

**GENIUS Final Meeting:
WP 440 (VO Tools and Services)
UBR (University of Bristol)**

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Sitges
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Context

- Table analysis software developed in Bristol:
 - TOPCAT: interactive GUI tool for analysis of tables/catalogues
 - STILTS: command-line/batch counterpart of TOPCAT
 - Capabilities: Data acquisition (including VO), visualisation, crossmatching, calculations, manipulation
 - Features: fast, large datasets, easy to use/install, open source
 - Leading science tools used in astronomy for catalogue work (thousands of users in Europe and worldwide)
 - Gaia archive:
 - Key dataset expected to benefit all areas of astronomy
- ⇒ Requirement:
- Ensure seamless access to Gaia archive from these tools

Resources

- Effort: 3 months \times 1 FTE (Mark Taylor at UBR)

TOPCAT/Gaia Data Access Overview

- Approach

- Use existing standard data access methods where applicable (don't reinvent the wheel)
- Make sure these function to allow optimal use of Gaia data from TOPCAT/STILTS

- Specifics

- Use existing Table Access Protocol (TAP) client in TOPCAT for custom access to Gaia archive
- Develop new client for CDS X-Match Upload service for bulk positional crossmatches with local tables



Table Access Protocol

- Suite of protocols developed by IVOA (International Virtual Observatory Alliance)
- In wide use for (especially) large and complex astro catalogue holdings
- Allows remote execution of SQL-like queries
- Includes upload of local tables to remote (Gaia) database for, e.g., crossmatches

Implementation context

- TOPCAT had pre-existing working TAP client
- ESAC provides TAP+ interface to DR1 Gaia catalogue
- Gaia catalogue is also available from other TAP services (CDS, ARI, more?)

GENIUS work

- Ensure that TOPCAT client works well with GACS TAP+ implementation
- Work with GACS team to run service validators (developed at UBR) as part of service release/deployment cycle, identify and fix TAP bugs/issues
- Ensure that TOPCAT client works well with other Gaia-hosting TAP services (especially at partner data centers, e.g. ARI)

TAP

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	Columns	FKeys
hip				Hipparcos identifier
tycho2_id				Tycho 2 identifier. T
solution_id				All Gaia data process
source_id				A unique single name
random_index				Random index which
ref_epoch	DOUBLE	Time[Julian ...		Reference epoch to v
ra	DOUBLE	Angle(deg)		Barycentric right asc
ra_error	DOUBLE	Angle(mas)		Standard error \sigm
dec	DOUBLE	Angle(deg)		Barycentric declinatio
dec_error	DOUBLE	Angle(mas)		Standard error \sigm
parallax	DOUBLE	Angle(mas)		Absolute barycentric
parallax_error	DOUBLE	Angle(mas)		Standard error \sigm
pmra	DOUBLE	Angular Vel...		Proper motion in righ

Service Capabilities

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

ADQL Text

Mode: Synchronous

```

1
SELECT TOP 50000
  gaia.source_id,
  gaia.hip,
  gaia.phot_g_mean_mag+5*log10(gaia.parallax)-10 AS g_mag_abs_gaia,
  gaia.phot_g_mean_mag+5*log10(hip.plx)-10 AS g_mag_abs_hip,
  hip.b_v
FROM gaiadr1.tgas_source AS gaia
  INNER JOIN public.hipparcos AS hip ON gaia.hip = hip.hip
WHERE gaia.parallax/gaia.parallax_error >= 5
  AND hip.plx/hip.e_plx >= 5
  AND hip.e_b_v > 0.0
  AND hip.e_b_v <= 0.05
  AND 2.5/log(10)*gaia.phot_g_mean_flux_error/gaia.phot_g_mean_flux <= 0.05;

```

Run Query

Plane Plot

Window Layers Subsets Plot Export Help

g_mag_abs_hip

b_v

Position: 0.27, 4.5 Count: 36,268 / 36,281

Frame Legend Axes

Table: 1: TAP_1_gaiadr1.tgas_source,public.hipparcos

X: b_v

Y: g_mag_abs_hip

Select Pan X/Y Stretch X/Y Frame X/Y Zoom Iso

CDS X-Match

X-Match service deployed by Centre de Données astronomique de Strasbourg

- Performs very fast standard positional crossmatches between CDS table and user-uploaded tables ($\lesssim 1$ Mrow)
- CDS/VizieR hosts Gaia catalogue (partner data center)

GENIUS work

- Develop TOPCAT/STILTS user interfaces to X-Match service
 - ▷ this makes it easy to match local catalogues with Gaia observations
 - ▷ client-side chunking allows crossmatch of arbitrarily large tables (STILTS)
 - ▷ it will also benefit non-Gaia data users

CDS X-Match

CDS Upload X-Match

Window Search Help

Remote Table

VizieR Table ID/Alias: GAIA DR1

Name: I/337/gaia

Alias: GAIA DR1

Description: GaiaSource data (Download) Gaia Sources as vo 1

Row Count: 1,142,679,769

Coverage: 0.9999797 (order 6)

Local Table

Input Table: 4: IL_328_allwise

RA column: _RAJ2000 degrees (J2000)

Dec column: _DEJ2000 degrees (J2000)

Match Parameters

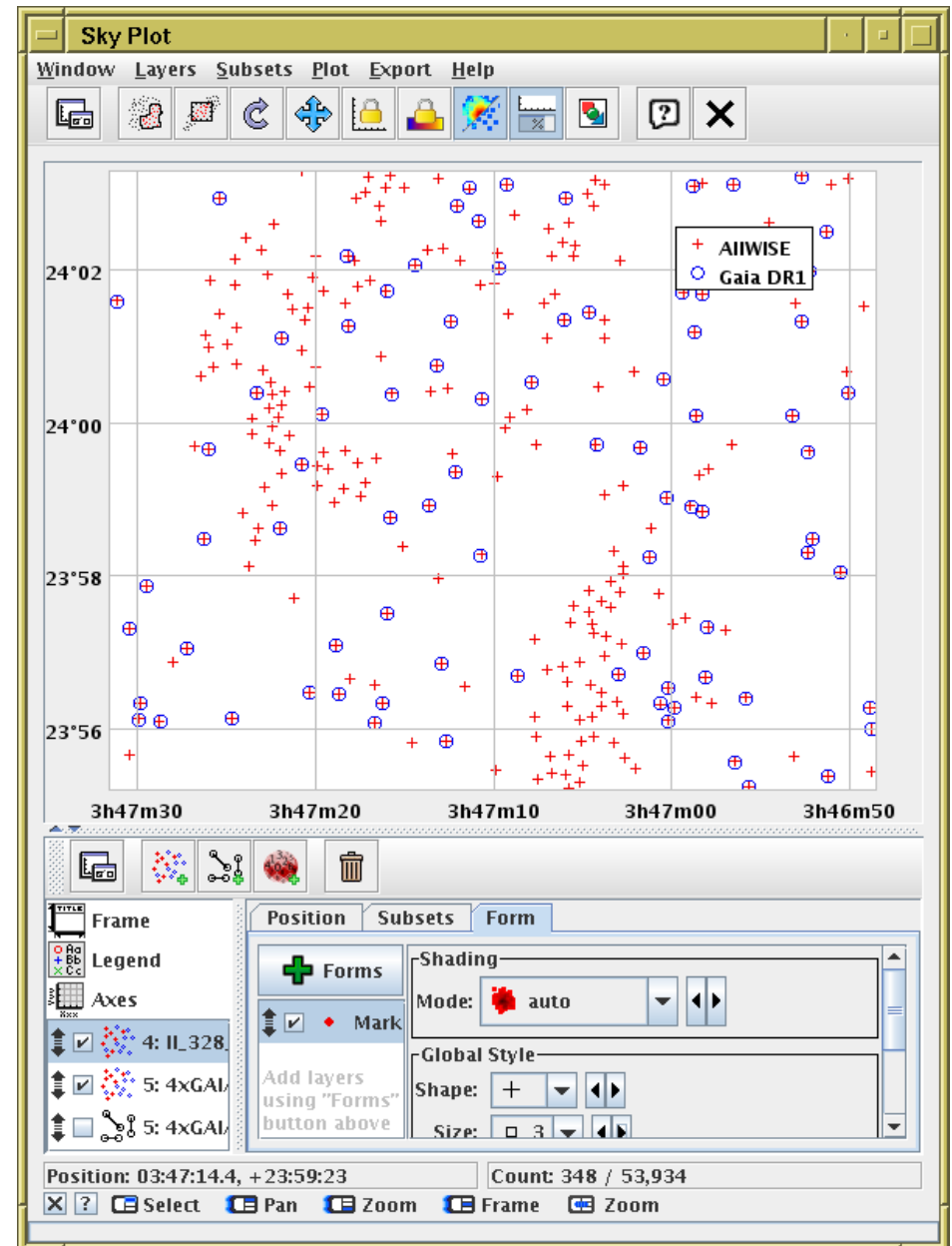
Radius: 1.0 arcsec

Find mode: Best

Rename columns: Duplicates Suffix: _X

Block size: 50000

Go Stop



Status

Status of planned work (complete):

- ✓ TOPCAT TAP window: works with Gaia DR1 data from GACS & ARI (GACS makes routine use of `taplint` validation from v0.5, Dec 2014)
 - ✓ TOPCAT CDS X-Match window, STILTS `cdsskymatch` command: works with Gaia DR1 (from TOPCAT v4.2/STILTS v2.5-3, July 2014)
- Both features are in use by community for Gaia DR1 access

Additional activities:

- Miscellaneous support (answer technical queries) to GENIUS partners
- Some additional travel
- Stay in contact with GENIUS partners to provide user support for this work, and inform future non-GENIUS work on TOPCAT