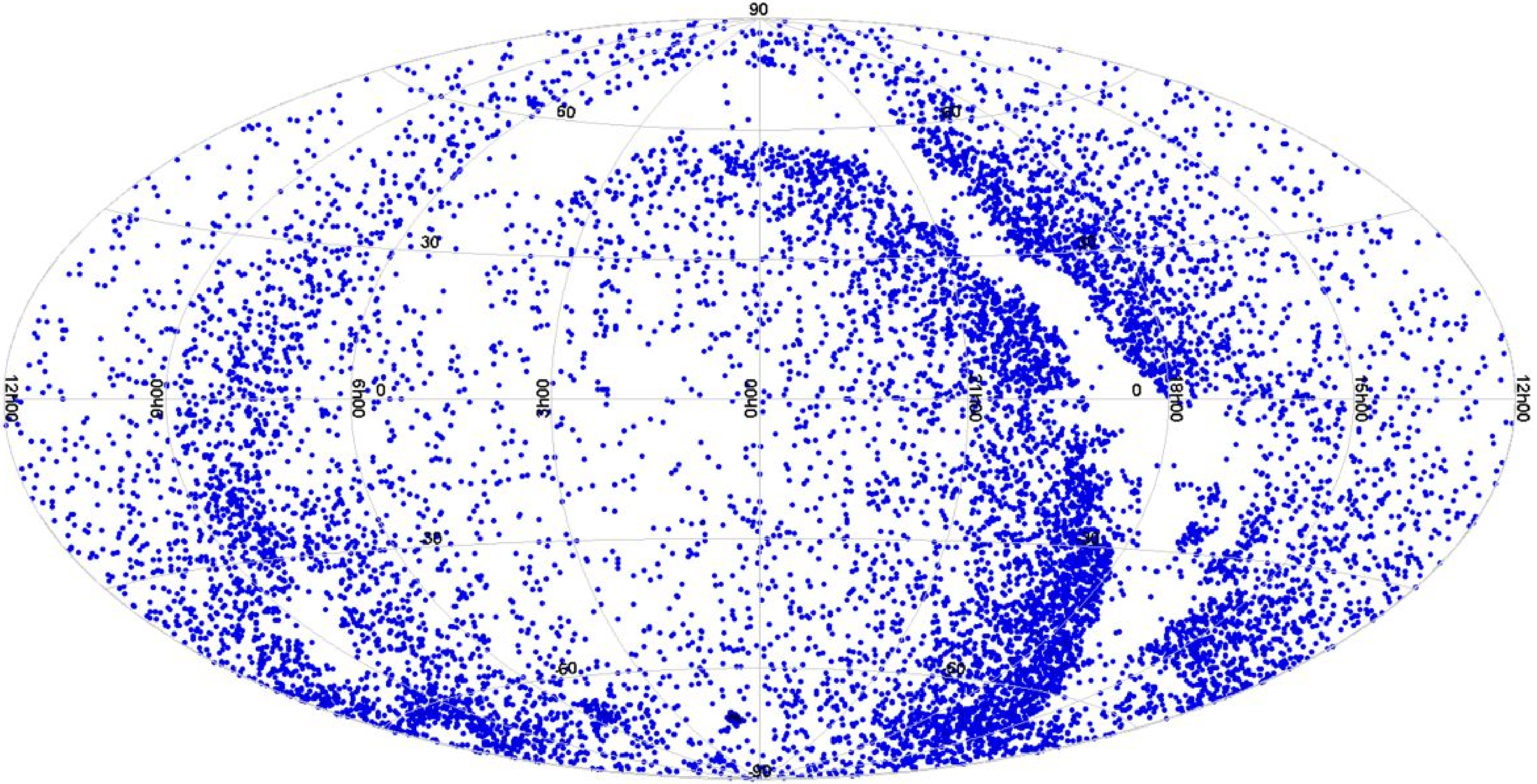


Creating our spectroscopic target list

- Congratulations! You have done some proper science.

  However, you were too slow… catalogues of candidate hot subdwarfs and blue horizontal branch stars have already been published in *Gaia!*:

  Geier et al. 2019:

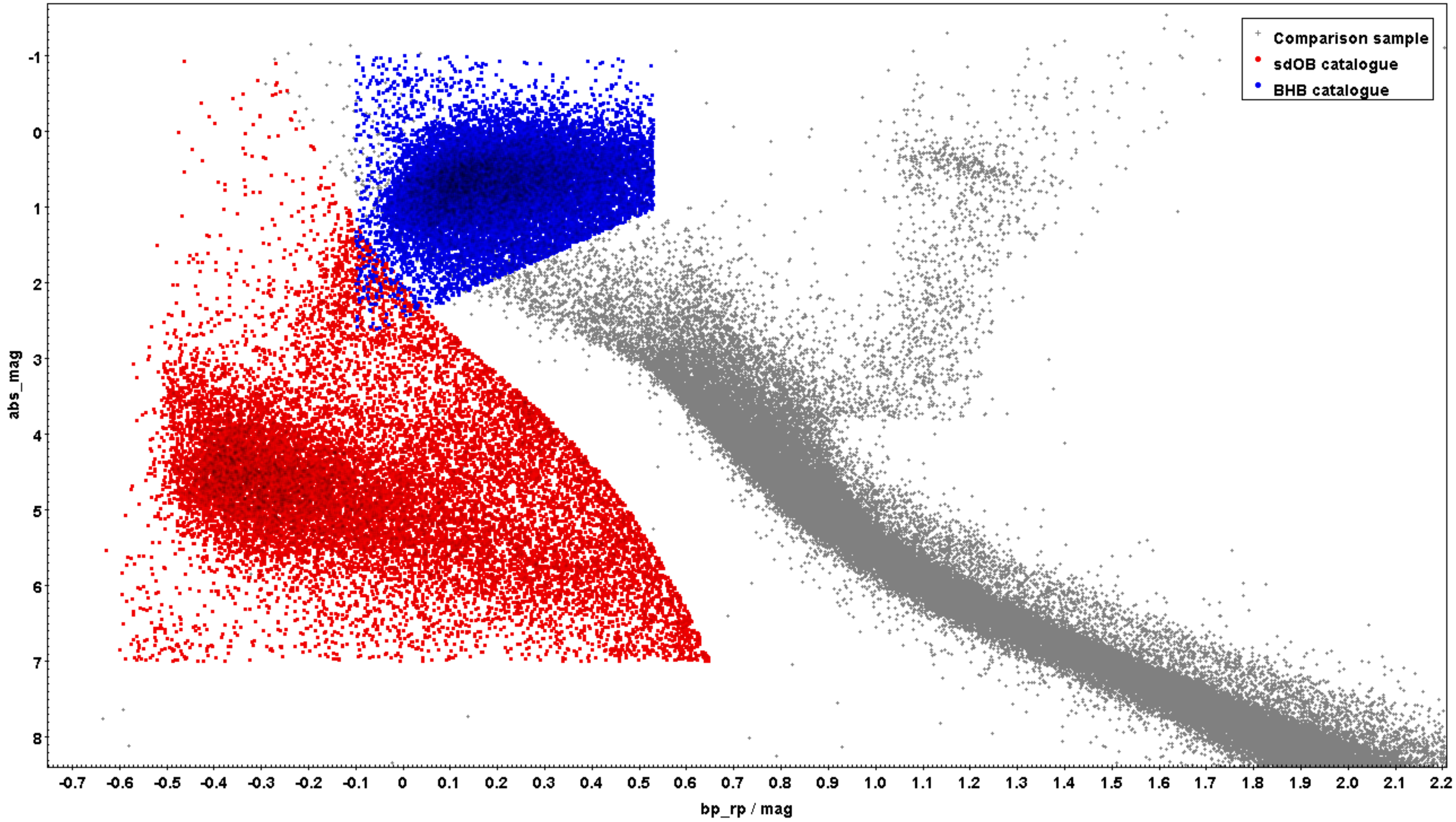
  The population of hot subdwarf stars studied with Gaia

  Culpan et al. 2021:

  Clean catalogues of blue horizontal-branch stars using Gaia EDR3

Current samples of sdBs and BHBs

Cuts are a bit more elaborate!



Download the combined catalogues here:

http://www.astro.physik.uni-potsdam.de/~hdawson/AstroWorkshop/sdOB_BHB_catalogue_edr3_combined_RUWE.fits

The projects:

- Volume-limited samples of hot subdwarf and red giant stars (500 pc)
- High-resolution, multi-epoch observations to obtain stellar parameters as well as radial velocity (RV) variability checks.

Download the red giant catalogues here:

http://www.astro.physik.uni-potsdam.de/~hdawson/AstroWorkshop/Target_list_red_giants_czech.csv

http://www.astro.physik.uni-potsdam.de/~hdawson/AstroWorkshop/Target_list_red_giants_slovakia.csv

Creating our spectroscopic target list

- Open the catalogue in TOPCAT.
- What is the brightness constraint for our telescope?
- What is the declination constraint given our location?
- What is the constraint in right ascension for this time of year?
  - You can use staralt again.

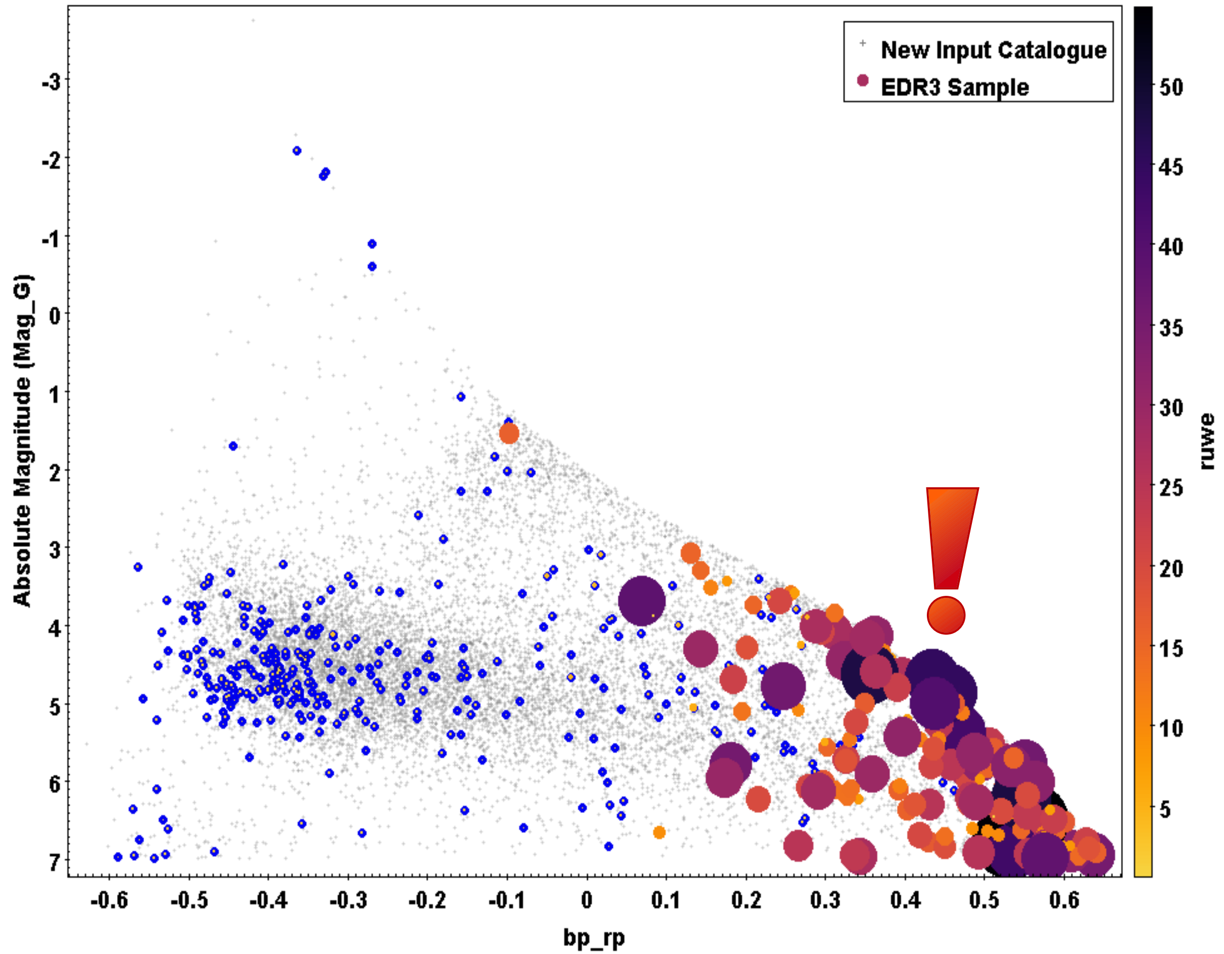
    Our location is approximately: 14.46ºE 49.54ºN 32m UT+2

➔ Constrain the distance to 500 pc for our volume-limited sample of hot subdwarf stars

➔ Have a look at the ‘ruwe’ column and ‘parallax_over_error’

The 500 pc hot subdwarf sample

→ Needs stricter quality criteria!



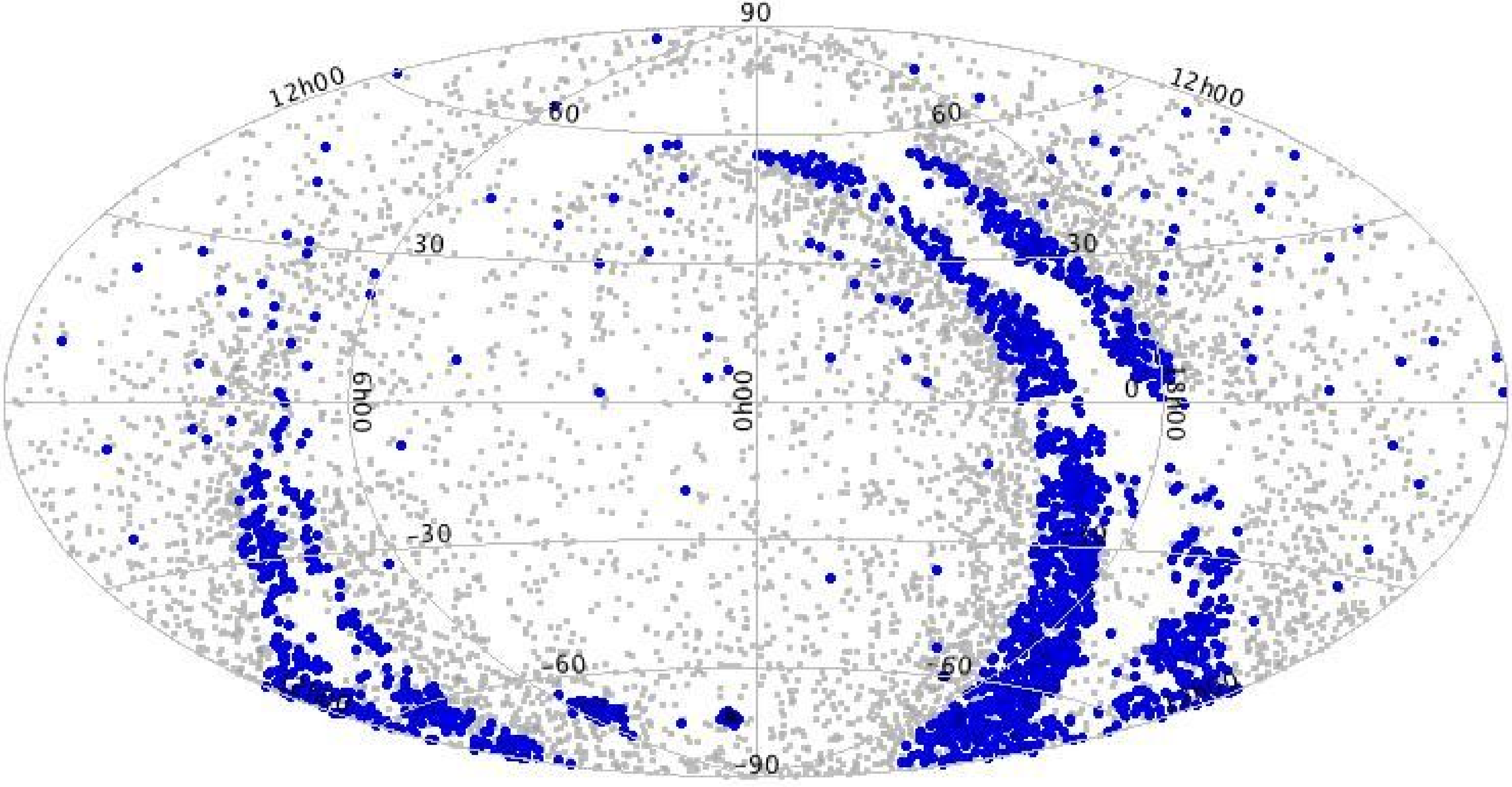
Renormalised **U**nit **W**eight **E**rror – a master quality criteria cut?!

Creating our spectroscopic target list

- Open the catalogue in TOPCAT.
- What is the brightness constraint for our telescope?
- What is the declination constraint given our location?
- What is the constraint in right ascension for this time of year?

NAME_SDCAT	RAJ2000_HMS	DEJ2000_HMS	SPEC_SIMBAD	SPEC_SDCAT	G_GAIA	BP-RP_GAIA
	00:54:35.22	19:11:18.32	A1Vn		6.1981	-1.8391
	00:09:20.15	79:42:52.44	A7IV		6.6357	-3.1425
	20:10:45.14	20:29:12.74	B8V		7.4272	-0.0909
	22:02:56.66	44:39:00.53			7.579	-0.252
	21:49:48.89	34:55:00.57	A0		7.9073	0.1132
	01:53:19.25	43:23:21.98	A2		8.3128	0.202
	19:27:09.59	16:26:27.48	A2		9.013	0.1901
	19:03:01.82	42:32:46.14	A2		9.1905	0.2682
	23:01:16.37	44:29:48.04	A3		9.228	0.2118
	19:24:19.22	31:55:35.58	A0		9.2762	0.0005
	21:09:47.38	20:12:29.18	B5		9.4754	-0.1932
	19:36:22.02	19:38:21.50	A0		9.5522	0.1759
	20:04:08.90	16:59:57.27	G5		9.6318	0.379
FB179	21:59:41.98	26:25:57.40	sdO6	sdO	9.6508	-0.4614
	20:46:17.78	28:52:47.31	A0		9.7432	0.2434
	20:35:52.47	31:01:34.93	A0		9.7728	0.1405
	19:56:33.68	29:13:26.66	A0		9.8662	0.2232
	20:10:56.20	22:37:18.64	A0		9.8978	0.1707
	21:04:55.58	46:32:31.16	B9V		9.9396	0.1792
BD+37442	01:58:33.43	38:34:23.85	sdOHe	sdO	9.9485	-0.3984

Crowded areas are problematic



In blue = in our query, but not in the final catalogue. Essentially the disc and the Magellanic clouds! These regions need stricter quality control cuts.

ADQL queries – Geometries

- Useful for searching a radius around given coordinates
- E.g.: get Gaia DR2 proper motions for stars with *unknown* `source_id` (3" search)

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- E.g.: get Gaia DR2 proper motions for stars with *unknown* `source_id` (3" search)

```
SELECT b.source_id, a.NAME_SDCAT, b.pmra, b.pmdec
FROM TAP_UPLOAD.t10 AS a
JOIN gaiadr2.gaia_source AS b ON 1=CONTAINS (
     POINT('ICRS', a.RAJ2000, a.DEJ2000),
     CIRCLE('ICRS', b.ra, b.dec, 3./3600.))
```

- Note: same thing could be done with a TOPCAT crossmatch, but that is not always the case (e.g. if a table is not listed for crossmatching).