Advanced TOPCAT
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TOPCAT & STILTS

- Both do basically the same things but

  - TOPCAT

- Easier to learn.

- Good for interactive use, especially exploring data to get a feel for what's there.

  - STILTS

- Better for reproducible work (it can be scripted). Steeper learning curve.

TOPCAT & STILTS

- Which is the best format?

    - Small table (<1000 rows): doesn't matter.

    - Medium-sized (rows*cols) < 20million): FITS.

    - Big (millions of rows, especially with lots of columns): colfits.

- If the input file is not in this format you can convert it using STILTS:

    - *stilts tpipe in=xxx.csv ifmt=csv out=xxx.fits*

TOPCAT & STILTS

- ## Output in Latex

TOPCAT & STILTS

- Concatenating tables in TOPCAT
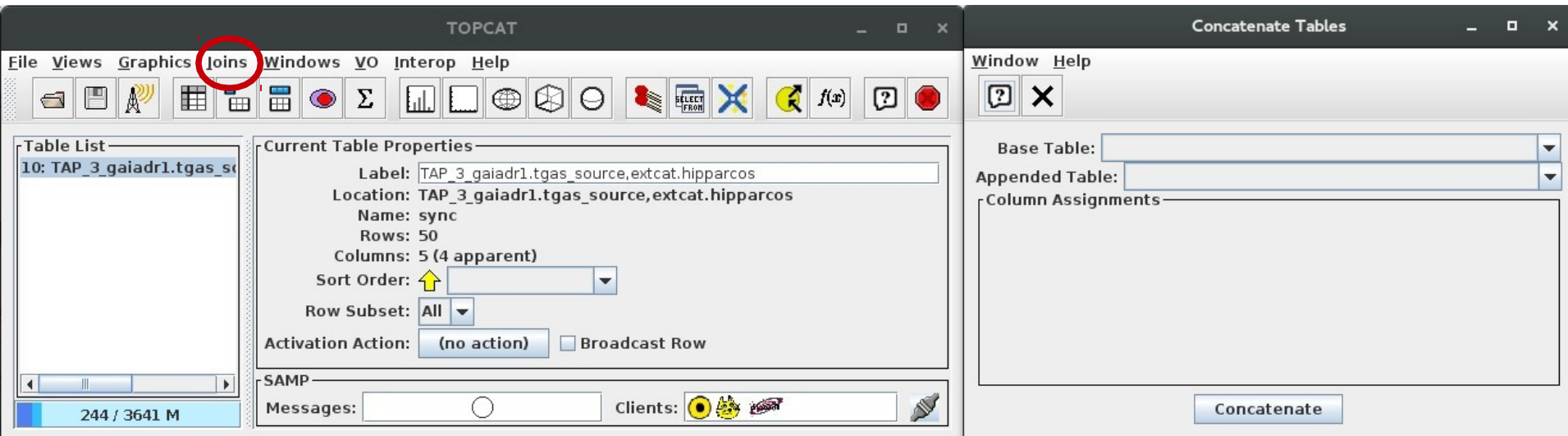
- Only two tables at a time.

TOPCAT & STILTS

- Concatenating multiple tables in STILTS

B.24.2 Examples

Here are some examples of `tcat`:

```
stilts tcat ifmt=ascii in=t1.txt in=t2.txt in=t3.txt out=table.txt
```

Concatenates the three named ASCII format tables to produce an output table. All three must have compatible numbers and types of columns.

```
stilts tcat ifmt=ascii in="t1.txt t2.txt t3.txt" out=table.txt
```

Has exactly the same effect as the previous example.

```
stilts tcat ifmt=ascii in=@inlist.lis out=table.txt
```

This will have the same effect as the previous two examples if a file name "inlist.lis" in the current directory contains three lines, "t1.txt", "t2.txt" and "t3.txt".

- Same input format
- Similar columns (in number and class).

TOPCAT & STILTS

- ## Concatenating multiple tables in STILTS

```
stilts tcatn nin=2 in1=survey.vot.gz ifmt2=csv in2=more_data.csv
            icmd1='addskycoords fk5 galactic RA2000 DEC2000 GLON GLAT' \
            icmd1='keepcols "OBJ_ID GLON GLAT"' \
            icmd2='keepcols "ident gal_long gal_lat"' \
            loccol=FILENAME
            omode=topcat
```

In this case we are trying to concatenate results from two tables which are quite dissimilar to each other. In the first place, one is a VOTable (no `ifmt1` parameter is required since VOTables can be detected automatically), and the other is a comma-separated-values file (for which the `ifmt2=csv` parameter must be given). In the second place, the column structure of the two tables may be quite different. By pre-processing the two tables using the `icmd1` & `icmd2` parameters, we produce in each case an input table which consists of three columns of compatible types and meanings: an integer identifier and floating point galactic longitude and latitude coordinates. The second table contains such columns to start with, but the first table requires an initial step to convert FK5 J2000.0 coordinates to galactic ones. `tcatn` joins the two doctored tables together, to produce a table which contains only these three columns, with all the rows from both input tables, and sends the result directly to a new or running instance of TOPCAT. An additional column named FILENAME is appended to the table before sending it; this contains "survey.vot.gz" for all the columns from the first table and "more_data.csv" for all the columns from the second one.

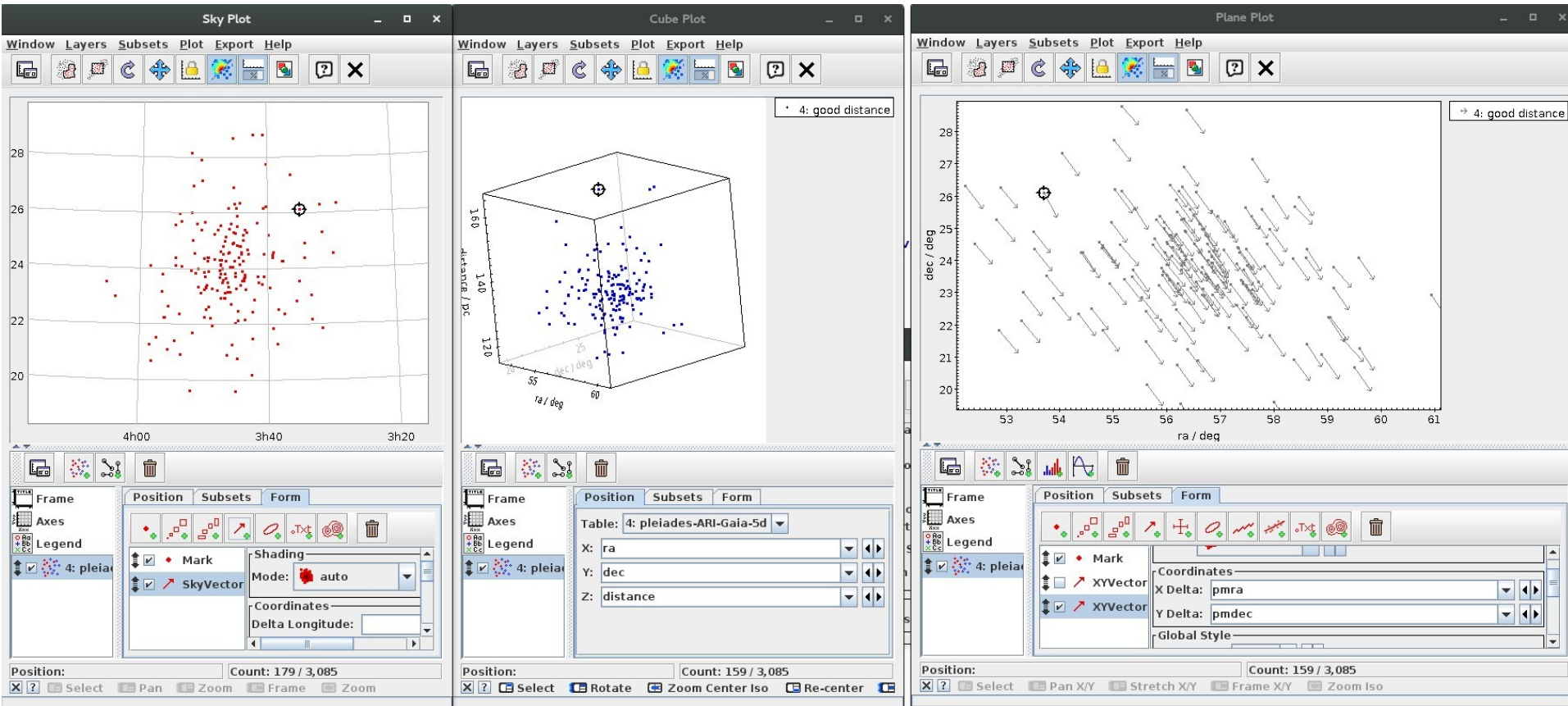# TOPCAT & STILTS

- Functions in TOPCAT

TOPCAT & STILTS

- ## Linked views

Same object is highlighted
in the different planes
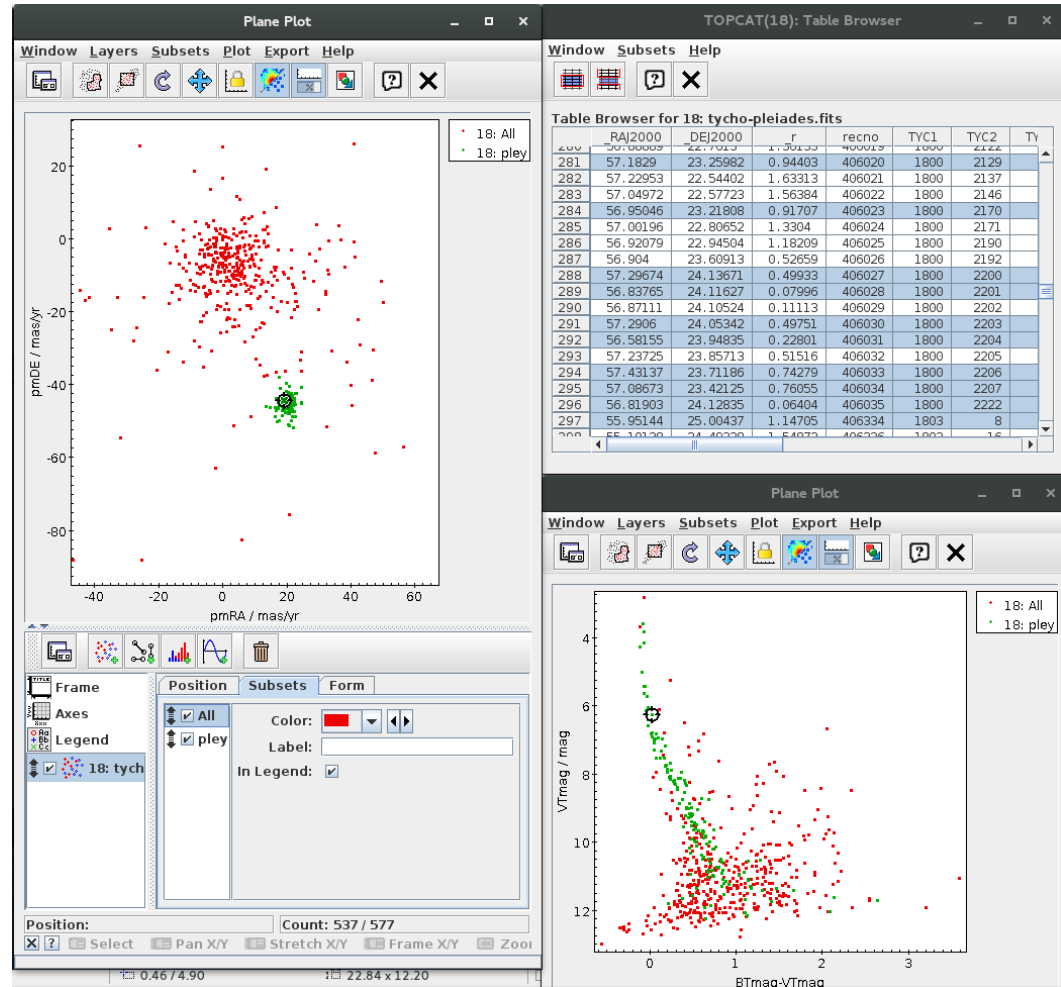
TOPCAT & STILTS

- Linked views: Good to identify anomalous objects

TOPCAT & STILTS

- Crossmatching

```
stilts tskymatch2 \
        in1=tycho-pleiades.fits ra1=_RAJ2000 dec1=_DEJ2000 \
            in2=2mass-pleiades.fits        ra2=_RAJ2000
dec2=_DEJ2000 \  join=1and2 find=best error=1 \
out=tycho-2mass.fits \
```

- There are lots of different match types (Algorithm selector), not just Sky.

- Think about the output options. Especially in crowded fields, the default Best Match, Symmetric can give surprising results.
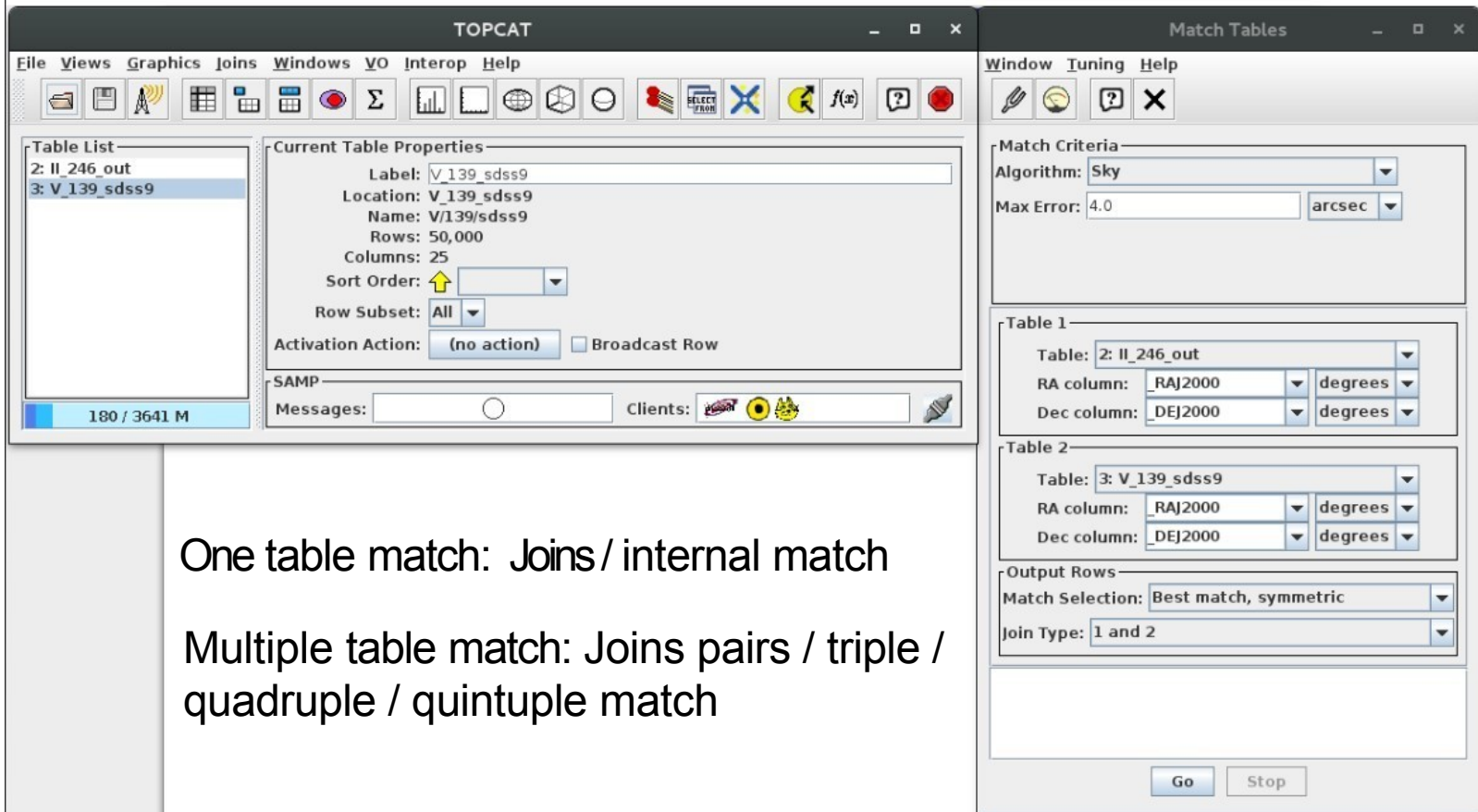
  For large tables (> million rows) , the crossmatch can run out of memory.

    Tip: Increase heap memory (run with java -jar -Xmx2048M topcat-full.jar) or use the *java -disk* option.

TOPCAT & STILTS

• Crossmatching - How to x-match two **medium-size** catalogues?

TOPCAT → Joins / Pair match

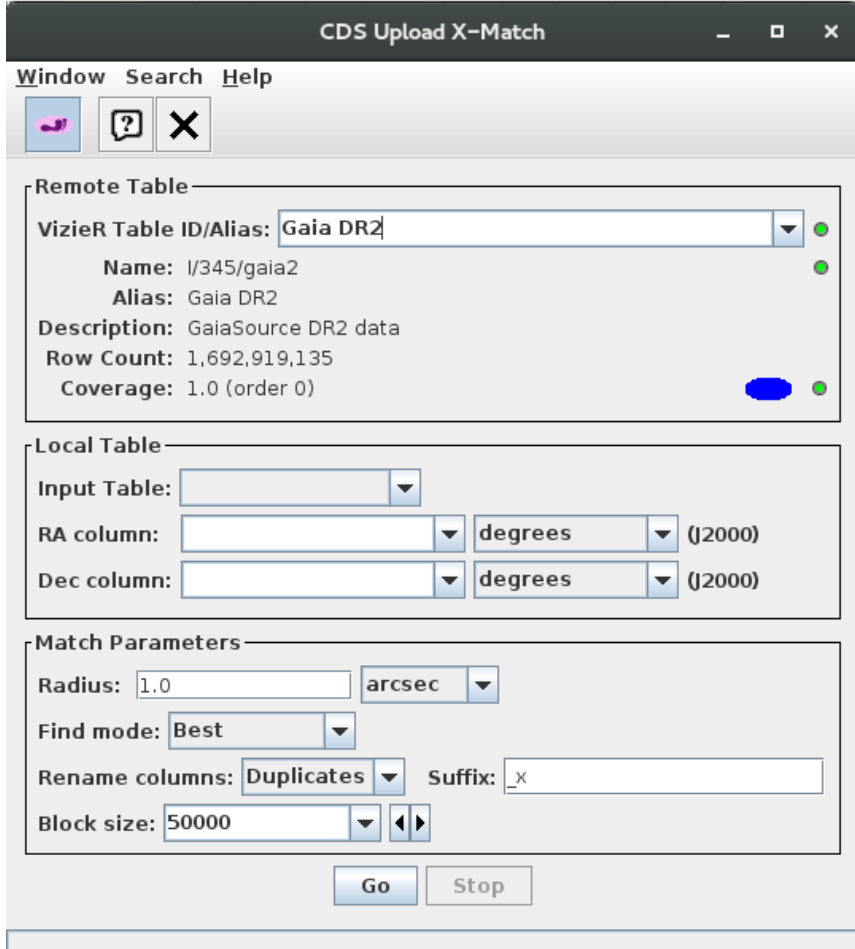One table match: Joins / internal match

Multiple table match: Joins pairs / triple / quadruple / quintuple match

TOPCAT & STILTS

- Crossmatching - How to x-match my catalogue with a **large catalogue** (in CDS) ?

TOPCAT → Joins → CDS Upload X-Match

- Advantages: Efficiency

- Disadvantages:
  - Only CDS catalogues
  - Only default columns (a problems if the needed columns are not selected by default. See next slide).

TOPCAT & STILTS

- ## Crossmatching   - How to x-match my catalogue with a **large catalogue** (in CDS) ?

Radmm R opt UV X Y	□ Hot Stuff for One Year (HSOY) (Altmann+, 2017)	2017A&A...600L...4A **ReadMe+ftp**
I/339		**Similar Catalogs**
	Post annotation	
1.I/339/hsoy	The HSOY catalogue (583001653 sources) (original column names in green) *(583001653 rows)*	

| | | | | | | Submit | Reset All |

Simple Constraint *List Of Constraints*

Query by **Constraints** (?) applied on Columns *(Output Order:* ⊙ + ○ - *)*

Standard ⊙ Original ○
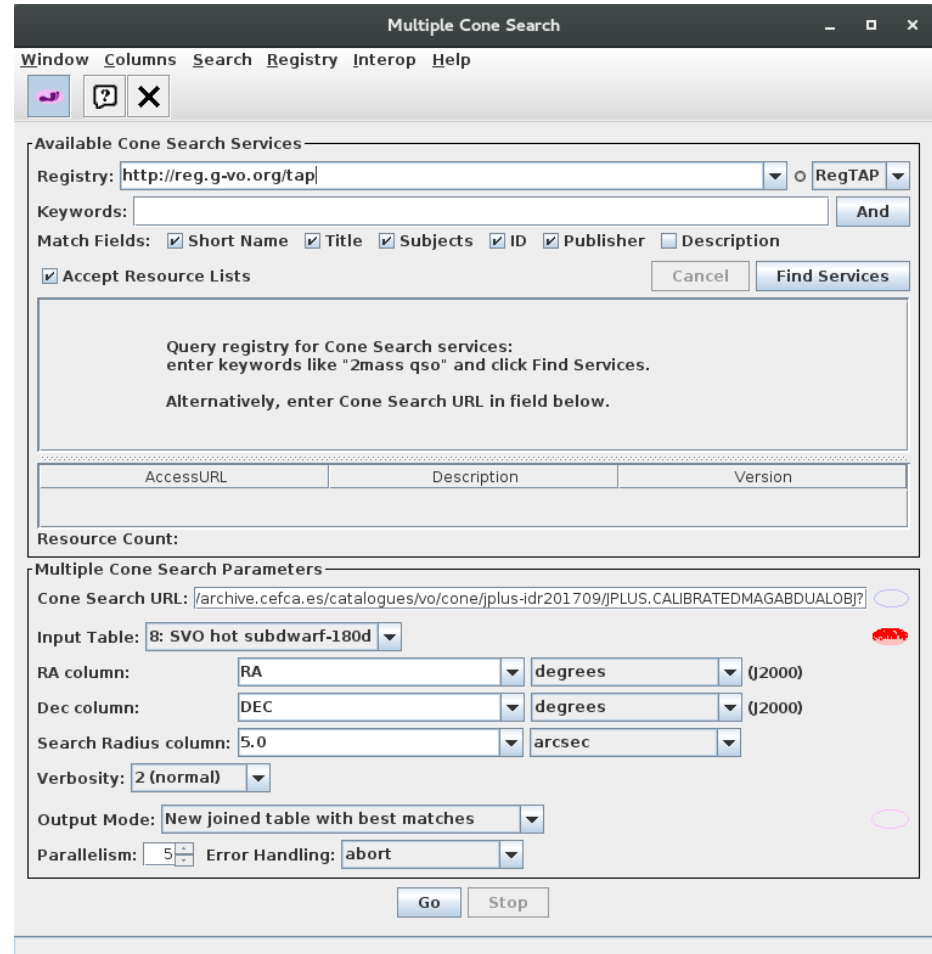
Show	Sort	Column	Clear	Constraint		Explain (UCD)
☑	○	RAJ2000			deg	[i] Right ascension, J2000.0, at epoch 2000 (raj2000) (pos.eq.ra;meta.main)
☑	○	DEJ2000			deg	[i] Declination, J2000.0, at epoch 2000 (dej2000) (pos.eq.dec;meta.main)
☑	○	ipix				[n][i] PPMXL object identifier (ipix) *(Note 1)* (meta.id;meta.main)
☑	○	comp				[0/4] Disambiguation counter (where multiple DR1 objects match one PPMXL object) (comp) *(Note 1)* (meta.code.multip)
☐	○	e_RAJ2000			mas	Mean error: RA*cos(DE) at mean epoch EpRA (e_ra) (stat.error;pos.eq.ra)
☐	○	e_DEJ2000			mas	Mean error: DE at mean epoch EpDE (e_de) (stat.error;pos.eq.dec)
☑	○	pmRA			mas/yr	Proper motion in RA, pmRA*cos(DE) (pmra) (pos.pm;pos.eq.ra)
☑	○	pmDE			mas/yr	Proper motion in DE (pmde) (pos.pm;pos.eq.dec)
☐	○	e_pmRA			mas/yr	Mean error in pmRA (e_pmra) (stat.error;pos.pm;pos.eq.ra)
☐	○	e_pmDE			mas/yr	Mean error in pmDE (e_pmde) (stat.error;pos.pm;pos.eq.dec)

TOPCAT & STILTS

- **Crossmatching**   - How to x-match my catalogue with a **large catalogue**?

TOPCAT → VO → Multicone

- Disadvantages:
  - Slow
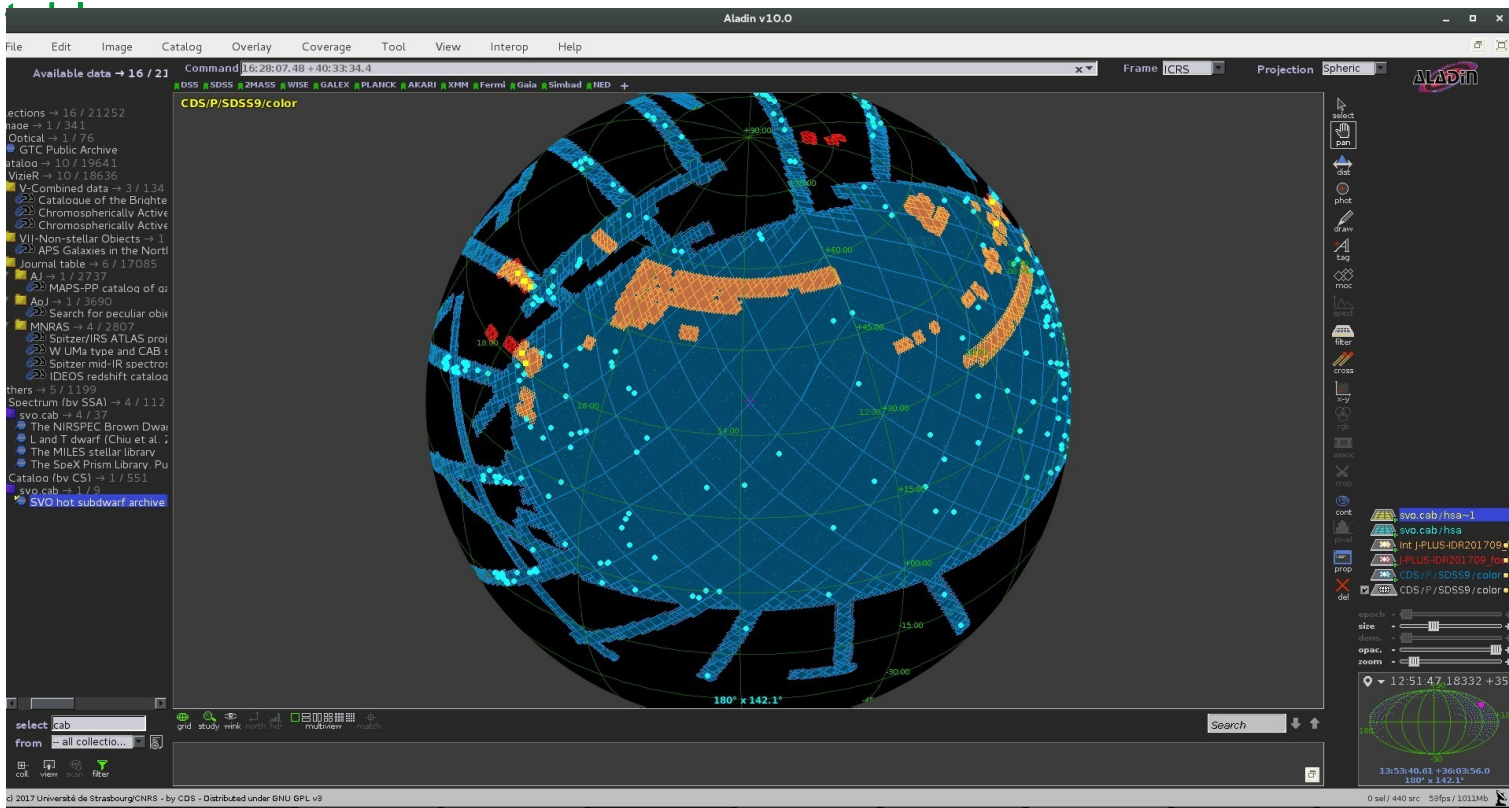
TOPCAT & STILTS

- **Crossmatching** - How to x-match my catalogue with a **large catalogue**?
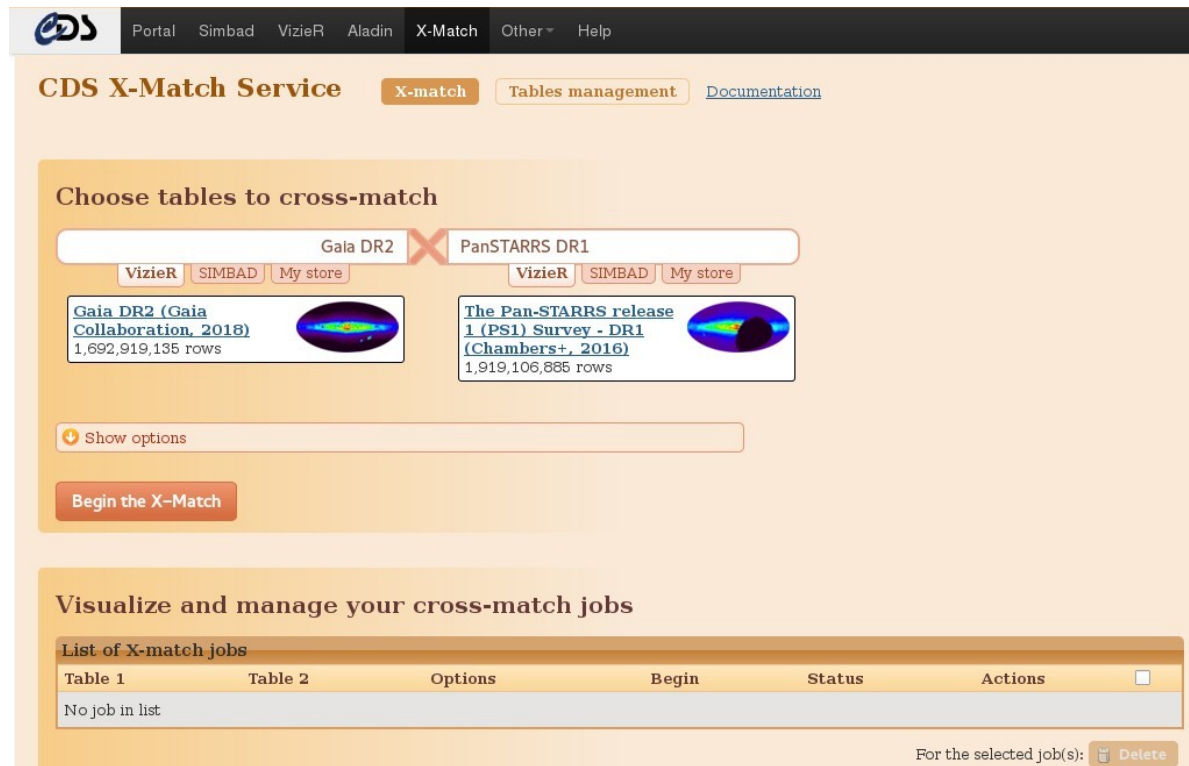
Alternative (for non all-sky surveys)

- Filter a table by MOC → X-match the filtered

TOPCAT & STILTS

- **Crossmatching** - How to x-match **two large catalogues** (in CDS)?

- Disadvantages:
  - No filtering
    - → Large outputs

TOPCAT & STILTS

- **Crossmatching** - How to x-match **two large catalogues** (in CDS) ?
  (Alternative)

  · STILTS
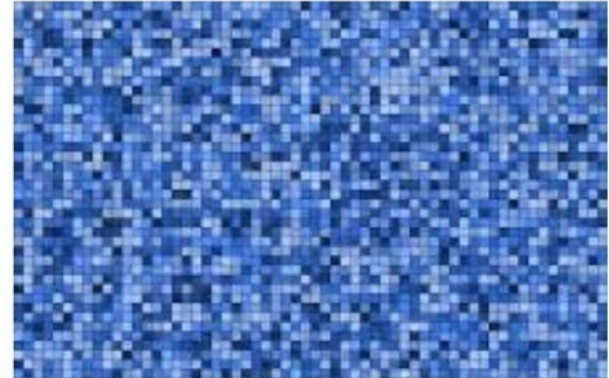
Tesellation

- Cross-match

```
java -jar stilts.jar tskymatch2 ifmt1=votable in1=2mass.xml ifmt2=votable
in2=sdss.xml ra1="RAJ2000" dec1="DEJ2000" ra2="RAJ2000" dec2="DEJ2000"
error=10 find=all out=cross.xml ofmt=votable'
```

- Filtering

```
java -jar stilts.jar tpipe ifmt=votable in=cross.xml cmd="select
zmag>12&&zmag<19.5&&rmag-kmag>(zmag+0.5)/2.5&&(rmag-
kmag)<(zmag+10.5)/2.5&&e_Kmag>0" out=rmkz.xml ofmt=votable
```

TOPCAT & STILTS

- ## Activation actions and activation window

  - The Activation Window lets you configure what happens when you click in a row of the table.

  - A list of suggested Activation Actions is displayed in the top left panel.
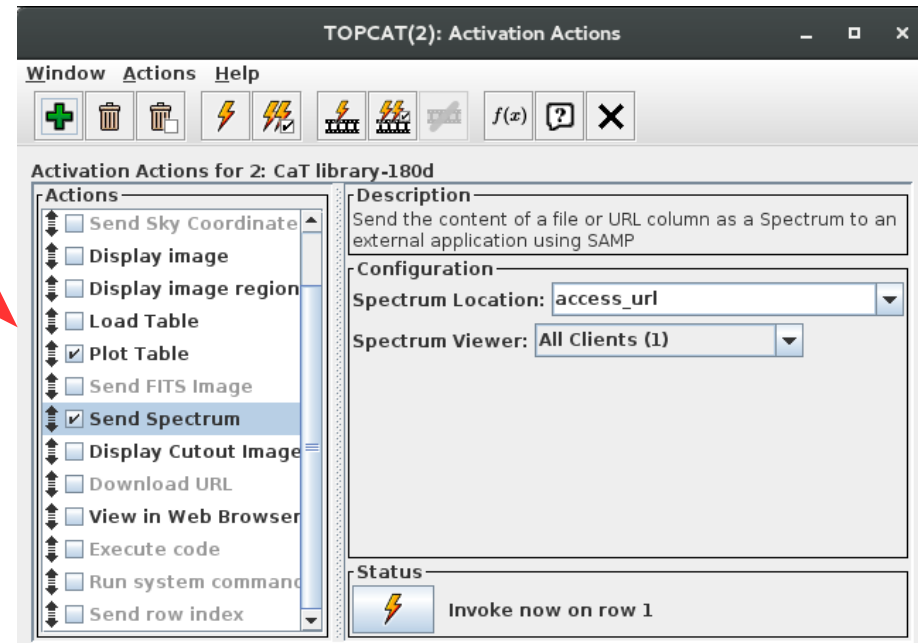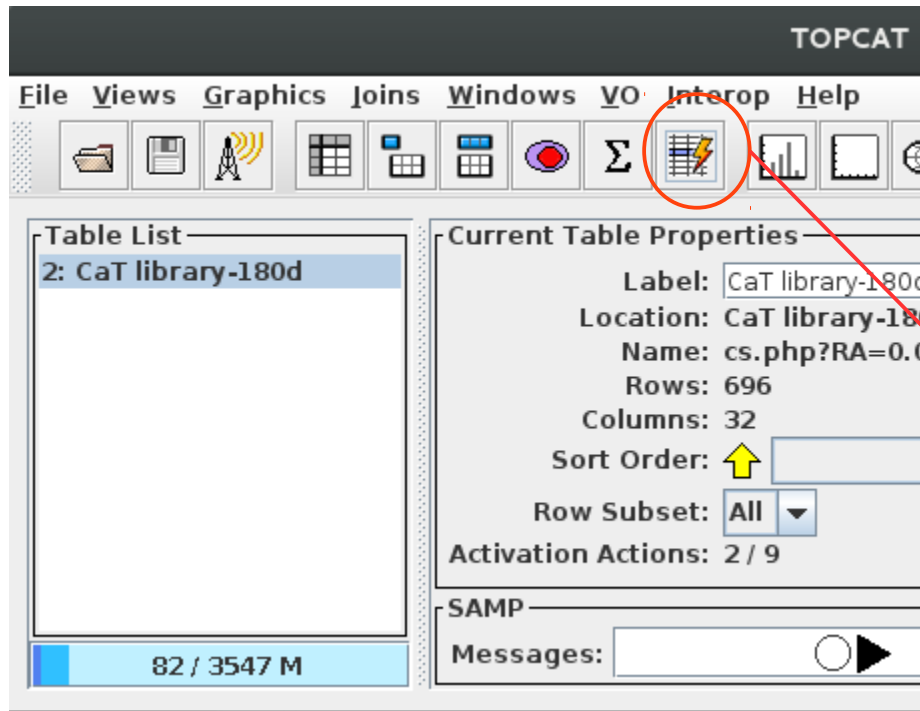
TOPCAT & STILTS

- ## Activation actions and activation window

  - By clicking in a row, the associated spectrum is sent to the VO application (SPLAT-VO in this case).

TOPCAT: Visualization

TOPCAT: What's new in Version 4.6-3? (released 9 May 2019)

- Among many other things (see full list at: http://www.star.bris.ac.uk/~mbt/topcat/sun253/versions.html)

- Improvements to the Draw Subset: Selection by free region, triangle, ellipse, polygon, below/above/right/left from a given position.
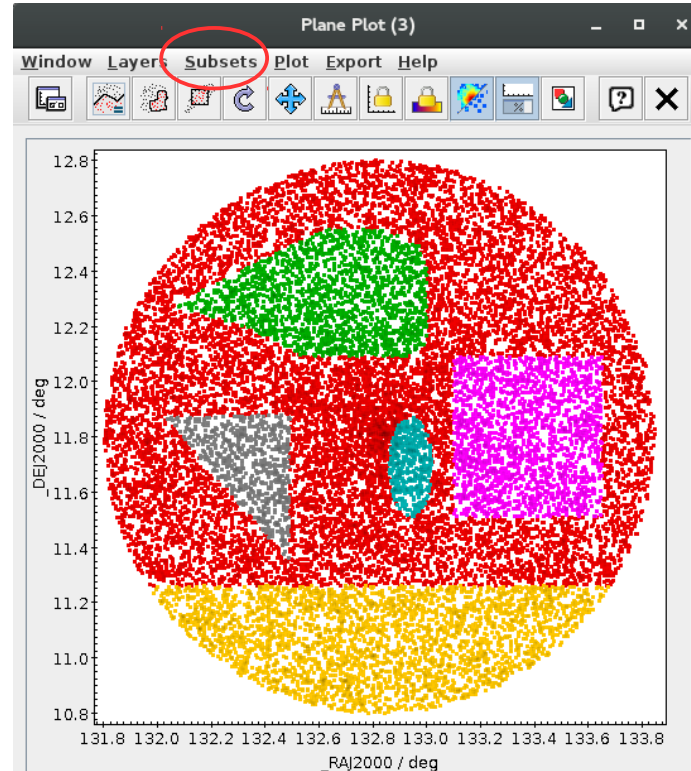
TOPCAT & STILTS

- More at:

  - TOPCAT v 4.6-3

http://www.star.bris.ac.uk/~mbt/topcat/sun253/sun253.html

  - STILTS v 3.1-6

http://www.star.bris.ac.uk/~mbt/stilts/sun256/sun256.html

  - TOPCAT/STILTS advanced tutorial

  http://andromeda.star.bris.ac.uk/topcat/tutorial-asterics1/