Use of Gaia DR1 data from TOPCAT

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Gaia DR1 Workshop Royal Observatory Edinburgh

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TOPCAT

• very short intro

Accessing Gaia-DR1 Data from TOPCAT

- ESA web interface
- Cone Search
- CDS XMatch client
- TOPCAT TAP window
- TGAS FITS file download
- (others)

Examples

- Pleiades distance determination
- Match with local catalogue
- TGAS-Hipparcos colour-magnitude diagram
- All-sky density maps

TOPCAT

TOPCAT = Tool for OPerations on Catalogues And Tables

Capabilities:

- Does stuff with tables
- Talks to the *Virtual Observatory*

Help is available:

- Comprehensive HTML / PDF user manual
- Help for Window 😰 button on every window
- Email support:
 - ▷ on list: topcat-user@bristol.ac.uk
 - ▷ in person: m.b.taylor@bristol.ac.uk
- Acknowledgement: 2005ASPC...347...29T

```
http:/www.starlink.ac.uk/topcat/
```



Data Access: ESA Web Interface

ESA Web interface

- Details
 - > http://gea.esac.esa.int/archive
 - ▷ see Giorgia's talk
- Suitability:
 - ▷ large or complex queries
 - ▷ has all Gaia DR tables
 - persistent uploads
 - result table management
 - precalculated neighbour tables
 - ▷ share results with collaborators
 - large compute resources
 - ▷ ...

Gaia Archive - Mozilla Firefox 💽 Gaia Archive × \ - 争 연 🖸 ☆ 自 M → EUROPEAN SPACE AGENCY I ABOUT ESAC I Mark B. Taylor (mtaylo02) 😐 🗘 gaia archive esa HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION VOSPACE ADQL Form Query Result Query examples Job name: SELECT source id/2199023255552 AS hpx0, AG(GSORT(ra_error*ra_error + dec_error*dec_error)) AS pos_error FROM gaiadrl.gaia_Source GROUP BY hpx0 🖻 Gaia Data Release 1 🗉 🚖 qaiadr1.allwise_best_neighb 🗉 🚖 gaiadr1.allwise neighbourhd 🕒 💮 gaiadr1.allwise_original_vali gaiadr1.aux qso icrf2 matc neset Form 🔍 Submit Query 🗉 🧾 gaiadr1.cepheid 🖲 🧾 gaiadr1.ext_phot_zero_point 🕒 💮 qaiadr1.qaia source gaiadr1.gsc23 best neighbo 0-Sep-2016, 11:55:32 888 K F 🗉 🚖 gaiadr1.gsc23_neighbourhod 0-Sep-2016, 11:41:20 888 KB 🗉 💮 gaiadr1.gsc23 original valid 5-Sep-2016, 17:17:16 1 MB 🖲 🧾 gaiadr1.phot variable time 5-Sep-2016.10:11:33 0 KB 9 ~ 雇 😐 🧮 gaiadr1.phot_variable_time_ < gaiadr1.ppmxl best neighbo 📧 🕢 1-20 of 50 🕟 🗎 Apply jobs filter Select all jobs Delete selected job 🗉 🚖 gaiadr1.ppmxl_neighbourho🖂 COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY, ALL RIGHTS RESERVED (v1.1.0)

- Usage:
 - Download se result table to local disk and set Load into TOPCAT
 - Or use SAMP button requires access using HTTP not HTTPS)

Mark Taylor, Use of Gaia DR1 Data with TOPCAT, Gaia DR1 Workshop, Edinburgh, 14 November 2016

Data Access: Cone Search

Use TOPCAT's Cone Search window

- Details:
 - Retrieves all Gaia/TGAS sources within a given radius of a given sky position
- Suitability:
 - ▷ If you want all Gaia sources in given sky region
 - Only selects on position (but can restrict further in TOPCAT)
 - ▷ Limit: 10 million rows
- Usage:
 - VO|Cone Search menu item
 - \triangleright Keywords: "gaia" \rightarrow Find Services
 - Select service ARI-Gaia
 - ▷ Fill in Object Name or RA/Dec and Radius, and hit OK
 - Verbosity selector controls which columns are included
 - Documentation: http://www.starlink.ac.uk/topcat/sun253/ConeSearchDialog.html

Cone Search						· •
<u>W</u> indow <u>C</u> olumns	<u>R</u> egistry	Interop	<u>H</u> elp			· · · · ·
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Keywords: tgas						And
Match Fields: 🕑	Short Nam	e 🗹 Ti	tle 🗹 Su	ıbjects	VID V	Publisher 🔲 C
Accept Resou	irce Lists			Can	cel	Find Services
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ARI-Gaia A	RI's TGAS Co	ne Searc	h Service	TGAS	ivo://uni	-heidelberg.de/1
AccessUI	RL	De	escription		V	ersion
Resource Count:	1					
Cone Parameter	s					
Cone URL: http:/	/gaia.ari.uni-	-heidelbe	erg.de/cor	ne/tgas		
Object Name: ple	eiades		1		_	Resolve
RA: 56.75	degre	es 🔻	()2000)		🖌 Accep	t Sky Positions
Dec 24.116	7 degre	es 🔻	()2000)			
Radius: 5	degre	es 🔻				
Verbosity: 2 (no	rmal) 🔻					
			ОК			

Data Access: CDS X-Match

Use TOPCAT's CDS Upload X-Match window

- Details:
 - Fast, scalable service for crossmatching VizieR tables
 - TOPCAT can use it for crossmatch of loaded table against Gaia
- Suitability:
 - Nearest/all nearby Gaia sources for each row of local table
 - ▷ Scales to millions (or more) of rows
 - ▷ Not all columns returned
 - Only selects on position (but can restrict results further in TOPCAT)

CDS Upload X-Match Window Search Help 🖸 🗙 ال -Remote Table-VizieR Table ID/Alias: GAIA DR1 - 0 Name: 1/337/gaia Alias: GAIA DR1 Description: GaiaSource data ((\bf Download) Gaia Sources as y Row Count: 1,142,679,769 Coverage: 0.9999797 (order 6) -Local Table-Input Table: 2: ngc346.fits -RA column: _RAJ2000 degrees (j2000) Dec column: _DEJ2000 degrees (J2000) -Match Parameters-Radius: 2 arcsec 💌 Ŧ Find mode: All Rename columns: Duplicates 💌 Suffix: _x Block size: 50000 - -Go Stop

- Usage:
 - ▷ Load local table into TOPCAT (or get it from VizieR, or TAP, or ...)
 - ▷ X VO CDS Upload X-Match menu item or toolbar button
 - Select VizieR Table ID/Alias: "GAIA DR1"
 - Docs: http://www.starlink.ac.uk/topcat/sun253/CdsUploadMatchWindow.html
 - ▷ Ack: "This research made use of the cross-match service provided by CDS, Strasbourg."

Data Access: TOPCAT TAP Window

Use TOPCAT's TAP (Table Access Protocol) client window

- Details:
 - ▷ Talks directly to ESA/ARI TAP services, and other non-Gaia TAP servers
 - Similar functionality, different GUI to ESA web interface
- Suitability:
 - Suitable for ADQL queries
 - Better integrated into TOPCAT than ESA web interface
 - results load directly into TOPCAT
 - can upload tables from TOPCAT
 - Table/column metadata browsing different
 - ▷ ADQL editing features (multi-tab, validation, undo/redo, ...)
 - \triangleright Limits: 10⁵ rows (ESA), 10⁷ rows (ARI)
- Usage:
 - WO Table Access Protocol (TAP) Query menu item or toolbar button \triangleright
 - Select Service Keywords: "gaia" \rightarrow ARI-Gaia or [ESA] GAIA \triangleright
 - Docs: http://www.starlink.ac.uk/topcat/sun253/TapTableLoadDialog.html



Table Access Protocol (TAP) Query Window TAP Registry Edit Interop Help

Select Service Use Service Resume Job Running Jobs

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Query Language: ADQL-2.0 👻 Max Rows: 100000 (default) 💌 Uploads: 1000krow,

parallax

2 X

📰 gaiadr1.aux_qso_icrf2_r

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📰 gaiadr1.phot_variable_ti 💻

🎹 gaiadr1.variable_summa 🕶

📰 gaiadr1.cepheid

🃰 gaiadr1.rrlyrae

🎹 gaiadr1.gaia_source

🌐 gaiadr1.tgas_source

Ĉ

🗹 Name 📃 Descrip

🔶 📑 gaiadr1 (8)

-Service Capabilities

Mode: Synchronous

SELECT TOP 50000

gaia.source_id, gaia.hip,

ADQL Text-

1

X

-Metadata

Find:

Info 🗳

Data Access: TGAS Download

Use monolithic TGAS FITS file

- Details:
 - Download to local disk, e.g.: http://andromeda.star.bristol.ac.uk/data/tgas_source.fits
 - \triangleright Size: 2057050 rows imes 60 columns, \sim 660 Mb
- Suitability:
 - ▷ Good size for TOPCAT (unlike gaia_source, \sim 325 Gb)
 - ▷ If you want all TGAS data, this may be the easiest way to use it in TOPCAT
- Usage
 - Load into TOPCAT using a Load window or from command line (instantaneous)

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Table List	Current Table Properties
1: tgas_source.fits	Label: tgas_source.fits
	Location: /data/andromeda1/data/gaiadr1/tgas_source.fits
	Name: sync
	Rows: 2,057,050
	Row Subset: All
	Activation Action: (no action) Broadcast Row
	[SAMP
53 / 5339 M	Messages: Clients: 💽 🌺 🔊 🖉

Mark Taylor, Use of Gaia DR1 Data with TOPCAT, Gaia DR1 Workshop, Edinburgh, 14 November 2016

Data Access: Others

Other ways to get Gaia DR1 data into TOPCAT:

- ARI-Gaia web page (http://gaia.ari.uni-heidelberg.de/)
 - ▷ nice GUI
 - ▷ precalculated statistics, single source search + TAP, Cone Search, more to come
- CDS X-Match web page (http://cdsxmatch.u-strasbg.fr/xmatch)
 - ▷ allows VizieR/Gaia crossmatch as well as local/Gaia crossmatch
- VizieR (http://vizier.u-strasbg.fr)
 - ▷ Standard CDS interface + API (including access from TOPCAT)
- Gaia@AIP (https://gaia.aip.de/)
 - Scriptable multi-threaded MySQL queries (beta)
- And more ...

Example A: Pleiades distance

Determine parallax of Pleiades (following Gaia-DR1 paper)

- Cone search TGAS within 5° of Pleiades
- Plot pmra vs pmdec
- Identify comoving sources, create subset graphically
- Plot parallax histogram of comoving subset
- Restrict subset further to exclude parallax outliers
- Use Statistics window to determine cluster μ_{arpi} , σ_{arpi}
- Visualise cluster and non-cluster sources: in 3d space, showing proper motions

A.1: TGAS Cone Search

Cone Search					
<u>Y</u> indow <u>C</u> olumns <u>R</u> egistry <u>I</u> nterop <u>H</u> elp					
Available Cone Services					
Registry: http://reg.g-vo.org/tap					
Keywords: tgas And					
Match Fields: 🗹 Short Name 🗹 Title 🗹 Subjects 🔽 ID 🗹 Publisher 🗌 C					
Accept Resource Lists Cancel Find Services					
A Short Name Title Subjects Identifie					
AccessURL Description Version					
http://gala.an.un=heldet					
Resource Count: 1					
Cone Parameters					
Cone URL: http://gaia.ari.uni-heidelberg.de/cone/tgas					
Object Name: pleiades Resolve					
RA: 56.75 degrees ▼ (J2000) ✓ Accept Sky Positions					
Dec 24.1167 degrees 🔻 (J2000)					
Radius: 5 degrees 💌					
Verbosity: 2 (normal)					
ОК					

- \bullet Want to query TGAS sources within 5° of Pleiades
- Use TOPCAT Cone Search window:
 - ▶ **† VO|Cone Search** menu item
 - ▷ Keywords: "tgas"
 - ▷ Object Name: "pleiades" + Resolve
 - ▶ Radius: "5"
- ... there are other ways to do it

A.2: Proper motion plot



- Plot sources in proper motion space:
 - Graphics Plane Plot menu item or toolbar button
 - ▷ X: "pmra"
 - ▷ Y: "pmdec"
 - \triangleright Note overdensity far from (0,0)
- Graphically select this comoving cluster as new Subset



New Subset Name: "comoving" + Add Subset

A.3: Parallax histogram



- Plot parallax histogram of comoving subset
 - ▶ **Graphics**|**Histogram plot** menu item or toolbar button
 - ▷ X: "parallax"

A.4: Exclude proper motion outliers



- Restrict comoving subset further to exclude parallax outliers
 - Views | Row Subsets menu item or toolbar button
 - toolbar button to create new algebraic subset
 - Subset Name: "cluster"

A.5: Cluster parallax statistics

- TOPCAT(1): Row Statist	tics					
Window Export Statistics [<u>)</u> isplay <u>H</u> elp					
]					
	_					
Row Statistics for 1: 1474368	0801740					
Name	Mean	SD				
hip	17492.	584.896	^			
tycho2_id						
solution_id	1.63538E18	0.	163537 🚃			
source_id	6.61832E16	5.69506E15	5090			
random_index	9.87840E5	5.98892E5				
ref_epoch	2015.	0.				
ra	56.4515	1.4508				
ra_error	0.373915	0.14705				
dec	23.8886	1.52508				
dec_error	0.180145	0.07722				
parallax	7.47807	0.402918				
parallax_error	0.348833	0.136904				
pmra	20.3032	1.55738				
pmra_error	0.70497	0.604852				
pmdec	-45.3699	1.85324				
nmdec error	0 357085	0 259462				
Subset for calculations: cluster						
4						

- Σ Views Column Statistics menu item or toolbar button
- Subset for Calculations: "cluster"
- See Mean and Stdev columns for parallax
- \rightarrow Pleiades $\mu_{\varpi} \approx 7.5 \pm 0.4$ mas
 - $ightarrow \mu_D pprox 1000./7.5 pprox 133 \pm 7 \,
 m pc$
 - ▷ ... but careful with priors
 - ▷ ... but $\sigma_{\varpi}/\varpi < 0.15$ for all cluster members (exercise: show this!) so it's probably OK

A.6: 3d cluster positions



- Graphics Sphere Plot menu item or toolbar button
- **Subsets** tab: select cluster subset only
- Lon: "ra"
- Lat: "dec"
- Radius: "1./parallax"
- Cluster positions are visible in 3d space
- You can turn on All/comoving subsets too

A.7: Visualise proper motions



- Graphics Sky Plot menu item or toolbar button
- Add new SkyVector form in Form tab
- Delta Longitude: "pmra"
- Delta Latitude: "pmdec"
- See the little arrows showing proper motion

Example B: Crossmatch with local catalogue

Match with Gouliermis et al. 2006 (NGC 346 HST/ACS photometry) (2006ApJS..166..549G)

- Find and download J/ApJS/166/549/table2 from VizieR load window
 - ▷ ... or any other way to load a positional catalogue in topcat
- Use CDS XMatch window to match with GAIA DR1 (Find mode: All)
- Sky plot of Gouliermis and Gouliermis/Gaia matched pairs (many counterparts)
- Plot histogram of angDist (spike near 0.3)
- Plot _RAJ2000-ra vs. _DEJ2000-dec
- Identify modal $(\Delta lpha, \Delta \delta)$
- Trace new subset to identify probable matches
- Now you have:
 - ▷ NGC 346 proper motion estimate
 - \triangleright G magnitudes for Gouliermis sub-sample ($\sim 1\,800/99\,000$ sources)

B.1: Acquire NGC 346 catalogue

VizieR Catalog	ue Service				
<u>W</u> indow <u>H</u> elp					
× 🔉 🗙					
└─VizieR Server───					
Server: http://vizi	ier.u-strasb	g.fr/	-		VIZIE
Row Selection					
Cone Selection	1				
Object Name:	ngc346			Resolve	
RA: 14.77	1207		degrees 🔻	()2000)	
Dec -72.1	.759		degrees 🔻	()2000)	
Radius: 1			degrees 🔻	•	
○ All Rows			II	_	
Maximum Row Co	unt: 10000	0	-		
Column Selection]
Outnut Columns:	standard			-	
Catalogue Selecti	on				
By Category	By Keyword	Surve	ys Mission	s	
Keywords: Goulie	ermis				
Sub-Table D	etalls 🔄 In	clude Ob	solete Lables		Casarda
	Development	Sea	artri Catalogu	es Canter	Search
∆ Name]/A+A/515/A56	Popularity 721	Density 66	NGC 346/N66	Descript JHKs photometry	ion / (Goulierm
J/ApJ/672/914	1048	10	HST photomet	ry in NGC 346 (H	ennekemp
J/ApJ/762/123	1368	271	PHAT. IV. Initia	al Mass Function (protions of NGC 2	Weisz+, 20
J/ApJJ/100/545	1 2021	271	In TACS ODSE		
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- Load catalogue from VizieR:
 - VO|VizieR Catalogue Service menu item
 - ▶ **All Rows** check box
 - ▶ Maximum Row Count: 100 000
 - Locate and load Gouliermis et al. 2006 (J/ApJS/166/549)
- Or grab it from CDS VizieR web page

B.2: Crossmatch with Gaia

CDS Upload X-Match
<u>W</u> indow Search <u>H</u> elp
Remote Table
VizieR Table ID/Alias: GAIA DR1
Name: I/337/gaia 🔹 💿
Alias: GAIA DR1
Description: GaiaSource data ({\bf Download } Gaia Sources as \
Row Count: 1,142,679,769
Coverage: 0.9999797 (order 6)
Local Table
Input Table: 2: ngc346.fits 🗨
RA column: _RAJ2000 🔽 degrees 💌 (J2000)
Dec column: _DEJ2000 💌 degrees 💌 (J2000)
Match Parameters
Radius: 2 arcsec 💌
Find mode: All
Rename columns: Duplicates 🔻 Suffix: _x
Block size: 50000 💌 🕩
Go Stop

- XO|CDS Upload X-Match menu item or toolbar button
- Vizier Table ID: "GAIA DR1"
- Radius: "1" arcsec
- Find mode: All

B.3: Plot crossmatch results



- Graphics Sky Plot menu item or toolbar button
- 🔅 Plot NGC 364 points
- Plot Gaia↔Gouliermis associations
 ([Goul] _RAJ2000, _DEJ2000, [Gaia] ra, dec)
- ... too many

B.4: Plot crossmatch offsets



- Graphics Histogram plot menu item or toolbar button
- X: "angDist" (Gaia—Gouliermis association distance)
- (some) true associations near 0.35 arcsec

B.5: Identify true matches



- Plot matches in xmatch offset space:
 - Graphics Plane Plot menu item or toolbar button
 - ▷ X: "_RAJ2000 ra"
 - ▷ **Y:** "_DEJ2000 dec"
- Obvious overdensity corresponds to true offset
 - Select new subset true_match graphically

B.6: Visualise true matches



- Return to sky plot
- **Subsets** tab: select true_match only
- Common association vector,

= $(\overline{\Delta \alpha}, \overline{\Delta \delta})$ in true_match subset, is displacement between Gouliermis (2004.6) and Gaia (2015.0) observations:

$$\overline{\cos \delta \Delta \alpha} \approx +210 \pm 20 \,\mathrm{mas}$$

 $\overline{\Delta \delta} \approx -284 \pm 15 \,\mathrm{mas}$

so proper motion:

$$\mu_{\alpha^{\star}} \approx +20.2 \pm 2 \,\mathrm{mas.yr}^{-1}$$

 $\mu_{\delta} \approx -27.3 \pm 1 \,\mathrm{mas.yr}^{-1}$

(or maybe not ... HST absolute astrometry?)

B.7: Combine HST and Gaia photometry



 Joined table now has Gaia G-band photometry alongside HST V/I-band photometry

Example C: TGAS-Hipparcos CMD

Use ARI **Example** query to generate fig 3 of Gaia DR1 paper

- Point TOPCAT TAP client at ARI-Gaia service
- Use Examples | Service-Provided | Gaia DR1 Color and Magnitude menu
- Plot Hipparcos B V vs absolute Gaia G
- Adjust TAP query to get more columns
- Colour-code points in CMD by parallax? galactic latitude?

C.1: Locate Gaia TAP service

Table Access Protocol (TAP) Query		
<u>W</u> indow <u>T</u> AP Registry <u>E</u> dit <u>I</u> nterop <u>H</u> elp		
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Select Service Use Service Resume Job Runn	ing Jobs	
Du Table Properties		
by rable riopercies by service riopercies		
Keywords: gaia		And
Match Fields: 🕑 l'able Name 🕑 l'able Descriptio	Cancel	E Find Convicor
	Calicer	Tinu Services
GAIA (3/42) - ivo://esavo/gaia/tap		
Selected TAP Service		
TAP URL: http://gaia.ari.uni-heidelberg.de/tap		
		Use Service
Run Query		

- WO Table Access Protocol (TAP) Query menu item or toolbar button
- Select Service tab, Keywords: "gaia"
- Select ARI-Gaia
- Hit Use Service button/tab

C.2: Execute Example CMD query

Table Access Protocol (TAP) Query						
Window <u>T</u> AP Registry <u>E</u> dit <u>Interop</u> <u>H</u> elp						
Select Service Use Service Resume Job Running Jobs						
_Metadata						
Find:	Service Schema	🛛 🔿 Table 🖉	Column	s O FH	Keys Hints	
🖌 🖌 Name 🔄 Descrip 🛛 🛛 🛛	Name	DataTvpe	Indexed	Unit		
	source_id	BIGINT	V		Unique source it 🔺	
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🚽 🗕 🧰 gaiadr1.cepheid	1	DOUBLE	V	deg	Galactic longituc	
📕 🗕 🎹 gaiadr1.gaia_source	b	DOUBLE	*	deg	Galactic latitude	
🚽 🗕 📰 gaiadr1.phot_variable_ti	ecl_lon	DOUBLE	*	deg	Ecliptic longitude	
— 🎟 gajadr1.phot variable ti =	ecl_lat	DOUBLE	*	deg	Ecliptic latitude	
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ajadr1 variable summ	pmdec	DOUBLE	~	mas/yr	Proper motion ir 🚽 📗	
	▲ III					
	•					
Service Capabilities						
Query Language: ADQL-2.0 💌 Ma	x Rows: 100000 (default)) 🔻 Uploads:	1000krd	w/		
ADQL Text						
Mode: Synchronous V						
Mode: Synchronous V	-4	Ģ L <u>-</u>		'') ["		
Mode: Synchronous	L .			<u>יי</u> ט וויי		
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Mode: Synchronous	netric parameters th Galactic coordinates indices or and magnitude 1/2 or and magnitude 2/2 sity by magnitude	G g_mag_abs_g abs_hip, ip.hip nd magnitude 1	aia,			
Mode: Synchronous	netric parameters th Galactic coordinates indices or and magnitude 1/2 or and magnitude 2/2 sity by magnitude ades density by parallax	i g_mag_abs_g b_abs_hip, nd magnitude 1	aia,	עי עי		
Mode: Synchronous	netric parameters ch Galactic coordinates indices or and magnitude 1/2 or and magnitude 2/2 sity by magnitude ades density by parallax Run Quer	<pre>i g_mag_abs_g abs_hip, p_hip nd magnitude 1</pre>	aia,	עי 		

- Use **Examples** menu near bottom of window
- Select Service-provided—Gaia DR1 Color and magnitude
- See ADQL is entered in window
- Hit Run Query to execute it

C.3: Plot CMD



- Graphics Plane Plot menu item or toolbar button
- X: "b_v"
- Y: "g_mag_abs_gaia"
- 🚛 Axes control, use Y Flip checkbox
 - ... it's almost too easy.

C.4: Customise ADQL and re-execute

Table Access Protocol (TAP) Q	uery		· • • •		
Window TAP Registry Edit Interop	o <u>H</u> elp				
🖋 🖒 🖓 🗙					
Calact Canvica Usa Canvica Dasu	ma lab				
Select Service Use Service Resu	me job Kunning jobs				
Metadata					
	Columns OFKeys	Hints			
Name Descrip Or	Service Sche	ema	® Table		
🔶 📑 gaiadr1 (8)	Name	DataType	Indexed		
📙 🔚 gaiadr1.aux_qso_icrf2_r	source_la				
🚽 🗕 🔠 gaiadr1.cepheid	dec	DOUBLE			
📃 🗕 🖽 gaiadr1.gaia_source	1	DOUBLE	v		
🚽 🚽 — 🏢 gaiadr1.phot_variable_ti	b	DOUBLE	v		
🚽 🚽 🔠 gaiadr1.phot_variable_ti =	ecl_lon	DOUBLE	<u> </u>		
— 🏾 gaiadr1.rrlyrae 📃	eci_lat	DOUBLE	<u> </u>		
- III gaiadr1.tgas_source	nmra				
gaiadr1.variable_summer		DOODLE			
-Service Capabilities					
Query Language ADOL-2.0 - Ma	Powe: 100000 (default)	- Unloads	• 1000krow(
ADOL Text	x Kows. 100000 (acraalo	opioaus	. 1000101010		
ADQL TEXT					
Mode: Synchronous 👻 👍	📬 💷 🕋 🧷 🥱		Eors		
SELECT TOP 50000			^		
gala.source_ru, gala.hip.					
gaia.phot_g_mean_mag+5*10	g10(gaia.parallax)-10 AS g	<u>;_mag_abs_g</u>	yaia, 💻		
gaia.phot_g_mean_mag+5*10	g10(hip.plx)-10 AS g_mag_a	abs_hip,			
hip.b_v,	in h				
FROM gaiadr1.tgas source AS gaia	1a. D				
INNER JOIN extcat.hipparcos	AS hip ON gaia.hip = hip.	hip	-		
Examples I I			Info 🗳		
Run Query					

- Back to TAP window, customise the query
- Request also gaia.parallax, gaia.l, gaia.b, more?
- Query again

C.5: Use customised query results



- Adjust the plot
- Use Weighted or Aux mode to colour points
- Find anything interesting? (maybe not)

Example D: All-sky density

Statistical/density maps of all TGAS/gaia sources

- Load tgas_source.fits
- Sky marker plot: tweak projection, view sky-system etc
- Source densities using shading modes: flat, auto, density
- Statistical plots of parallax_error, phot_g_n_obs, hypot(pmra_error,pmde_error),
 ... using shading modes aux, weighted

D.1: Display weighted TGAS all-sky plots



- Weighted phot_g_n_obs in ecliptic coords
- Weighted parallax_error in galactic coords
- Plot interactive 2Mrow density map in a few seconds



Most of TOPCAT's capabilities can be scripted

- STILTS: from command line (e.g. un*x shell)
- JyStilts: from Jython (python interface, but not CPython)

Details

- Not covered in this talk!
- But some examples available:

See http://www.star.bristol.ac.uk/~mbt/gaia/tutorial.html

• Full documentation and examples in http://www.starlink.ac.uk/stilts/



- Lots of ways to get Gaia data into TOPCAT
 - Different ones most suitable for different situations
- Lots of things you can do with it once it's there
 - Play around with plots
 - Use documentation
 - Support on mailing list, email me, ...
- Scriptable access/manipulation available using STILTS or JyStilts
- Materials: http://www.star.bristol.ac.uk/~mbt/gaia/tutorial.html