

# Composición química del Cúmulo Abierto NGC 2682 (M67)

Ricardo Carrera



# ¿Qué es un cúmulo abierto?

Agrupaciones de entre unas pocas decenas a varios miles de estrellas.

Formados a partir de una misma nube molecular en único episodio de formación estelar:

- misma edad
- misma composición química
- misma dinámica (se mueven de forma conjunta).

Tienen un amplio rango de masas, luminosidades, características estructurales y edades.

Se usan para estudiar una gran variedad de aspectos astrofísicos:

- ❖ Interiores estelares, nucleosíntesis, evolución estelar.
- ❖ Formación y evolución de las galaxias que los contienen.



Fuente: ESO

# El cúmulo abierto NGC 2682 (M67)

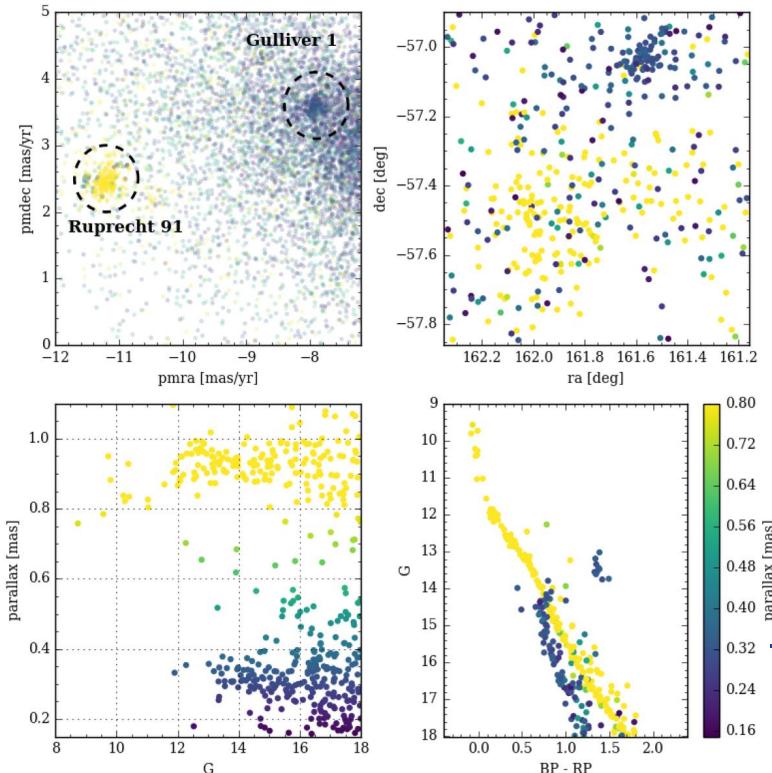
Cúmulo abierto viejo, 3.6 Ga, situado a unos 860 pc y con metalicidad cercana a la solar.

Se usa como referencia en estudios de varios tipos.

Se ha sugerido que el Sol podría provenir de este cúmulo.



# Identificación de las estrellas miembros



Probabilidades de membresía obtenidas a partir de:

- posiciones
- movimientos propios
- paralajes

Cantat-Gaudin et al. 2018

<https://ui.adsabs.harvard.edu/abs/2018A%26A...618A..93C/abstract>

# Obtener la información de membresía

≡ VIEW

**Abstract**

Citations (360)

References (123)

Co-Reads

Similar Papers

Volume Content

Graphics

Metrics

Export Citation

≡ FEEDBACK

**A Gaia DR2 view of the open cluster population in the Milky Way**

Show affiliations

Cantat-Gaudin, T. [ID](#); Jordi, C.; Vallenari, A. [ID](#); Bragaglia, A. [ID](#); Balaguer-Núñez, L.; Soubiran, C. [ID](#); Bossini, D. [ID](#); Moutinho, A. [ID](#); Castro-Ginard, A.; Krone-Martins, A. [ID](#); Casamiquela, L.; Sordo, R. [ID](#); Carrera, R. [ID](#)

Context. Open clusters are convenient probes of the structure and history of the Galactic disk. They are also fundamental to stellar evolution studies. The second Gaia data release contains precise astrometry at the submilliarcsecond level and homogeneous photometry at the mmag level, that can be used to characterise a large number of clusters over the entire sky.

Aims: In this study we aim to establish a list of members and derive mean parameters, in particular distances, for as many clusters as possible, making use of Gaia data alone.

Methods: We compiled a list of thousands of known or putative clusters from the literature. We then applied an unsupervised membership assignment code, UPMASK, to the Gaia DR2 data contained within the fields of those clusters.

Results: We obtained a list of members and cluster parameters for 1229 clusters. As expected, the youngest clusters are seen to be tightly distributed near the Galactic plane and to trace the spiral arms of the Milky Way, while older objects are more uniformly distributed, deviate further from the plane, and tend to be located at larger Galactocentric distances. Thanks to the quality of Gaia DR2 astrometry, the fully homogeneous parameters derived in this study are the most precise to date. Furthermore, we report on the serendipitous discovery of 60 new open clusters in the fields analysed during this study.

Full Table 1 is only available in electronic form at the CDS via anonymous ftp to  
<http://cdsarc.u-strasbg.fr> (ftp://130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/618/A93>

≡ FULL TEXT SOURCES

Publisher arXiv

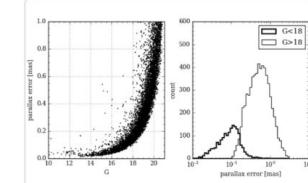
DATA PRODUCTS

**SIMBAD (317)** IRSA (1)

**CDS (1)**

Add paper to library

GRAPHICS



Click to view more

ASSOCIATED WORKS (1)

Catalog Description: 2018yCat..36180093C



# Obtener la información de membresía

CDSS Portal Simbad VizieR Aladin X-Match Other Help VizieR

## Gaia DR2 open clusters in the Milky Way : J/A+A/618/A93

Access to [VizieR](#) [FTP](#) [ReadMe](#) [TAP](#) [Xmatch](#)

Authors : Cantat-Gaudin T. [id](#), Jordi C., Vallenari A. et.al  
VizieR DOI : [10.26093/cds/vizier.36180093](https://doi.org/10.26093/cds/vizier.36180093) [Cite](#)  
Bibcode : [2018A&A...618A..93C](#) (ADS)

Article Origin Description See also Prov FTP **VizieR**

A UAT : Surveys, Open star clusters  
Compilation (CCC)



A Gaia DR2 view of the open cluster population in the Milky Way. (2018)  
Go to the original article ([10.1051/0004-6361/201833476](https://doi.org/10.1051/0004-6361/201833476))

Keywords : stars distances - Galaxy: disk - Galaxy: structure - open clusters and associations: general

Abstract: Open clusters are convenient probes of the structure and history of the Galactic disk. They are also fundamental to stellar evolution studies. The second Gaia data release contains precise astrometry at the submilliarcsecond level and homogeneous photometry at the mmag level, that can be used to characterise a large number of clusters over the entire sky. In this study we aim to establish a list of members and derive mean parameters, in particular distances, for as many clusters as possible, making use of Gaia data alone. We compiled a list of thousands of known or putative clusters from the literature. We then applied an unsupervised membership assignment code, UPMASK, to the Gaia DR2 (Cat. [I/345](#)) data contained within the fields of those ...[\(more\)](#)

Inserted into VizieR : 19-Oct-2018  
Last modification : 30-Sep-2020

# Obtener la información de membresía

The screenshot shows the VizieR interface for the Gaia DR2 open clusters dataset. The top navigation bar includes links for Portal, Simbad, VizieR, Aladin, X-Match, Other, and Help. The VizieR logo is in the top right corner.

**Catalog**

**Search Criteria**

Keywords: J/A+A/618/A93  
Tables: J/A+A/618/A93..table1 ..members

**J/A+A/618/A93**

Radius: 100 pc X Y

Legend: Yellow square = Gaia DR2 open clusters in the Milky Way (Cantat-Gaudin+, 2018)

Table: J/A+A/618/A93

Summary of mean parameters for the OCs characterised in this study (1229 rows)

Membership probabilities of all individual stars (401448 rows)

Reset All

Query selected Tables | Join selected Tables

(c) indicates tables which contain celestial coordinates

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f o t w Contact

Hay dos tablas disponibles:

- Parámetros promedios de cada cúmulo
- Información de las estrellas individuales.

# Obtener el centro del cúmulo

**Catalog**

Search Criteria  
 Keywords: J/A+A/618/A93  
 Tables: J/A+A/618/A93...table1...members  
 Preferences: max: 50  
 HTML Table  
 All columns  
 Compute  
 Mirrors: CDS, France

Query selected Tables | Join selected Tables

ALL

Reset All

(c) indicates tables which contain celestial coordinates

J/A+A/618/A93 Gaia DR2 open clusters in the Milky Way (Cantat-Gaudin+, 2018)

(c) Summary of mean parameters for the OCs characterised in this study (1229 rows)

Membership probabilities of an individual star (0.01407709)

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Help

VizieR

Fast Xmatch with large catalogs or Simbad

Target dimension: 2 arcmin

Radius  Box size

=NGC\_2682

**Simple Constraint** List Of Constraints

Query by Constraints applied on Columns (Output Order: + -)

Show Sort Column Clear Constraint Explain (UD)

Column	Type	Description
recno	char	Record number assigned by the VizieR team. Should Not be used for identification. ( <a href="#">meta.record</a> )
Cluster	char	Cluster name (cluster) ( <a href="#">meta.id.parent</a> )
RAJ2000	deg	(i) Mean right ascension of members (J2000) (ra) ( <a href="#">pos.eq.ra:meta.main</a> )
DEJ2000	deg	(i) Mean declination of members (J2000) (dec) ( <a href="#">pos.eq.dec:meta.main</a> )
GLON	deg	Mean Galactic longitude of members (l) ( <a href="#">pos.galactic.lon</a> )
GLAT	deg	Mean Galactic latitude of members (b) ( <a href="#">pos.galactic.lat</a> )
r50	deg	Radius containing half the members (r50) ( <a href="#">phys.angSize:src</a> )
Nstars	int	Number of members (probability over 0.5) (nstars) ( <a href="#">meta.number</a> )
pmRA	mas/yr	Mean proper motion along RA of members (pmra) ( <a href="#">pos.pm:pos.eq.ra</a> )
s_pmRA	mas/yr	Standard deviation of pmRA of members (sigpmra) ( <a href="#">stat.stdev:pos.pm:pos.eq.ra</a> )
e_pmRA	mas/yr	Standard deviation of pmRA of members over square root of nstars (uncertpmra) ( <a href="#">stat.error:pos.pm:pos.eq.ra</a> )

All cols Reset All Clear

Submit | Reset All

**Table**

Full	Cluster	RAJ2000	DEJ2000	GLON	GLAT	r50	Nstars	pmRA	pmDE	plx	dmode	dmode+01	dmode-01	X	Y	Z	Rgc	SimbadName
		deg	deg	deg	deg	deg		mas/yr	mas/yr	mas	pc	pc	pc	pc	pc	pc		
1	NGC_2682	132.846	+11.814	215.691	31.921	0.166	691	-10.986	-2.964	1.135	859.1	791.2	939.9	-592.2	-425.4	454.3	8942.4	NGC_2682

# Obtener la información estrellas individuales

**Catalog**

J/A+A/618/A93 Gaia DR2 open clusters in the Milky Way (Cantat-Gaudin+, 2018)

Similar Catalogs 2018A&A\_618A\_93C ReadMe&fp

Search Criteria  
 Keywords J/A+A/618/A93  
 Tables J/A+A/618/A93  
 table1  
 .members  
 ALL  
 (c) indicates tables which contain celestial coordinates

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**VizieR**

Simple Target | List Of Targets  
 Target Name (resolved by Session or Position): J2000 Target dimension: 2 arcmin  
 NR: The epoch used for the query is the original epoch of the table(s) | Radius: Box size

Similar Catalogs 2018A&A\_618A\_93C ReadMe&fp

Search Criteria  
 Save in ODS/SQL  
 Keywords J/A+A/618/A93  
 Tables J/A+A/618/A93  
 table1  
 .members  
 Choose  
 Preferences max: 50  
 HTML Table  
 All columns  
 Compute  
 Mirrors CDS, France  
 Contact

Simple Constraint | List Of Constraints  
 Query by Constraints applied on Columns (Output Order: + - )  
 Show Sort Column Clear Constraint Explain (CCD)  
 (c) recno deg Record number assigned by the VizieR team. Should not be used for identification. (meta\_main)  
 (c) RA\_ICRS deg [1] Gaia DR2 right ascension (ICRS) at Ep=2015.5 (ra) (pos.eq.ra.meta\_main)  
 (c) DE\_ICRS deg [1] Gaia DR2 declination (ICRS) at Ep=2015.5 (dec) (pos.eq.dec.meta\_main)  
 (c) Source deg Gaia DR2 source\_id (source\_id) (meta.id.meta\_main)  
 (c) GLON deg [1] Gaia DR2 Galactic longitude (l) (pos.galactic.lon)  
 (c) GLAT deg Gaia DR2 Galactic latitude (b) (pos.galactic.lat)  
 (c) pmRA mas Gaia DR2 parallax (parallax) (pos.parallax.trig)  
 (c) pmDE mas Gaia DR2 parallax error (parallax\_error) (stat.error.pms.parallax)  
 (c) e\_pmRA mas/yr Gaia DR2 proper motion along RA (pmra) (pos.pm.pos.eq.ra)  
 (c) e\_pmDE mas/yr Gaia DR2 proper motion along Dec (pmde) (stat.error.pms.pm.eq.ra)  
 (c) pmRA mas/yr Gaia DR2 pmRA error (pmra\_error) (stat.error.pms.pm.eq.ra)  
 (c) pmDE mas/yr Gaia DR2 proper motion along Dec (pmde) (pos.pm.pos.eq.dec)  
 ALL cols Reset All Clear (0) indexed column Submit  
 (c) c\_pmDE mas/yr Gaia DR2 pmDE error (pmde\_error) (stat.error.pms.pms.eq.dec)  
 (c) RADecCor mas/yr Gaia DR2 correlation factor (radec\_corr) (stat.correlation)  
 (c) e\_pmRA mas/yr Gaia DR2 pmRA error (pmra\_error) (stat.error.pms.pms.eq.ra)  
 (c) pmDE mas/yr Gaia DR2 proper motion along DE (pmde) (pos.pm.pms.eq.dec)  
 ALL cols Reset All Clear (0) indexed column Submit  
 (c) e\_pmDE mas/yr Gaia DR2 pmDE error (pmde\_error) (stat.error.pms.pms.eq.dec)  
 (c) RADecCor mas/yr Gaia DR2 correlation factor (radec\_corr) (stat.correlation)  
 (c) RApmRAcor mas/yr Gaia DR2 correlation factor (ra\_pmra\_corr) (stat.correlation)  
 (c) RApmDEcor mas/yr Gaia DR2 correlation factor (ra\_pmde\_corr) (stat.correlation)  
 (c) DEpmRAcor mas/yr Gaia DR2 correlation factor (de\_pmra\_corr) (stat.correlation)  
 (c) DEpmDEcor mas/yr Gaia DR2 correlation factor (de\_pmde\_corr) (stat.correlation)  
 (c) PxmraRACor mas/yr Gaia DR2 correlation factor (pxmra\_pmra\_corr) (stat.correlation)  
 (c) PxmraDEcor mas/yr Gaia DR2 correlation factor (pxmra\_pmde\_corr) (stat.correlation)  
 (c) pmApdmDEcor mas/yr Gaia DR2 correlation factor (pmra\_pmde\_corr) (stat.correlation)  
 (c) o\_Gmag mag Gaia DR2 number of G observations (phot\_n\_obs) (meta.number)  
 (c) Gmag mag Gaia DR2 mean G magnitude (phot\_mean\_mag) (phot.mag.em.gpt)  
 (c) BP\_RP mag (0) Gaia DR2 BP minus RP colour null if missing in DR2 (bp\_rp) (phot.color.em.opt.B.prm.opt.R)  
 (c) PMemb deg Membership probability (prob) (meta.id.prob)  
 (c) Cluster=NGC\_2682 char Corresponding cluster (cluster) (meta.id.cluster)  
 (c) Simbad char Designation understandable by the Simbad database (meta.id)  
 (c) \_RA\_icrs deg (0) Right Ascension (ICRS, epoch 2000) computed by CDS (pos.eq.ra)  
 (c) \_DE\_icrs deg (0) Declination (ICRS, epoch 2000) computed by CDS (pos.eq.dec)  
 ALL cols Reset All Clear (0) indexed column Submit  
 Adapt form Display your selection only Modify Reset to default columns Modify  
 Display UCD1+ UCD1  
 Thanks for acknowledging the VizieR Service  
 Rules of usage of VizieR data

Seleccionar columnas, nos interesan:  
**source** (ID de Gaia DR2)  
**Pbmemb** (probabilidad de ser miembros)  
**Cluster**

=NGC\_2682

# Obtener la información estrellas individuales

Para poder descargar los datos hay que modificar las preferencias

The screenshot shows the Vizier search interface. In the 'Search Criteria' section, there are buttons for '?', 'B', and 'Back'. Below it, 'Save in CDSportal' is checked. Under 'Keywords', there is a list: 'J/A+A/618/A93/me...' and a 'Back' button. In the 'Tables' section, 'J/A+A/618/A93' is selected, with an 'Add' button next to it. Below these are '..table1' and '..members'. A 'Choose' button is at the bottom. In the 'Preferences' section, there are dropdown menus for 'max:' set to '50' and 'HTML Table' set to 'HTML Table'. There is also a checkbox for 'All columns' which is unchecked. Under the 'Compute' section, several checkboxes are available: 'Distance q', 'Position angle θ', 'Distance (x,y)', 'Galactic', 'J2000', 'B1950', 'Ecl. J2000', and 'default', where 'default' is checked. Below these are radio buttons for 'Sort by Distance' ('+ order -' is selected) and 'No sort'. At the bottom, 'Position in:' has 'Sexagesimal' (selected), 'Decimal °', and 'Truncated prec.' checkboxes. A 'Mirrors' section shows 'CDS, France'.

**MAX:** cambiar a *Unlimited*

**HTML Table** cambiar a **VOTable**

Cuando hacemos esto se descarga automáticamente un fichero llamado **vizier\_votable.vot**  
Normalmente se guarda en la carpeta de descargas.  
Conviene guardarla en otra carpeta y cambiarle el nombre p. eg. **m67\_dr2\_member.vot**

# Obtener la información EDR3 estrellas miembros

Lo obtenemos del archivo de Gaia. Es necesario entrar con nuestro usuario porque vamos a subir una tabla.

En el modo anónimo no podemos.

Gaia Archive → Advance (ADQL)

The image shows two screenshots of the Gaia interface. On the left, the 'Gaia Catalogue Upload' screen is displayed. It has fields for 'Table name' (set to 'M67\_dr2\_member'), 'Table description' (set to 'Uploaded from disk'), and 'File Upload' (with a file named 'm67\_dr2\_member.vot' selected). A red arrow points from this screen to the 'gaia archive' interface on the right. The 'gaia archive' interface shows a list of submitted jobs. One job is highlighted with a checkmark and the ID '1643888171730'. Below the list is a table with columns: Status, Job, Creation date, Num. rows, and Size. The table contains several rows of job information, all with checkmarks in the Status column. A second red arrow points from the 'User tables' section of the upload interface to the 'User tables' section of the archive interface, which lists 'user\_rcarrera.m67\_dr2\_member'.

Status	Job	Creation date	Num. rows	Size
✗	1643888171730	03-Feb-2022, 12:46:57	0	0 KB
✓	15859585815600	04-Apr-2020, 02:03:01	1	1 KB
✓	15859585796530	04-Apr-2020, 02:02:59	1	1 KB
✓	15859585776880	04-Apr-2020, 02:02:57	1	1 KB
✓	15859585758120	04-Apr-2020, 02:02:55	1	1 KB
✓	15859585740500	04-Apr-2020, 02:02:54	1	1 KB

# Obtener la información EDR3 estrellas miembros

Vamos a obtener movimientos propios, paralajes y magnitudes (`gaiaedr3.gaia_source`) usando la tabla de correlación entre Gaia DR2 y EDR3 (`gaiaedr3.dr2_neighbourhood`) pero solo para las estrellas que nos interesan (`user_XXXX.m67_dr2_member`)

```
SELECT
dr2.dr3_source_id,mem.source,dr2.dr2_source_id,edr3.source_id,edr3.ra,edr3.dec,edr3.parallax,edr3.pmra,edr3.pmdec
,edr3.phot_g_mean_mag,edr3.phot_bp_mean_mag,edr3.phot_rp_mean_mag,mem.pmemb
FROM gaiaedr3.gaia_source AS edr3
INNER JOIN dr2_neighbourhood AS dr2 ON edr3.source_id = dr2.dr3_source_id
INNER JOIN user_rcarrera.m67_dr2_member AS mem ON dr2.dr2_source_id = mem.source
WHERE dr2.magnitude_difference>=-0.2 AND dr2.magnitude_difference<=0.2 AND dr2.angular_distance<=600
```

A screenshot of the Gaia Archive search interface. At the top, there's a navigation bar with links for HOME, SEARCH, VISUALISATION, HELP, VSPACE, and SHARE. Below that is a sub-navigation bar with links for Basic, Advanced (AQL), and Query Results. The main area has tabs for 'Basic' and 'Advanced (AQL)'. A red arrow points from the left towards the 'Advanced (AQL)' tab. The interface includes a 'Job name:' input field, a 'Cori-Space for query autocompletion' dropdown, and 'Reset Form' and 'Submit Query' buttons. Below these are sections for 'Status' and 'Jobs'. The 'Status' section shows a list of jobs with checkboxes and icons. The 'Jobs' section lists individual jobs with columns for Job ID, Creation date, Num. rows, and Size. Each job entry has a series of small icons for actions like download or delete.

Status	Job	Creation date	Num. rows	Size
✓	16438800171130	03-Feb-2022, 12:46:57	0	0 KB
✓	1589595816600	04-Apr-2020, 02:03:01	1	1 KB
✓	15895958796030	04-Apr-2020, 02:02:59	1	1 KB
✓	1589595877680	04-Apr-2020, 02:02:57	1	1 KB
✓	1589595878120	04-Apr-2020, 02:02:55	1	1 KB
✓	1589595874000	04-Apr-2020, 02:02:54	1	1 KB

# Obtener la información EDR3 estrellas miembros

Si ha funcionado debemos obtener algo del tipo:

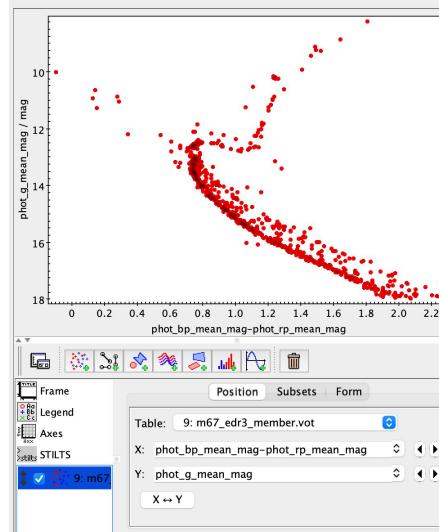
Status	Job	Creation date	Num. rows	Size	
✓	16439683002150	04-Feb-2022, 10:51:40	848	63 KB	

Descargamos los resultados:

Obtendremos algo tipo: **16439683002150-result.vot.gz**

Copiarlo en la carpeta de trabajo y cambiarle el nombre y descomprimirlo. **m67\_edr3\_member.vot**

Podemos abrirlo con TOPCAT,  
pintar el diagrama color-magnitud, etc.



# Obtener los resultados de APOGEE

Archivo SDSS búsqueda por SQL

<http://skyserver.sdss.org/dr17/SearchTools/sql>

```
1 SELECT apo.apstar_id,
2 apo.apogee_id, apo.gaiaedr3_source_id, apo.ra,apo.dec, apo.starflag, apo.andfl,
3 apo.vhelio_avg, apo.vscatter, apo.verr,
4 aspcap.*
5 FROM apogeeStar apo
6 JOIN dbo.fGetNearbyApogeeStarEq(132.85,11.81,120) near on
7 apo.apstar_id=near.apstar_id
8 JOIN aspcapStar aspcap on aspcap.apstar_id = apo.apstar_id
```

SELECT apo.apstar\_id, apo.apogee\_id, apo.gaiaedr3\_source\_id, apo.ra,apo.dec, apo.starflag,  
apo.andflag, apo.vhelio\_avg, apo.vscatter, apo.verr, aspcap.\*  
FROM apogeeStar apo  
JOIN dbo.fGetNearbyApogeeStarEq(132.85,11.81,120) near on apo.apstar\_id=near.apstar\_id  
JOIN aspcapStar aspcap on aspcap.apstar\_id = apo.apstar\_id

Para descargarla seleccionar **CSV** en *OUTPUT FORMAT*

La información está en dos tablas:

**apogeeStar**: Info general y velocidades radiales

**aspcapStar**: Parámetros atmosféricos y abundancias

# Obtener los resultados de GALAH

The screenshot shows the Data Central Query interface. At the top, there's a navigation bar with links for Services, Search, Surveys, Archives, and Schema. Below the navigation is a search bar with placeholder text "Submit a SQL/ADQL query to the Data Central database server". A "New Query" button is located below the search bar. The main area is titled "Query" and contains a form with fields for "Title" (containing "Return GAMA galaxies within redshift < 0.06") and "Notes". Below these fields is a large text area labeled "SQL/ADQL" containing the following code:

```
SELECT
galah_main.* , gaia_vac.ra,gaia_vac.dec
FROM galah_dr3p2.main_star AS galah_main
INNER JOIN galah_dr3p2.vac_gaia_edr3
AS gaia_vac ON galah_main.dr3_source_id = gaia_vac.dr3_source_id
WHERE 1=CONTAINS(POINT('ICRS', gaia_vac.ra, gaia_vac.dec),
CIRCLE('ICRS', 132.85, 11.81, 2.0 ))
```

A red arrow points from the text above this code block to the "SQL/ADQL" text area.

Below the code area, there are sections for "Valid ADQL/SQL", "Add to the queue" (with a checked checkbox), and "Email" (with a note about receiving an email when the query is finished). At the bottom right is a "Queue" button.

Archivo GALAH Data Central búsqueda por ADQL  
<https://datacentral.org.au/services/query/>

La información está en dos tablas:

**galah\_dr3p2.main\_star**: Resultados GALAH

**galah\_dr3p2.vac\_gaia\_edr3**: Cruce con Gaia EDR3

SELECT

```
galah_main.* , gaia_vac.ra,gaia_vac.dec
FROM galah_dr3p2.main_star AS galah_main
INNER JOIN galah_dr3p2.vac_gaia_edr3
AS gaia_vac ON galah_main.dr3_source_id = gaia_vac.dr3_source_id
WHERE 1=CONTAINS(POINT('ICRS', gaia_vac.ra, gaia_vac.dec),
CIRCLE('ICRS', 132.85, 11.81, 2.0 ))
```

# Obtener los resultados de GALAH

Archivo GALAH Data Central búsqueda por ADQL  
<https://datacentral.org.au/services/query/>

The screenshot shows a web interface for querying the GALAH Data Central. At the top, there are tabs for 'New Query' and 'Result'. Below the tabs, a message says 'logged in users can save query results'. The main area is titled 'Query Result' with a sub-section 'M67 GALAH all'. It displays a table of 999 rows from a total of 1812. The table has columns: star\_id, object\_id, dr2\_source\_id, dr3\_source\_id, survey\_name, field\_id, flag\_repeat, wg4\_field, and wg4\_pip. The first few rows are:

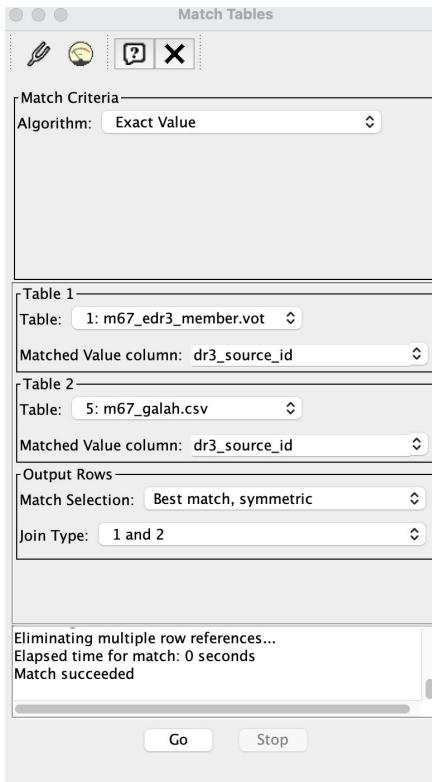
star_id	object_id	dr2_source_id	dr3_source_id	survey_name	field_id	flag_repeat	wg4_field	wg4_pip
08433724+1138183	160111002601363	601909262461777408	601909262461777408	k2_hermes	6609	0	10k_51	lbol
08440311+1121501	160111002601381	601847277493841536	601847277493841536	k2_hermes	6609	0	10k_26	lbol
08440932+1120274	160111002601384	601846998320123648	601846998320123648	k2_hermes	6609	0	10k_8	lbol
08480688+1124102	160106004101222	598920751201927936	598920751201927936	k2_hermes	6605	0	10k_57	lbol
08481235+1040481	160106004101174	598553759132071296	598553759132071296	k2_hermes	6605	0	10k_49	lbol

Descargar

0b95031c-1af4-4528-8512-56f9e6ad7233.tar.gz  
Copiar, descomprimir y renombrar  
m67\_galah.vot

# Cruzar Gaia EDR3 y Membresía con GALAH

TOPCAT → Joins → Pair Match (emparejamos en source\_id)

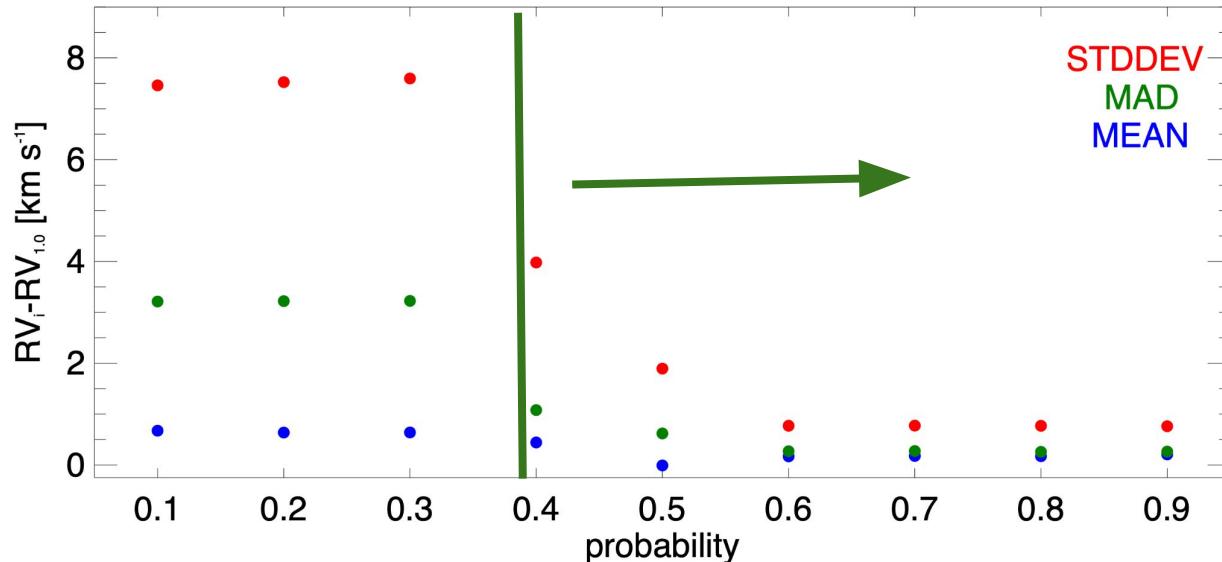


Obtenemos 278 estrellas en común.

**Consejo:** Es conveniente poner un nombre que nos permita identificar que contiene la nueva tabla.

# Limpieza del catálogo

Probabilidad astrométrica membresía baja



Carrera et al. 2019

Mmemb >= 0.4

# Limpieza del catálogo

## Recomendaciones de GALAH

### Recommended flag values

Overall, we make three recommendations: (1) `snr_c3_iraf > 30`; (2) only stellar parameters for stars with `flag_sp == 0`, `flag_fe_h == 0`; (3) only elemental abundances with `flag_X_fe == 0`.

For more information, see our [Flag bitmask documentation](#).

The main recommended `GALAH_DR3_main_allstar_v2` catalogue contains a number of flags. For most science cases, the two most important to consider are the stellar parameter quality flag (`flag_sp`) and the iron abundance quality flag (`flag_fe_h`). `flag_sp` folds in many potential sources of errors in the input values (e.g., unreliable astrometry, very low signal spectra, reduction problems, possibly binarity). `flag_fe_h` indicates problems with the stellar parameter determination. **By default, we recommend that users only consider stellar parameters ( $T_{\text{eff}}$ ,  $\log g$ , [Fe/H], broadening velocity, radial velocity) for stars with `flag_sp == 0` and `flag_fe_h == 0`.**

For the abundance information there is similarly flags. For the overall abundance (`alpha_fe`) and each individual elemental abundance `X_fe` there is a `flag_X_fe` that indicates problems with the elemental abundance determination. **We strongly recommend only considering the abundance of element `X` when `flag_X_fe == 0`.** As for all of our previous GALAH releases, we want to stress that we discourage the use of element abundances with `flag_X_fe > 0` without consideration of the possible systematics that these flagged measurements can introduce.

We would recommend considering only stars with a signal to noise `snr_c3_iraf > 30`.

Estrellas con una señal-ruido razonable  
`snr_c3_iraf > 30`

Estrellas cuyos parámetros atmosféricos se han obtenido sin problemas.

`flag_sp == 0`  
`flag_fe_h == 0`

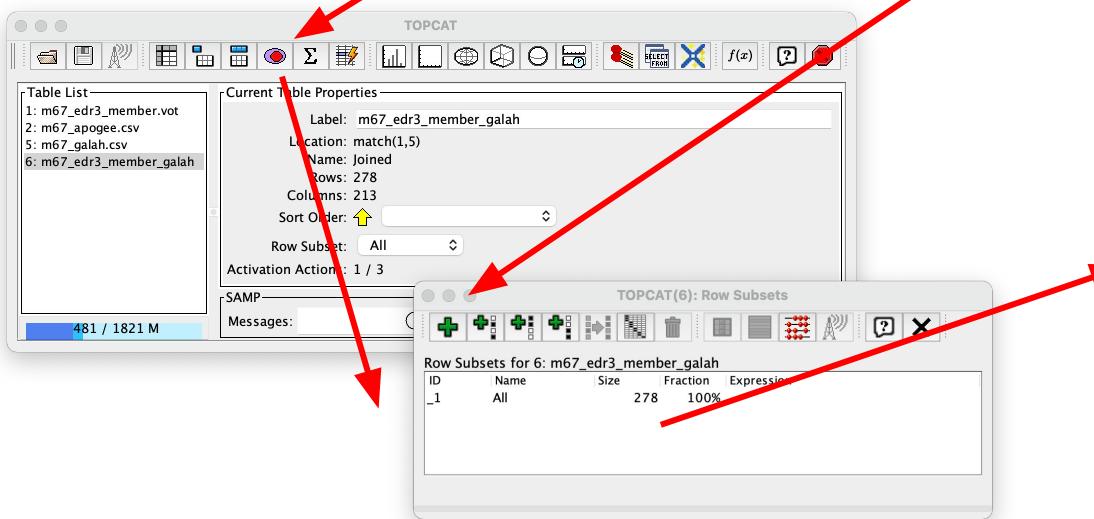
Más adelante, cuando estudiemos abundancias individuales, para el elemento X

`flag_X_h == 0`

# Limpieza del catálogo

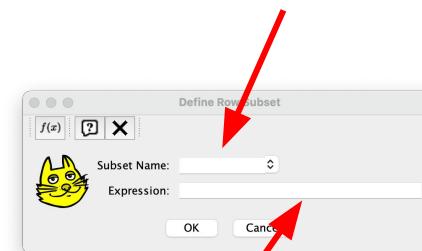
Aplicamos estas restricciones: creamos un subconjunto

TOPCAT → ROW SUBSET → DEFINE NEW SUBSET



Obtenemos 127 estrellas

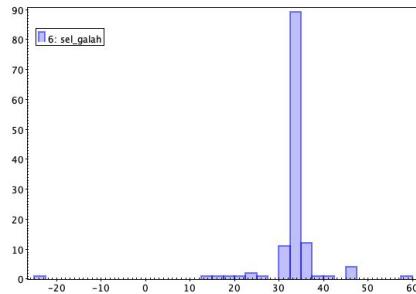
Nombre identificativo  
**sel\_galah**



$pmemb \geq 0.4 \& snr\_c3\_iraf > 30 \& flag\_sp == 0 \& flag\_fe\_h == 0$

# Limpieza del catálogo: velocidades radiales

TOPCAT: pintamos histograma velocidades radiales (rv\_galah)

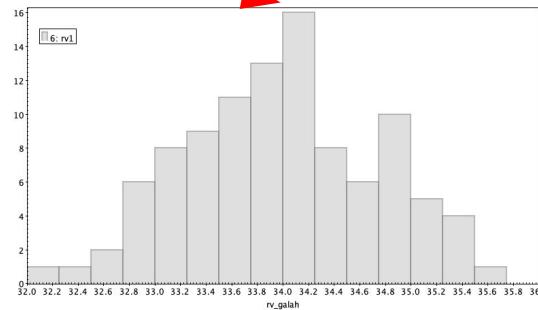


media  $33.99 \text{ km s}^{-1}$   
STD  $0.76 \text{ km s}^{-1}$

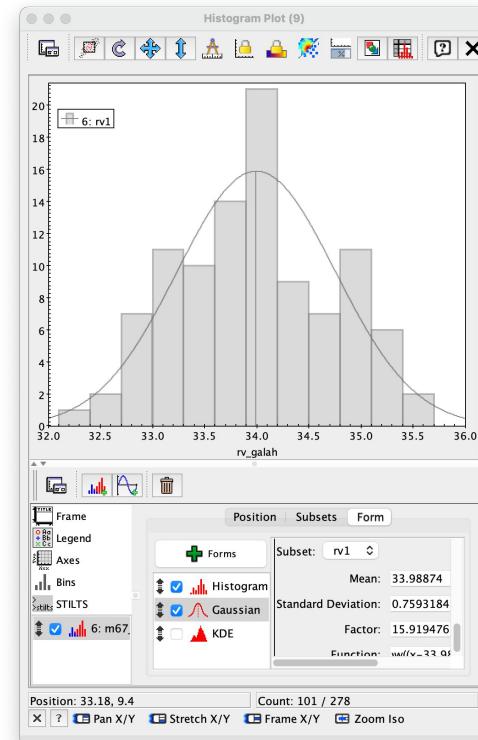
$33.96 \pm 0.44 \text{ km s}^{-1}$   
Carrera et al. 2022

Jugamos con los  
parámetros del histograma

**BINS:** 0.3  
**RANGE** p. ej. 32-36



Ajustamos  
Gaussiana



# Limpieza del catálogo: velocidades radiales

TOPCAT: añadimos condición de  $rv_{\text{galah}}$  dentro de media  $\pm 3 \times \text{std}$

ID	Name	Size	Fraction	Expression
-1	All	278	100%	
-6	members	104	37%	pmemb>=0.4 & snr_c3_iraf > 30 & flag_sp==0 & flag_fe_h==0 & rv_galah>=33.99-3*0.76 & rv_galah<=33.99+3*0.76

añadimos:  $\& rv_{\text{galah}}>=33.99-3*0.76 \& rv_{\text{galah}}<=33.99+3*0.76$

104 estrellas cumplen estas condiciones

# Inspeccionamos los resultados

Diagrama color-magnitud

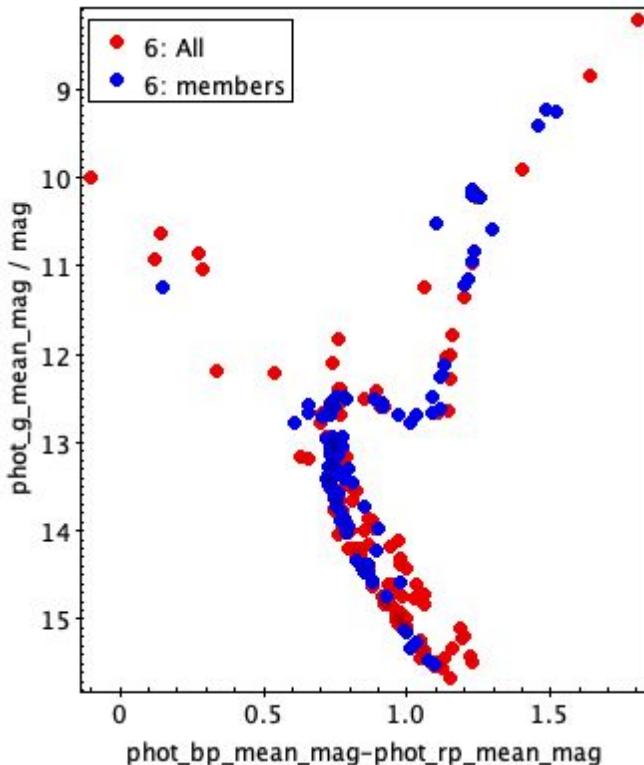
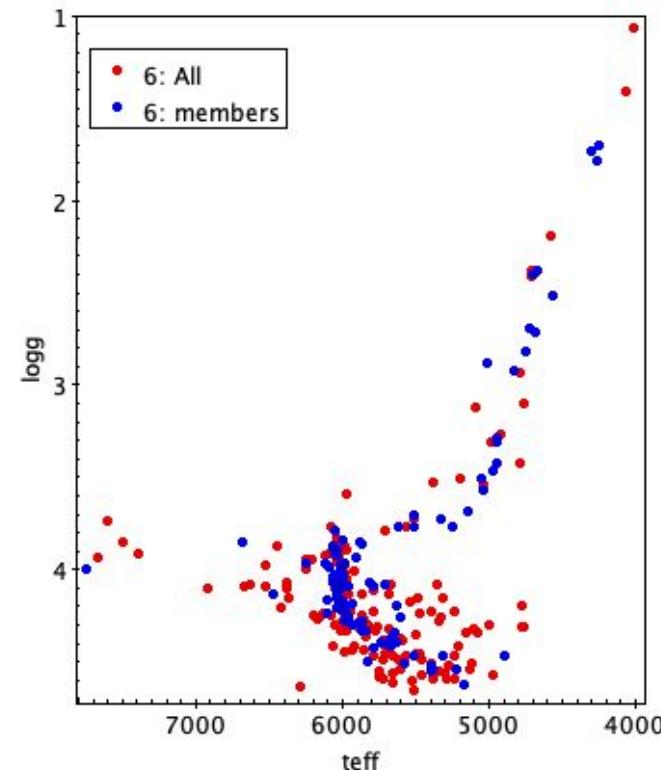


Diagrama HR



# Cálculo de Abundancias promedio

Elementos ligeros: Li, C, O

Elementos Z impar: Na, Al, K

Elementos α: Mg Si, Ca, Ti (y Ti II)

Elementos pico Fe: Sc, V, Cr, Mn, Co, Ni, Cu, Zn

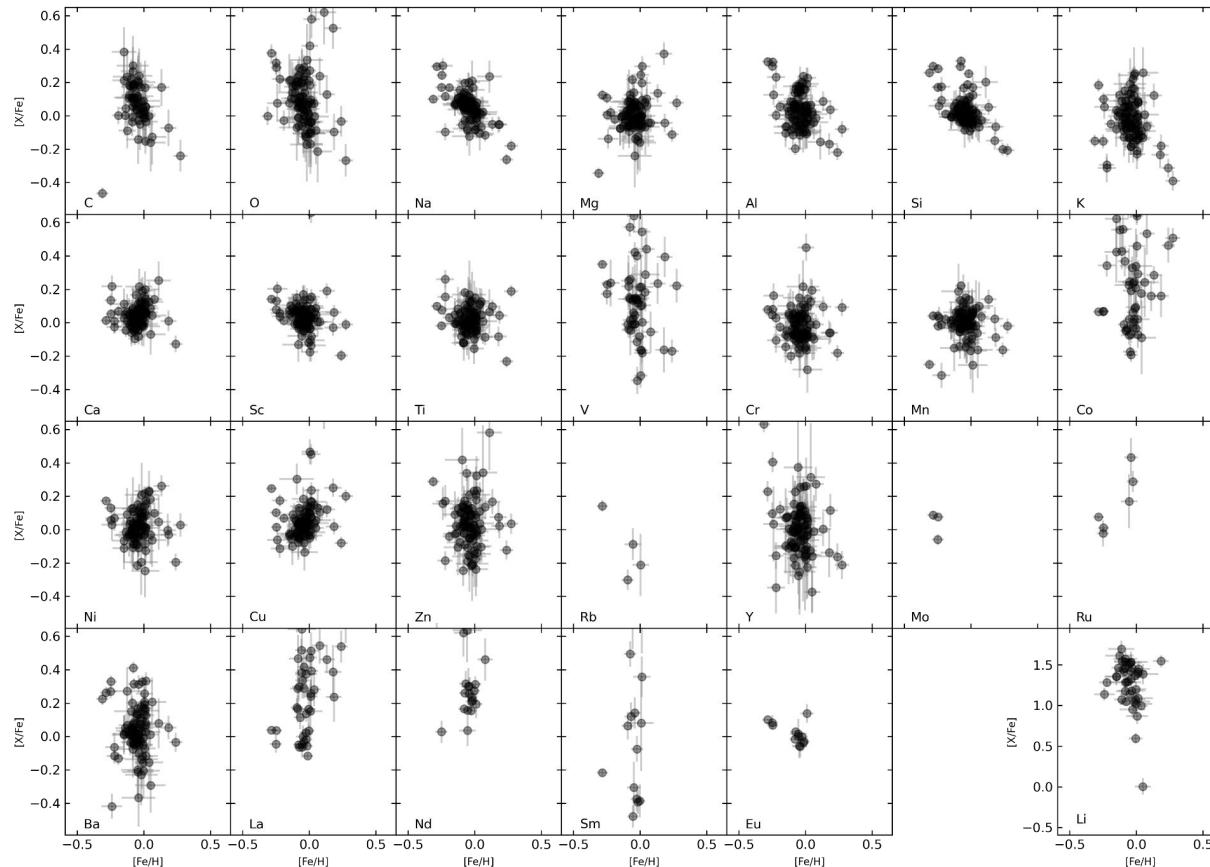
Elementos captura de neutrones:

lentos: Y, Ba, La, Rb, Mo, Ru, Nd, Sm

rápidos: Eu

Jupyter notebook: `calculo_abundancias.ipynb`

# Cálculo de Abundancias promedio



# A partir de las abundancias químicas ¿Puede el Sol haberse formado en NGC 2682?

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doi:10.1088/0004-6256/143/3/73

## THE SUN WAS NOT BORN IN M67\*

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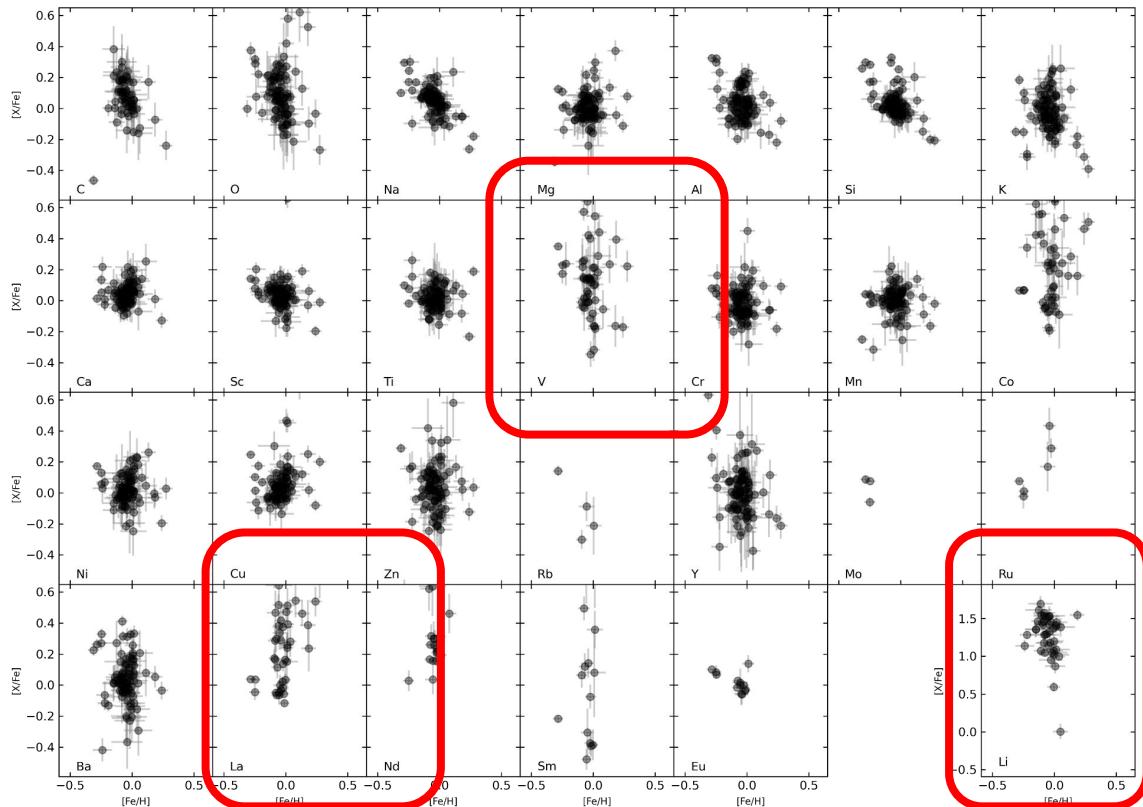
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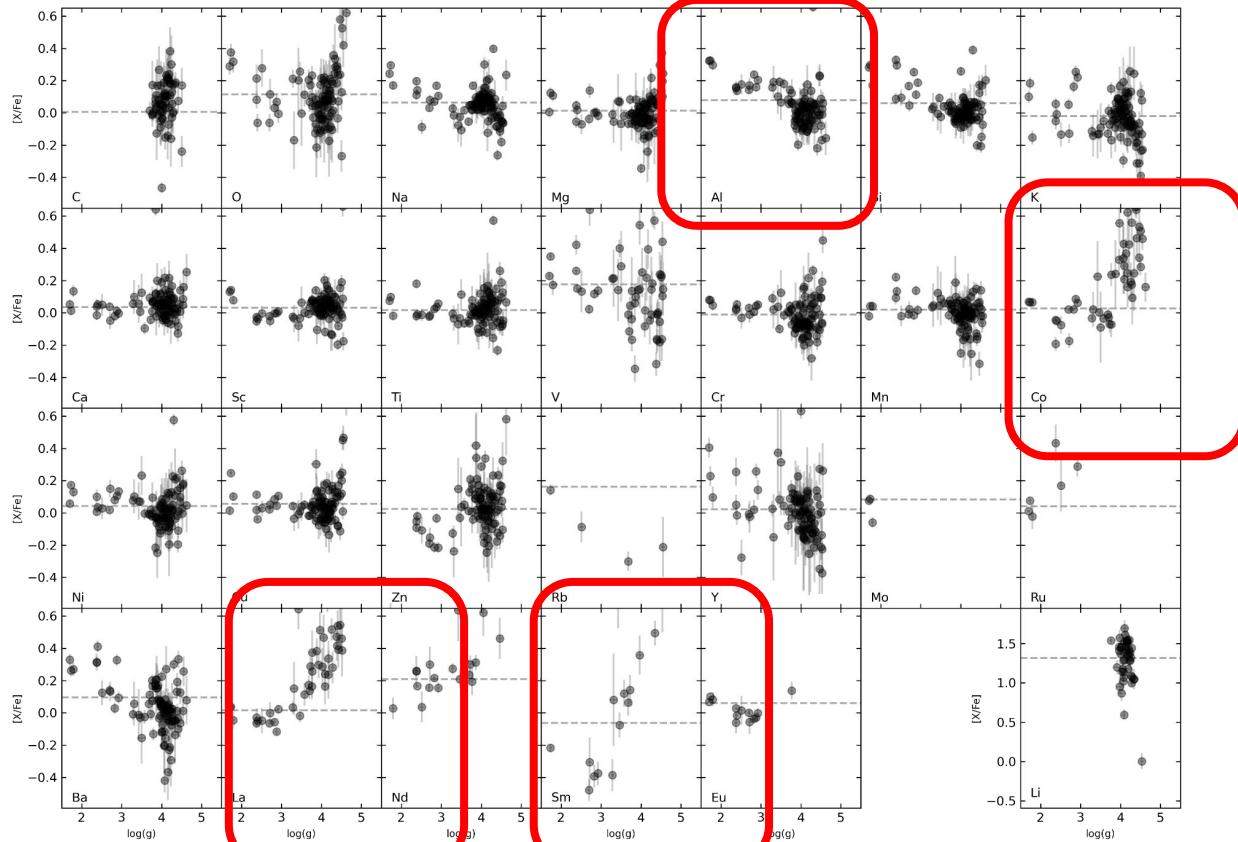
*Received 2011 April 23; accepted 2011 December 24; published 2012 February 14*

# Distribuciones particulares

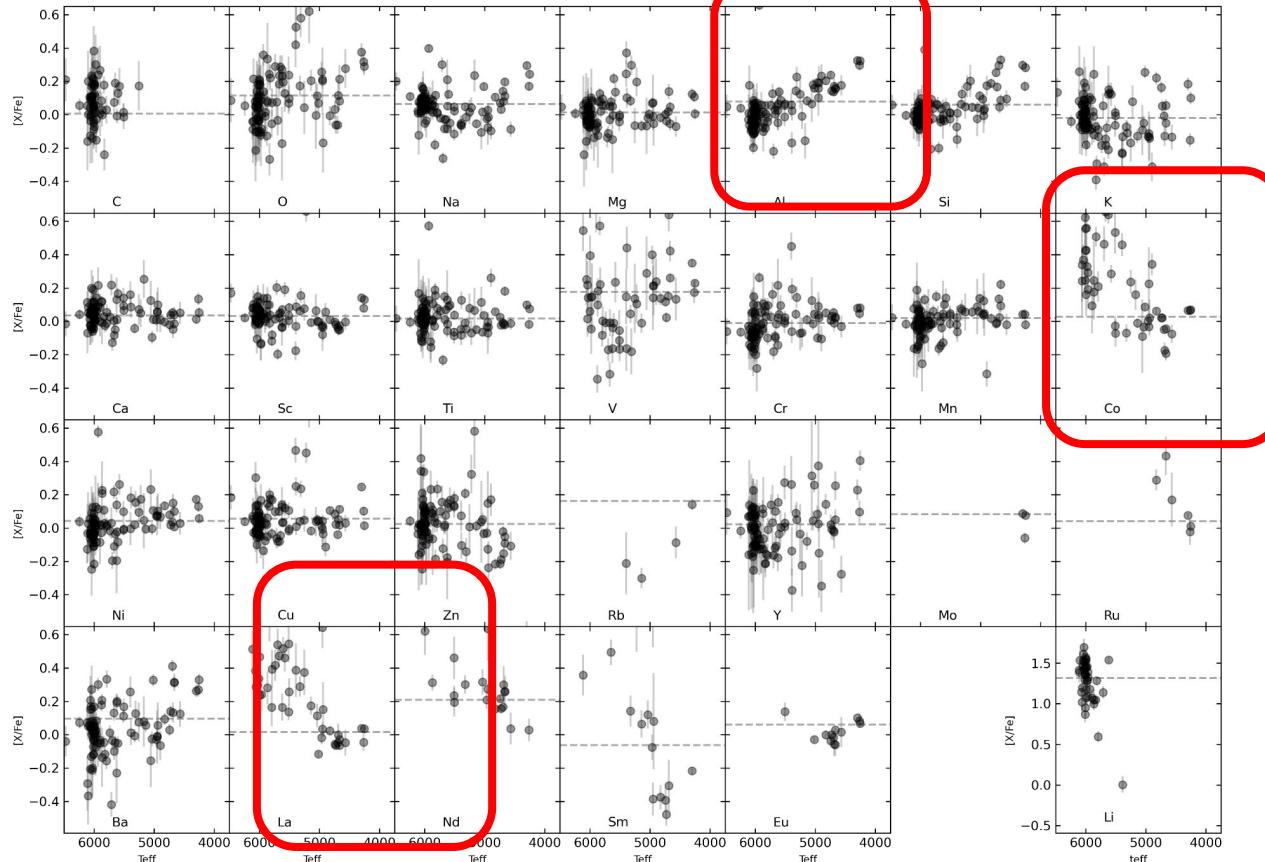
¿Son reales o debidas a las incertidumbres?



# Abundancias en función del estadio evolutivo



# Abundancias en función del estadio evolutivo



Esto se conoce como  
difusión atómica y  
mezcla

La atmósfera se  
contamina con material  
sintetizado en el interior  
Todavía no es bien  
comprendido

Podéis repetir el mismo ejercicio con APOGEE

# Obtener los resultados de APOGEE

Archivo SDSS búsqueda por SQL

<http://skyserver.sdss.org/dr17/SearchTools/sql>

```
1 SELECT apo.apstar_id,
2 apo.apogee_id, apo.gaiaedr3_source_id, apo.ra,apo.dec, apo.starflag, apo.andfl,
3 apo.vhelio_avg, apo.vscatter, apo.verr,
4 aspcap.*
5 FROM apogeeStar apo
6 JOIN dbo.fGetNearbyApogeeStarEq(132.85,11.81,120) near on
7 apo.apstar_id=near.apstar_id
8 JOIN aspcapStar aspcap on aspcap.apstar_id = apo.apstar_id
```

SELECT apo.apstar\_id, apo.apogee\_id, apo.gaiaedr3\_source\_id, apo.ra,apo.dec, apo.starflag,  
apo.andflag, apo.vhelio\_avg, apo.vscatter, apo.verr, aspcap.\*  
FROM apogeeStar apo  
JOIN dbo.fGetNearbyApogeeStarEq(132.85,11.81,120) near on apo.apstar\_id=near.apstar\_id  
JOIN aspcapStar aspcap on aspcap.apstar\_id = apo.apstar\_id

Para descargarla seleccionar **CSV** en *OUTPUT FORMAT*

La información está en dos tablas:  
**apogeeStar**: Info general y velocidades radiales  
**aspcapStar**: Parámetros atmosféricos y abundancias

# Obtener los resultados de APOGEE

Descarga un fichero con un nombre parecido a `Skyserver_SQL2_4_2022 10_53_01 AM.csv`

Copiarlo al directorio de trabajo y llamarlo `m67_apogee.csv`

## Atención:

El fichero da problemas al abrirlo con TOPCAT porque hay tres líneas de código HTML al principio y tres al final que hay que eliminar.

Abridlo con un editor de texto y borrarlas a mano.

Para usar las abundancias hay que tener en cuenta las recomendaciones!!!