

Science with the VO: Do the properties of exoplanetary systems vary with their host star's parameters?

Ada Nebot

VO-School @ Nice 08-09/10/2024



CENTRE DE DONNÉES
ASTRONOMIQUES DE STRASBOURG

□ Outline

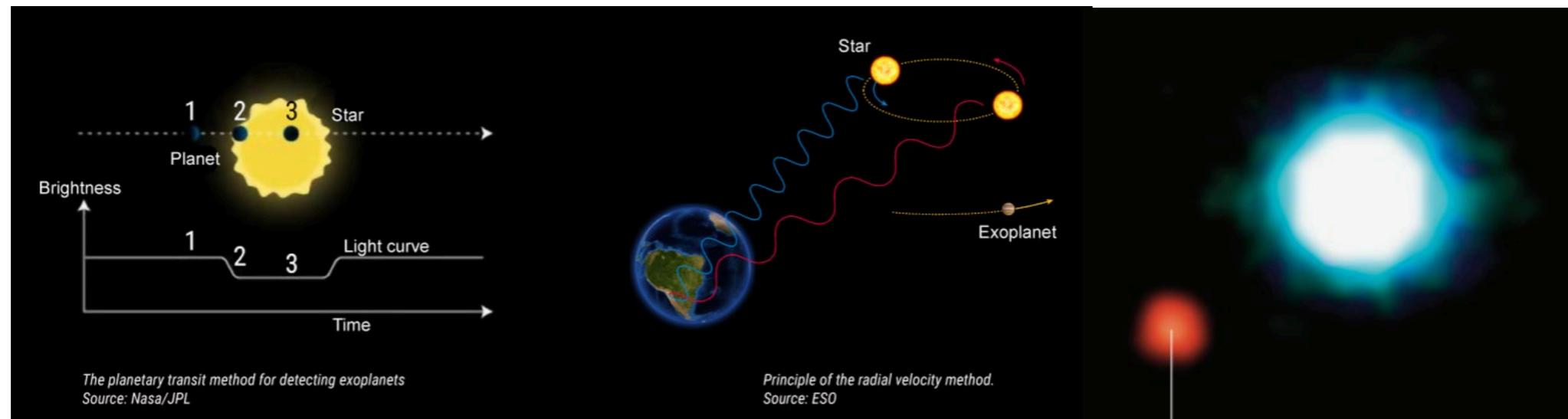
- Simbad
- TAP & ADQL
- To the science case.
- Data access and visualisation using topcat



Exoplanets

Do the properties of exoplanetary systems vary with their host star's parameters?

- Host stars are bright and dominate the light. The stellar parameters are determined
 - Using spectroscopy
 - Through SED fitting
 - Asteroseismology
- Planets are discovered via different methods:
 - Via transits observed in light curves
 - Through measured doppler effect in radial velocities curves
 - Direct imaging
 - Their sizes are typically measured using interferometry



- Results and data are published, entering the ingestion process at CDS

□ Simbad - overview

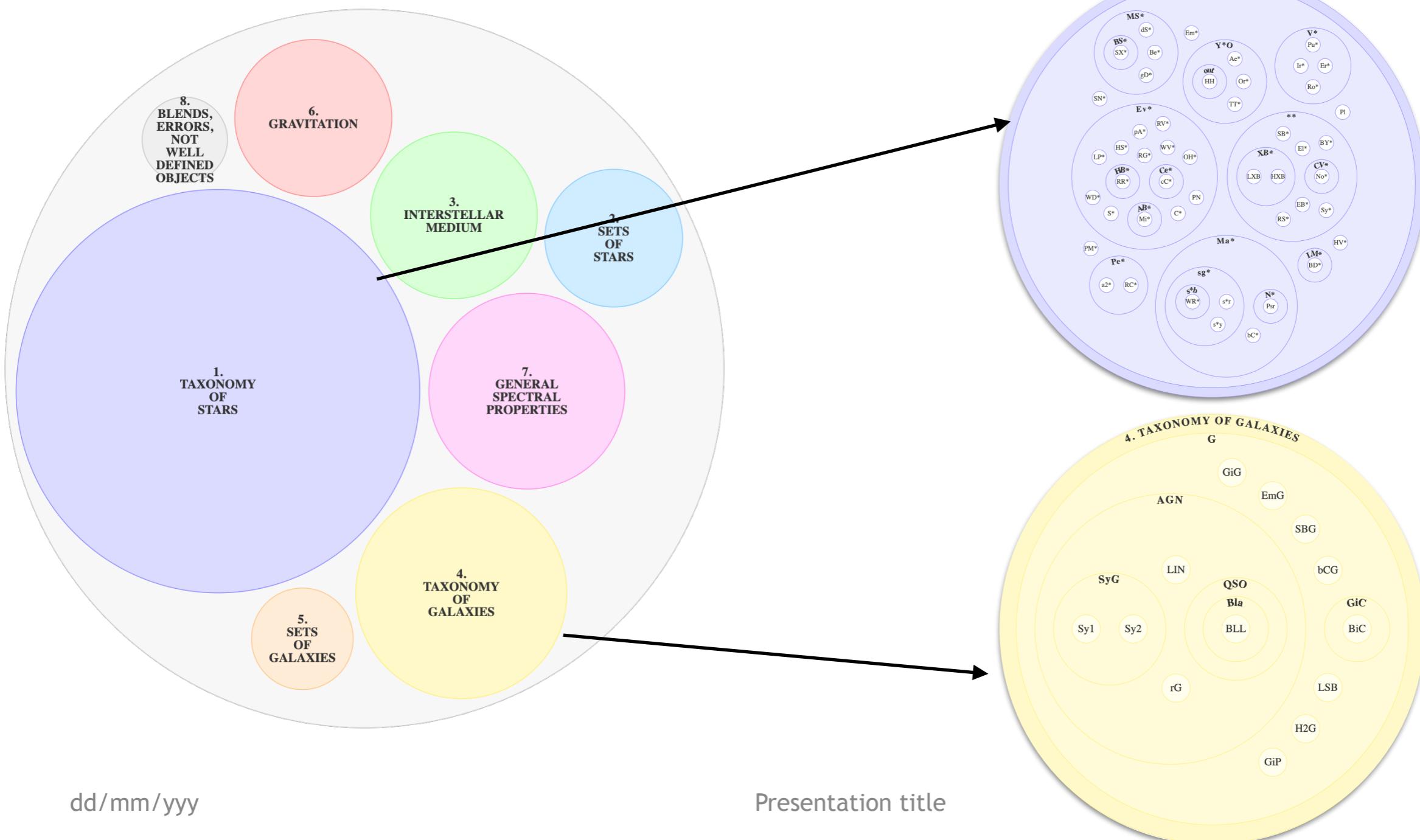
- Simbad is a database providing basic data, cross-ids, biblio and measurements
 - Access data through the web, using *astroquery*, using TAP&ADQL,...

The screenshot shows the homepage of the SIMBAD Astronomical Database. At the top, there is a navigation bar with links to CDS, PORTAL, SIMBAD, Vizier, ALADIN, X-MATCH, OTHERS, HELP, and a question mark icon. Below the navigation bar, the title "SIMBAD Astronomical Database - CDS (Strasbourg)" is displayed. The main content area is divided into several sections:

- Queries** (left sidebar): basic search, by identifier, by coordinates, by criteria, reference query, scripts, TAP queries.
- Documentation**: Object types, Nomenclature & Dictionary, Recommendations for Data Publication, User's guide, Measurement description, List of journals, User annotations documentation, Query by urls, Acknowledgment.
- Information**: Presentation, Image thumbnails, Mobile version, SimWatch, Release: SIMBAD4 1.8 - 2024-09, Releases history.
- Content**: A box containing text about the database's purpose and usage.
- Basic search**: A search input field with placeholder text "identifier, coordinates (radius=10 arcmin), or bibcode", and buttons for "SIMBAD search", "clear", and "help". Below the search bar is a link to "Install the Simbad basic search in your tool bar".

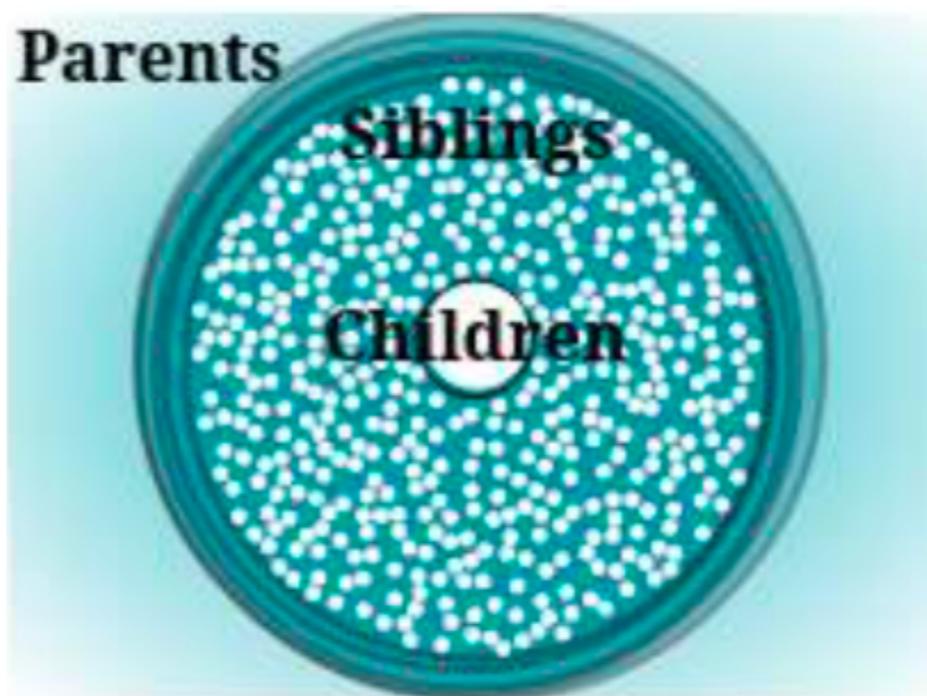
□ Simbad object types

- Object types
 - 9 different main classes, subdivided into more detailed ones



□ Simbad hierarchy

- Object types might be linked to other object types, e.g.
 - A star can have one or more planets:
 - The star is the parent
 - The planets are the children
 - The planets are siblings



Simbad measurements

Basic data :

Kepler-887c -- Extra-solar Planet

Other object types: [Pl?](#) ([2014ApJS](#),[KOI](#)), [Pl](#) ([2020AJ](#),[Kepler](#))

ICRS coord. (*ep*=J2000) : 19 20 21.7979161656 +39 49 01.044750000 (Optical) [0.0085 0.0102 90] A [2020yCat.1350....0G](#)

FK4 coord. (*ep*=B1950 *eq*=1950) : 19 18 40.3336616776 +39 43 20.823766218 [0.0085 0.0102 90]

Gal coord. (*ep*=J2000) : 071.7925043294584 +11.8842490504277 [0.0085 0.0102 90]

Proper motions *mas/yr* : -6.312 -11.232 [0.010 0.012 90] A [2020yCat.1350....0G](#)

Parallaxes (*mas*) : 1.1302 [0.0105] A [2020yCat.1350....0G](#)

SIMBAD [Query around](#) within arcmin



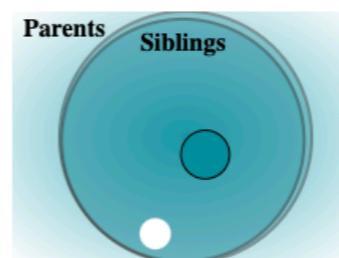
Hierarchy : number of linked objects

whatever the membership probability is (see description [here](#)) :

[parents](#) : 1

[siblings](#) : 1

Display criteria :



All [CDS](#) (CDSPortal)

Send to [Aladin](#) [Esa](#)

 [Photometry](#) within arcsec [?](#)

Identifiers (2) :

An access of full data is available using the icon Vizier near the identifier of the catalogue

[Kepler-887c](#)

KOI-1534.02

References (19 between 1850 and 2024) (Total 19)

Simbad bibliographic survey began in 1850 for stars (at least bright stars) and in 1983 for all other objects (outside the solar system).

 [Follow new references on this object](#)

Reference summaries :

from: to:

or select by : (not exhaustive, [explanation here](#)) [In table](#) [Title](#)|[Abstract](#)|[Keyword](#) [Score](#)

Collections of Measurements [?](#)

[Diameter](#) : 1

[display selected measurements](#) [display all measurements](#) [clear](#)

Warning : measurements from IRAS, IRC, SAO, CL.g (ACO), GJ have been removed
(they are still available using the icon Vizier near the identifier of the catalogue, or at the bottom of the page in the section "External links" to get the full data)

[Diameter](#) (1)

diameterQ	unit	error	filter	method	reference	
1.30E+04	km	4.15E+03			2015ApJ...799..180S	

□ Simbad using TAP&ADQL

- TAP: **Table** Access Protocol
- ADQL: Astronomical Data Query Language (for tables)
- Simbad is organised as a set of tables linked between them

"Contrarily to usual web-services, TAP lets query the service on all its exposed data with customized conditions. Thus you can get only the data which interest you in the format of your choice."



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What is SIMBAD ?

Queries
basic search
by identifier
by coordinates
by criteria
reference query
scripts
TAP queries
Output options

Documentation
Object types
Nomenclature & Dictionary
Recommendations for Data Publication
User's guide
Measurement description
List of journals
User annotations documentation
Query by urls
Acknowledgment

Information
Presentation
Image thumbnails
Mobile version
SimWatch
Release:
SIMBAD4 1.8 - 2024-09
Releases history

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"Contrarily to usual web-services, TAP lets query the service on all its exposed data with customized conditions. Thus you can get only the data which interest you in the format of your choice."

Simbad: TAP Service

Login Preferences Register

The screenshot shows the "Simbad: TAP Service" interface. On the left, there is a sidebar titled "Execution options" with various settings: "Query name" (empty), "Format" (set to "Text"), "Max records" (set to "1000"), and checkboxes for "Batch mode" (unchecked) and "Check before start" (checked). Below these are buttons for "Upload(0)", "TAP resources", and "Help" (with links to "What is TAP?", "ADQL cheat sheet", and "Simbad tables"). At the bottom of the sidebar is a "More links" button. The main area has a blue header bar with "ADQL QUERY TO EXECUTE (or choose an example: - None -)". Below this is a large empty text area for the ADQL query. At the bottom of this area are "Check!" and "Start!" buttons. To the right of the main area is a "LIST OF YOUR TAP BATCH QUERIES" section. It includes a table header with columns: ID, Name, Start, Duration, Phase, and Destruction. A message "No data available in table" is displayed. At the bottom of this section are buttons for "Refresh", "Properties", "Abort", "Destroy", and "Results". A search bar "Search:" is also present. The bottom of the page features a footer with navigation links: "First", "Previous", "Next", and "Last".

□ Simbad using TAP&ADQL

- TAP: Table Access Protocol
- ADQL: Astronomical Data Query Language (for tables)
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"Contrarily to usual web-services, TAP lets query the service on all its exposed data with customized conditions. Thus you can get only the data which interest you in the format of your choice."

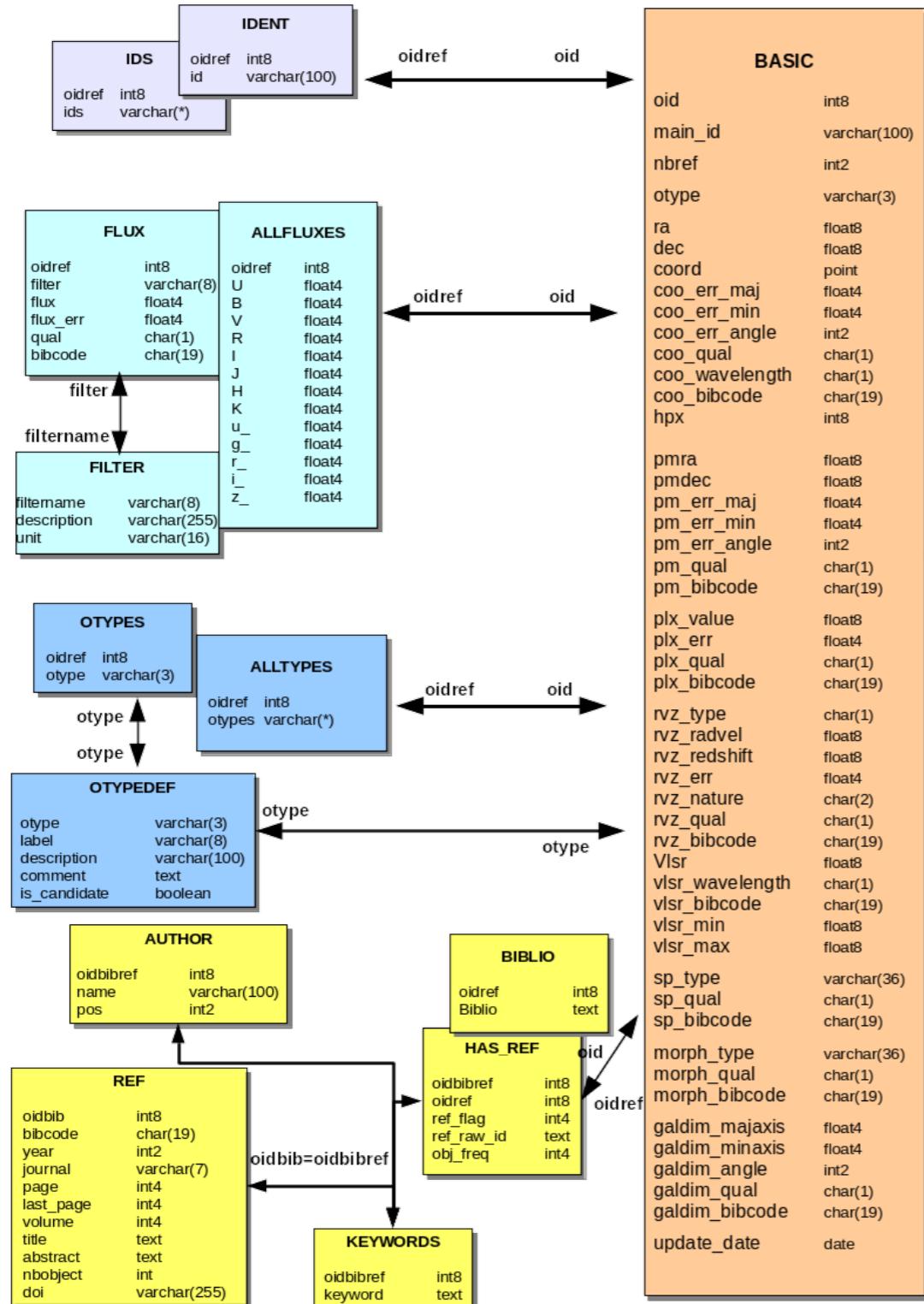
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Simbad using TAP&ADQL

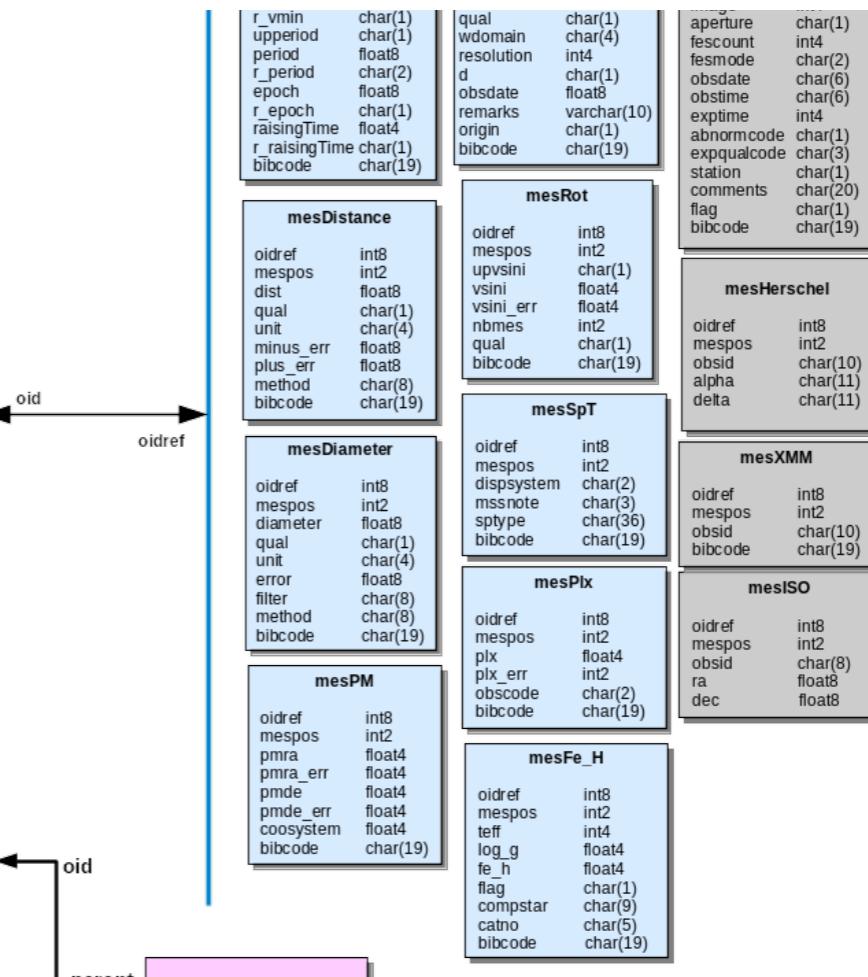
Keywords Search : Submit



Keywords Search : Submit

Suggested columns :

- mesDiameter (table)
Collection of stellar diameters.
- mesDiameter.diameter
Diameter value
- mesDiameter.diameter_prec
Precision (# of decimal positions) associated with the column diameter



Every measurement field *fld* of type floatN has an associate field *fld_prec* of type int2 containing the number of decimal digits to take in account. i.e. vmax=6.3 , vmax_prec=2 => field value = 6.30
The precision fields are not shown here, but are available for any floating point field

2022-Jun : New Description of otypes

□ Simbad using TAP&ADQL

- Where can I find the diameter of the planets?

Keywords Search :

Suggested columns :

- mesDiameter (table)
Collection of stellar diameters.
- mesDiameter.diameter
Diameter value
- mesDiameter.diameter_prec
Precision (# of decimal positions) associated with the column diameter

- Where can I find the parameters of the stars?

Keywords Search :

Suggested columns :

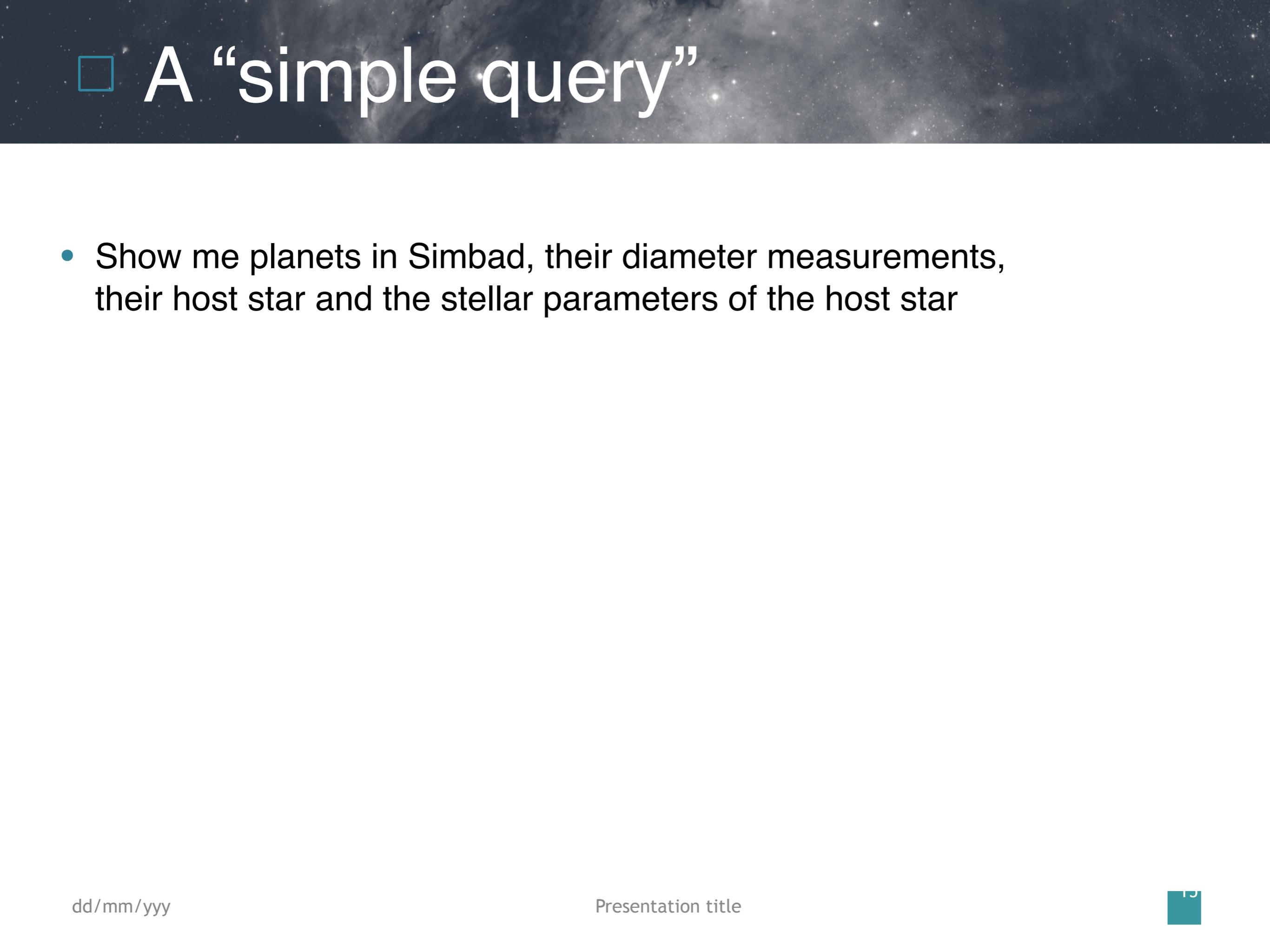
- mesFe_h (table)
Collection of metallicity, as well as Teff, logg for stars.
- mesFe_h.fe_h
Metallicity index relative to the Sun

- Where can I find the link between the planet and the star?

Keywords Search :

Suggested columns :

- h_link.child
child oid



□ A “simple query”

- Show me planets in Simbad, their diameter measurements, their host star and the stellar parameters of the host star

□ A “simple query”

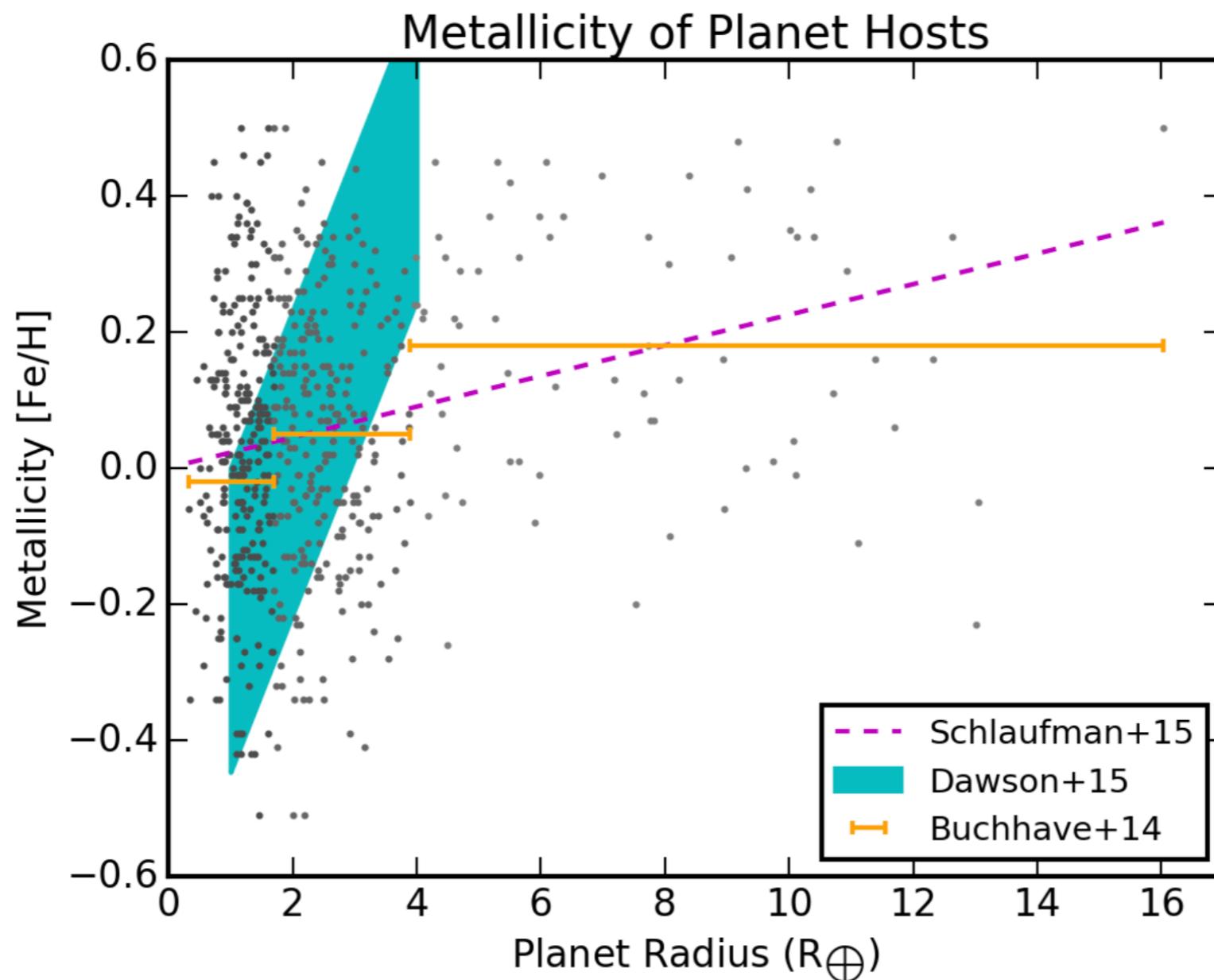
- Show me planets in Simbad, their diameter measurements, their host star and the stellar parameters of the host star

```
SELECT TOP 50000 planet.main_id, star.main_id AS parent,
          star.ra, star.dec, planet.otype, diam.diameter,
          teff, log_g, fe_h
FROM basic AS planet
JOIN h_link ON planet.oid=child
JOIN basic AS star ON star.oid = parent
LEFT JOIN mesDiameter as diam ON planet.oid=diam.oidref
LEFT JOIN mesFe_H AS mesFeH ON star.oid=mesFeH.oidref
WHERE planet.otype = 'planet..'|
```

```
SELECT TOP 50000 planet.main_id AS planet, star.main_id AS host_star,
          star.ra, star.dec, planet.otype, diam.diameter,
          teff, log_g, fe_h
FROM basic AS planet
JOIN h_link ON planet.oid=child
JOIN basic AS star ON star.oid = parent
LEFT JOIN mesDiameter as diam ON planet.oid=diam.oidref
LEFT JOIN mesFe_H AS mesFeH ON star.oid=mesFeH.oidref
WHERE planet.otype = 'planet..'
```

□ A “simple query”

Mulders 2024 - arXiv:1805.00023v2



A “simple query”

- Show me planets in Simbad, their diameter measurements, their host star and the stellar parameters of the host star

[Login](#) [Preferences](#) [Register](#)

Execution options

Query name:

Format: Text

Max records: 1000

Batch mode

Check before start

Upload(0)

TAP resources

Help

- [What is TAP ?](#)
- [ADQL cheat sheet](#)
- [Simbad tables](#)

More links

ADQL QUERY TO EXECUTE (or choose an example: -- None --)

```
SELECT TOP 50000 planet.main_id AS planet, star.main_id AS host_star,
       star.ra, star.dec, planet.otype, diam.diameter,
       teff, log_g, fe_h
  FROM basic AS planet
    JOIN h_link ON planet.oid=child
    JOIN basic AS star ON star.oid = parent
    LEFT JOIN mesDiameter as diam ON planet.oid=diam.oidref
    LEFT JOIN mesFe_H AS mesFeH ON star.oid=mesFeH.oidref
 WHERE planet.otype = 'planet..'
```

Check ! *Correct query !*

Start ! **Clear**

LIST OF YOUR TAP BATCH QUERIES

Show 10 entries

Refresh Properties Abort Destroy Results

Search:



A “simple query”

- Show me planets in Simbad, their diameter measurements,

about:blank

i about:blank

Exec

Query n

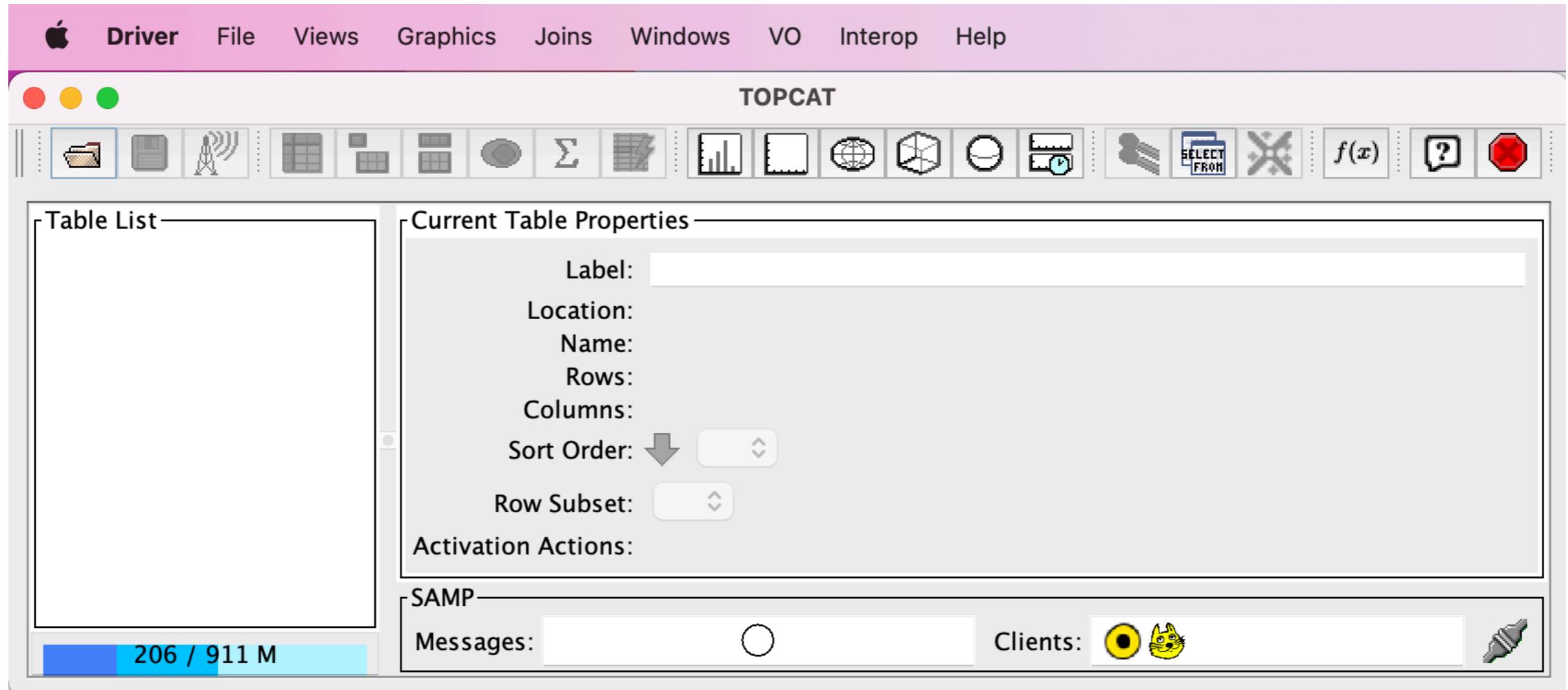
Format: Text Max rec: 1000 Batch Check Uplo TAP Help

• Who • ADC • Sim More

planet	host_star	ra	dec	otype	diameter	teff	log_g	fe_h
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6168	4.26	0.07
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6208		0.04
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6287	4.36	
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6154	4.23	0.1
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6119	4.27	0.09
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6207	4.285	0.038
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6401	4.4	
"Kepler-887c"	"Kepler-887"	290.09082465069	39.816956875	"Pl"	13000.0	6193	4.42	
"Kepler-1939b"	"Kepler-1939"	285.68999538496	40.99453465417	"Pl"		4514	4.585	0.1333
"Kepler-1939b"	"Kepler-1939"	285.68999538496	40.99453465417	"Pl"		4341		0.13
"Kepler-1939b"	"Kepler-1939"	285.68999538496	40.99453465417	"Pl"		4563	4.534	0.155
"Kepler-1939b"	"Kepler-1939"	285.68999538496	40.99453465417	"Pl"		4546	4.5869	0.182
"Kepler-1357b"	"Kepler-1357"	291.54808494425	50.35330804923	"Pl"		5708	4.69	-0.08
"Kepler-1357b"	"Kepler-1357"	291.54808494425	50.35330804923	"Pl"		5708	4.69	-0.08
"Kepler-1357b"	"Kepler-1357"	291.54808494425	50.35330804923	"Pl"		5707	4.69	-0.08
"NAME G 162-44b"	"G 162-44"	154.64640515055876	-11.716734265389722	"Pl"		3358	4.85	0.06
"NAME G 162-44b"	"G 162-44"	154.64640515055876	-11.716734265389722	"Pl"		3354	4.83	0.13
"NAME G 162-44b"	"G 162-44"	154.64640515055876	-11.716734265389722	"Pl"		3433		-0.21
"NAME G 162-44b"	"G 162-44"	154.64640515055876	-11.716734265389722	"Pl"		3434	4.74	-0.27
"NAME G 162-44b"	"G 162-44"	154.64640515055876	-11.716734265389722	"Pl"			4.896	0.28
"TOI-2196b"	"TOI-2196"	312.33986404438	-70.48498549481	"Pl"				
"WASP-132b"	"WASP-132"	217.60912357636	-46.15920093128	"Pl"		4572	4.51	0.25
"WASP-132b"	"WASP-132"	217.60912357636	-46.15920093128	"Pl"		4714	4.576	0.18
"WASP-132b"	"WASP-132"	217.60912357636	-46.15920093128	"Pl"		4742	4.23	0.21
"HD 40307c"	"HD 40307"	88.51766875012	-60.02347027990001	"Pl"		4870	4.56	-0.31
"HD 40307c"	"HD 40307"	88.51766875012	-60.02347027990001	"Pl"		4977	-1.7097	-0.31
"HD 40307c"	"HD 40307"	88.51766875012	-60.02347027990001	"Pl"			-0.31	
"HD 40307c"	"HD 40307"	88.51766875012	-60.02347027990001	"Pl"		4774	4.42	-0.36
"HD 40307c"	"HD 40307"	88.51766875012	-60.02347027990001	"Pl"		4956	4.63	

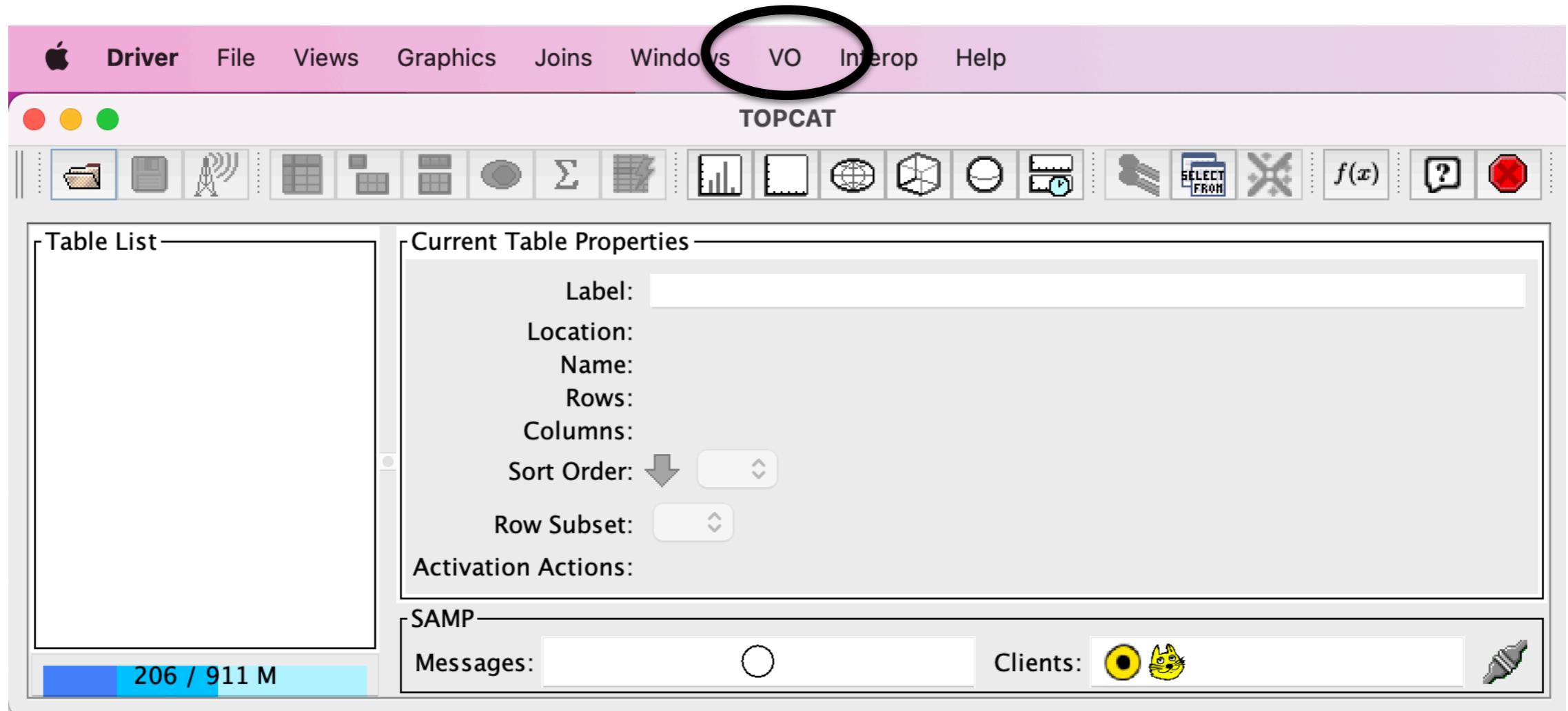
□ A “simple query”

- Let's open topcat and perform that query and visualise the results



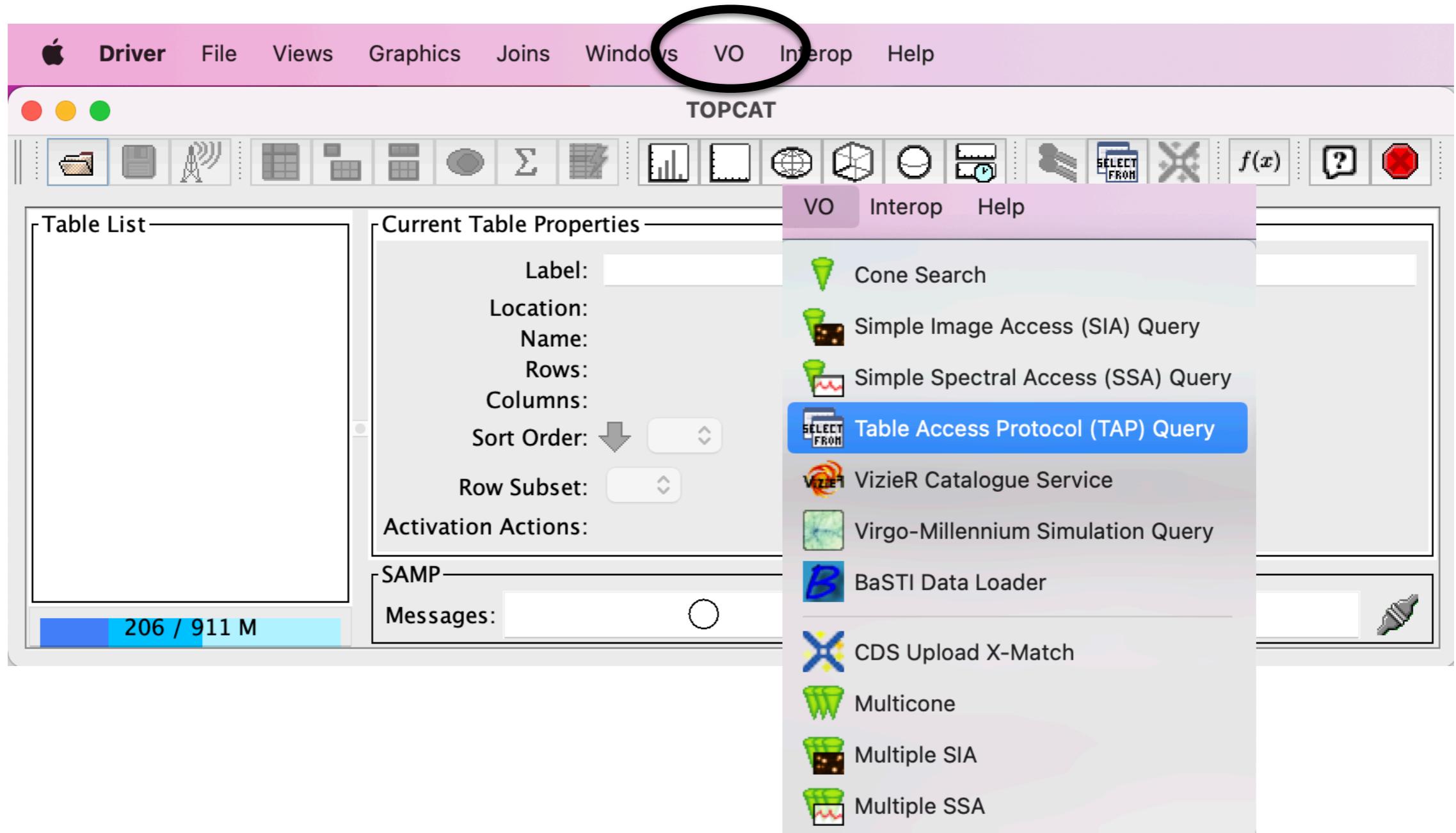
□ A “simple query”

- Let's open topcat and perform that query and visualise the results



□ A “simple query”

- Let's open topcat and perform that query and visualise the results



A “simple query”

- Let's open to

the results

The screenshot shows the "Table Access Protocol (TAP) Query" application window. The menu bar includes "Driver" and "File". The main interface has a toolbar with icons for search, refresh, help, and close. A top navigation bar offers "Select Service", "Use Service", "Resume Job", and "Running Jobs". Below this is a "Locate TAP Service" panel with tabs for "By Table Properties" and "By Service Properties". It features a "Keywords:" search field, "Match Fields:" checkboxes for "Table Name", "Table Description", and "Service", and "Find Services" and "Cancel" buttons. A list of services is displayed under "All TAP services (123)", including TAPVizieR, VSA TAP, WSA TAP, Data Lab TAP, HEASARC, WFAU OSA TAP, SSA, GAVO DC TAP, GAIA, PDS-PPI TAP, ARI-Gaia, Gaia@AIP TAP Service, ESASky, ESASky Legacy, ESO TAP_CAT, and SkyMapper TAP. At the bottom, a "Selected TAP Service" section contains a "TAP URL:" dropdown and a "Use Service" button. A "Run Query" button is located at the very bottom. The status bar at the bottom left shows "dd/mm/yyyy" and "PRESENTATION TITLE".

☐ A “simple query”

- Let's open to

Table Access Protocol (TAP) Query

Select Service Use Service Resume Job Running Jobs

Locate TAP Service

Keywords: simbad And

Match Fields: Table Name Table Description Service

Cancel Find Services

Selected TAP services (6/123)

- > TAPVizieR (147/58548) – ivo://cds.vizier/tap
- > Data Lab TAP (2/2053) – ivo://noirlab.edu/datalab/tap
- > GAVO DC TAP (1/253) – ivo://org.gavo.dc/tap
- > ESO TAP_CAT (1/106) – ivo://eso.org/tap_cat
- > ChiVO TAP (1/16) – ivo://chivo/tap
- > SIMBAD TAP (0/35) – ivo://cds.simbad/tap

Table List

206 / 911 M

Selected TAP Service

TAP URL:

Use Service

Run Query

f(x) ? X

try

try

dd/mm/yyyy

PRESERATION

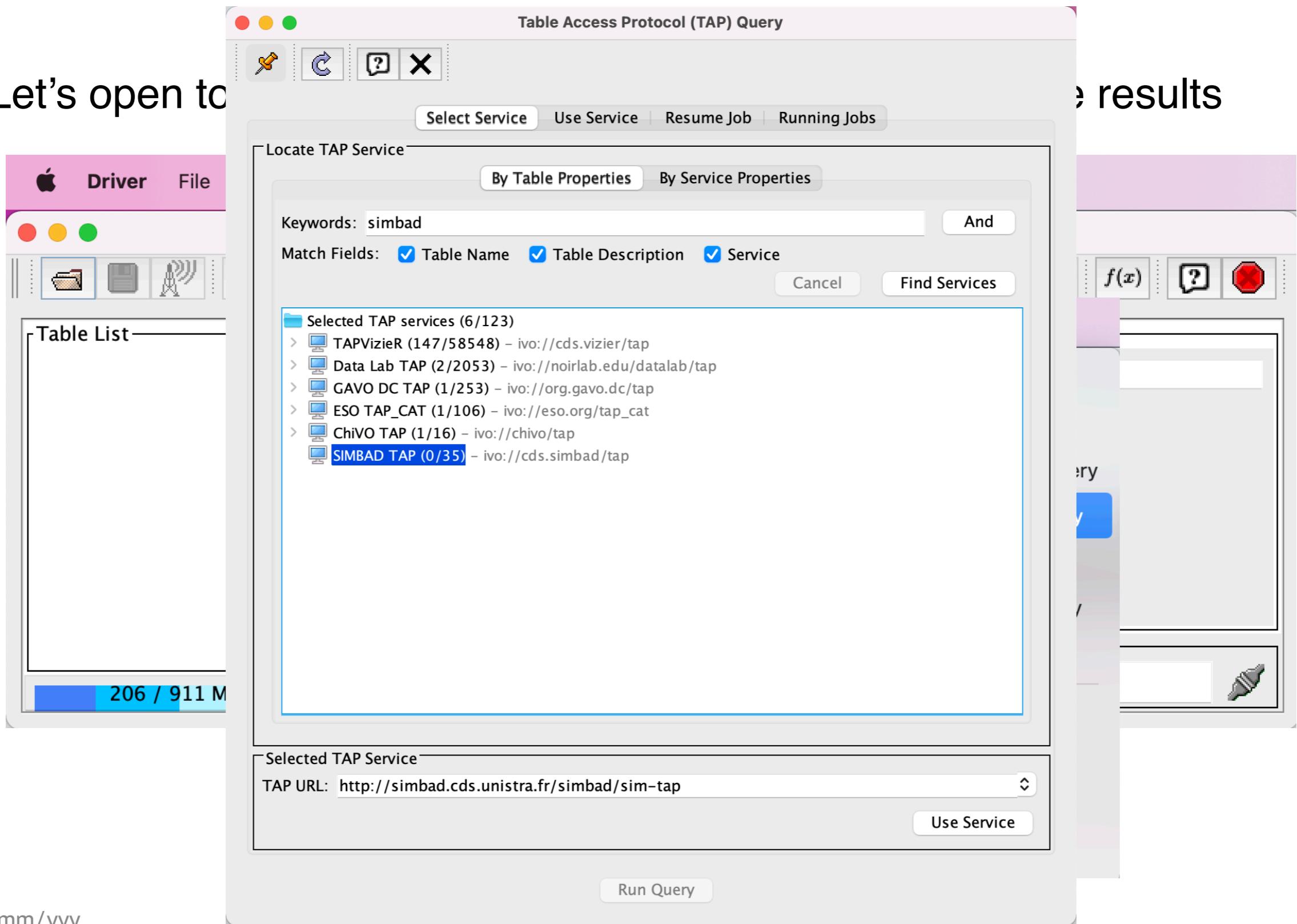
L4

The screenshot shows the 'Table Access Protocol (TAP) Query' application window. In the top menu bar, there are icons for Driver and File. The main interface has a toolbar with various icons. Below the toolbar is a menu bar with 'Select Service', 'Use Service', 'Resume Job', and 'Running Jobs'. A 'Locate TAP Service' dialog is open, containing a search field with 'Keywords: simbad' and an 'And' button. Under 'Match Fields', three checkboxes are checked: 'Table Name', 'Table Description', and 'Service'. There are 'Cancel' and 'Find Services' buttons. The results section shows a list titled 'Selected TAP services (6/123)' with six items: TAPVizieR, Data Lab TAP, GAVO DC TAP, ESO TAP_CAT, ChiVO TAP, and SIMBAD TAP. At the bottom of the window, there is a 'Selected TAP Service' section with a 'TAP URL:' input field and a 'Use Service' button. A 'Run Query' button is also present at the bottom.

A “simple query”

- Let's open to

results



□ A “simple query”

- Correlation between the metallicity and effective temperature of the stars and the size of planets?
- Are these biases or is there a physical relationship?

