

天文研究有用的工具

- SIMBAD/google/wikipedia 某天體的性質、找某類天體
- 影像 Images 庫 --- Digital Sky Survey (DSS)、PS1
 - ✓ 觀看影像 (FITS; Flexible Image Transport System) : ds9
- 數據 Data 庫 --- VizieR <https://vizier.u-strasbg.fr/>
 - ✓ TOPCAT 處理「目錄式」數據 processing/analysis/visualization

應用在星團

- *Gaia* 太空望遠鏡數據 (恆星的坐標、距離、運動)
- PARSEC 恆星演化計算



google.com/search?q=simbad+ngc726&rlz=1C1CAFC_enTW890TW890&oq=simbad+ngc726&aqs=chrome



simbad ngc726



全部

圖片

地圖

影片

新聞

更多

工具

約有 1,650 項結果 (搜尋時間 : 0.36 秒)

<http://simbad.u-strasbg.fr> > sim-basic ▾ 翻譯這個網頁

NGC 726 - SIMBAD Astronomical Database - Université de Strasbourg



The **SIMBAD** astronomical database provides basic data, cross-identifications, bibliography and measurements for astronomical objects ... Query : **NGC 726** ...

<https://simbad.u-strasbg.fr> > sim-id ▾ 翻譯這個網頁

ngc7226 - SIMBAD Astronomical Database



The **SIMBAD** astronomical database provides basic data, cross-identifications, bibliography and



NGC 726

other query modes :

Identifier query

Coordinate query

Criteria query

Reference query

Basic query

Script submission

TAP

Output options

Help

Query : NGC 726

Basic data :**NGC 726 -- Galaxy**

Other object types:

G (6dFGS,KUG,...)

ICRS coord. (*ep*=J2000) :

01 55 31.873 -10 47 59.19 (Infrared) [] C 2006AJ....131.1163S

FK5 coord. (*ep*=J2000 *eq*=2000) :

01 55 31.874 -10 47 59.19 []

FK4 coord. (*ep*=B1950 *eq*=1950) :

01 53 04.288 -11 02 39.46 []

Gal coord. (*ep*=J2000) :

168.724275 -67.774378 []

Radial velocity / Redshift / cz :

V(km/s) 5346 [11] / z(~) 0.017994 [0.000037] / cz 5394.53 [11.00]
D 2005A&A...430..373T

Morphological type:

Sp D ~

Angular size (*arcmin*):

0.363 0.283 100 (NIR) C 2006AJ....131.1163S

Fluxes (4) :

B 14.27 [~] E ~

J 13.471 [0.080] C 2006AJ....131.1163S

H 12.735 [0.098] C 2006AJ....131.1163S

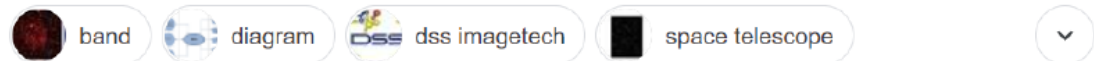
K 12.109 [0.107] D 2006AJ....131.1163S

SIMBAD Query around within 2



約有 50,200,000 項結果 (搜尋時間：0.60 秒)

「dss images」的圖片搜尋結果



意見回饋

全部顯示 →

<https://irsa.ipac.caltech.edu> > data > DSS ▾ 翻譯這個網頁

DSS Data Collection Atlas - IRSA/IPAC ✓

Digitized Sky Survey (DSS) Data Access ... clicking on any area in red on the above image, or by typing a coordinate below. ... Images must cover coordinate ...

<https://archive.eso.org> > dss > dss ▾ 翻譯這個網頁

ESO Online Digitized Sky Survey - ESO Archive ✓

2016年8月29日 — The images of these surveys are based on photographic data obtained ... A client to access the DSS-1 and DSS-2 at ESO directly from your ...

<https://www.eso.org> > public > images ▾ 翻譯這個網頁

DSS image | ESO - Eso.org ✓





Barbara A.

MIKULSKI ARCHIVE FOR SPACE TELESCOPES

MAST

STScI

Tools

Mission Search

Search Website



Follow Us

Register

Forum

DSS Home

About DSS

Getting Started

DSS Search Form

DSS Target Search

FAQ

Search & Retrieval

About DSS Data

Data Reduction & Analysis

Related Sites

Data Use Policy



The **Digitized Sky Survey** comprises a set of all-sky photographic surveys in E, V, J, R, and N bands conducted with the Palomar and UK Schmidt telescopes. The [Catalogs and Surveys Branch \(CASB\)](#) is digitizing the photographic plates to support HST observing programs but also as a service to the astronomical community.

The 6.5-degree x 6.5-degree plates are scanned using a modified PDS microdensitometer to a pixel scale of about 1.7 arcseconds per pixel for the POSS, SERC, and Palomar Quick-V surveys, and to about 1.0 arcseconds per pixel for the POSS-II surveys.

Images of any part of the sky may be extracted from the DSS, in either FITS or GIF format.

News

September 26, 2018:

New HLSP: ATLAS-REFCAT2

September 13, 2018:

New HLSP: HUGS

September 04, 2018:

HST, Kepler, K2, and FUSE Downloads Options Change

August 23, 2018:

New HLSP: URANUS-STIS

July 27, 2018:

OPAL HLSP Update



Missions

Hubble

Hubble Legacy Archive

Hubble Spectral Legacy

The STScI Digitized Sky Survey

NOTE: To obtain target coordinates for **HST Phase 2 proposals**, select the [HST Phase 2 \(GSC2\)](#) survey option.

[[New!](#) | [Help](#) | [FAQ](#) | [©](#) | [Acknowledging DSS](#) | [Other DSS Sites](#) | [Archive](#) | [STScI](#)]

[Get an Object's Coordinates](#)

Object name GET COORDINATES
Get coordinates from [SIMBAD](#) [NED](#)

[Retrieve an Image](#)

Target: NGC 0726 (G) Resolved by: SIMBAD

[Retrieve from](#)

POSS2/UKSTU Red
POSS2/UKSTU Blue
POSS2/UKSTU IR
POSS1 Red
POSS1 Blue
Quick-V
HST Phase 2 (GSC2)

[\(detailed information about the Surveys\)](#)

[RA](#) [Dec](#) J2000

[Height](#) (max: 60.0) [Width](#) (max: 60.0) arcminutes

[File format](#) [Compression \(FITS only\)](#)

Save file to disk (instead of displaying)

[HST Field of View Overlay \(1st generation GIF only\):](#)

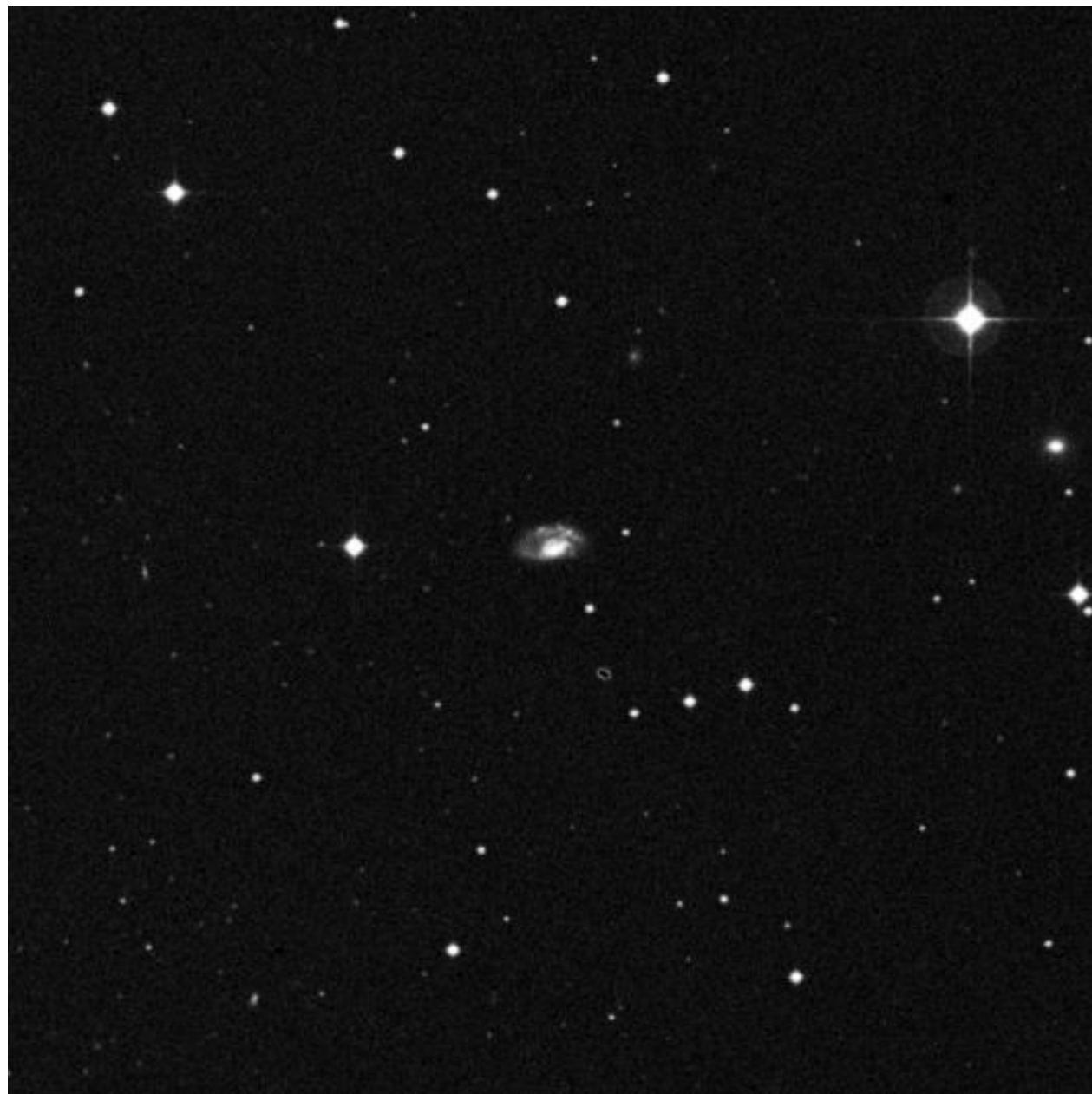
[Roll angle \(Y3\):](#)

Image	Band	Approximate wavelength range
-------	------	------------------------------

DSS1B	B _j	3950 - 5400 Å
DSS1R	R	6125 - 6475 Å
DSS2B	B _j	3950 - 5400 Å
DSS2R	R	6300 - 6900 Å
DSS2IR	I	6950 - 9000 Å

← 包括了氫元素的訊號 H_α λ656.3 nm

<https://irsa.ipac.caltech.edu/applications/FinderChart/docs/coverage.html>



NGC 726 blue



NGC 726 red

SAOImageDS9

An image display and visualization tool for astronomical data

DOWNLOAD

New Features of SAOImageDS9 version 8.2

Themes

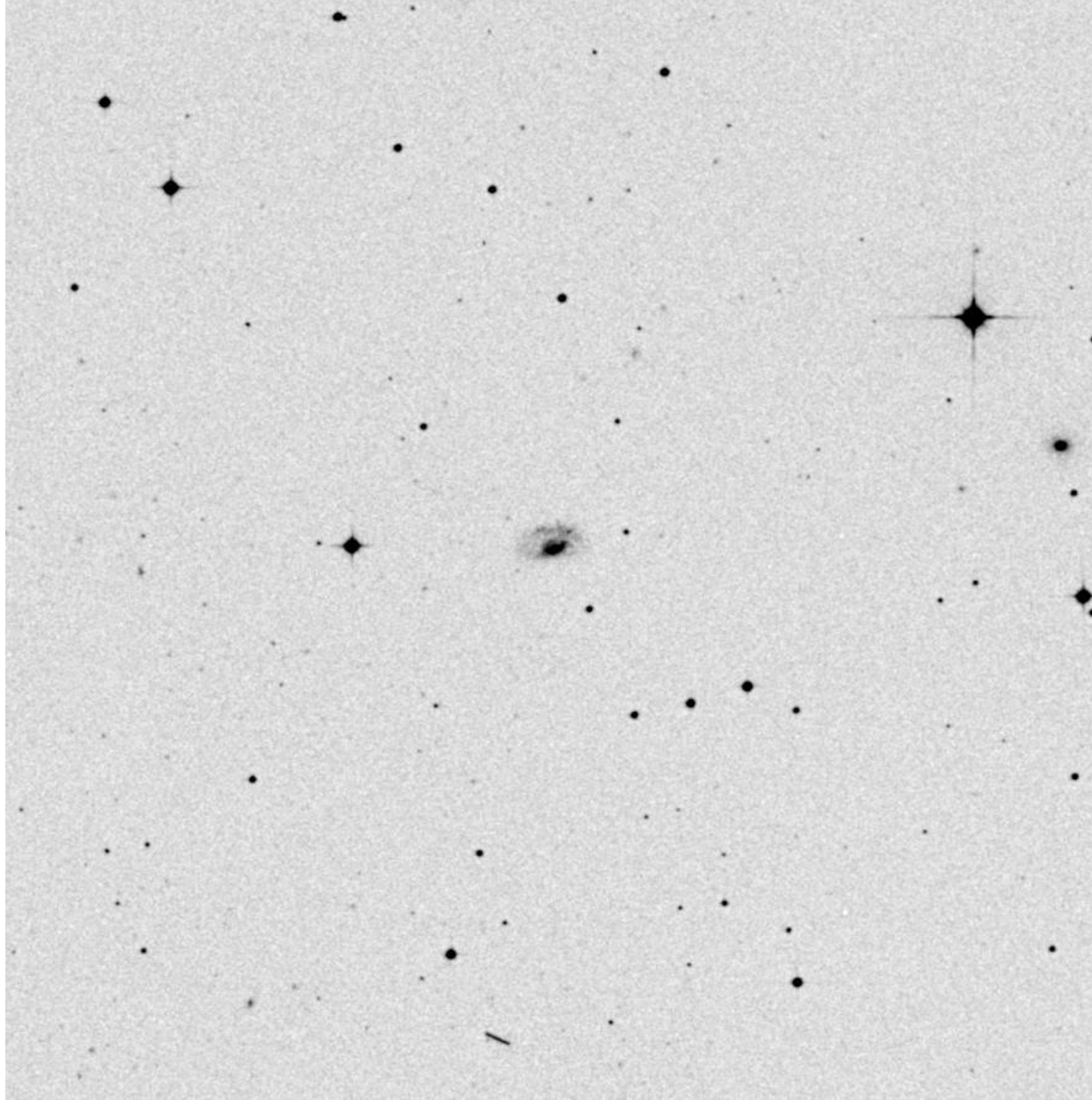


SAOImageDS9 8.....exe ^

En @ 正 顯示 X

ds9

Color inverted
Export to jpeg



Try

✓ M51

✓ M67

✓ NGC 6823

Messier catalog

https://en.wikipedia.org/wiki/Messier_object

Catalog of Nebulae and Star Clusters (110)

Check out M1, M31, M42, M51, M82

New General Catalog (NGC)

(of Nebulae and Clusters of Stars)

7840 galaxies, star clusters, emission nebulae

Arranged in RA order

Rough coordinates of NGC 726?

Index Catalog (IC)

+5386 entries

Latest version 2019, a total of ~14,000 objects

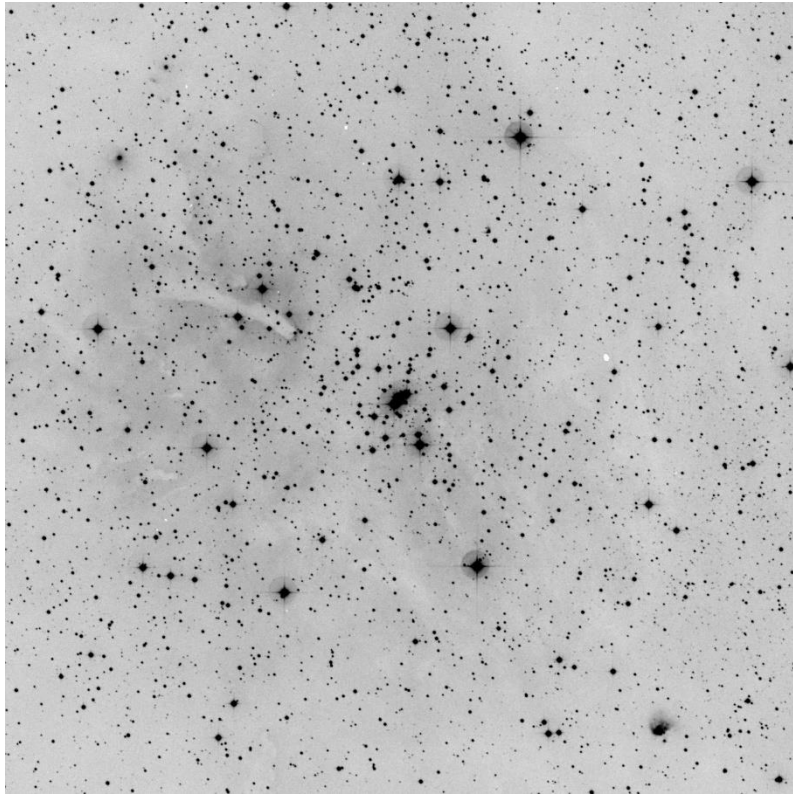
習題

- 某位家人的生日，例如今天 07/26
找出 NGC 726 是什麼天體？有哪些已知的性質？
下載 NGC 726 的影像 (gif, FITS)，
短波（藍色）、長波（紅色）
檢視這些影像，試試下載不同範圍 (5', 30') 的影像
- 然後試 NGC 6823，這是什麼天體？距離、年齡？
(怎麼知道?)

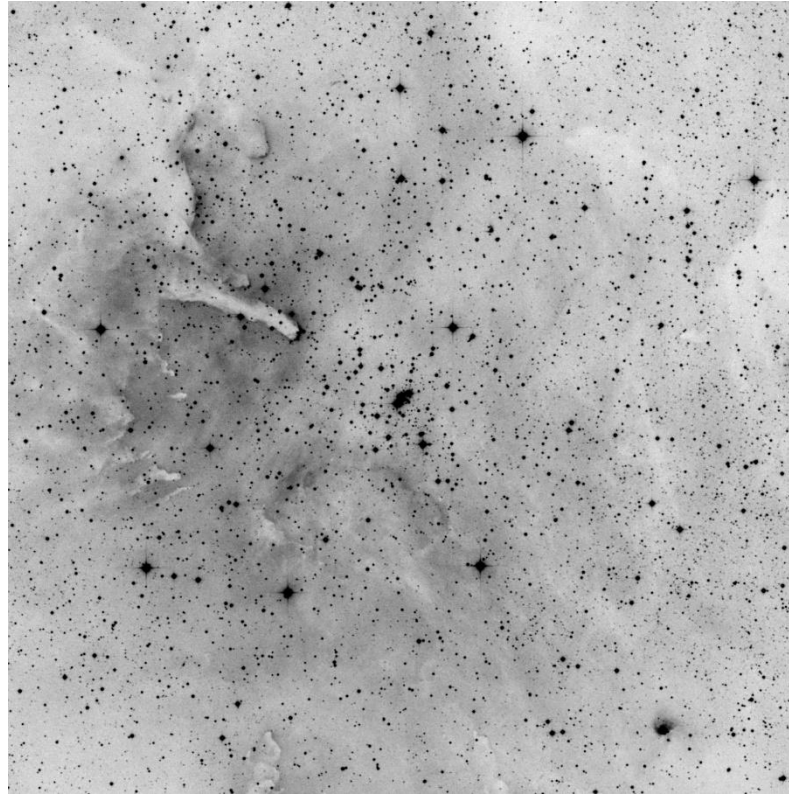
ds9

--- display, adjust brightness/contrast/color (inverted)/window size,
--- export jpeg

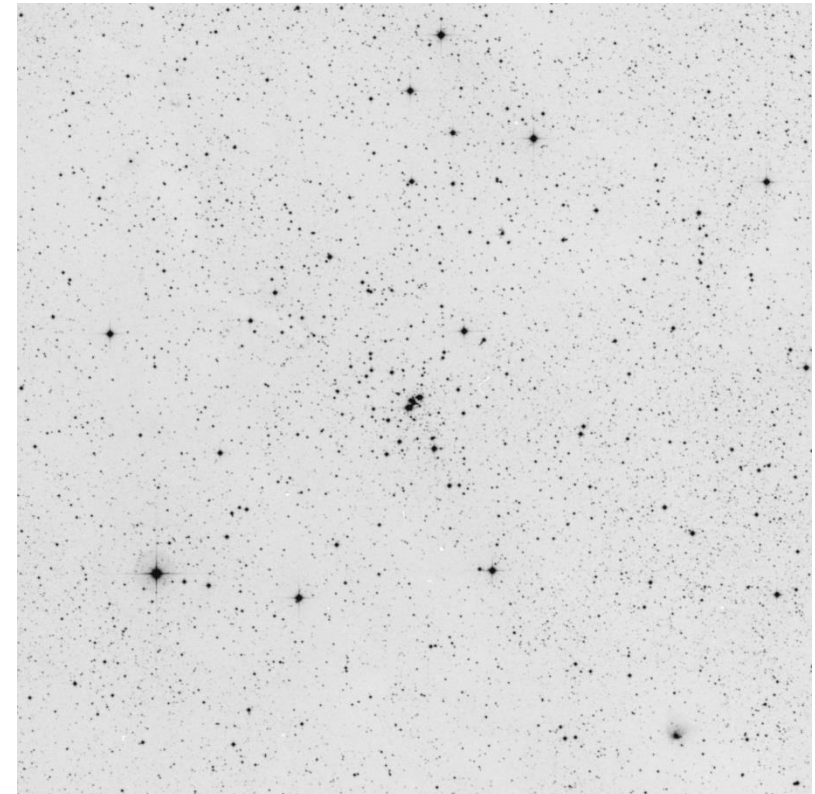
DSS filter responses <https://irsa.ipac.caltech.edu/applications/FinderChart/docs/coverage.html>



blue



red



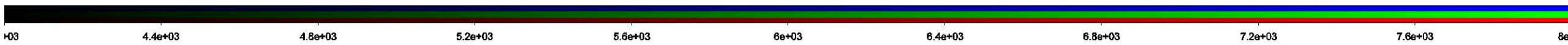
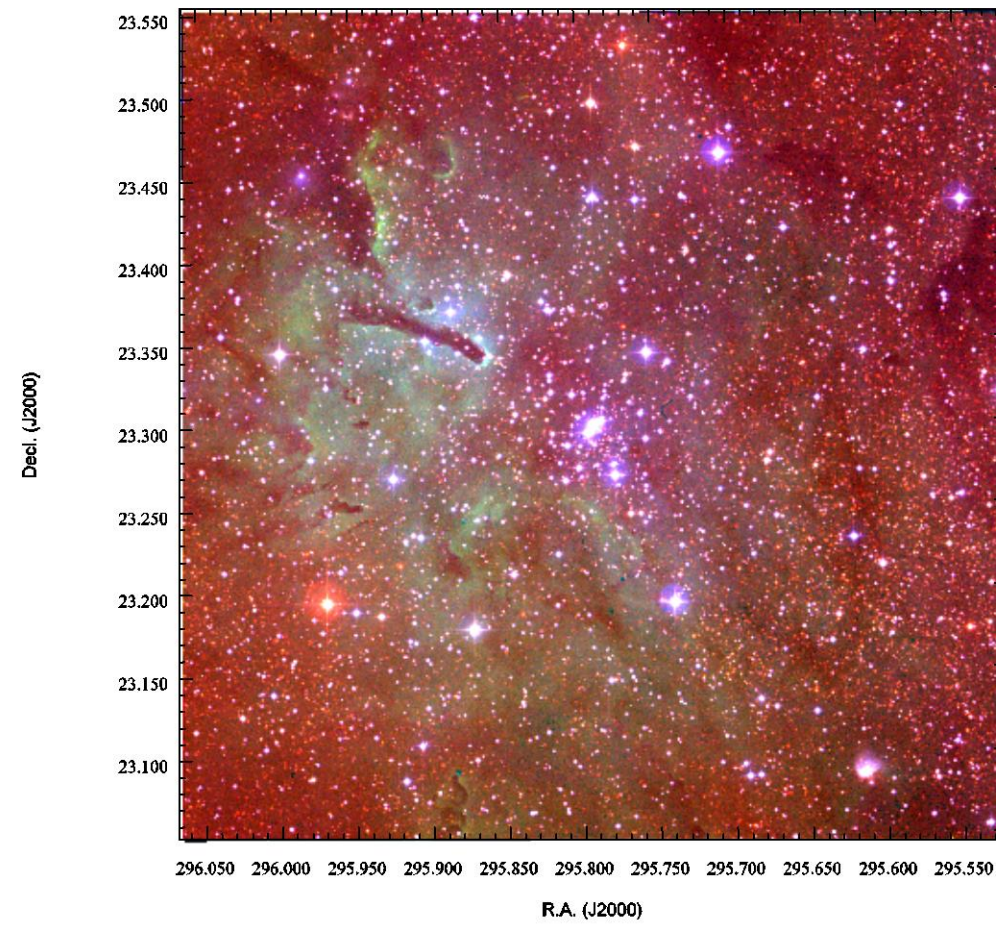
infrared

Tri-color composite

ds9

- Frame, New Frame RGB
- Select Current View, one of the b, g, and r images
- RGB
- Open



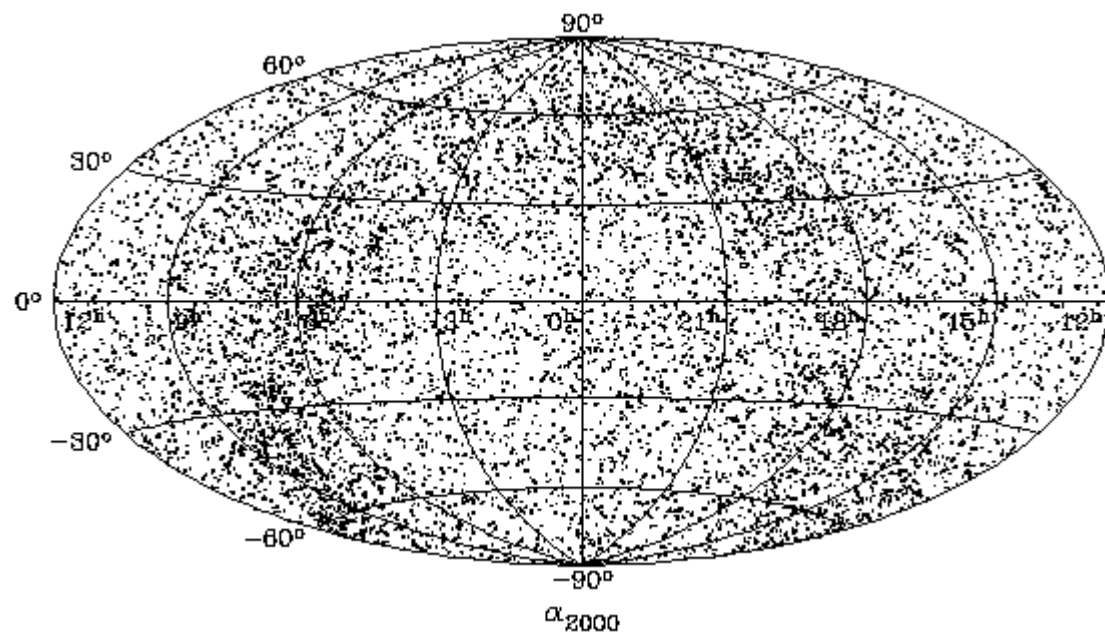




<https://www.cloudynights.com/topic/584227-ngc-6823-hasho/>

Yale Bright Star Catalog BSC5

<http://tdc-www.harvard.edu/catalogs/bsc5.html>



習題

1. 下載BSC5，並繪製全天亮星位置
2. 只繪出亮於二等的亮星。試試以較大的符號表示較亮的星

Full	RAJ2000 “h:m:s”	DEJ2000 “d:m:s”	GLON deg	GLAT deg	Vmag mag	SpType
1	00 05 09.9	+45 13 45	114.44	-16.88	6.70	A1Vn
2	00 05 03.8	-00 30 11	98.33	-61.14	6.29	gG9
3	00 05 20.1	-05 42 27	93.75	-65.93	4.61	K0IIIbCN-0.5
4	00 05 42.0	+13 23 46	106.19	-47.98	5.51	G5III
5	00 06 16.0	+58 26 12	117.03	-3.92	5.96	G5V
6	00 06 19.0	-49 04 30	321.61	-66.38	5.70	G1IV
7	00 06 26.5	+64 11 46	118.06	1.75	5.59	B9III
8	00 06 36.8	+29 01 17	111.26	-32.83	6.13	K0V
9	00 06 50.1	-23 06 27	52.21	-79.14	6.18	A7V
10	00 07 18.2	-17 23 11	74.36	-75.90	6.19	A6Vn
11	00 07 44.1	-02 32 56	98.02	-63.29	6.43	B8IIIpSi
12	00 07 46.8	-22 30 32	55.56	-79.07	5.94	A2Vp:
13	00 08 03.5	-33 31 46	355.91	-78.67	5.68	K1III
14	00 08 12.1	-02 26 52	98.34	-63.24	6.07	K2III+F
15	00 08 23.3	+29 05 26	111.73	-32.84	2.06	B8IVpMnHg
16	00 08 17.4	-08 49 26	91.79	-69.04	5.99	gG8
17	00 08 41.0	+36 37 36	113.45	-25.45	6.19	F8IV
18	00 08 33.4	-17 34 39	74.69	-76.25	6.06	M0III
19	00 08 52.2	+25 27 46	110.97	-36.42	6.23	K0III
20	00 09 20.2	+79 42 53	120.98	17.00	6.01	A7IV
21	00 09 10.7	+59 08 59	117.52	-3.27	2.27	F2III-IV
22	00 09 02.4	+18 12 43	108.99	-43.51	5.53	G9III
23	00 09 02.4	-54 00 07	316.25	-62.02	6.33	G4IV

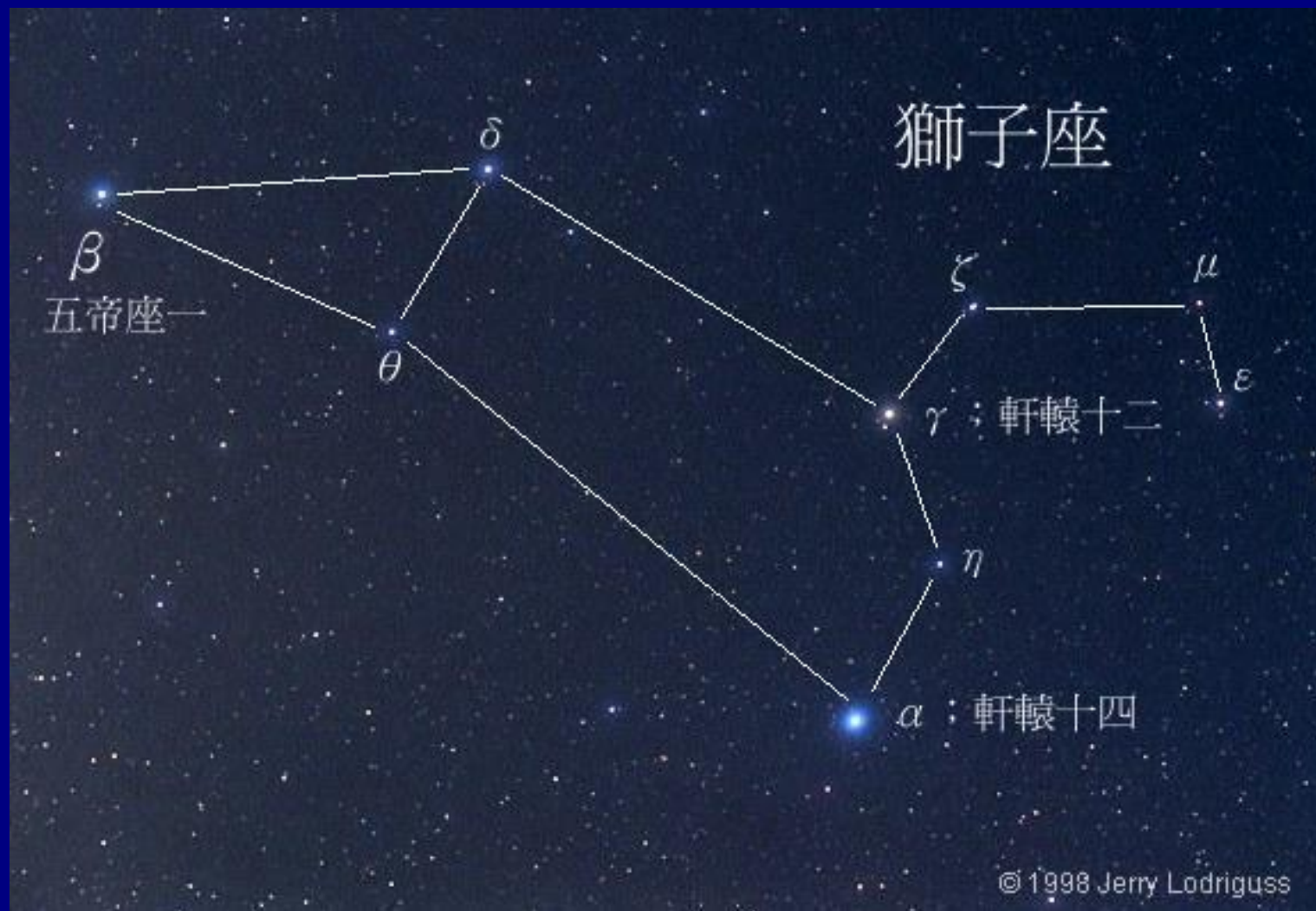
自己問：

1. 星表中一共有多少顆星？全天空為何分布不均勻？
2. 最亮的星是哪顆？有多亮？
3. 星表中最暗的星是哪顆？視星等為多少？
4. 按照亮度的分布如何？小於0等、0~1等、1~2等 ...

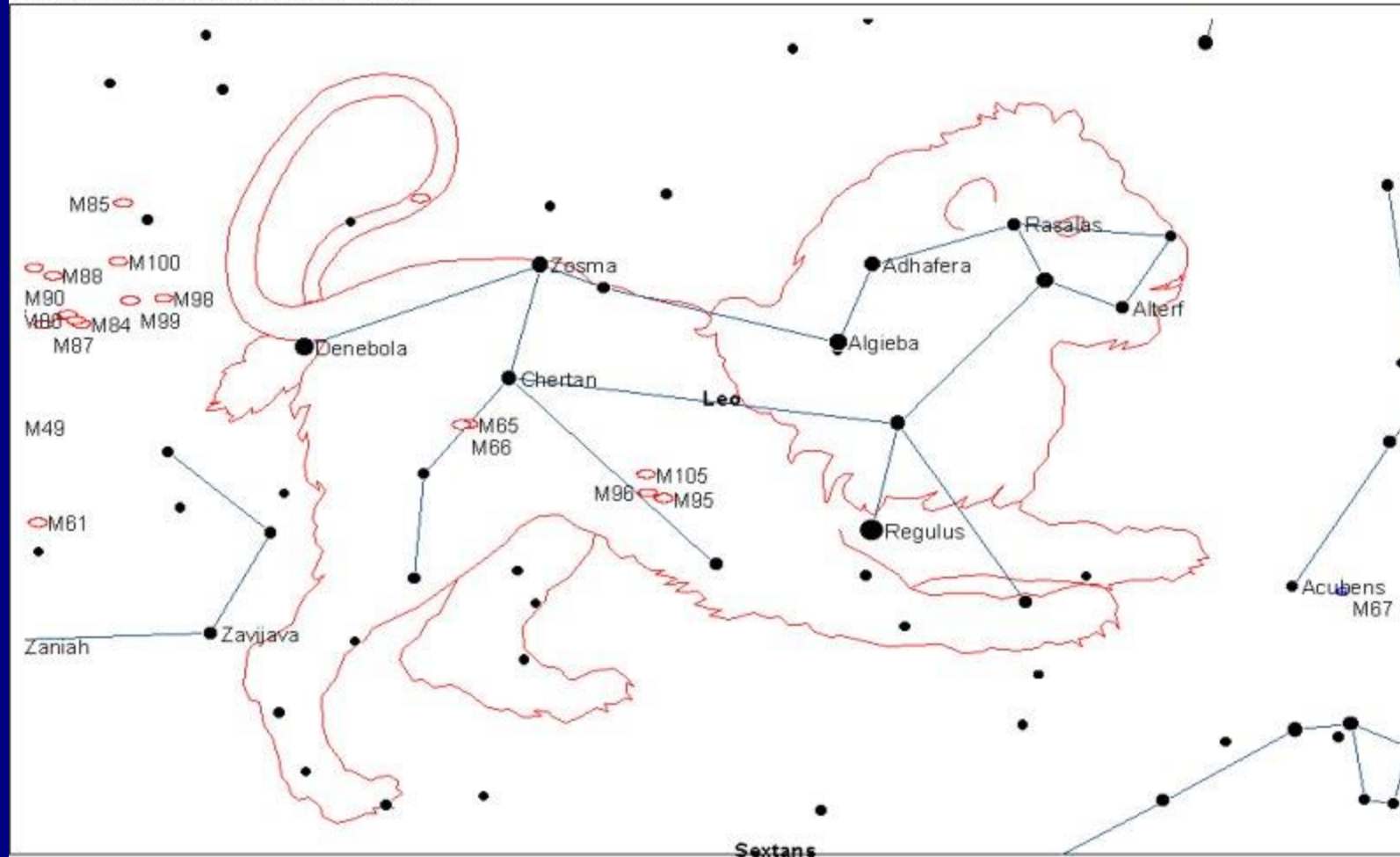
- ✓ ASCII (alpha-numericals 拉丁字母、數字、標點符號)
- ✓ Binary (code), Unicode (統一碼，14萬個字元)、UTF-8, Big-5 code (一字兩碼) ...
- ✓ It's messy.
- ✓ It' s messy. (用中文編碼編輯英文的結果)

星座 (constellations) --- 星球「看起來」形成的圖樣，其實彼此可能遠近不同而毫無關連





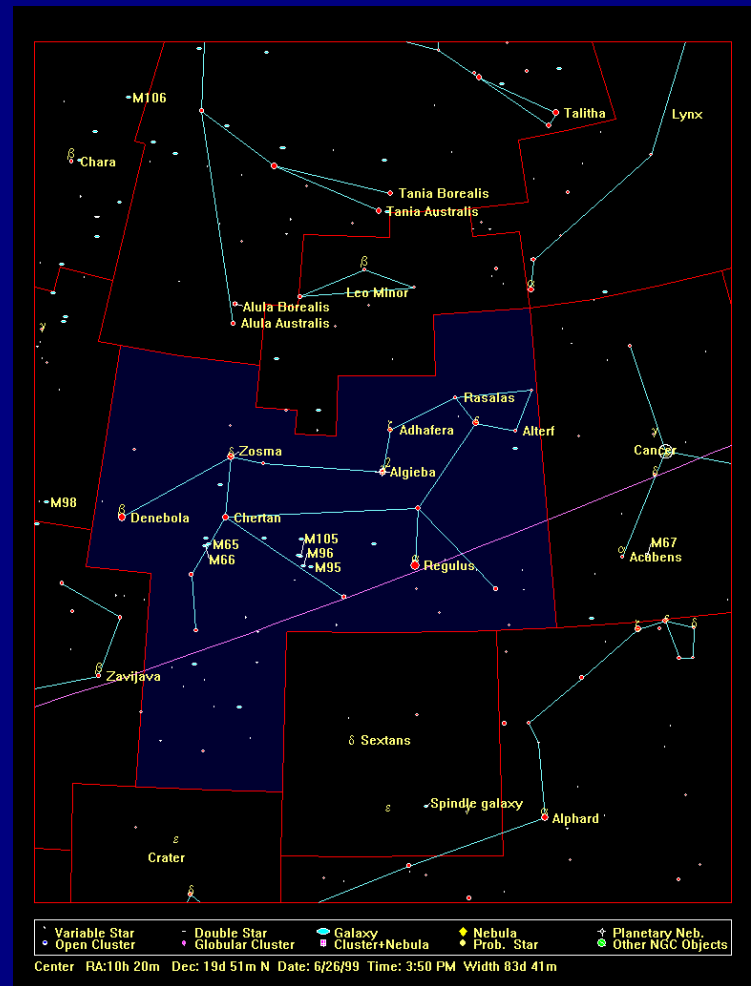
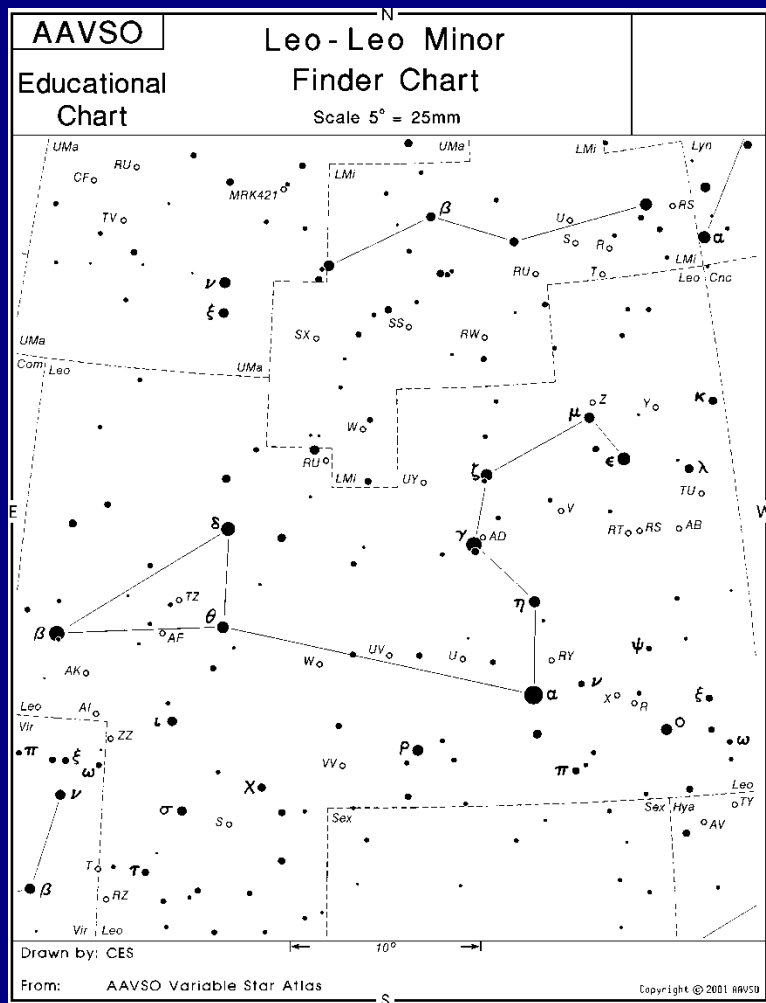
亮星「看起來」構成特殊圖樣，此處所示為春季夜空的「**獅子**」(Leo)



Leo

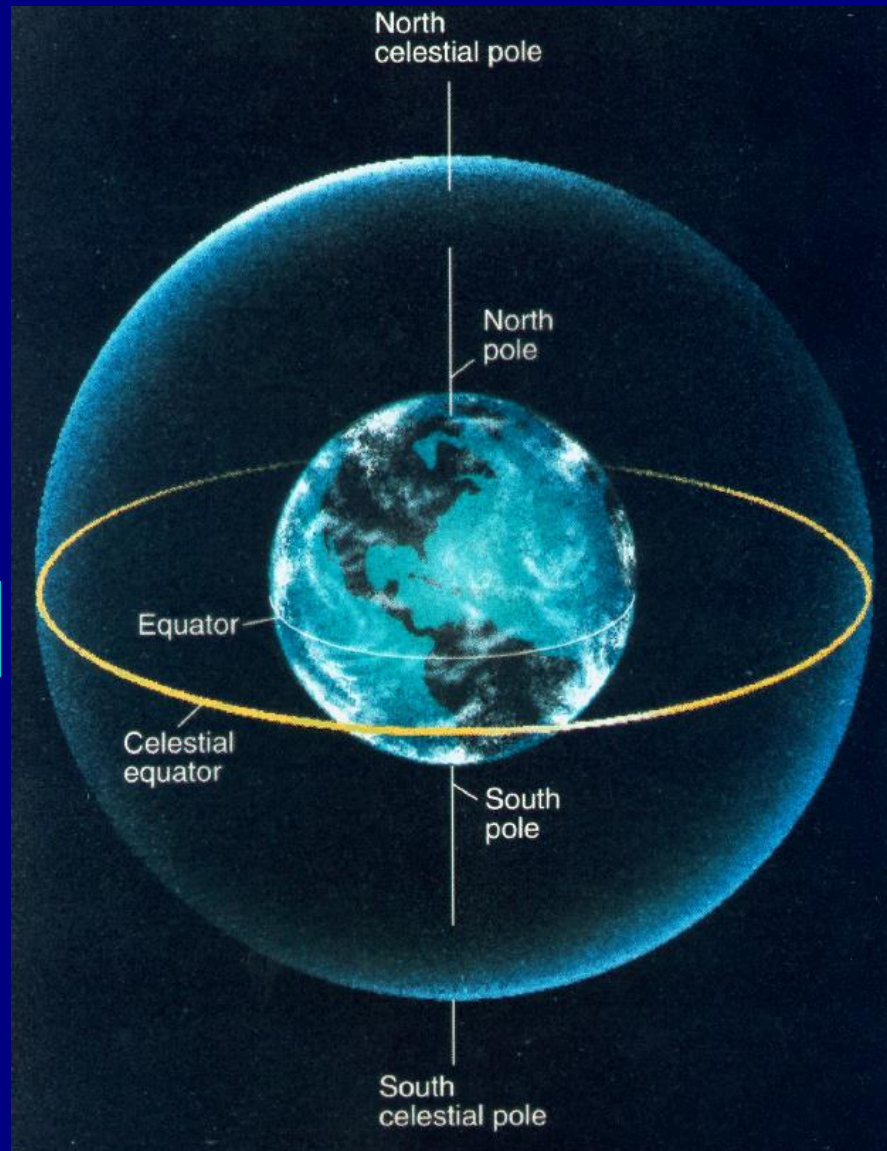
Abbreviation: Leo
Genitive Form: Leonis
Description: The Lion

Pronunciation: LEE' oh
Genitive Pronunciation: lee OH' nis
Sky Database: Constellation Labels



天空共有 88 個天區，以星座命名。星座不只是個圖騰，或某幾顆星，而是個「天區」。此處所示為獅子座附近的星圖

天球北極



(地球) 北極

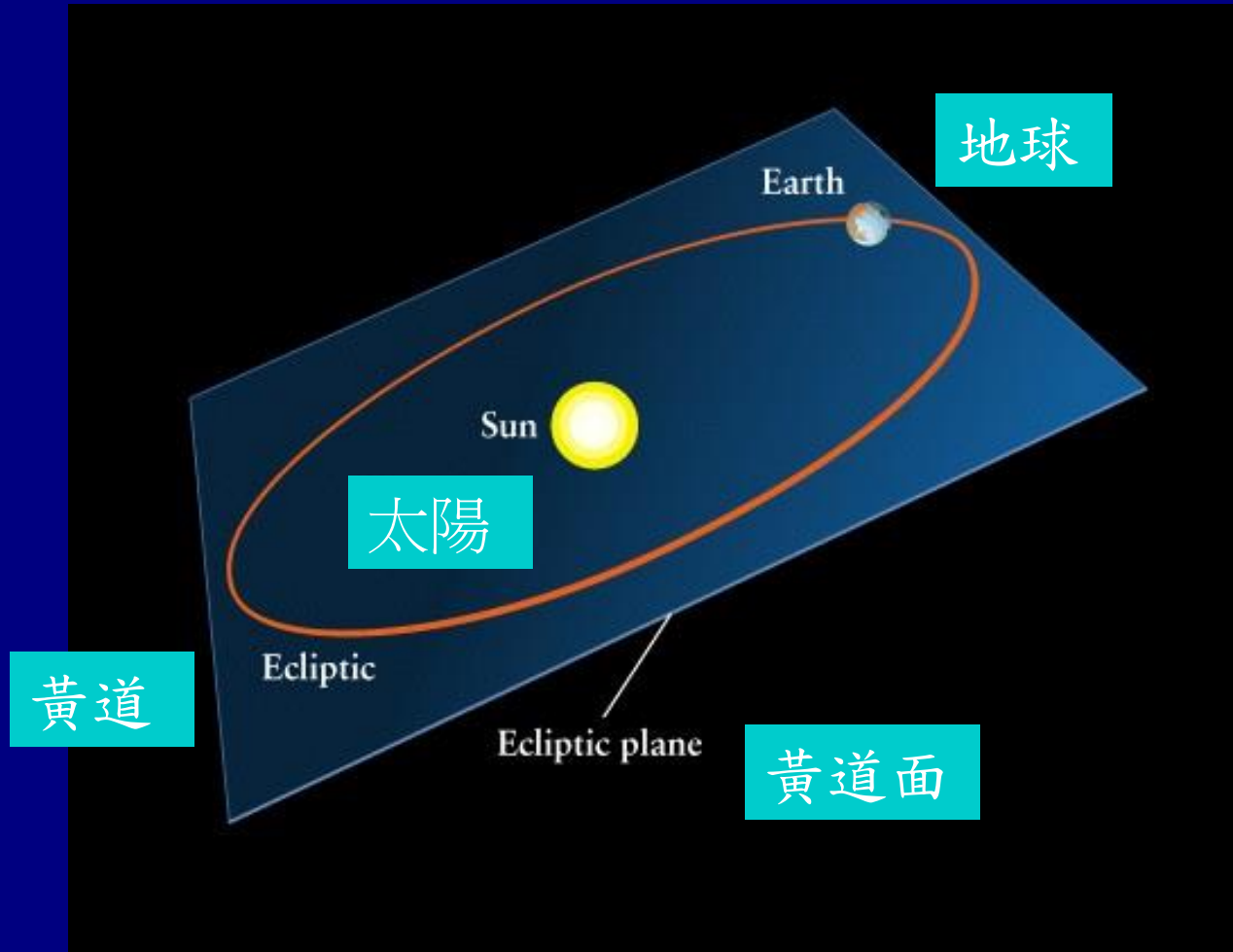
(地球) 赤道

天球赤道

(地球) 南極

天球南極

Earth's Revolution 地球公轉



地球繞著太陽公轉，軌跡稱為「黃道」(ecliptic)，所在的平面稱為「黃道面」(ecliptic plane)

黃道面：太陽在天空走過的面（實際上是地球公轉面），與天球赤道成 23.4 度

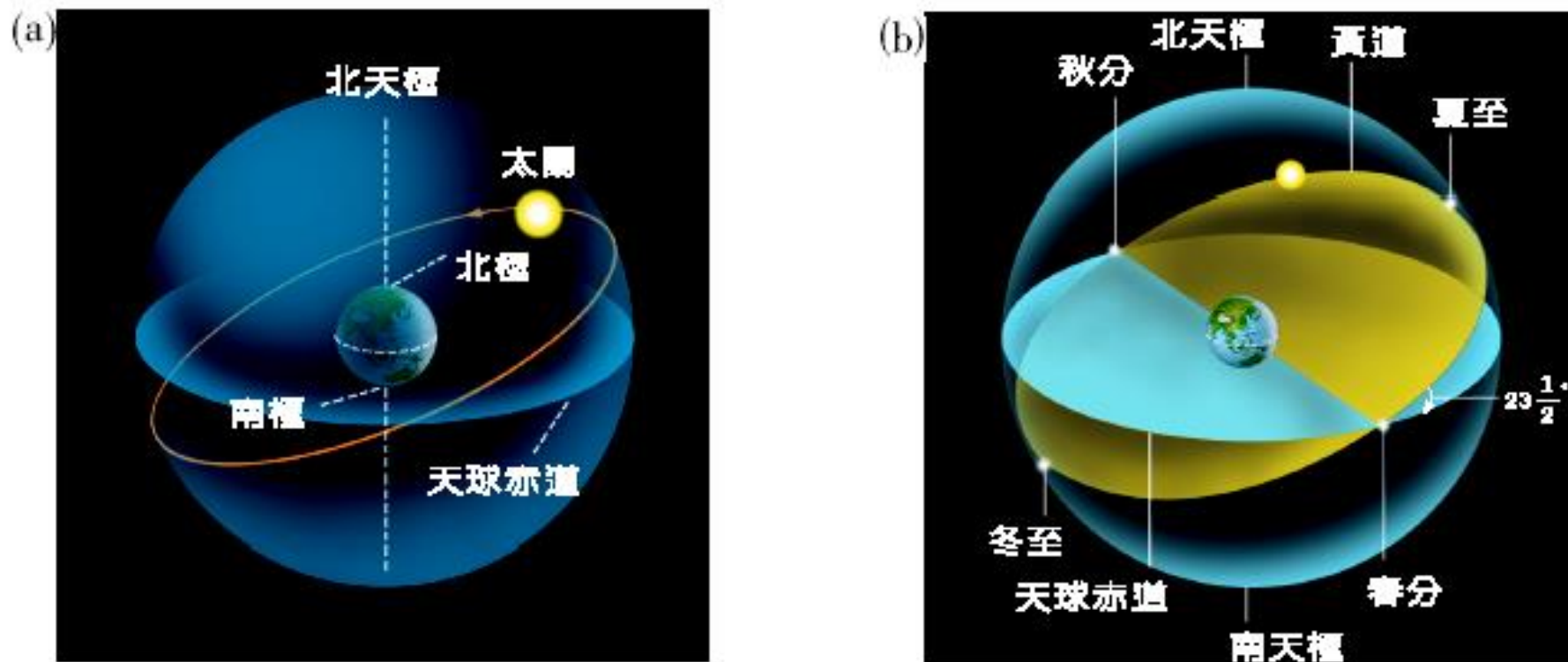
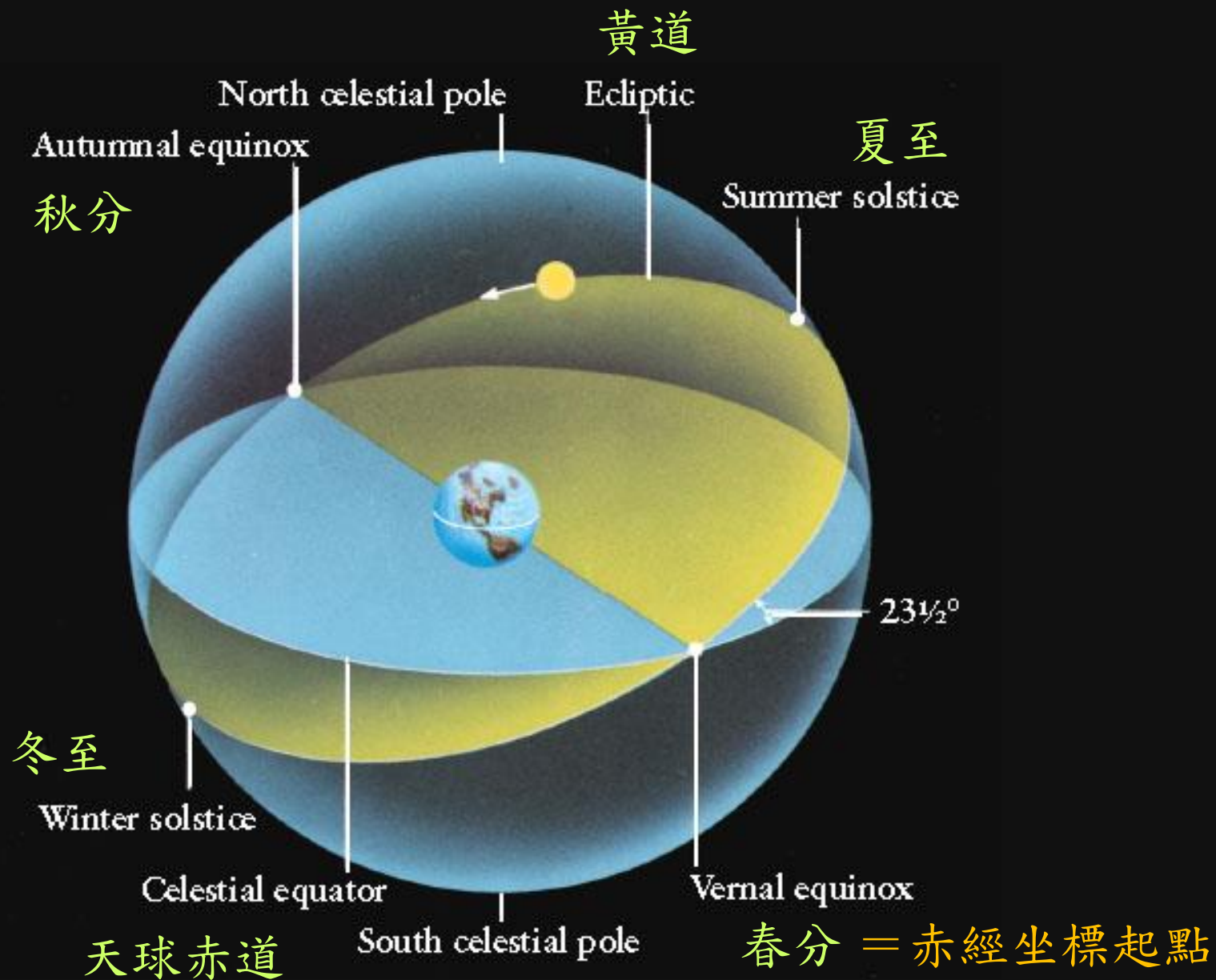


圖 2-12 (a)從地球看太陽一年當中的運動，最北時達到赤緯北方 23.5 度，然後通過天球赤道，繼續南行直到赤緯南方 23.5 度。

(b)黃道面與天球赤道成 23.5 度傾角，兩個面的交點分別稱為春分點及秋分點，黃道面最（上）北方的點稱為夏至，最南方的點則稱為冬至。



地表經度以通過格林威治的經度線為起點

想像牆壁上畫了赤經、赤緯線。隨著地球自轉，經度線（看起來）在轉，但緯度線沒動

赤經以春分點為起點 = 0^h ，向東增加

這樣某顆星就有固定的赤道坐標，對某觀測者來說，例如頭頂的赤經坐標依季節、時刻而變，而赤緯則不變，等於該觀測者所在的地球緯度而定

太陽每年春分時期（大約3月21日）通過春分點，太陽附近的星球看不到，RA 差了12小時的天空（太陽正對面）在半夜則高掛天空，也就是 $RA \approx 12^h$

一個月後 04/21 太陽會在 $RA = 2^h \dots$

09/21 太陽在 $RA = 12^h$ ，半夜面對 $RA = 24^h = 0^h$

xx/21	Sun	0 am	RAbest	8 pm	4 am	RA range	
3	0	12	180	8	16	120	240
4	2	14	210	10	18	150	270
5	4	16	240	12	20	180	300
6	6	18	270	14	22	210	330
7	8	20	300	16	0	240	0
8	10	22	330	18	2	270	30
9	12	0	0	20	4	300	60
10	14	2	30	22	6	330	90
11	16	4	60	0	8	0	120
12	18	6	90	2	10	30	150
1	20	8	120	4	12	60	180
2	22	10	150	6	14	90	210

Vega

other query modes :

Identifier query

Coordinate query

Criteria query

Reference query

Basic query

Script submission

TAP

Output options

Help

Query : Vega

Basic data :*** alf Lyr -- delta Sct Variable**

Other object types:

* (*,AG,...), IR (AKARI,IRAS,...), ** (ADS,CCDM,...), PM* (LSPM,LTT,...), V* (CSV,NSV,...), UV (CEL,EUVE,...), smm (JCMTSE,JCMTSF), dS* (2003AstL), X (1E)

ICRS coord. (*ep*=J2000) :

18 36 56.33635 +38 47 01.2802 (Optical) [3.51 2.81 90] A 2007A&A...474..653V

FK4 coord. (*ep*=B1950 *eq*=1950) : 18 35 14.66713 +38 44 09.8049 [3.51 2.81 90]**Gal** coord. (*ep*=J2000) :

067.44820813 +19.23725227 [3.51 2.81 90]

Proper motions *mas/yr* :

200.94 286.23 [0.32 0.40 0] A 2007A&A...474..653V

Radial velocity / Redshift / *cz* :V(km/s) -20.60 [0.2] / z(~) -0.000069 [0.000001] / *cz* -20.60 [0.20]
A 2006AstL...32..759GParallaxes (*mas*):

130.23 [0.36] A 2007A&A...474..653V

Spectral type:

A0Va C 2003AJ....126.2048G

織女星 RA=18.5時，所以6、7月為最佳觀測季節

台灣北緯大約+25度，因此赤緯25度的星球會通過天頂，
例如 Pleiades 昴宿星團 RA=24h, NGC 6823

Basic data :

NGC 752 -- Open Cluster

Other object types: **c1*** (2020A&A,C,...), **OpC** (2013A&A,OC1), **As*** (2019AJ,[KC2019])
ICRS coord. (*ep=J2000*) : **01 56 53.5 +37 47 38 (Optical) [] D 2020A&A...633A..99C**
FK4 coord. (*ep=B1950 eq=1950*) : **01 53 54.8 +37 33 01 []**
Gal coord. (*ep=J2000*) : **136.9588 -23.2884 []**
Proper motions *mas/yr* : **9.8092 -11.7637 [0.0191 0.0180 90] B 2018A&A...616A..10G**
Radial velocity / Redshift / cz : **V(km/s) 4.7 [0.1] / z(spectroscopic) 0.000016 [0.000000] / cz 4.70 [0.10]**
(Opt) **A 2017A&A...600A.106C**
Parallaxes (*mas*): **2.2304 [0.0027] B 2018A&A...616A..10G**
Angular size (*arcmin*): **58.2 58.2 0 (Opt) D 2020A&A...633A..99C**

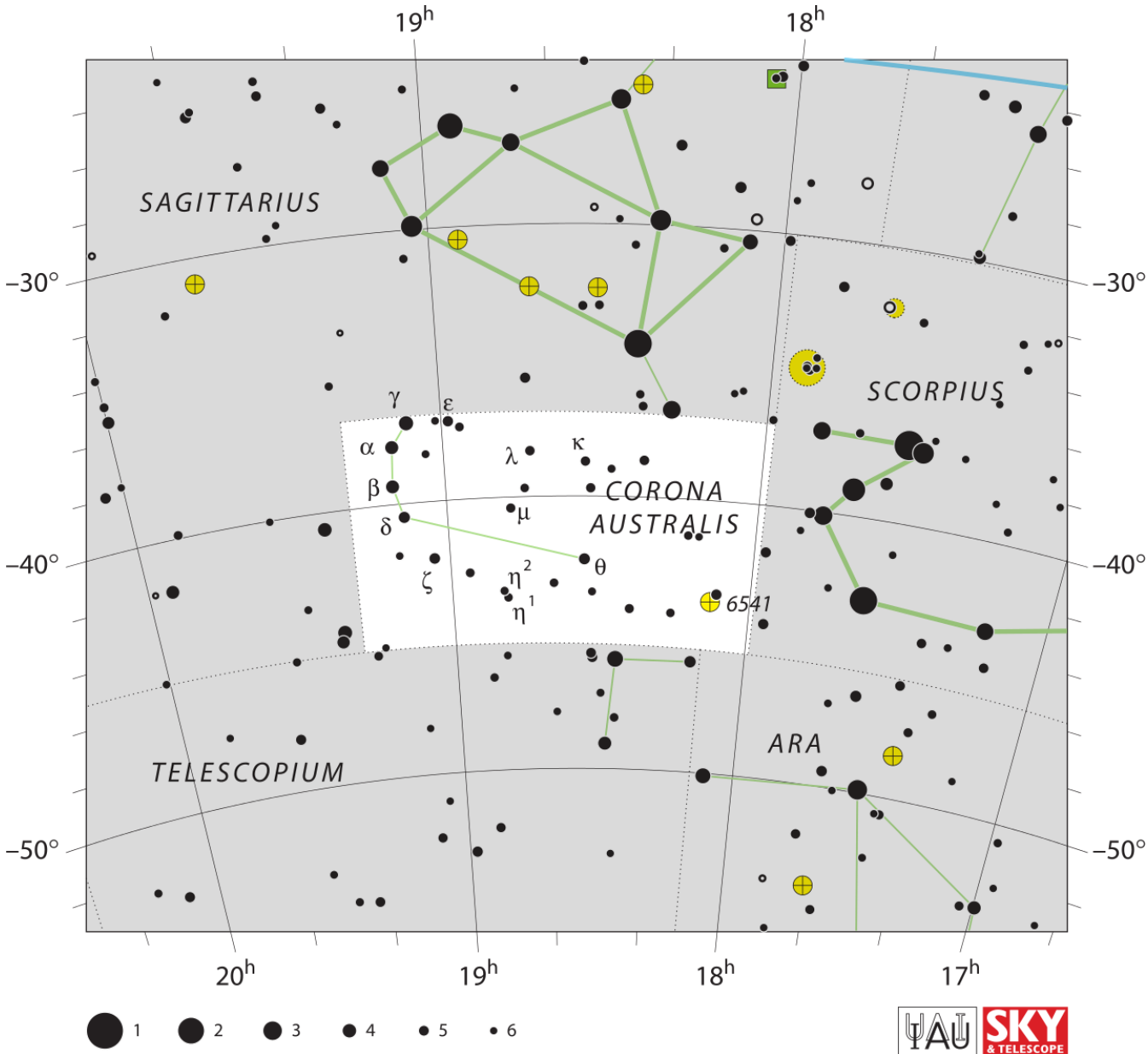
SIMBAD within arcmin

01 56 54.000 +37 47 36.00

SIMBAD

FoV: 1.47°

2MASS DSS SDSS



VizieR



VizieR provides the most complete library of published astronomical catalogues --tables and associated data-- with verified and enriched data, accessible via multiple interfaces. Query tools allow the user to select relevant data tables and to extract and format records matching given criteria. Currently, 20519 catalogues are available [more info](#)
 [VO compatibility](#)

Free text search

Position

Go to the classic form

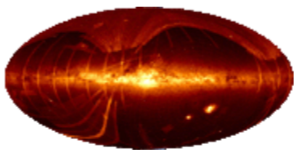
- VizieR
- How to publish my catalog
- Help and tutorials
- View large catalogs
- Rules of usage
- Mirrors

- Other related services
- TAPVizieR
- Photometry viewer
- CDS cross-match service
- VizieR images, spectra service
- VizieR using the batch mode

- Catalogue collection access
- Catalogue collection
- By hierarchical organisation
- By acronyms or abbreviations
- Recently entered into VizieR
- Catalogs having images, spectra...

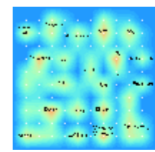
- News
- 2 Jan Catalogs added between 26-Dec-2020 and 02-Jan-2021
- 26 Dec Catalogs added between 19-Dec-2020 and 26-Dec-2020
- 19 Dec Catalogs added between 05-Dec-2020 and 19-Dec-2020
- 5 Dec Catalogs added between 28-Nov-2020 and 05-Dec-2020
- 21 Oct VizieR new version with time capabilities and TAP updates
- 12 Oct Troubleshooting on the University of Strasbourg network

The VizieR mine



The VizieR Mine is a graphical interface to locate the catalogues existing on sky regions

Kohonen map



The Kohonen Self-Organizing Map groups on nearby locations of a map catalogues having similar contents.

<https://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/355&-to=2>

VizieR Portal Simbad VizieR Aladin X-Match Other Help

Catalog

Gaia DR3 is available in CDS
Gaia DR3 in VizieR

I/355 Gaia DR3 Part 1. Main source (Gaia Collaboration, 2022) [acknowledge and cite Gaia DR3](#) [spectrum](#) [timeSerie](#) [Similar Catalogs](#) [2022yCat.1355...0G](#) [ReadMe+ftp](#)

Table	Description	Rows
<input checked="" type="checkbox"/> I/355/gaiadr3	(c) Gaia data release 3 (Gaia DR3). (original column names in green) [timeSerie]	(1811709771 rows)
<input type="checkbox"/> I/355/paramp	(c) 1D astrophysical parameters produced by the Apsis processing chain developed in Gaia DPAC CU8 (1590932717 sources) (astrophysical parameters) (original column names in green)	(1590932717 rows)
<input type="checkbox"/> I/355/paramsup	(c) Additional parameters from the Apsis processing chain, compared to the main table astrophysical parameters, from modules that produce more than one result for a parameter (473020612 sources) (astrophysical parameters supp) (original column names in green)	(473020612 rows)
<input type="checkbox"/> I/355/tgextmap	Total Galactic Extinction (TGE) map for extinction parameters A0 (original column names in green)	(4177920 rows)
<input type="checkbox"/> I/355/tgextopt	Optimum version of the Total Galactic Extinction Map, derived from the table tgextmap.dat (total _{galactic} extinction_map) at a single HELPix level 9	(3145728 rows)
<input type="checkbox"/> I/355/oaninfo	Content of a Self-Organized Map calculated from a dataset composed by outliers by the Apsis module OA (oa _{neuron} information) (original column names in green)	(900 rows)
<input type="checkbox"/> I/355/oaxpsp	Prototype BP/RP spectrum corresponding to each of the neurons of the Self-Organised-Map produced by the Apsis module OA (oa _{neuron} xp_spectra) (original column names in green)	(78300 rows)
<input type="checkbox"/> I/355/epphot	(c) Light curves for a given object in bands G, BP and RP (555868797 rows) (epoch_photometry) (original column names in green)	(555868797 rows)
<input type="checkbox"/> I/355/gcrf3xm	Full cross-match information for the Gaia-CRF3 sources (Gaia _{CRF3} Xm) (original column names in green)	(1614173 rows)
<input type="checkbox"/> I/355/rvsmean	(c) RVS mean sampled spectrum table (2400147645 lines) (rvs _{mean} spectrum) (original column names in green)	(2400147645 rows)
<input type="checkbox"/> I/355/xpsummary	(c) Auxiliary information about the mean BP/RP spectrum (219197643 sources) (xp_summary) (original column names in green)	(219197643 rows)
<input type="checkbox"/> I/355/xpsample	(c) BP/RP externally calibrated sampled mean spectrum (11822651939 rows) (xp _{sampled} mean_spectrum) (original column names in green)	(11822651939 rows)
<input type="checkbox"/> I/355/xpsamp	Definition of XP spectra standard sampling schemes (xp_sampling) (original column names in green)	(37730 rows)
<input type="checkbox"/> I/355/xpmerge	Coefficients used to merge the BP and RP externally calibrated sampled spectra into the final merged product (xp_merge) (original column names in green)	(343 rows)
<input type="checkbox"/> I/355/xpcont	(c) Mean BP and RP spectra based on the continuous representation in basis functions (219197643 rows) (gaia _{dr3} xpcont) (original column names in green)	(219197643 rows)

ALL

(c) indicates tables which contain celestial coordinates

→ Cite/acknowledge VizieR catalogue
→ Rules of usage of VizieR data

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f y t c Contact



CDS X-Match Service

X-match

Tables management

Documentation

Login Preferences Register

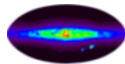
Choose tables to cross-match

Gaia EDR3 X 2MASS

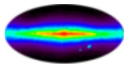
VizieR SIMBAD My store

VizieR SIMBAD My store

Gaia EDR3 (Gaia Collaboration, 2020)
1,811,709,771 rows



2MASS All-Sky Catalog of Point Sources (Cutri+ 2003)
470,992,970 rows



Hide options

Cross-match criteria

By position

Radius: 2 arcsec

By position including error

Sigma: 3.43935 (completeness: 99.73 %)

Max. distance: 5 arcsec

Cross-match area

All sky

Cone

Center: m67

Radius: 30 arcmin

Healpix cell (ICRS, NESTED scheme)

Nside: 4

Index: 0

Begin the X-Match

1611306004048A.csv

1611303385212A.csv

1611302208433A.csv

En @ | 正 | 0 | ✖



Tool for Operations on Catalogues And Tables

Does what you want with tables

Latest (see [Version History](#) for details)

Version 4.8 released 11 January 2021

New: Auto mode guesses input file types better

TOPCAT can now guess file formats by filename, so e.g. you don't need to choose "CSV" for *.csv files.

Improved: More multithreaded operations

The [Statistics Window](#) and [Sort](#) operation now run in parallel, and concurrent access to synthetic columns or subsets works better; performance for certain things should be better on multi-core machines.

Introduction/Tutorial Video (available August 2020)

Tutorial: Introduction to TOPCAT

TOPCAT introduction/demo [video](#) and [accompanying slides](#) as presented to [Shristi Astronomy](#) course.

- [What is TOPCAT?](#)
- [Features](#)
- [Screenshots](#)
- [Documentation](#)
- [Frequently Asked Questions](#)
- [Mailing Lists](#)
- [Downloads](#)
 - [Jar File](#)
 - [MacOS X](#)
 - [WebStart](#)
 - [Starjava](#)
- [Version history](#) — *Version 4.7-3 released 23 October 2020*
- [Further information](#)

What is TOPCAT?

TOPCAT is an interactive graphical viewer and editor for tabular data. Its aim is to provide most of the facilities that astronomers need for analysis and manipulation of source catalogues and other tables, though it can be used for non-astronomical data as well.

習題

- 利用 vizier 下載自己主題天體的蓋婭數據（先試試 2'，然後 20'，然後 2 deg）
- 繪製這些恆星的天球位置
- 繪製這個區域恆星的自行運動（向量圖）

CMD 3.4 input form

A web interface dealing with stellar isochrones and their derivatives

Latest news

- [NEW!](#) (18nov20) Gaia EDR3 filters available.
- (16sep20) New COLIBRI tracks from [Pastorelli et al. \(2020\)](#) available.
- (16sep20) Look at the new LPV section, with LPV periods from [Trabucchi et al. \(2017\)](#) and [Trabucchi et al. \(2019\)](#).

[Help](#) [FAQ](#)

Submit Reset

Evolutionary tracks

PARSEC tracks ([Bressan et al. \(2012\)](#)) are computed for a scaled-solar composition and following the $Y=0.2485+1.78Z$ relation. The present solar metal content is $Z_{\odot}=0.0152$. [Tables of evolutionary tracks](#) are also available. COLIBRI tracks ([Marigo et al. \(2013\)](#)) extend their evolution to the end of the TP-AGB phase, for several choices of mass loss and dredge up parameters.

Available sets of tracks:

PARSEC	COLIBRI
going from the PMS to either the 1st TP, or C-ignition:	add the TP-AGB evolution, from the 1st TP to the total loss of envelope:
<input checked="" type="radio"/> PARSEC version 1.2S Available for $0.0001 \leq Z \leq 0.06$ ($-2.2 \leq [M/H] \leq +0.5$); for $0.0001 \leq Z \leq 0.02$ the mass range is $0.1 \leq M/M_{\odot} < 3.50$; for $0.03 \leq Z \leq 0.04$ $0.1 \leq M/M_{\odot} < 1.50$, and for $Z=0.06$ $0.1 \leq M/M_{\odot} < 2.0$ (cf. Tang et al. (2014) for $0.001 \leq Z \leq 0.004$, and Chen et al. (2015) for other Z). With revised and calibrated surface boundary conditions in low-mass dwarfs (Chen et al. (2014)).	<input checked="" type="radio"/> + COLIBRI S_37 (Pastorelli et al. (2020)) for $0.008 \leq Z \leq 0.02$, + COLIBRI S_35 (Pastorelli et al. (2019)) for $0.0005 \leq Z \leq 0.006$ + COLIBRI PR16 (Marigo et al. (2013) , Rosenfield et al. (2016)) for $Z \leq 0.0002$ and $Z \geq 0.03$)
	<input type="radio"/> + COLIBRI S_35 (Pastorelli et al. (2019)) (limited to $0.0005 \leq Z \leq 0.03$)
	<input type="radio"/> + COLIBRI S_07 (Pastorelli et al. (2019)) (limited to $0.0005 \leq Z \leq 0.03$)
	<input type="radio"/> + COLIBRI PR16 (Marigo et al. (2013) and Rosenfield et al. (2016)) (limited to $0.0001 \leq Z \leq 0.06$)
	<input type="radio"/> No (no limitation in Z)

Photometric system

Choose among the available photometric systems: They are briefly described [here](#).

Available sets of bolometric corrections:

version	short description	spectral libraries		
		for "normal stars"	for cool giants	for very hot stars and WRs
<input checked="" type="radio"/> YBC (Chen et al. (in prep.))	This option expands and supersedes the NBC tables from Chen et al. (2014) . All details in the YBC web interface , which provides more options with the stellar spectral libraries (eg., Kurucz only or Phoenix only).	An mix of ATLAS9 ODFNEW (Castelli & Kurucz (2004)) and PHOENIX BT-Settl (Allard et al. (2012))	O-rich and C-rich spectra from COMARCS, Aringer et al. (2009) and Aringer et al. (2016)	from Chen et al. (2015) , O, B star models computed with WM-basic , WR star models from PoWR
<input type="radio"/> OBC	The library used in most Padova+PARSEC isochrones, described in Girardi et al. (2002) and then expanded until Marigo et al. (2017)	Mostly based on ATLAS9 ODFNEW from Castelli & Kurucz (2004) , as described on Girardi et al. (2008)	O-rich and C-rich spectra from COMARCS, Aringer et al. (2009) and Aringer et al. (2016)	blackbodies...

Circumstellar dust

This will only affect stars in the TP-AGB phase and with significant mass loss. In the case of [Bressan et al. \(1998\)](#) and [Groenewegen \(2006\)](#), the RT calculations are applied using the scaling relations described in [Marigo et al. \(2008\)](#) (see also [Pastorelli et al. \(2019\)](#)). In the case of [Nanni et al. \(2016\)](#), the dust growth model is fixed for M stars, while one can choose between a few sets of optical data for C stars.

Available dust compositions:

	for M stars	for C stars
Using scaling relations as in Marigo et al. (2008) :	<input type="radio"/> No dust	<input type="radio"/> No dust
	<input type="radio"/> Silicates as in Bressan et al. (1998)	<input type="radio"/> Graphites as in Bressan et al. (1998)
	<input type="radio"/> 100% AlOx as in Groenewegen (2006)	<input type="radio"/> 100% AMC as in Groenewegen (2006)
	<input checked="" type="radio"/> 60% Silicate + 40% AlOx as in Groenewegen (2006)	<input checked="" type="radio"/> 85% AMC + 15% SiC as in Groenewegen (2006)
	<input type="radio"/> 100% Silicate as in Groenewegen (2006)	

Warning: The options for C-star dust below should be discarded in the light of the results of [Nanni \(2018\)](#).

Using Nanni et al.'s dust growth models:	For M stars: Pyroxene, olivine, quartz, periclase, iron:	For C stars: For the following choices of optical sets For example, you can choose dust (and including SiC iron):
--	--	--

- Add just the fundamental mode and first overtone periods, using the preliminary fitting formula described in [Marigo et al. \(2017\)](#).
- Add LPV periods from the fundamental mode to the 4th overtone, using the fitting formulas from [Trabucchi et al. \(2019\)](#). NOTE: As a more complete alternative, you can use [Trabucchi's pulsation code.](#), which will include the growth rates.

Initial mass function

The IMF will be used to compute the stellar occupation along the isochrones, and to compute integrated magnitudes, LFs, etc. (see section Output below)

IMF for single stars: ▼

Ages/metallicities

Choose your metallicity values using the approximation $[M/H] = \log(Z/X) - \log(Z/X)_{\odot}$, with $(Z/X)_{\odot} = 0.0207$ and $Y = 0.2485 + 1.78Z$ for PARSEC tracks.

Input form for multiple values of ages/metallicities (up to a maximum of 1e4 isochrones):

		initial value	final value	step (use 0 for a single value)
ages	<input type="radio"/> linear age (yr) =	<input type="text" value="1.0e9"/> yr	<input type="text" value="1.0e10"/> yr	<input type="text" value="0.0"/> yr
	<input checked="" type="radio"/> log(age/yr) =	<input type="text" value="6"/> dex	<input type="text" value="10"/> dex	<input type="text" value="1"/> dex
metallicities	<input checked="" type="radio"/> metal fraction Z =	<input type="text" value="0.0152"/>	<input type="text" value="0.03"/>	<input type="text" value="0.0"/>
	<input type="radio"/> [M/H] =	<input type="text" value="-2"/> dex	<input type="text" value="0.3"/> dex	<input type="text" value="0.0"/> dex

Output

Kind of output:

- Isochrone tables: stellar parameters as a function of initial mass
- Luminosity functions: star counts expected, in the interval from to mag, with bins mag wide, per 1 Msun of stellar population
- Simulated populations with a total mass of Msun

gzip the output file (Files above 50 Mby will always be gzipped!)

This service is maintained by [Leo Girardi](#) at the [Osservatorio Astronomico di Padova](#).
 Questions, comments and special requests should be directed to leo.girardi@oapd.inaf.it.
 Last modified: Wed Nov 18 10:22:21 2020

CMD 3.4 output

Results

Your job was submitted on Wed Jan 13 10:05:04 CET 2021
 Your job was completed on Wed Jan 13 10:05:14 CET 2021 .
 The results are available at output368009173617.dat, and will be deleted in 2 h from now.

Output header:

```
# File generated by CMD 3.4 (http://stev.oapd.inaf.it/cmd) on Wed Jan 13 10:05:04 CET 2021
# isochrones based on PARSEC release v1.2S + COLIBRI S_37 + S_35 + PR16
# Basic references: Bressan et al. (2012), MNRAS, 427, 127 + Chen et al. (2014, 2015), MNRAS, 444, 2525 + MNRAS, 452, 1068 + Tang et al. (2014), MNRAS, 445, 4287 + Marigo et al. (2017), ApJ, 835, 77 + Pastorelli al. (2019), MNRAS, 485, 5666 + Pastorel
# Thermal pulse cycles included
# On RGB, assumed Reimers mass loss with efficiency eta=0.2
# LPV periods and growth rates added cf. Trabucchi et al. (2019)
# Photometric system: Gaia EDR3 (all Vegamags, Gaia passbands from ESA/Gaia website)
# Using YBC version of bolometric corrections as in Chen et al. (2019)
# O-rich circumstellar dpm0d60alox40 dust from Groenewegen (2006)
# C-rich circumstellar AMCSIC15 dust from Groenewegen (2006)
# IMF: Kroupa (2001, 2002) + Kroupa et al. (2013) canonical two-part-power law IMF corrected for unresolved binaries
# Kind of output: isochrone tables
```

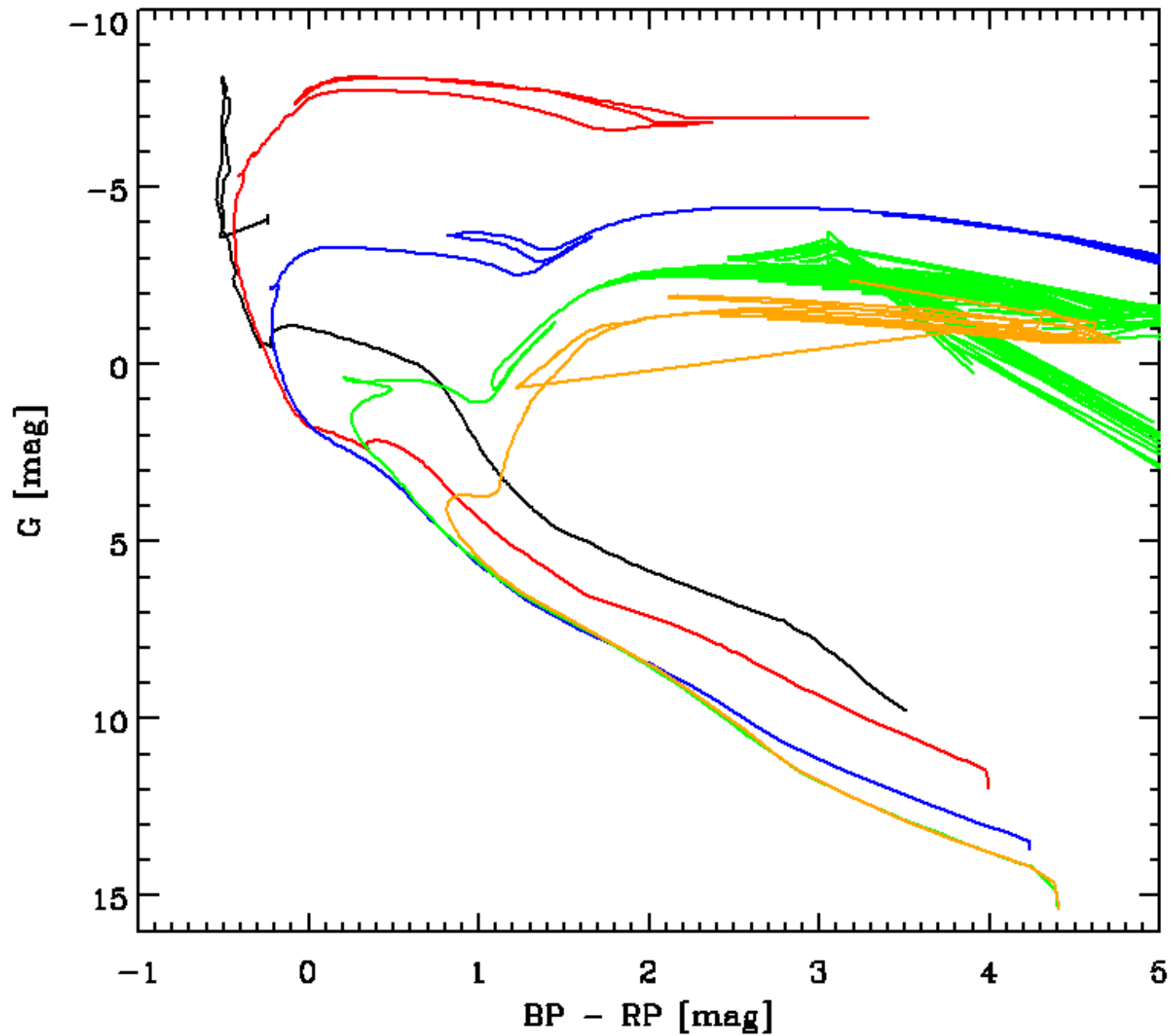
Useful system parameters

Filter	G	G_BP	G_RP
$\lambda_{\text{eff}} (\text{\AA})$	6422.01	5335.42	7739.17
$\omega_{\text{eff}} (\text{\AA})$	3620	2060	2500
A_{λ}/A_V	0.86117	1.06126	0.64753

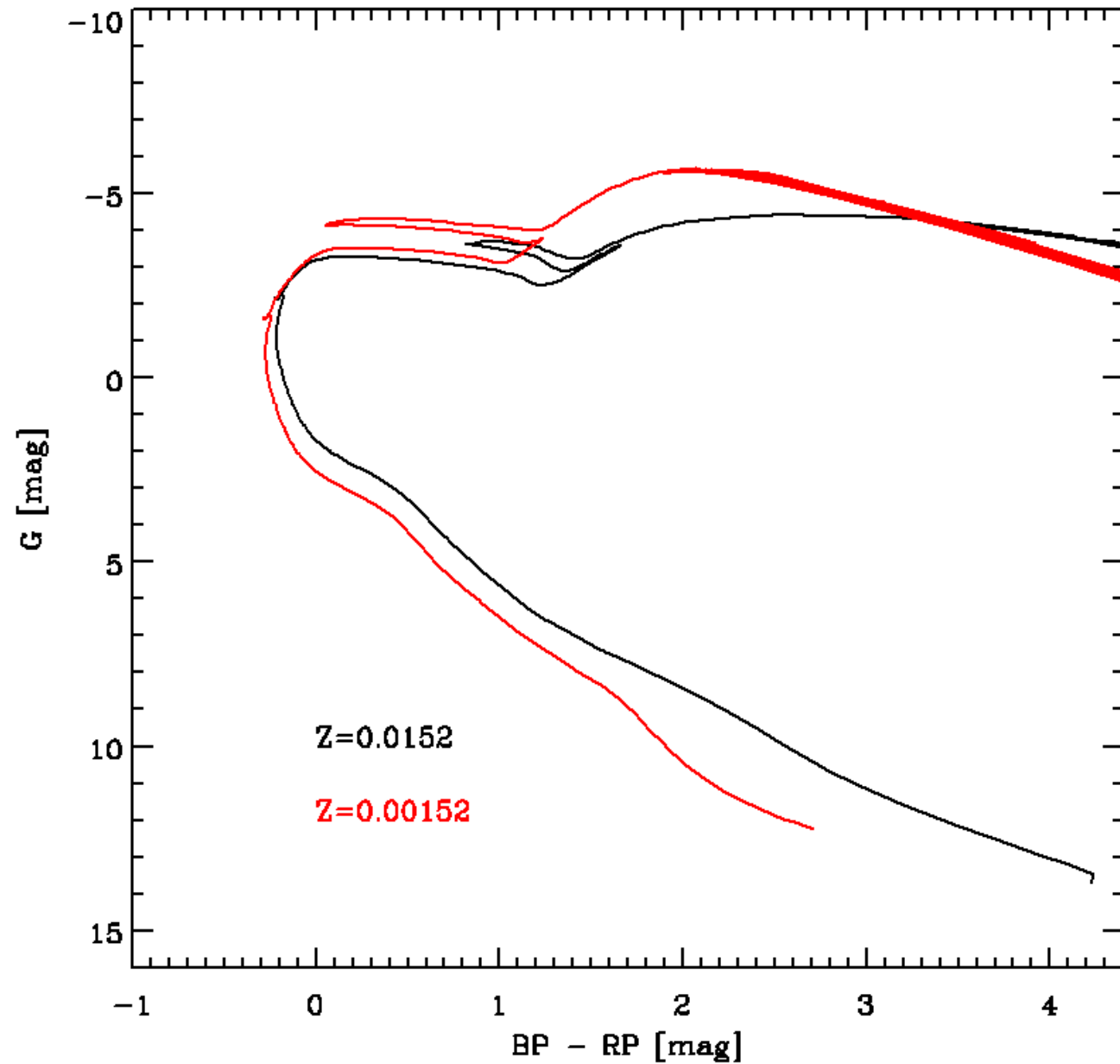
These values are for a G2V star, using [Cardelli et al. \(1989\)](#) + [O'Donnell \(1994\)](#) extinction curve with $R_V=3.1$.

[Back to input form](#)

PARSEC Isochrones



PARSEC Isochrones



「金屬豐度低」
→ 較熱、較亮

以M67為例

- 什麼樣的天體
- 在天空何處（赤經、赤緯；銀經、銀緯）；何時適合觀看
- 距離
- 大小（角度、實際長度）
- 年齡
- 多少成員星
- 豐度
- 怎麼運動（看起來、實際）
- 多少比例是雙星、是變星
周圍有行星
- 有哪些X射線源、紅外源
- 是否有共存的分子雲

- https://www.astro.ncu.edu.tw/~wchen//Data/HiTeachers2021/m67twomassDR3_30min.csv

-

https://www.astro.ncu.edu.tw/~wchen//Data/HiTeachers2021/taurus2massDR3_30min.csv

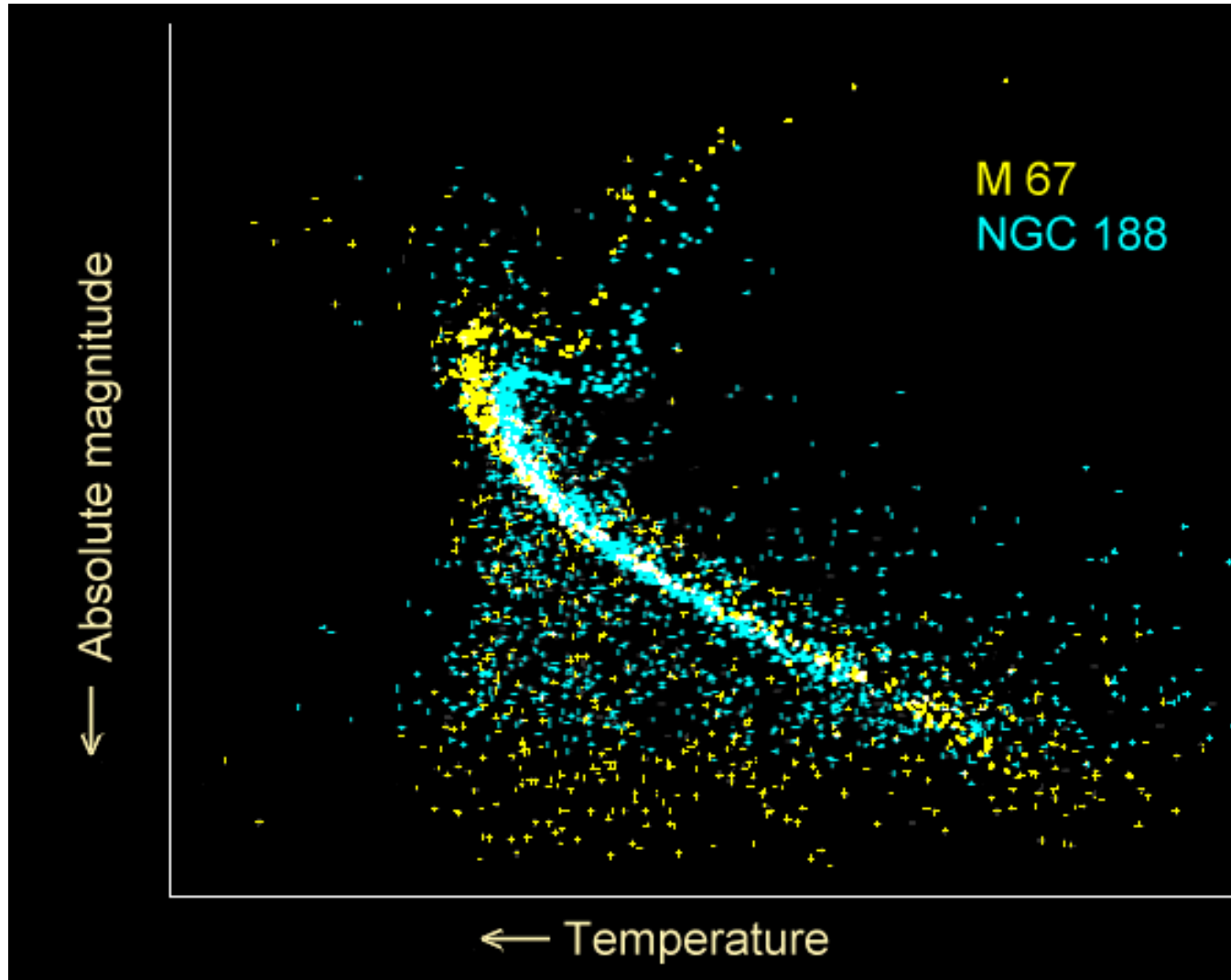
To Identify Members in a Star Cluster

Member stars are grouped in at least 6-dimensional space, 3 in location (position and distance) and 3 in motion (proper motion and radial velocity) (and in metallicity, etc.)

- ➔ To secure the member list, find
- grouping in space (sky coordinates + distance)
 - grouping of proper motions (and radial velocity)
 - grouping along the main sequence/isochrone (CMD)

Members: similar in positions and in space motions ...

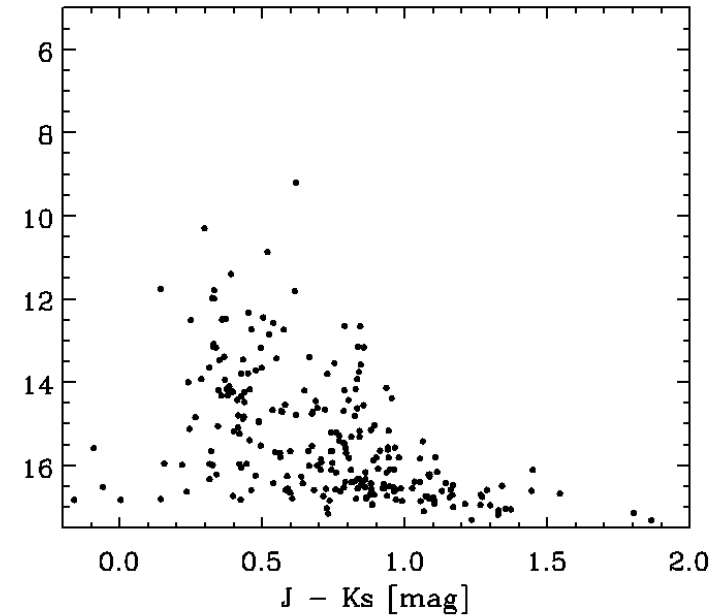
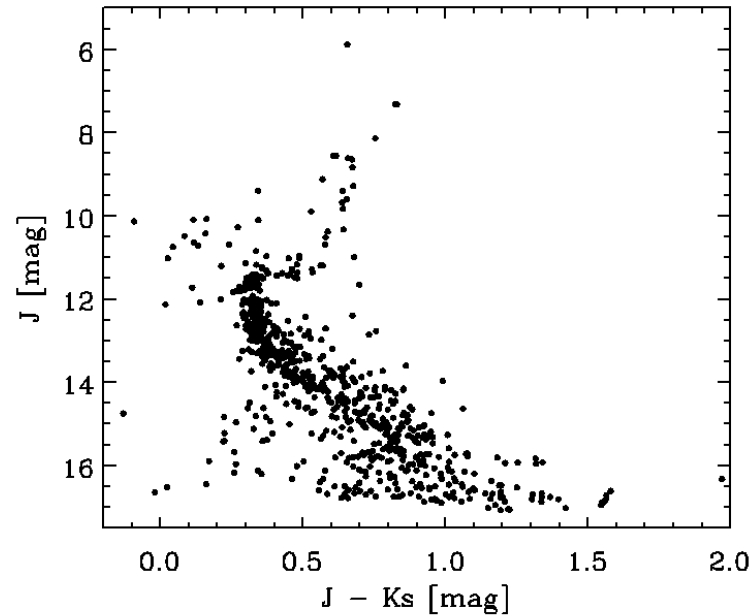
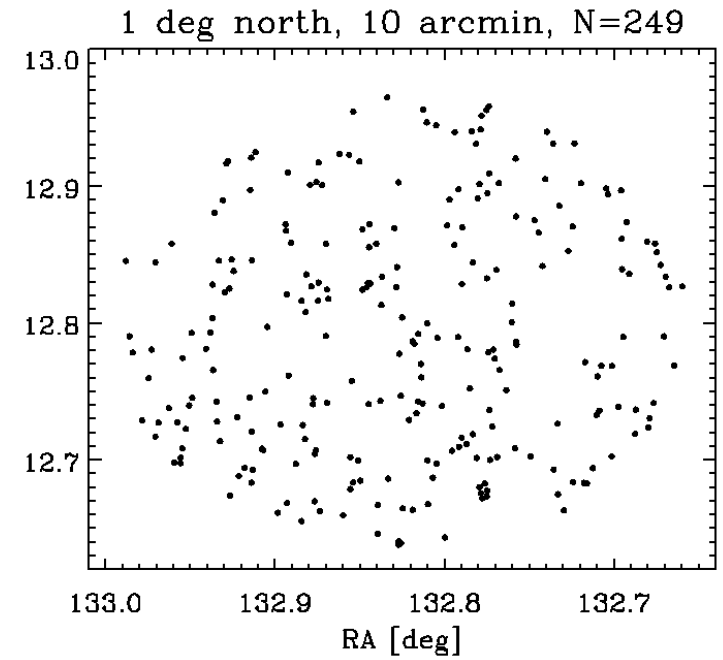
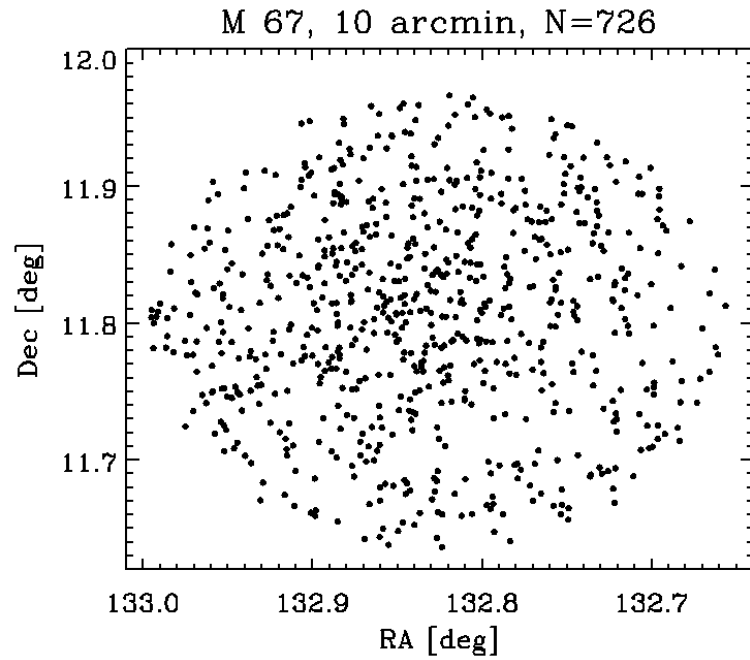
A Case Study **M67** an OC ~ 4 Gyr old (i.e., solar age), $[Fe/H] = -0.1$, distance 800 to 900 pc, an apparent angular diameter $> 30'$



2 old OCs ₆₀

Two Micron All Sky Survey (2MASS) data

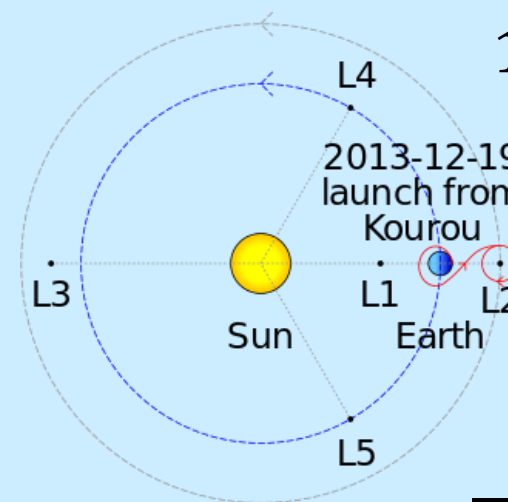
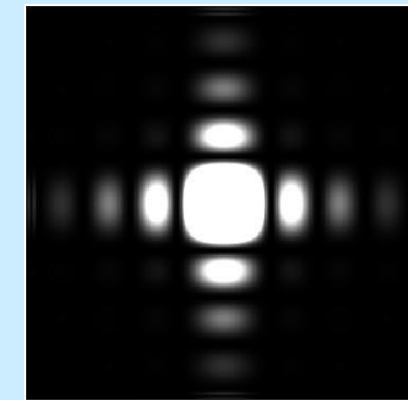
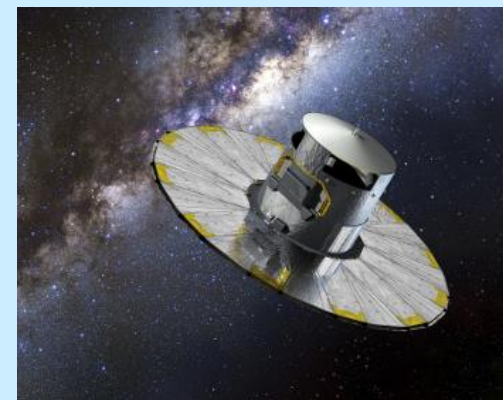
M67 field vs a Galactic field



Gaia (Space Telescope)

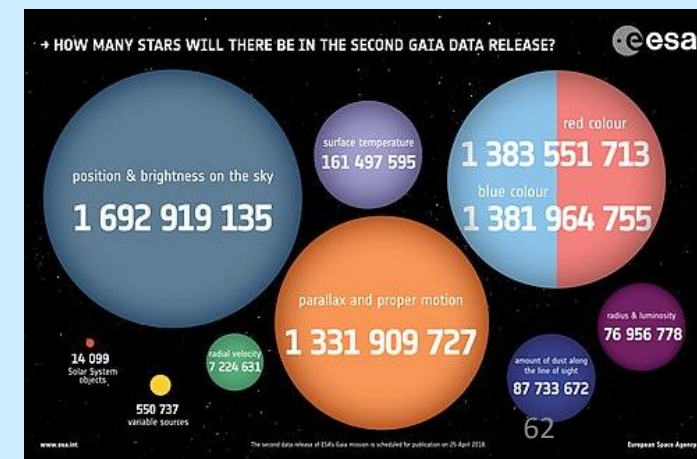
- ✓ 2013 to 2022? by ESA
- ✓ High-precision astrometry (position) → distance + motion → 3D map of MW and beyond; quasars, exoplanets
- ✓ < 20 mag (1% MW)

- ✓ *G*, *BP*, *RP* photometry + spectroscopy → *L*, T_{eff} , *g*, [*M*/*H*], and RV
- ✓ Latest DR2 in 2018

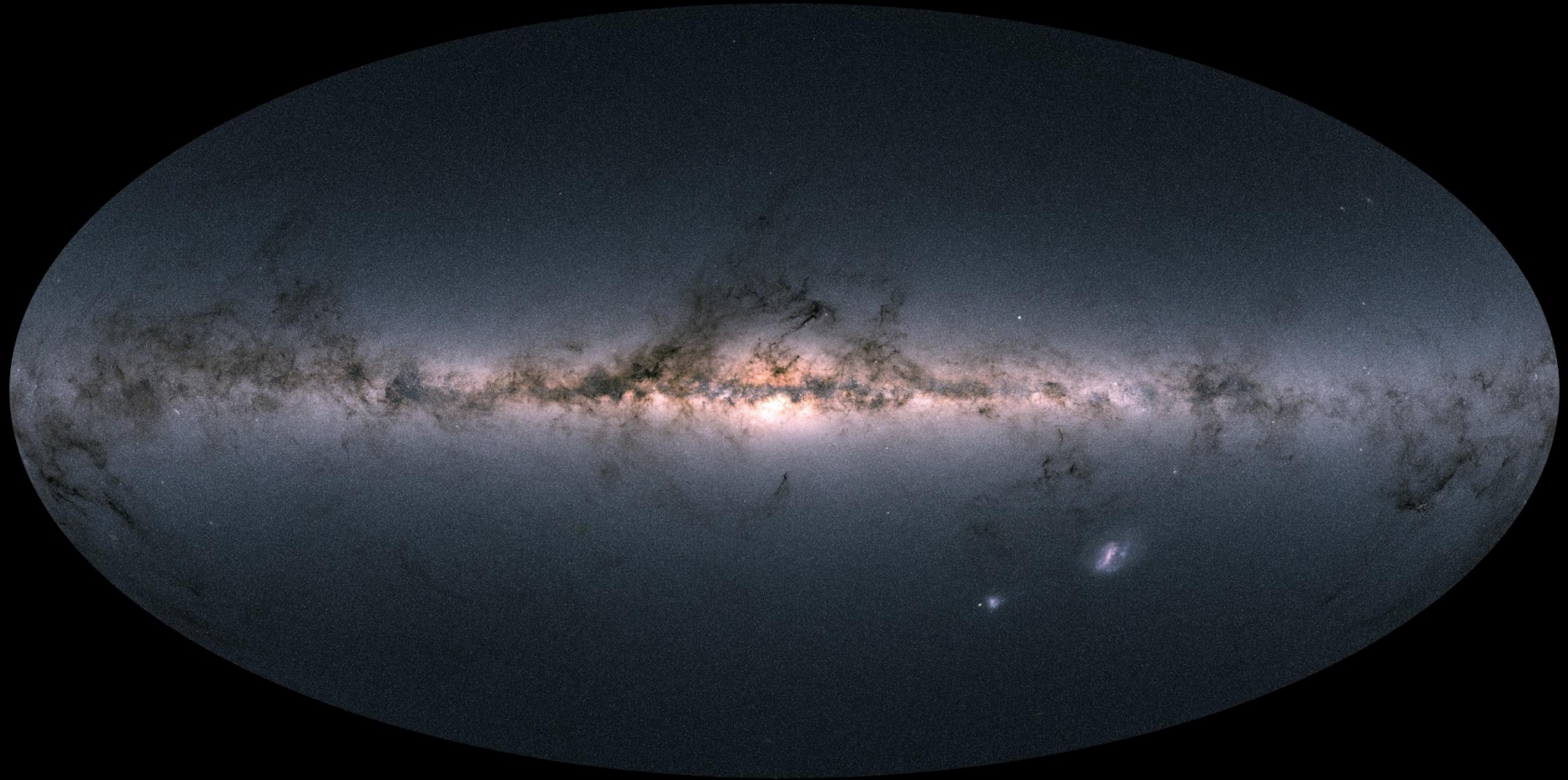


1.45 m × 0.5 m primary

Orbit @Sun-Earth L2



Gaia's Sky in Color



Gaia data vizier and the cross-match tool

The screenshot displays the VizieR web interface. At the top, the browser address bar shows 'vizier.u-strasbg.fr/viz-bin/VizieR-4'. The main header includes navigation links like 'Portal', 'Simbad', 'VizieR', 'Aladin', 'X-Match', and 'Other'. A search criteria sidebar on the left shows 'I/345/gaia2' selected. The main content area features a title 'VizieR' and a description of the data: 'Gaia DR2 (Gaia Collaboration, 2018)'. Below this, a table of data is presented with columns for RA, DE, parallax, and various magnitudes. The table is partially obscured by a large text block containing search instructions and tool options like 'start AladinLite', 'plot the output', and 'query using TAP/SQL'. The bottom of the image shows a Windows taskbar with various application icons and the system clock.

Search Criteria
Save in CDSportal
Keywords: I/345/gaia2, m67
Tables: I/345, ..gaia2, ..rvstdcat, ..rvstdmes, ..allwise
Constraints: m67 (arcmin 30)
Preferences: max: unlimited, ascii table, All columns, Compute
Mirrors: CDS, France

The 2 columns in **color** are computed by VizieR, and are **not part of the original data** (note that the **computed coordinates** are computed from the positions **and** the proper motions given in the table)

[I/345/gaia2](#) [Gaia DR2 \(Gaia Collaboration, 2018\)](#) [2018A&A...616A...1G](#) [ReadMe+ftp](#)
Gaia data release 2 (Gaia DR2). (Download all Gaia Sources as VOTable, FITS or CSV [here](#). Query from the command line using `find_gaia_dr2` available in [cdsclient](#) [here](#))
(original column names in green) (1692919135 rows)

[start AladinLite](#) [plot the output](#) [query using TAP/SQL](#)

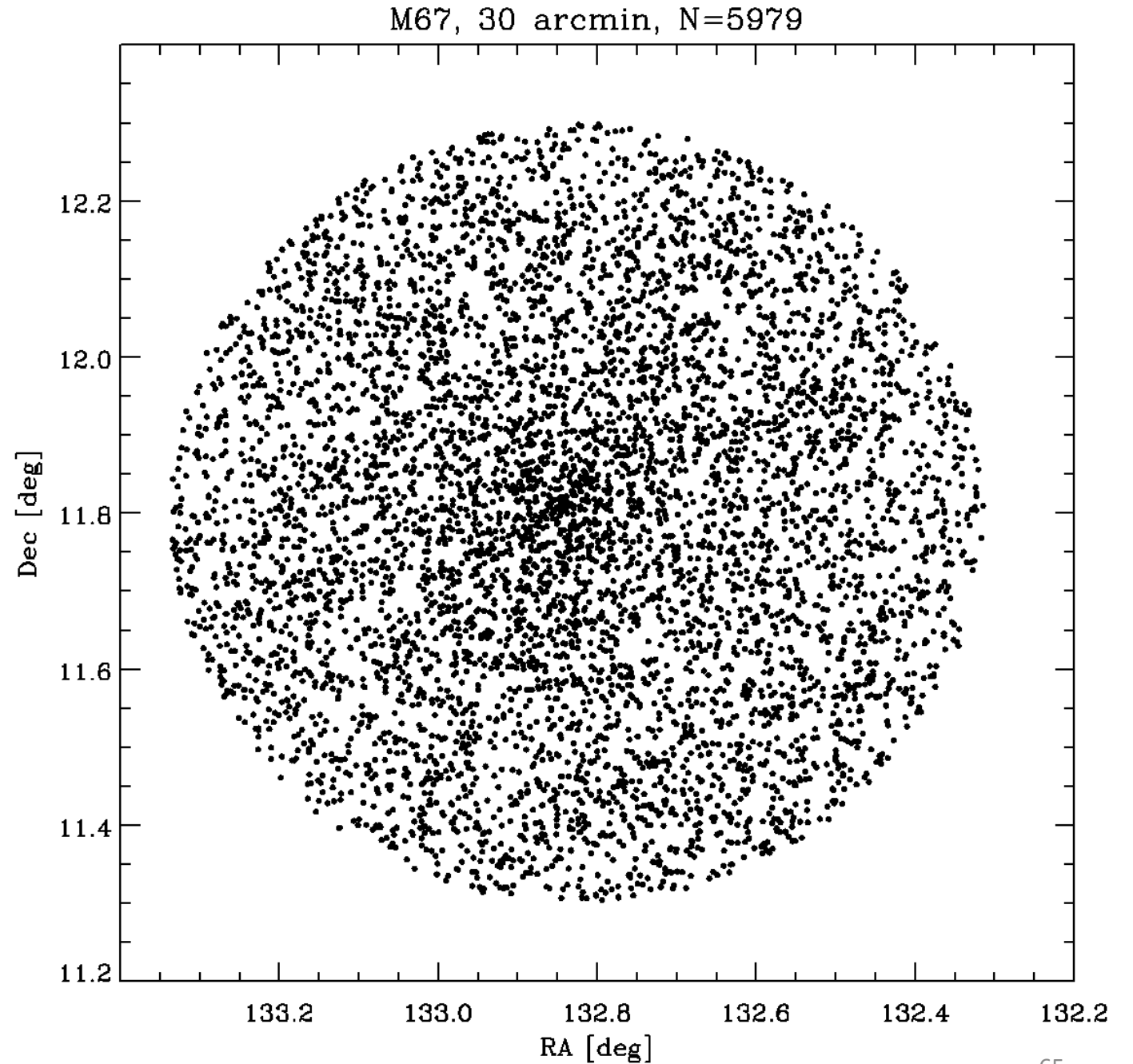
<u>RAJ2000</u> deg	<u>DEJ2000</u> deg	<u>RA_ICRS</u> deg	<u>DE_ICRS</u> deg	<u>Plx</u> mas	<u>e</u> mas	<u>pmRA</u> mas/yr	<u>e</u> mas/yr	<u>pmDE</u> mas/yr	<u>e</u> mas/yr	<u>Gmag</u> mag	<u>BPmag</u> mag	<u>RPmag</u> mag	<u>BP-RP</u> mag
132.8299226162889	+11.7985256382575	132.82987418602	+11.79851185969	1.1192	0.0297	-11.011	0.052	-3.200	0.036	13.5486	13.8501	13.0802	0.7699
132.8212494533925	+11.8044937007844	132.82119918404	+11.80447951662	1.1358	0.0441	-11.429	0.075	-3.294	0.047	9.9176	10.5819	9.1695	1.4124
132.8290692230935	+11.8060449245690	132.82902141009	+11.80603334054	1.9054	0.3988	-10.870	0.621	-2.690	0.433	19.0312	20.0089	17.8285	2.1803
132.8210549535808	+11.8074473236618	132.82100637873	+11.80743388323	1.2615	0.1233	-11.043	0.276	-3.122	0.165	17.0712	17.6951	16.0018	1.6933
132.8300638049211	+11.8075031505621	132.83001546773	+11.80749017419	1.3261	0.1272	-10.989	0.210	-3.014	0.148	17.3308	18.2001	16.3522	1.8479
132.8211176032303	+11.8085982740707	132.82107701131	+11.80858665962	2.0893	0.2980	-9.228	0.587	-2.698	0.369	18.6129	19.3510	17.3767	1.9743
132.8287367969011	+11.8090055393501	132.82873088318	+11.80898899371	1.2093	1.1288	-1.344	1.875	-3.843	1.179	20.2724	20.1690	19.4323	0.7368
132.81544881188682	+11.8043646239834	132.81543972025	+11.80436849047	0.8835	0.0363	7.184	0.066	0.898	0.048	14.2219	14.4983	13.7784	0.7198
132.8291770484616	+11.7892404173382	132.82912631885	+11.78922867924	0.9777	0.1891	-11.534	0.322	-2.726	0.225	18.0548	18.9631	17.0176	1.9454
132.8373179358715	+11.7997504013885	132.83731663709	+11.79974220684	0.2711	1.4595	-0.295	2.720	-1.903	1.577	20.3608	20.3165	19.7724	0.5440
132.8328708996924	+11.8104600881295	132.83285368253	+11.81043969115	0.8922	0.0836	-3.914	0.141	-4.737	0.100	16.6047	17.1318	15.8890	1.2427
132.8143608672775	+11.7920751961745	132.81430957931	+11.79206603391	1.1639	0.0448	-11.661	0.083	-2.128	0.052	12.5585	12.8171	12.1486	0.6685
132.8329565807328	+11.8113348580671	132.83290601381	+11.81132614346	1.1613	0.3387	-11.496	0.593	-2.024	0.370	18.8095	18.4508	18.5726	-0.1218
132.8388446924892	+11.8023155444027	132.83888736424	+11.80228713172	-0.0697	0.3509	9.701	0.573	-6.599	0.406	18.9920	19.2755	18.1512	1.1244
132.8362691705725	+11.8087521492644	132.83622067450	+11.80873880347	1.2356	0.1700	-11.025	0.337	-3.100	0.196	17.8415	18.8076	16.7825	2.0251
132.8169925705098	+11.7873819838047	132.81694215524	+11.78736702694	1.6121	0.3439	-11.462	0.585	-3.474	0.445	18.9908	19.8882	17.6830	2.2052
132.8180345915104	+11.7865121910740	132.81797681497	+11.78645851422	2.1272	0.7654	-13.136	1.236	-12.467	0.834	19.9166	20.2732	18.4982	1.7750
132.8367189303211	+11.8104768701601	132.83671893032	+11.81047687016	99999.9999	99.9999	99999.999	99.999	99999.999	99.999	20.8218	20.5003	19.9421	0.5582
132.8278619972595	+11.7840884811571	132.82781522493	+11.78407580413	1.2109	0.0425	-10.634	0.071	-2.944	0.050	12.3721	12.8032	11.7895	1.0137
132.8114999029881	+11.7900063930180	132.81145210917	+11.78999357786	1.1458	0.0448	-10.866	0.076	-2.976	0.060	12.6952	12.9886	12.2461	0.7425
132.8222783498457	+11.7835184816486	132.82223064631	+11.78350555993	1.1753	0.0371	-10.846	0.063	-3.001	0.044	12.9527	13.2416	12.5052	0.7365
132.8327762404199	+11.7842559220483	132.83272725340	+11.78424450153	1.0352	0.0699	-11.138	0.112	-2.653	0.074	15.9963	16.1764	15.0303	1.1461
132.81865553479023	+11.8167170542278	132.81860797898	+11.81670486542	1.0254	0.1290	-10.769	0.209	-2.831	0.152	17.3629	18.1698	16.4326	1.7373
132.8368790658013	+11.8137757117679	132.83687906580	+11.81377571177	99999.9999	99.9999	99999.999	99.999	99999.999	99.999	21.2193	99.9999	99.9999	99.9999
132.8239003147036	+11.7818691791171	132.82385227477	+11.78185696868	1.2794	0.0550	-10.923	0.104	-2.836	0.063	15.4586	16.0374	14.7288	1.3087
132.8329462746250	+11.7834556067724	132.83289465651	+11.78343753214	1.2172	0.0432	-11.736	0.071	-4.198	0.050	12.0335	12.2698	11.6494	0.6204
132.8422497082013	+11.8077660661810	132.84220101745	+11.80775221726	1.0839	0.0536	-11.070	0.093	-3.217	0.063	15.4550	15.9417	14.7984	1.1433
132.8125572714621	+11.8146675939230	132.81250929515	+11.81465583088	1.2248	0.1132	-10.907	0.194	-2.732	0.159	17.1144	17.9132	16.1882	1.7250
132.8450156268397	+11.8004946231179	132.84496703037	+11.80048201177	1.1978	0.0408	-11.048	0.074	-2.927	0.058	10.1657	10.7347	9.4868	1.2479
132.8109976776418	+11.8140541416626	132.81094769192	+11.81404093135	1.0396	0.1107	-11.364	0.218	-3.068	0.139	16.9241	17.6368	16.0690	1.5678
132.8091540646923	+11.7871545804013	132.80914580239	+11.78714220088	1.2468	0.1719	-11.198	0.280	-3.878	0.212	17.8448	18.7464	16.8267	1.9887

Gaia positions

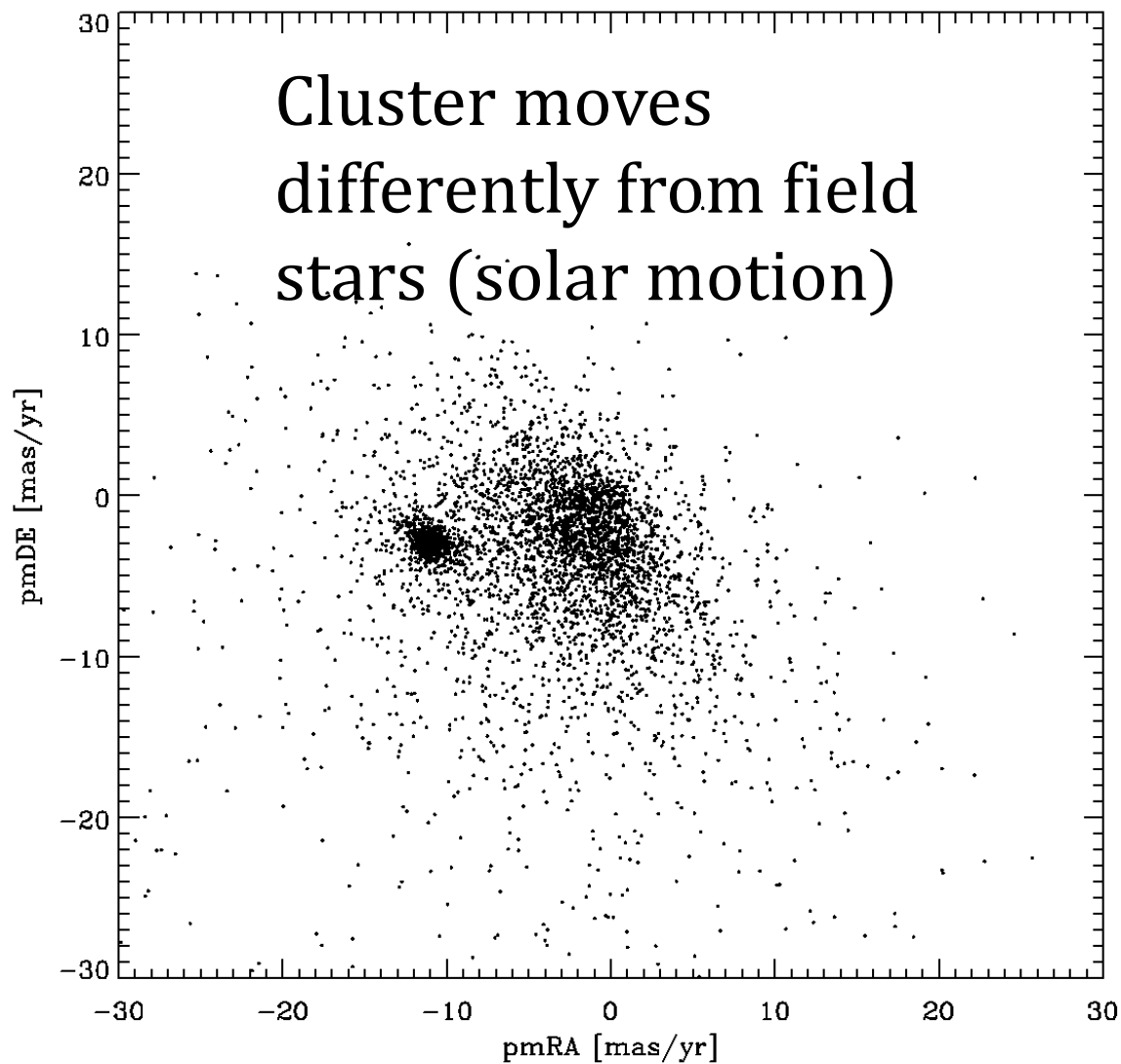
All stars within 1 deg field ...

Concentration at center (the cluster) obvious

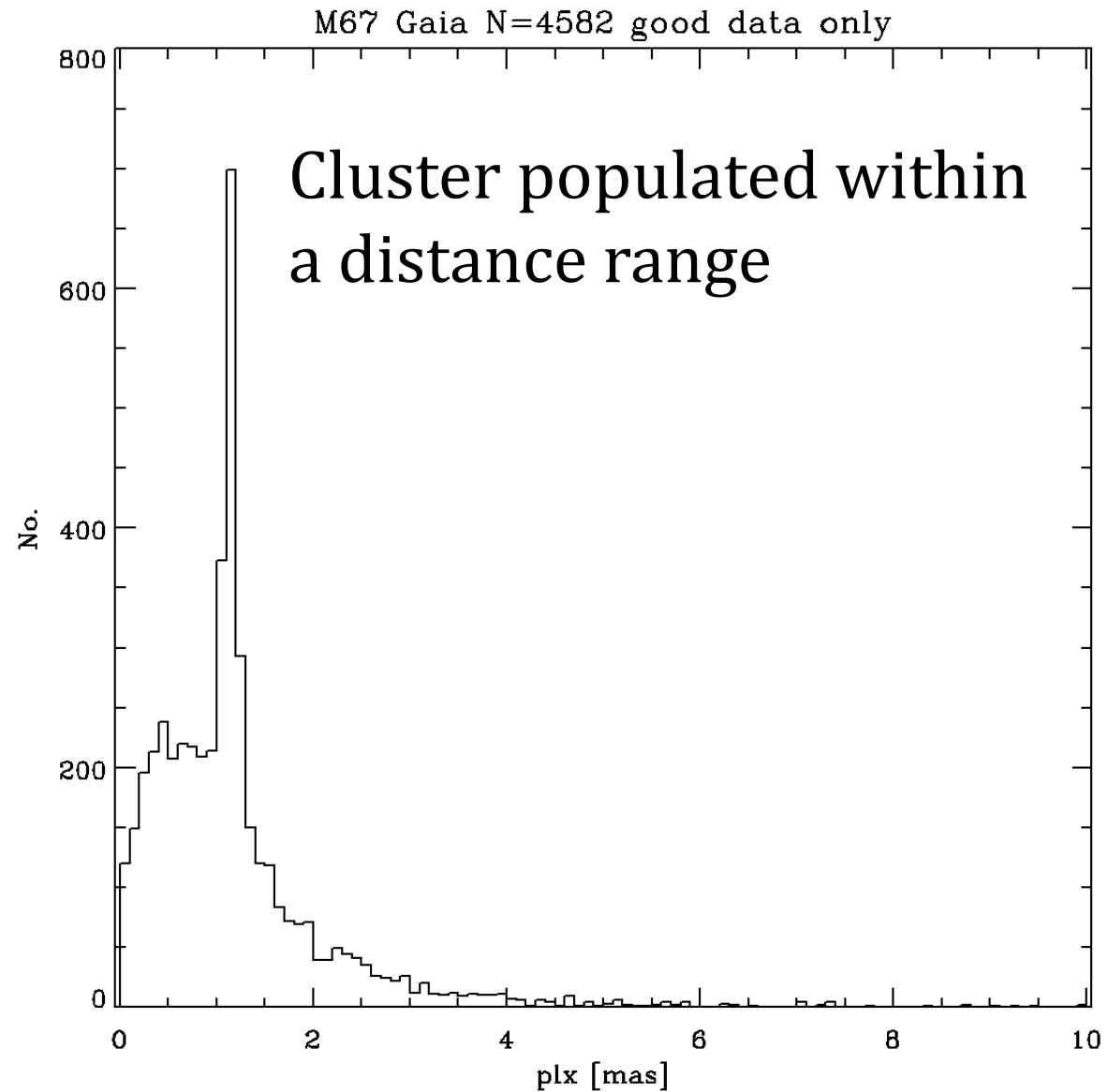
Extended shape?



Gaia proper motions

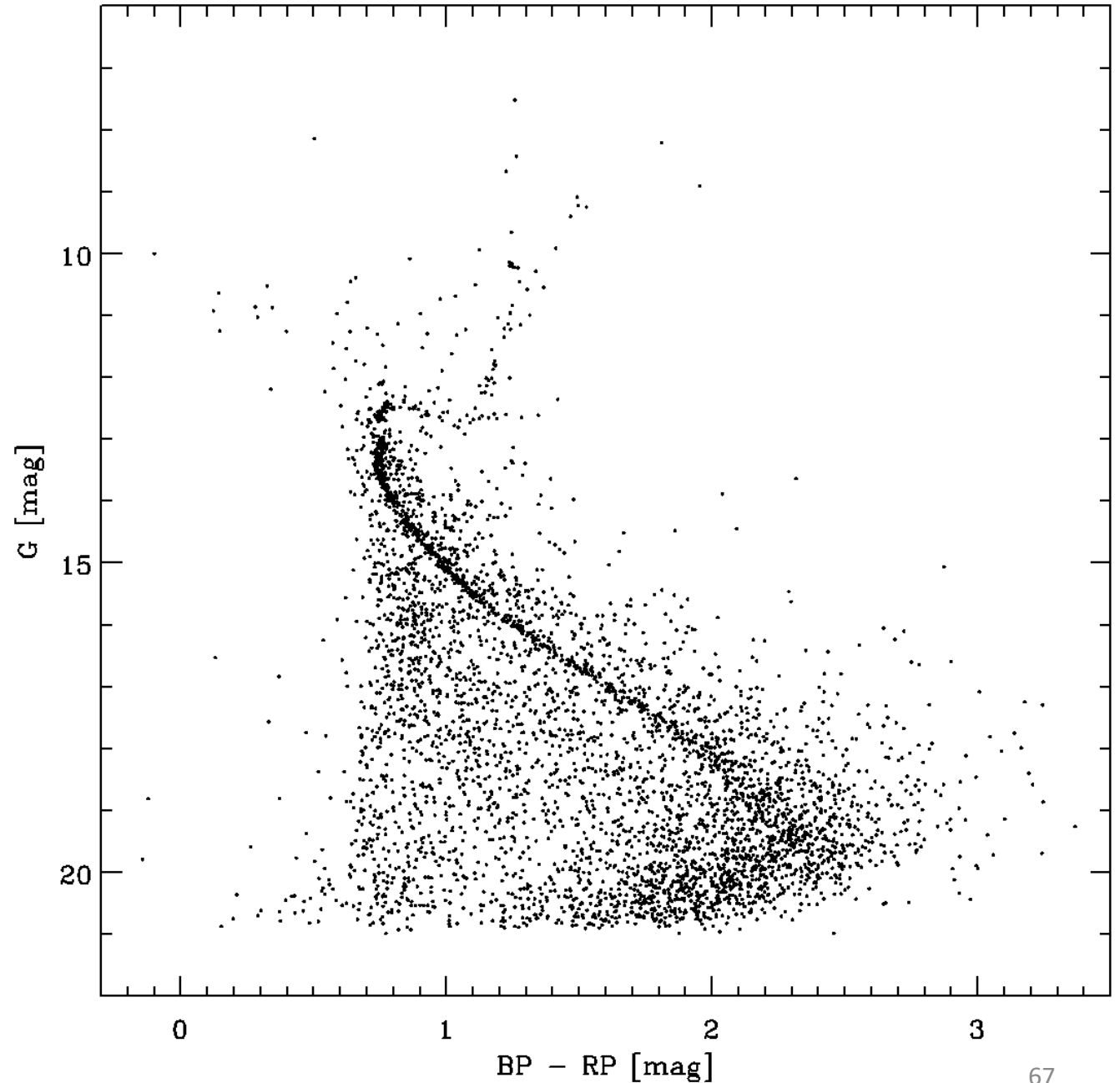


Gaia parallaxes



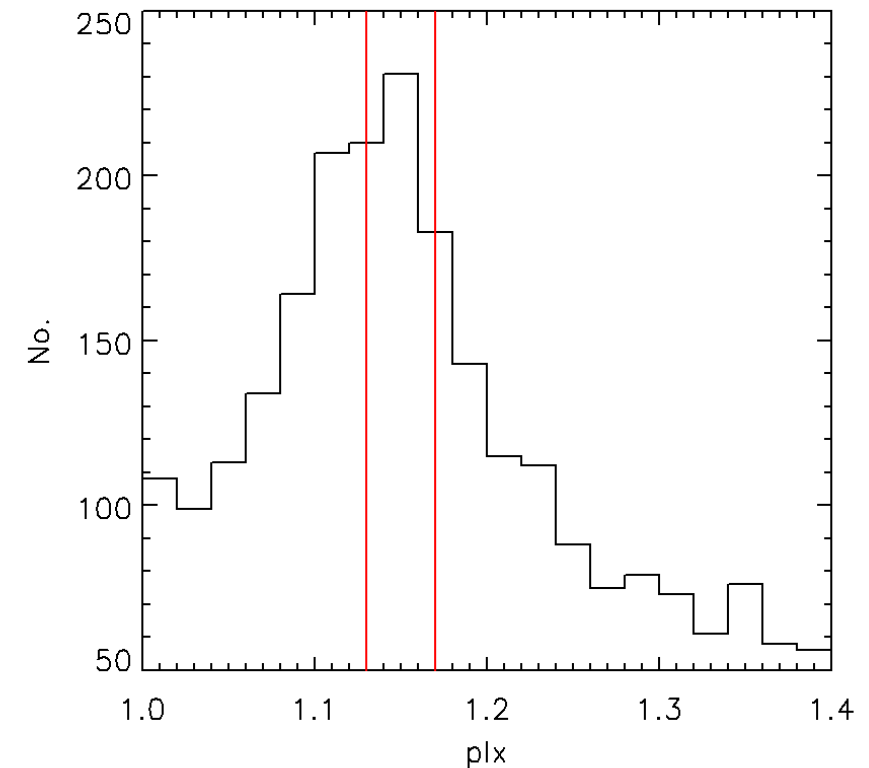
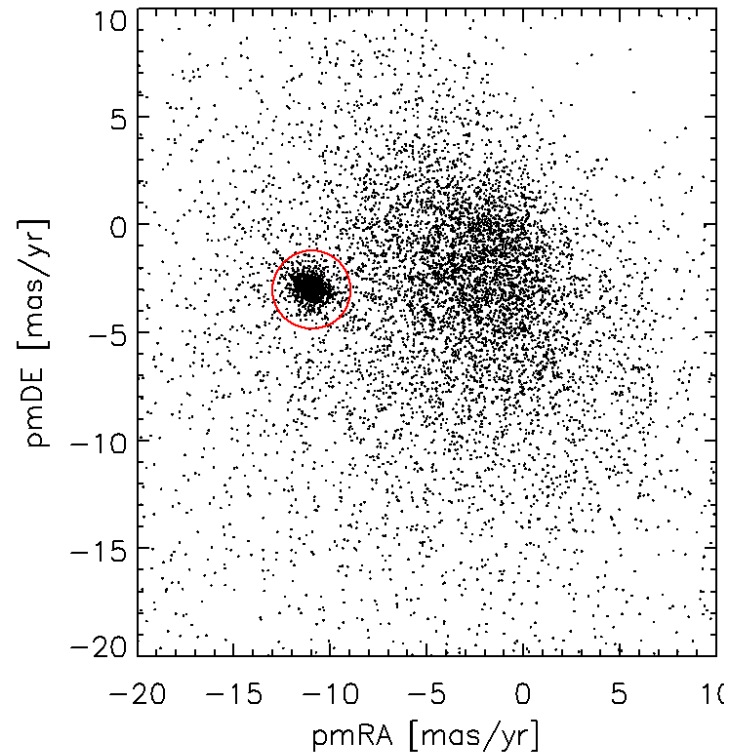
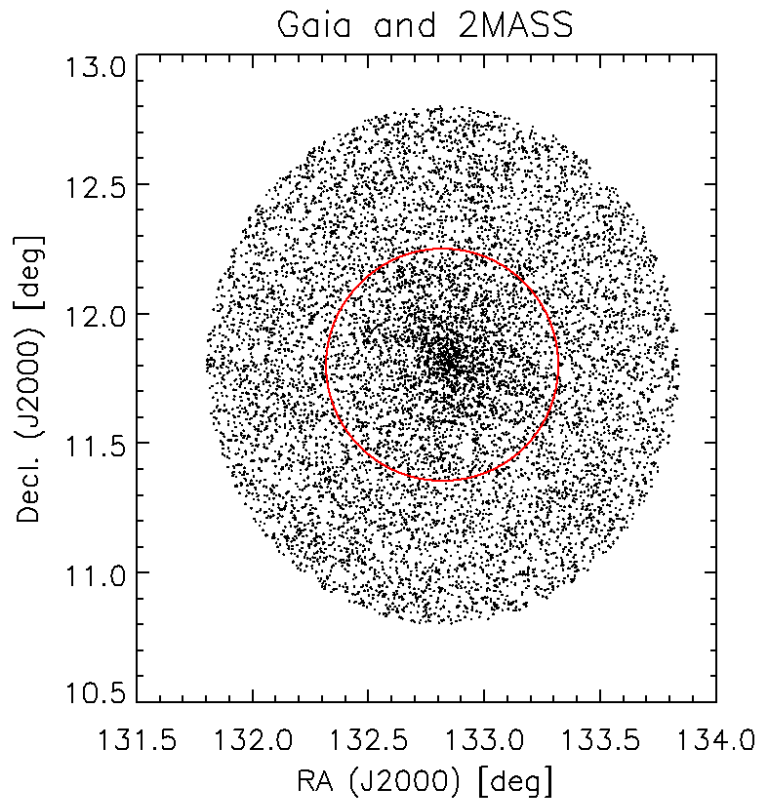
Gaia CMD

The cluster sequence stands out clearly in the CMD, though there are many contaminations, i.e., non-members.



With some preliminary selection criteria in sky coordinates, proper motion, and parallax ...

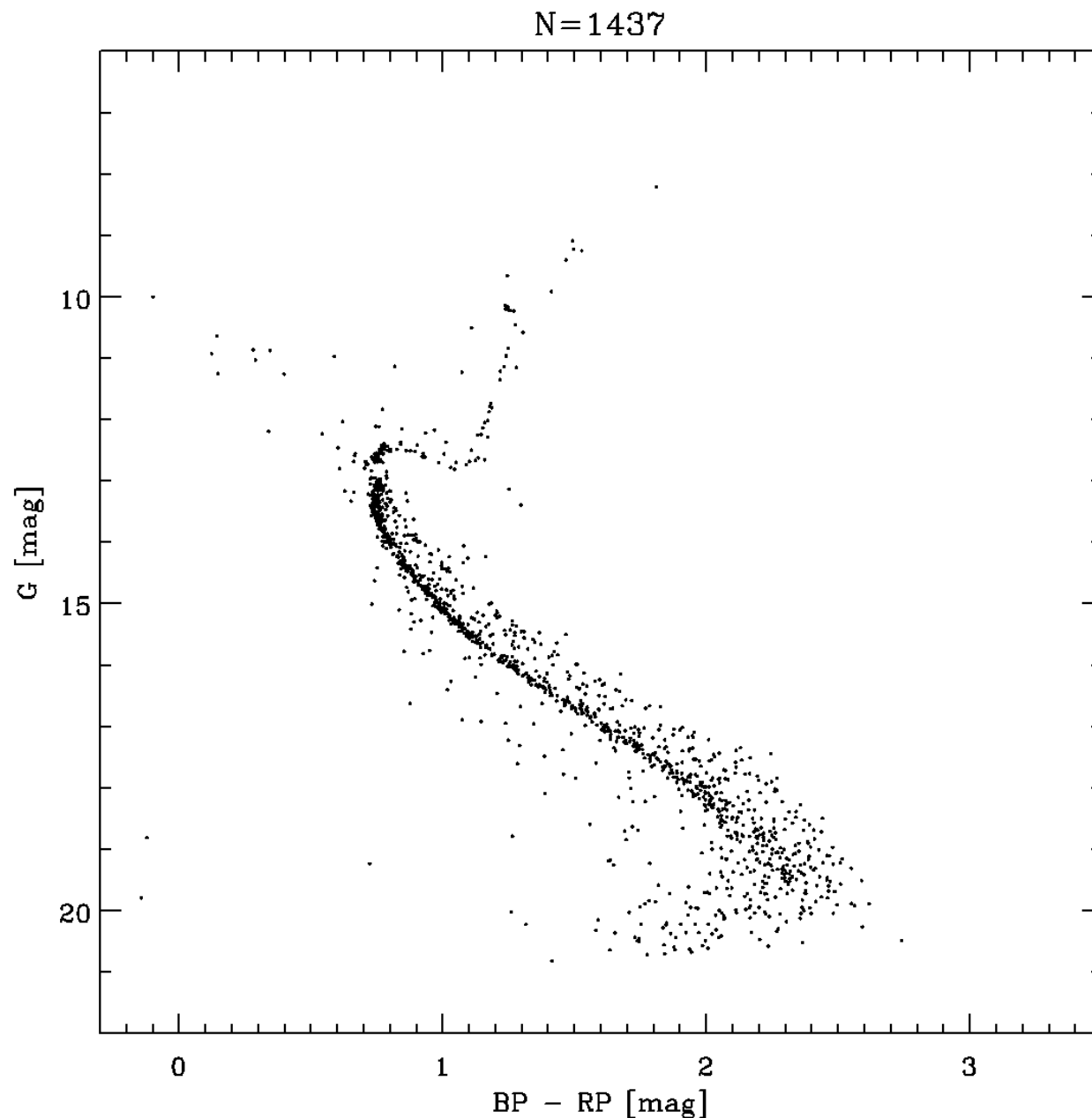
```
ok=WHERE( plx LT 10 and plx  
GT 0 and plx LT 1.5 and plx  
GT 0.5 and ABS(pmra+12) LT  
5 and ABS(pmde+4) LT 5 )
```



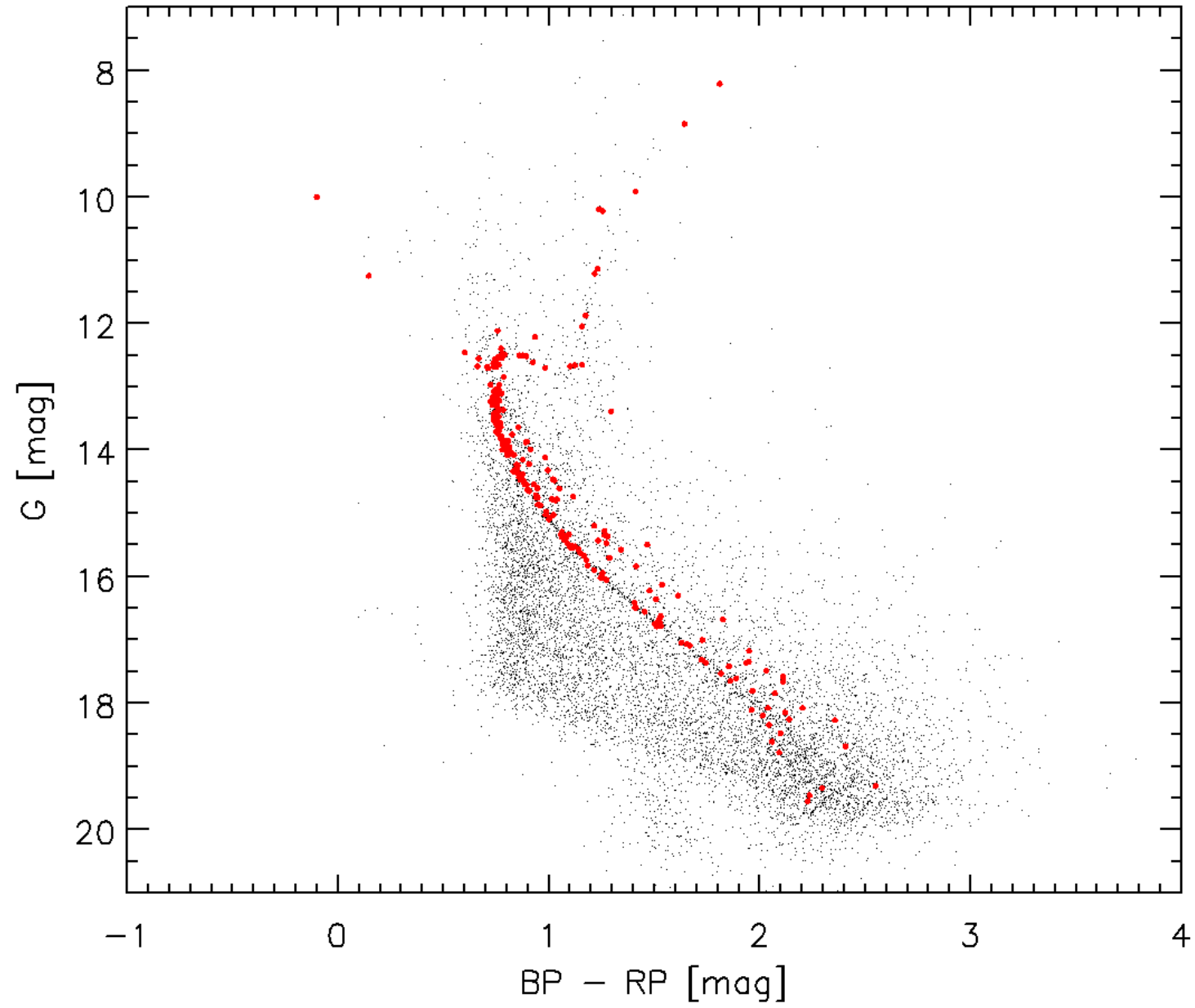
plx(max)=1.15 \rightarrow d=870 pc

Iterative membership selection

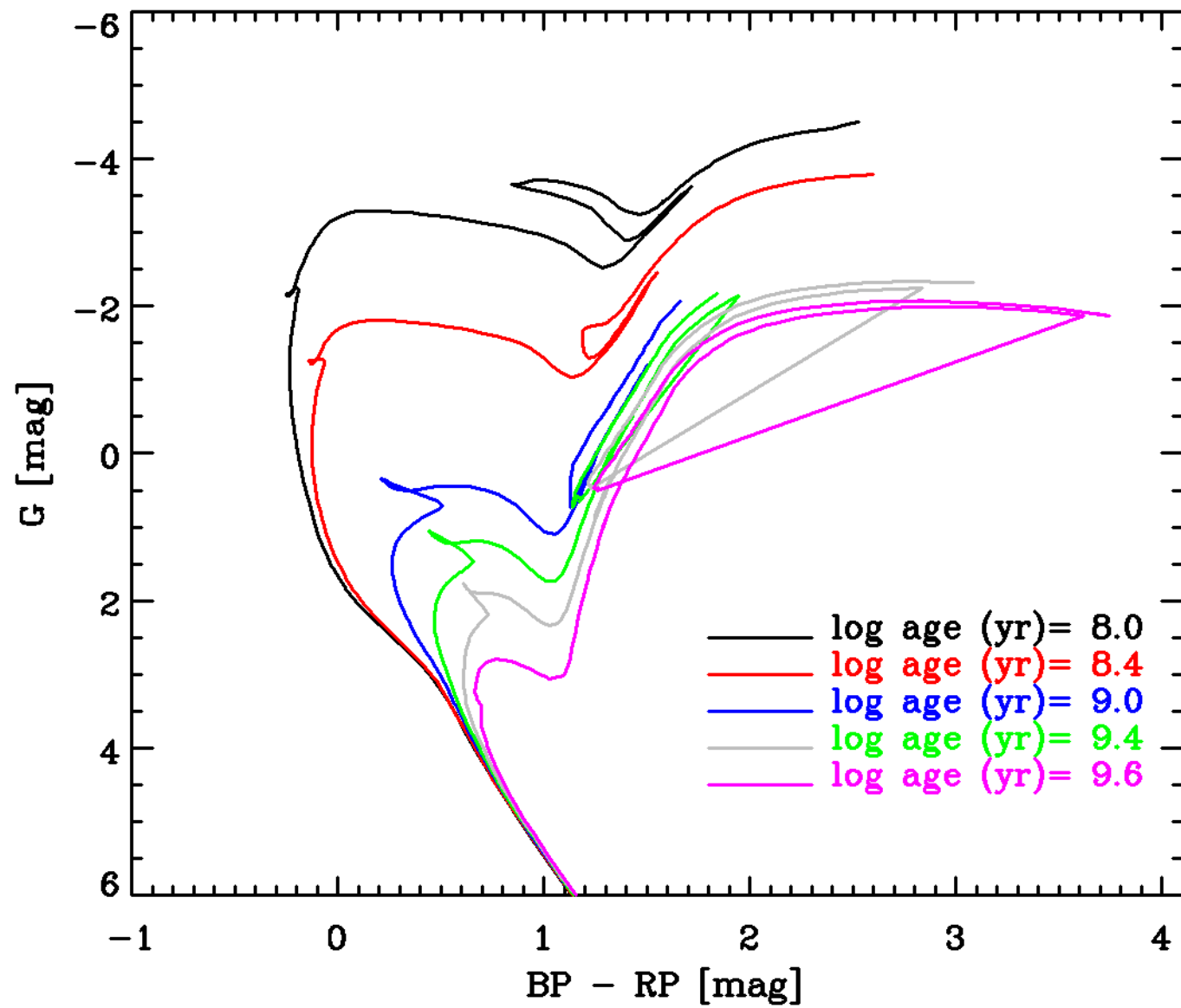
- ✓ Age and distance
- ✓ Blue stragglers
- ✓ Red clump giants
- ✓ “Blue clump”?
- ✓ Binaries
- ✓ White dwarfs?
- ✓ Brown dwarfs?



N=257



CMD 1.1



CTTSs characterized by infrared excess in the SEDs

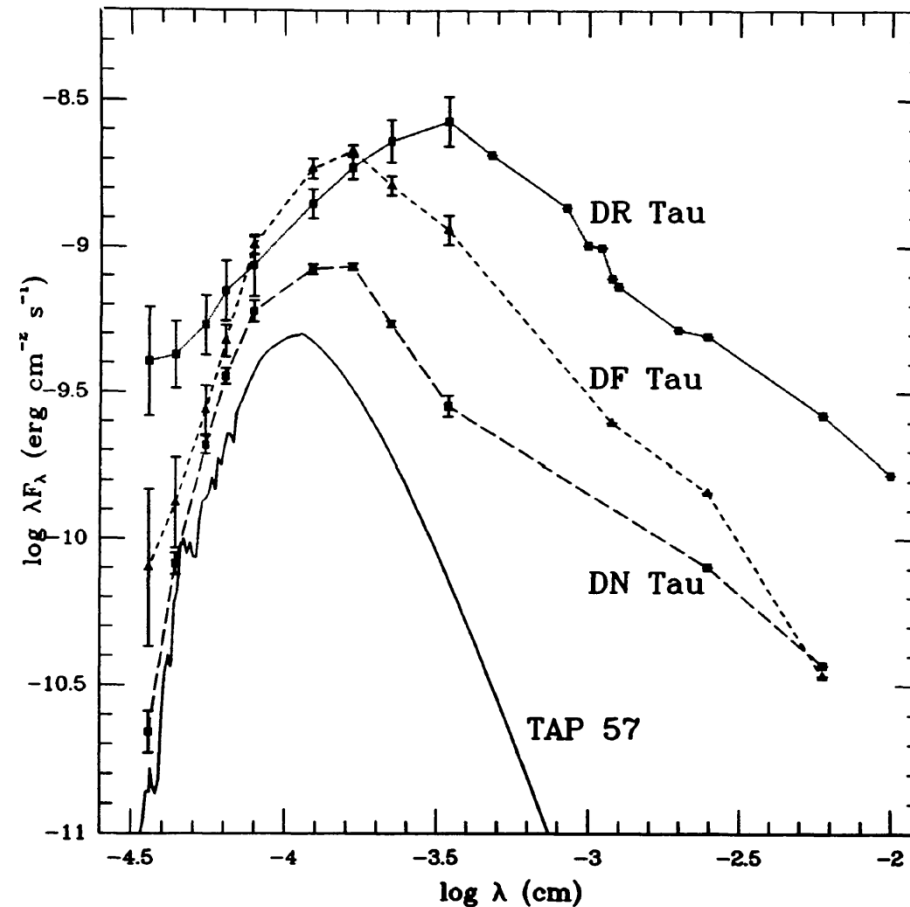


Figure 3 Observed spectral energy distributions from 3600 Å to 100 μm of the stars whose spectra are shown in Figure 2. The energy distribution of the K7V WTTs TAP 57, shown as a solid line, has been displaced downward by 0.3 dex. The filled symbols are simultaneous (for DN Tau and DF Tau) or averaged (for DR Tau) photometric data (cf. Bertout et al. 1988) supplemented by *IRAS* data (Rucinski 1985). When available, observed variability is indicated by error bars. When compared with WTTs such as TAP 57, CTTSs display prominent ultraviolet and infrared excesses. Excess continuum flux and optical emission-line activity are often correlated.

... and also UV excess
→ spectral “veiling”

利用「紅外超量」 infrared excess 指認年輕恆星

- M67 方向 直徑30角分；星團區＝成員＋場星
- ✓ Gaia eDR3（選擇下載「需要」的參數）
- ✓ 先少量，然後無限制、999 filled，可以下載道 CDSportal
- ✓ 2MASS data, 同樣天區
- ✓ Cross-match 結合兩個目錄，也就是同樣一顆星有兩筆數據庫的資料
- Do the same for the Taurus cloud, and identify young stellar candidates.

M67

