

Produire un diagramme HR avec les données GAIA

Cours Astro-I - lundi 26 mai 2025

TITRE

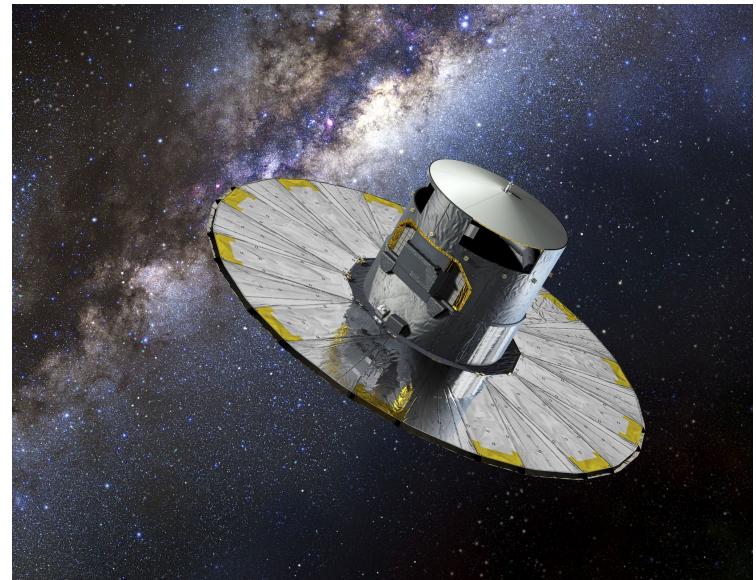
- TEXTE

But de la séance du jour

- Apprendre à télécharger des données scientifiques
- Utiliser fitsio (ou astropy) et divers packages python pour utiliser les données
- Jouer un peu avec les données
- Produire un diagramme HR

Télescope Gaia

- Mission spatiale consacrée à la mesure de la position, de la distance et du mouvement des étoiles
- Développée par l'Agence Spatiale Européenne (ESA)
- 2013 - Mars 2025
- But Scientifique: **Astrométrie**
 - Ascension droite (RA) et déclinaison (DEC)
 - Distance au système solaire
 - Mouvement propre
 - Vitesse radiale



Accéder aux archives

<https://gea.esac.esa.int/archive/>

The screenshot shows the homepage of the Gaia ESA Archive. At the top, there is a navigation bar with links to the European Space Agency and About ESAC, and a sign-in button. The main header is "gaia archive". Below the header, there is a menu with links to HOME, SEARCH, SINGLE OBJECT, VISUALISATION, and HELP. The main content area features a banner with a red background and a circular logo containing a stylized representation of the Gaia mission. The text "Welcome to the Gaia ESA Archive" is displayed. A detailed description of the Gaia mission follows, mentioning its purpose of providing astrometry, photometry, and spectroscopy for nearly 2000 million stars. To the right of the text is a circular logo for the Gaia mission, featuring a red and white design with the word "gaia" and the "esa" logo.

Welcome to the Gaia ESA Archive

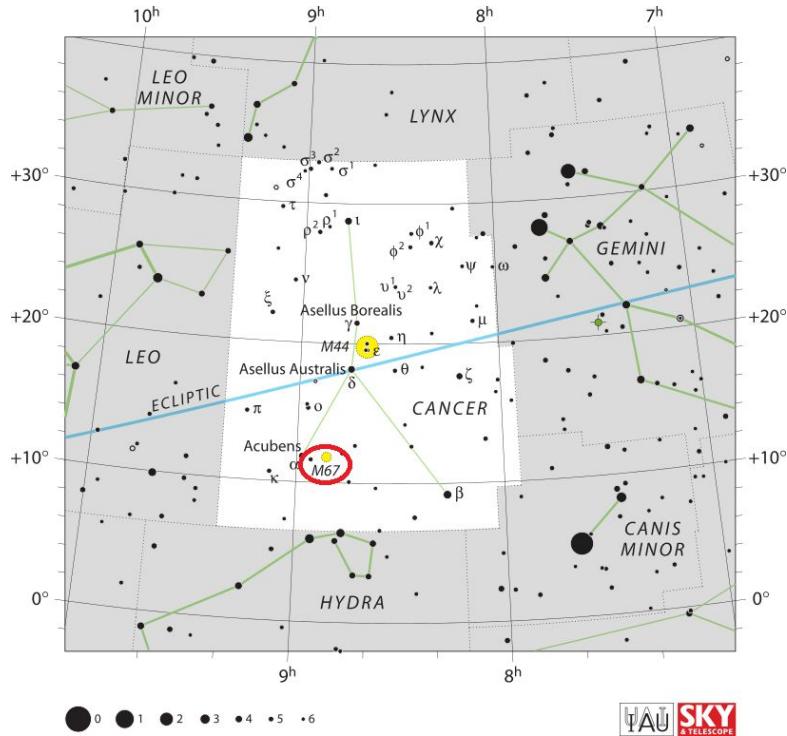
Gaia is a European space mission providing astrometry, photometry, and spectroscopy of nearly 2000 million stars in the Milky Way as well as significant samples of extragalactic and solar system objects. The Gaia ESA Archive contains deduced positions, parallaxes, proper motions, radial velocities, and brightness measurements. Complementary information on multiplicity, photometric variability, and astrophysical parameters is provided for a large fraction of sources.

Top Features

 Gaia Mission News, Gaia alerts, information, and resources on the Gaia mission for the scientific community.	 Gaia DR3 Direct access to Gaia DR3 papers, known issues, tools, auxiliary data, etc.	 Gaia FPR Direct access to all information of the Focused Product Release.	 Download Direct bulk download of Gaia data in ECSV format.
 Software Tools Software tools for resampling of spectra, calibration of data, etc.	 Auxiliary Data Small data sets related to calibration, photometric pass bands, exoplanets, asteroids, etc.	 Citation How to cite and acknowledge the use of Gaia data and where to find DOIs.	 Partners Partner data centres also serving Gaia data.

Messier 67: King Cobra Cluster

<https://www.messier-objects.com/messier-67-king-cobra-cluster/>



ADQL Query

La query est simple avec Gaia

1. Cliquer sur l'onglet “Search”



Top Features



Gaia Mission
News, Gaia alerts, information, and resources on the Gaia mission for the scientific community.



Gaia DR3
Direct access to Gaia DR3 papers, known issues, tools, auxiliary data, etc.



Gaia FPR
Direct access to all information of the Focused Product Release.



Download
Direct bulk download of Gaia data in ECSV format.



Software Tools
Software tools for resampling of spectra, calibration of data, etc.



Auxiliary Data
Small data sets related to calibration, photometric pass bands, exoplanets, asteroids, etc.



Citation
How to cite and acknowledge the use of Gaia data and where to find DOIs.



Partners
Partner data centres also serving Gaia data.

ADQL Query

La query est simple avec Gaia

1. Cliquer sur l'onglet “Search”
2. La fenêtre du Basic Query s'affiche

Position File

Name Equatorial

Target in Circle Box

Name

Radius 1 deg ▾

Search in: gaiadr3.gaia_source ▾

▶ Extra conditions

▶ Display columns

 [Reset Form](#)  [Show Query](#)  [Submit Query](#)

Output is limited to 2,000 sources

ADQL Query

La query est simple avec Gaia

1. Cliquer sur l'onglet “Search”
2. La fenêtre du Basic Query s'affiche
3. Sélectionnez les étoiles avec les propriétés suivantes:
 - a. Se trouvent dans un rayon de un degré dans M67
 - b. Magnitude < 18
 - c. parallax_over_error > 10
 - d. Cliquez sur



Submit Query

ADQL Query

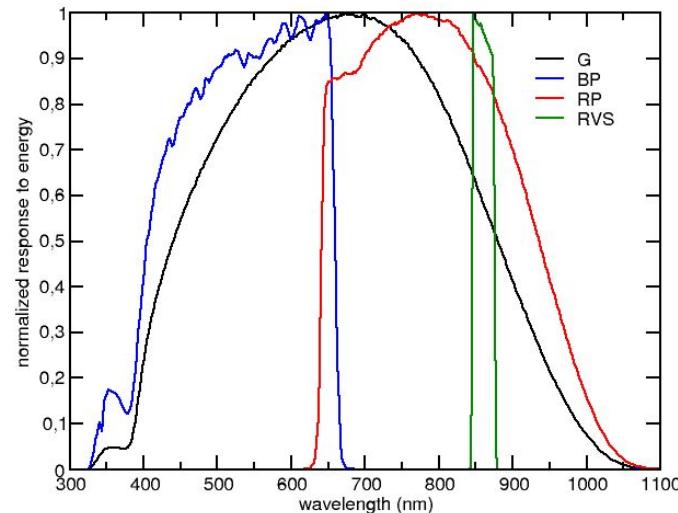
La query est simple avec Gaia

1. Cliquer sur l'onglet “Search”
 2. La fenêtre du Basic Query s'affiche
 3. Sélectionnez les étoiles
 4. Téléchargez le catalogue au format “FITS”

	ra	pmdec	ruwe	phot_g_mean_mag	bp_rp	radial_velocity	phot_variable_flag	non_single_i
	sky-1	mas.yr^-1		mag	mag	km.s^-1		
Gaia DR3 604959513875785344	604959513875785344	133.19525893545858	12.78918682721104	3.1274779508808246	11.414096045608912	-5.388490211334784	1.0237778	17.027678
Gaia DR3 605019055007636224	605019055007636224	132.64930883611063	12.846560486582	2.8405724586196053	-14.492714636379127	-14.591980813376733	0.9771593	17.360235
Gaia DR3 604685048285445248	604685048285445248	133.1278178936602	11.519048361617	1.120916169210305	-11.0967112228661	-2.914618182102079	0.98706514	16.515097
Gaia DR3 604934156389089920	604934156389089920	133.42626684872187	11.9709213598177	1.6169061354003211	-3.8755274172138807	2.142795859694797	1.1940936	14.505628
Gaia DR3 5988694500362425984	5988694500362425984	132.4065626758723	11.4336757215454	1.3180571397432248	-10.61270929273367	-2.84869001564958	1.0009631	16.669706
Gaia DR3 60473322998310784	60473322998310784	133.4219052402822	11.6839734249693	0.4669458532442577	-2.0664110715620096	-0.7595019025213221	1.0305927	14.934686
Gaia DR3 60473985206800888	60473985206800888	133.43843062602132	11.8338334092169	1.1870194063715322	-11.37832690880901	-3.16282618809829	1.0075197	15.314507
Gaia DR3 604707981953241088	604707981953241088	133.3847933442916	11.5717921428902	3.8520870438743222	12.1093082297979	-17.77389713833674	0.9970809	14.673808
Gaia DR3 598970649537645440	598970649537645440	132.25486447268398	11.781767200018	1.2218176698271004	-10.774157896994926	-3.171066139686675	1.0433453	17.016638
Gaia DR3 604731777529567488	604731777529567488	133.40058135667556	11.6125624452773	0.7453030818006844	-4.571498678972728	4.959664988488965	0.9948818	15.193969
Gaia DR3 598958104533143808	598958104533143808	132.2604807348562	11.726023355977	1.5648818674610887	-6.458472416860435	-0.53818571694766	0.9682669	14.658085

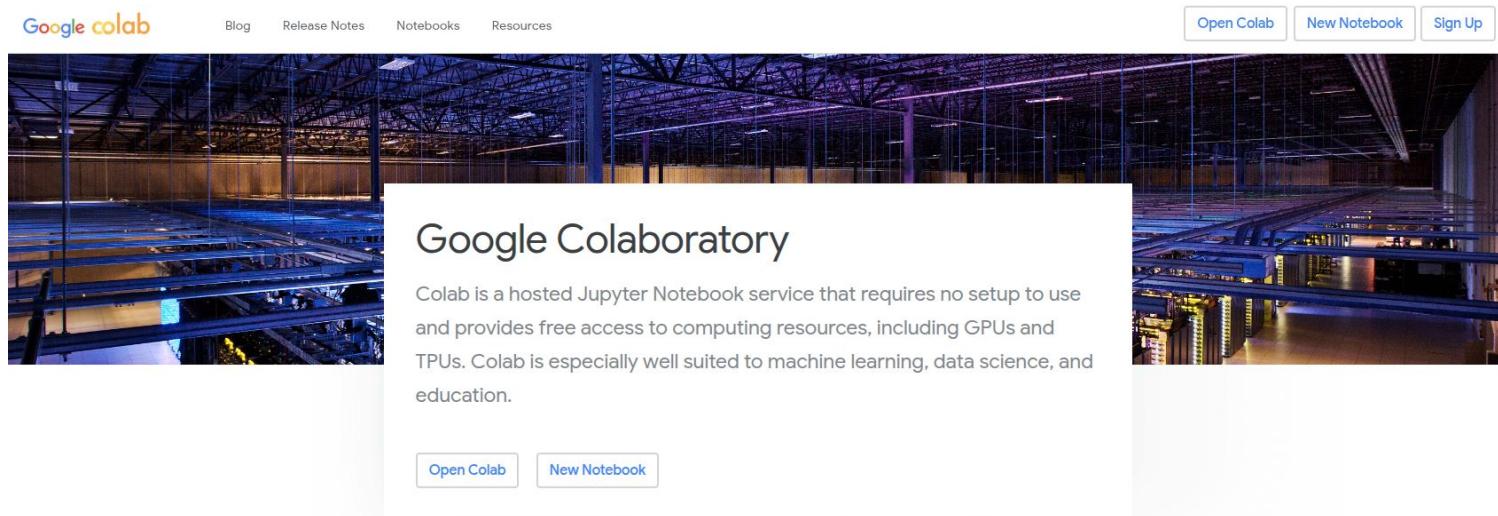
Gaia Catalogue Résumé

- **ra**: Ascension Droite
- **dec**: Déclinaison
- **parallax**: Parallax
- **pmra**: Vitesse propre en ra
- **pmdec**: Vitesse propre en dec
- **phot_g_mean_mag**: G-band magnitude
- **bp_rp**: BP - RP couleur en magnitude
- **radial_velocity**: Vitesse radiale
- **ag_gspphot**: Extinction dans la G-band
- **teff_gspphot**: Température effective
- **mh_gspphot**: Métallicité globale (M/H)



Google Colab

- Nous allons utiliser Google Colab pour écrire un scripte python
- <https://colab.google/>
- Créez un compte et ouvrez un nouveau Notebook



Premiers pas dans Google Colab

- Dans la première cellule, veuillez écrire la ligne de code suivante:

```
!pip install fitsio
```

- Ensuite, importez les packages suivants:

```
import numpy as np
```

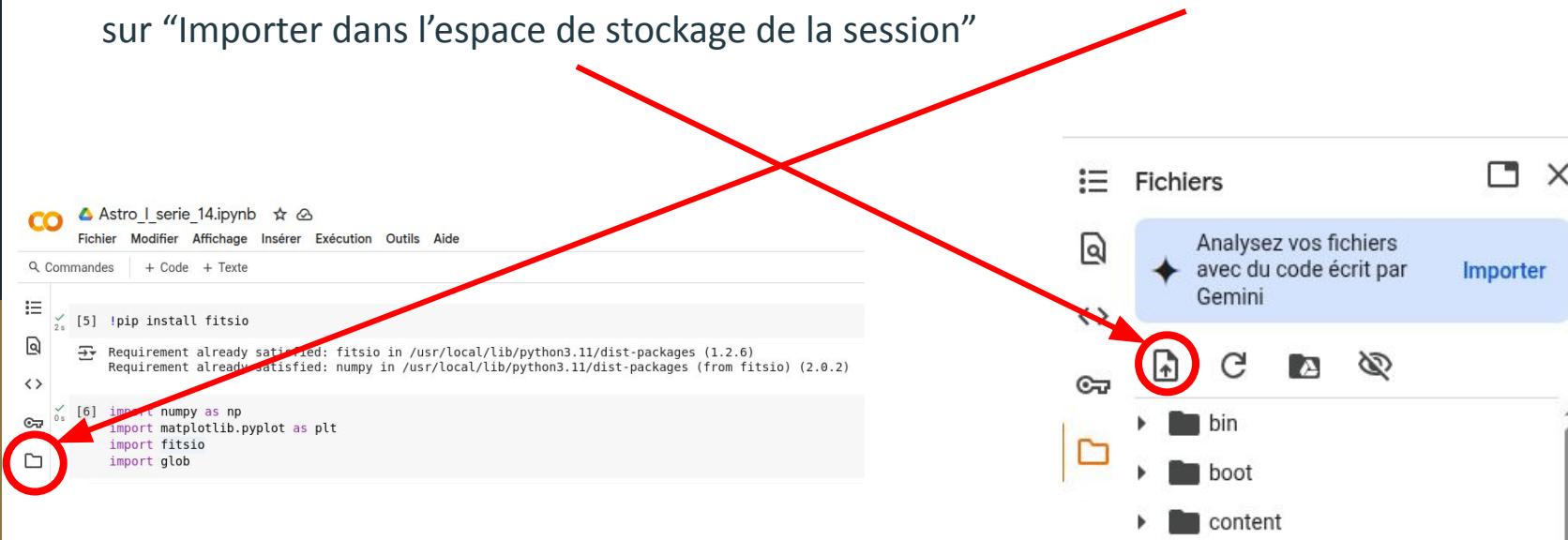
```
import matplotlib.pyplot as plt
```

```
import fitsio
```

```
import glob
```

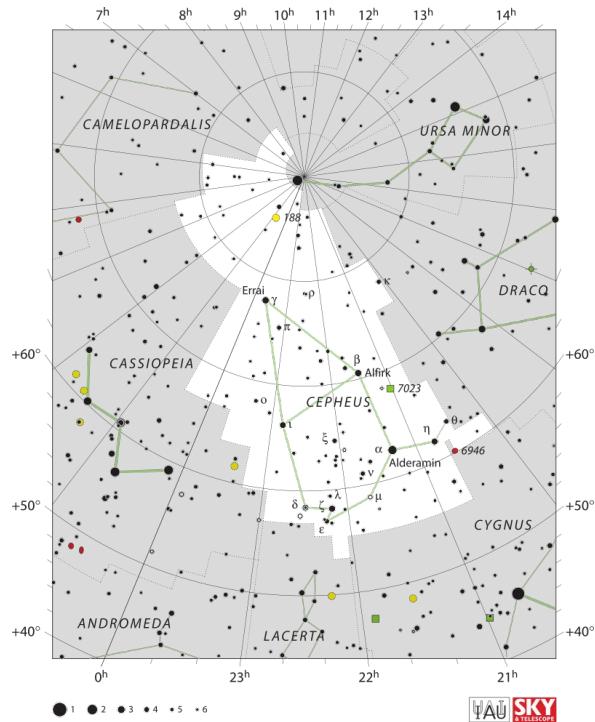
Premiers pas dans Google Colab

Importez vos fichiers Gaia sur le notebook en cliquant sur le dossier à gauche (“Fichiers”) puis sur “Importer dans l'espace de stockage de la session”



Voir Notebook pour la suite du cours !

Bonus I: Comparez M67 avec NGC 188



Bonus II: Young clusters

- NGC 6611: Haute métallicité
- NGC 6067: Étoiles type O
- NGC 6357: Région active en formation d'étoile
- NGC 3293: Environ 12 million d'années
- NGC 146: Étoiles en pré-séquence principale

Bonus III: Stellar Isochrone (Difficile !)

- Tenter de fit des isochrones pour approximer l'âge des clusters