Use of Gaia DR1 data from TOPCAT

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Gaia DR1 Workshop IoA Cambridge

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TOPCAT

• very short intro

Accessing Gaia-DR1 Data from TOPCAT

- GACS 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/
```



Mark Taylor, Use of Gaia DR1 Data with TOPCAT, Gaia DR1 Workshop, IoA Cambridge, 27 September 2016

Data Access: GACS

GACS Web interface

- Details
 - b 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
 - ▷ large compute resources
 - ▷ ...

🖻 Gaia > Gaia Scier	n 🗴 💽 Gaia > Gaia	DR1 🗙 💽 Gaia	Archive ×	🛯 🔄 Index of	file:///mbt	× ÷
() gea.esa	ac.esa.int/archive/		C 🗖		ρ 🖡	
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nple Form ADQL F	orm Query Results					
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	Name pleiades	for Simba	-	Radius 5	deg	
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Display columns						
	sults: 500 v	Reset Form	Show Query		Submit Que	rv –
Max number of re		Repet Form	Show Query		Cubinit Que	,
Max. number of re						

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

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>Window Columns Registry Interop H</u> elp	
🖉 🗊 🗙	
Available Cone Services	
Registry: http://reg.g-vo.org/tap	▼ O RegTAP ▼
Keywords: tgas	And
Match Fields: 🗹 Short Name 🗹 Title 🔽 Subjects 🔽 II) 🗹 Publisher 🔲 C
Accept Resource Lists Cancel	Find Services
△ Short Name Title Subjects	Identifie
AKI-Gaia AKI'S I GAS Cone Search Service GAS V0	.//uni-heideiberg.de/1
AccessURL Description	Version
http://gaia.ari.uni-heidel	
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	

Data Access: CDS X-Match

Use TOPCAT's CDS Upload X-Match window

- Details:
 - Fast, scalable service for crossmatching VizieR tables
 - Description 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 GACS/ARI TAP services, and other non-Gaia TAP servers
 - Similar functionality, different GUI to GACS web interface
- Suitability:
 - ▷ Suitable for ADQL queries
 - Better integrated into TOPCAT than GACS 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, ...)
 - ▷ Limits: 10^5 rows (GACS), 10^7 rows (ARI)
- Usage:
 - ▷ 📾 VO Table Access Protocol (TAP) Query menu item or toolbar button
 - \triangleright Select Service **Keywords**: "gaia" \rightarrow ARI-Gaia or [ESA] GAIA
 - Docs: http://www.starlink.ac.uk/topcat/sun253/TapTableLoadDialog.html

Select Service Use Service	Resu	ime Job Running Jobs			
Metadata					
Find:		Columns O FKeys	Hints		
🗹 Name 📃 Descrip	Or	Service Service	chema 👘	Table	
🔶 📑 gaiadr1 (8)	§	Name	DataType	Indexed	1
– 🃰 gaiadr1.aux_qso_id	rf2_r	source_id			
- III gaiadr1.cepheid	1000	der.			
- 📰 gaiadr1.gaia_sourc	e 🔤	1	DOUBLE	~	
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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)

TOPCAT	
<u>File V</u> iews <u>G</u> raphics Joins <u>W</u> indows <u>V</u> O <u>I</u> nterop <u>H</u> elp	
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	
Columns: 59	
Sort Order: 🔶 🗖	
Row Subset: All 💌	
Activation Action: (no action) 🗌 Broadcast Row	
rsamp	
53 / 5339 M Messages: O Clients: Image: Clients:	

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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}
- Plot cluster and non-cluster sources in 3d space

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 (norma)
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 proper motion statistics

- TOPCAT(1): Row Statist	tics							
<u>W</u> indow Export <u>S</u> tatistics <u>D</u> isplay <u>H</u> elp								
Row Statistics for 1: 1474368	Row Statistics for 1: 14743680801740							
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	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 calculation	ons: cluster	-						
			-					

- **∑** Views|Column Statistics menu item or toolbar button
- Subset for Calculations: "cluster"
- See Mean and Stdev columns
- \rightarrow pleiades parallax $pprox 7.5 \pm 0.4$ mas
- careful with priors if converting to distance
- ... but parallax_error/parallax is quite high for all cluster members

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

Example B: Crossmatch with local catalogue

Match with Gouliermis et al. 2006 (NGC 346 HST/ACS photometry)

• Find and download J/ApJS/166/549/table2 from VizieR load window

 \triangleright ... 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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			ок		

- 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 & Gaia observations (1992?-2015.0):

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

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

so proper motion:

$$\mu_{lpha^{\star}} \approx -9.1 \,\mathrm{mas.yr}^{-1}$$

 $\mu_{\delta} \approx 12 \,\mathrm{mas.yr}^{-1}$

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		
📌 🖄 🖓 🗙		
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						
<u>W</u> indow <u>T</u> AP Registry <u>E</u> dit <u>I</u> nterop <u>H</u> elp						
Select Service Use Service Resu	ime 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 🔺	
🕈 🖂 gaiadr1 (8)	ra	DOUBLE	~	deg	Right ascension 🔚	
🚽 🕂 🔠 gaiadr1.aux_qso_icrf2_r	dec	DOUBLE	~	deg	Declination	
🚽 🗕 🧰 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	
- III gajadr1 rrivrae	parallax	DOUBLE	~	mas	Parallax	
- III gajadr1 toas source	pmra	DOUBLE	~	mas/yr	Proper motion in	
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	-4	Ģ L <u>-</u>		'') ("		
Mode: Synchronous	L .			<u>יט</u> (די		
Mode: Synchronous 1 SELECT TOP 50000 gala source id	- *			יי ט וויי		
Mode: Synchronous	netric parameters			v) (*		
Mode: Synchronous	netric parameters	g_mag_abs_g	aia,			
Mode: Synchronous	netric parameters th Galactic coordinates indires	g_mag_abs_g g_abs_hip,	aia,	'U ("		
Mode: Synchronous	netric parameters th Galactic coordinates indices	i g_mag_abs_g	aia,	'U ("		
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Mode: Synchronous	netric parameters th Galactic coordinates indices or and magnitude 1/2 or and magnitude 2/2	<pre> g_mag_abs_g _abs_hip, p.hip </pre>	aia,	יז) ניי 		
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 p_abs_hip, p_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 וויי		
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 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) Query							
Window <u>T</u> AP Registry <u>E</u> dit <u>Interop</u> <u>H</u> elp							
💉 🖸 😒							
Select Service Use Service Resu	ime Job Running Jobs						
[Metadata			-11				
Find:	Columns O FKeys	Hints	_				
🖌 Name 📃 Descrip 🛛 🛛 🛛 🛛 🛛 🗖	Service Sch	ema 🛛 🖲 Table					
• 🗖 gajadr1 (8)	Name	DataType Indexed					
aiadr1.aux_gso_icrf2_r	source_id						
- 🗐 qaiadr1.cepheid	ra dec						
🚽 🗕 🖩 gaiadr1.gaia_source	I	DOUBLE V					
🚽 🚽 🖩 gaiadr1.phot_variable_ti	b	DOUBLE 🖌					
🚽 🚽 — 🏢 gaiadr1.phot_variable_ti =	ecl_lon	DOUBLE 🖌					
🚽 🗕 🖩 gaiadr1.rrlyrae 📃	ecl_lat						
- 🌐 gaiadr1.tgas_source	nmra						
📃 🔚 gaiadr1.variable_summa 💌			-				
Service Capabilities							
Ouery Language: ADOL-2.0 - Ma	x Rows: 100000 (default)	✓ Uninads: 1000kroy	NI				
ADOL Text		oprovasi					
Mode: Synchronous 💌 🖬	[🔂 💶 👛 🧷 🥱	I 🔊 III 🖸 🚺					
	11						
SELECT TOP SOCOO		I					
gaia.source id.							
gaia.hip,							
gaia.phot_g_mean_mag+5*10	g10(gaia.parallax)-10 AS	g_mag_abs_gaia,					
hin h y	gio(nip.pix)-io AS g_mag_	aus_nip,					
gaia.parallax, gaia.b, ga	ia.b						
FROM gaiadr1.tgas_source AS gaia							
INNEK JUIN extcat.nipparcos	AS hip UN daia.hip = hip	.n1p					
Examples ()		Info 🖾					
e <u> </u>	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