



Produire un diagramme HR avec les données GAIA

Cours Astro-I - lundi 26 mai 2025



TITRE

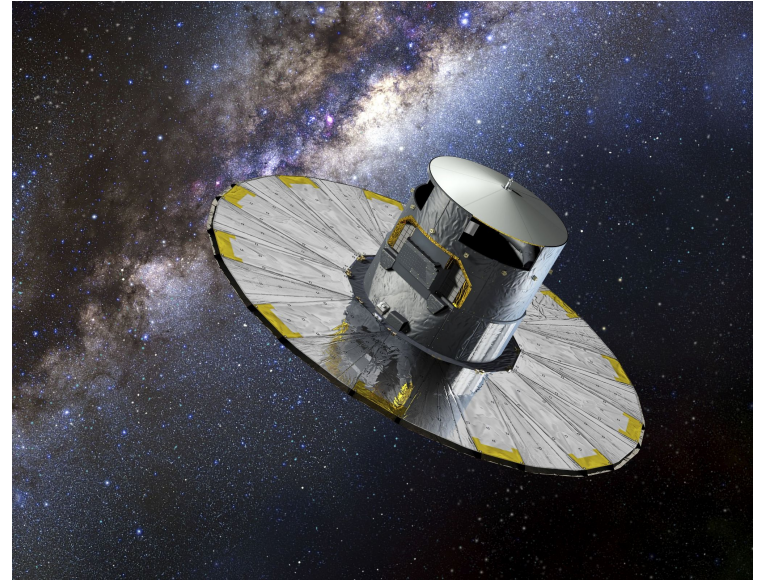
- TEXTE

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



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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



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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.

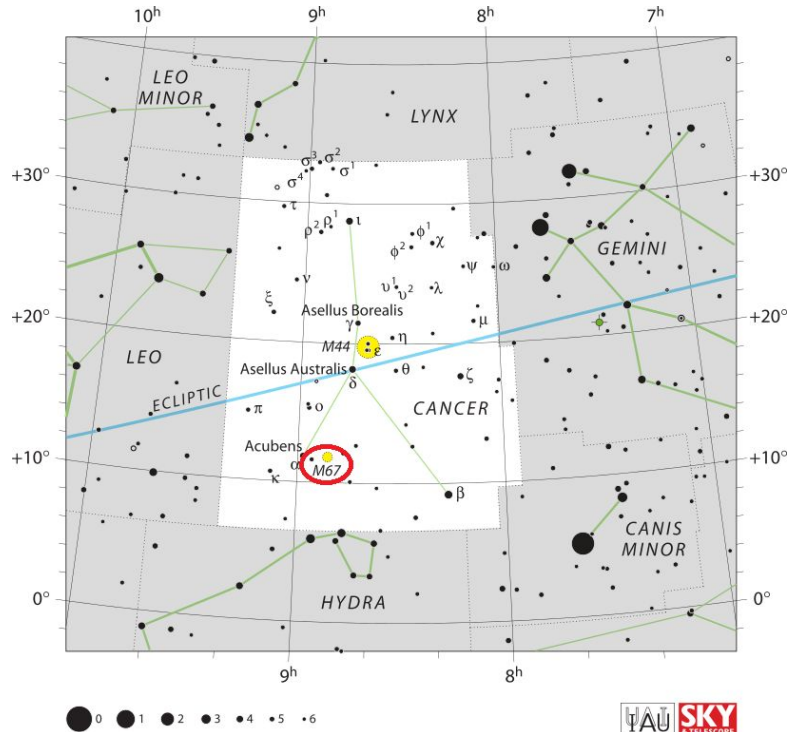


Partners

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"



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

The screenshot displays the 'Position' tab of the ADQL Query interface. It features a 'Name' radio button selected under 'Target in', a 'Circle' radio button selected under 'Target in', a 'Name' text input field, a 'Radius' input field with the value '1', and a 'deg' unit dropdown. Below these are 'Search in:' dropdowns with 'gaiadr3.gaia_source' selected. At the bottom, there are expandable sections for 'Extra conditions' and 'Display columns', and three buttons: 'Reset Form', 'Show Query', and 'Submit Query'. A note at the bottom states 'Output is limited to 2,000 sources'.

Position File

☒ Name
☐ Equatorial

Target in ☒ Circle ☐ Box

Name

Radius

Search in:

► 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



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"

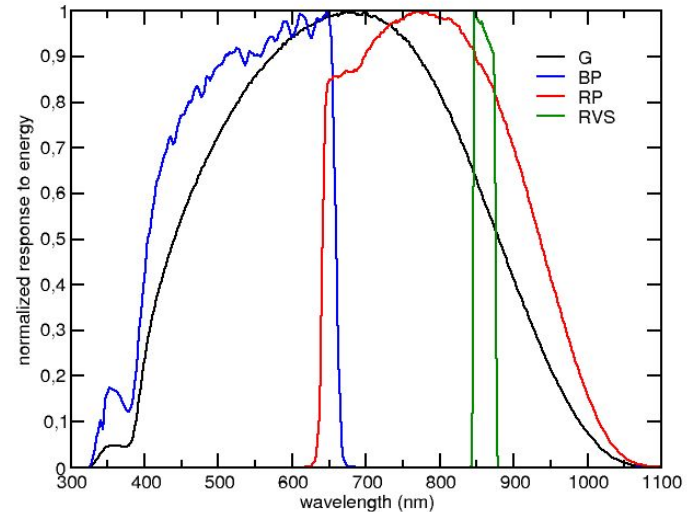
Gaia DR3 604959513875785344	604959513875785344	133.19525893545858	12.78918682721104	3.1274779508808246	11.414090645608912	-5.388490211334784	1.0237778	17.027678	2.335105	NOT_AVAILABLE	0	
Gaia DR3 605019050007636224	605019050007636224	132.64930883611063	12.9465604886082	2.8405724586196053	-14.492714636379127	-14.59180813376733	0.9771593	17.360235	2.4401016	NOT_AVAILABLE	0	
Gaia DR3 604685048285445248	604685048285445248	133.1278178936602	11.3190463161617	1.1209106169210035	-11.0967111228661	-2.914618182102079	0.98706514	16.515097	1.4160576	NOT_AVAILABLE	0	
Gaia DR3 604934156399089920	604934156399089920	133.4262684672187	11.97709213598177	1.6169061354003211	-3.8755274172138607	2.142796580694797	1.1940936	14.505628	1.0636787	VARIABLE	0	
Gaia DR3 598894500362425984	598894500362425984	132.4085662758723	11.42346757215454	1.3180571397432248	-10.61270929273387	-2.848698001564958	1.0009631	16.089706	1.472497	NOT_AVAILABLE	0	
Gaia DR3 604733254998310784	604733254998310784	133.4219052402822	11.68079374246936	0.4669458324442577	-2.066410751620086	-0.7595019025213221	1.0305927	14.934686	0.5853634	NOT_AVAILABLE	0	
Gaia DR3 604739852068005888	604739852068005888	133.43684308620132	11.8338334092169	1.1870194063715325	-11.37832690880901	-3.162826318809829	1.0075197	15.314507	1.0695724	NOT_AVAILABLE	0	
Gaia DR3 604707961935241088	604707961935241088	133.3847933442916	11.5779214128902	3.8528507438743222	12.10593082297997	-17.777389713833674	0.9970809	14.673906	1.6589098	-3.278523	NOT_AVAILABLE	0
Gaia DR3 598970645837645440	598970645837645440	132.25486447268398	11.78875675005018	1.2218176898271004	-10.774137889694526	-3.171066136686675	1.0433453	17.016638	1.6066303	NOT_AVAILABLE	0	
Gaia DR3 604731777529567488	604731777529567488	133.40008135667556	11.6125624452773	0.7453030818008844	-4.571498879877298	4.9596964988488965	0.9948818	15.193969	0.8014574	NOT_AVAILABLE	0	
Gaia DR3 598958104533143808	598958104533143808	132.2604807348562	11.7261023355977	1.5648818674610887	-6.4584724716860435	-0.5381857571694766	0.9682669	14.658085	0.9708109	69.744	NOT_AVAILABLE	0



ra s.yr ⁻¹	pmdec mas.yr ⁻¹	ruwe	phot_g_mean_mag mag	bp_rp mag	radial_velocity km.s ⁻¹	phot_variable_flag	non_single
092135338046546	-3.4672740993977933	1.0111734	14.231588	0.84349537	7.387824	NOT_AVAILABLE	0
3.45514606563599	-2.6558672913078	1.0152706	15.365417	1.0208712	NOT_AVAILABLE	0	0
494563411360751	-0.17239715017167043	0.9860662	14.192791	0.67934036	40.370117	NOT_AVAILABLE	0
5.4537699794747	-7.74272884198821	1.0373029	16.943838	-0.42409897	NOT_AVAILABLE	0	0
3.697245828689677	14.900410562220635	1.069598	16.374704	2.085765	NOT_AVAILABLE	0	0
1.457724239968627	-8.7657015602260533	0.93648565	16.842354	2.8545017	NOT_AVAILABLE	0	0
3.861308883955953	-2.682721734133006	0.96313643	12.880277	0.72293377	33.915455	NOT_AVAILABLE	0
5375708633983771	-2.65904696927691	1.008841	13.79559	0.780056	-9.168343	NOT_AVAILABLE	0
1.354412061459623	6.159085391907994	1.0356469	17.261538	1.7335508	NOT_AVAILABLE	0	0
11.414090645608912	-5.388490211334784	1.0237778	17.027678	2.335105	NOT_AVAILABLE	0	0
-14.492714636379127	-14.59180813376733	0.9771593	17.360235	2.4401016	NOT_AVAILABLE	0	0
-11.0967111228661	-2.914618182102079	0.98706514	16.515097	1.4160576	NOT_AVAILABLE	0	0
-3.8755274172138607	2.142796580694797	1.1940936	14.505628	1.0636787	6.746811	VARIABLE	0
-10.61270929273387	-2.848698001564958	1.0009631	16.089706	1.472497	NOT_AVAILABLE	0	0
-2.066410751620086	-0.7595019025213221	1.0305927	14.934686	0.5853634	NOT_AVAILABLE	0	0
-11.37832690880901	-3.162826318809829	1.0075197	15.314507	1.0695724	NOT_AVAILABLE	0	0
12.10593082297997	-17.777389713833674	0.9970809	14.673906	1.6589098	-3.278523	NOT_AVAILABLE	0
-10.774137889694526	-3.171066136686675	1.0433453	17.016638	1.6066303	NOT_AVAILABLE	0	0
-4.571498879877298	4.9596964988488965	0.9948818	15.193969	0.8014574	NOT_AVAILABLE	0	0
-6.4584724716860435	-0.5381857571694766	0.9682669	14.658085	0.9708109	69.744	NOT_AVAILABLE	0

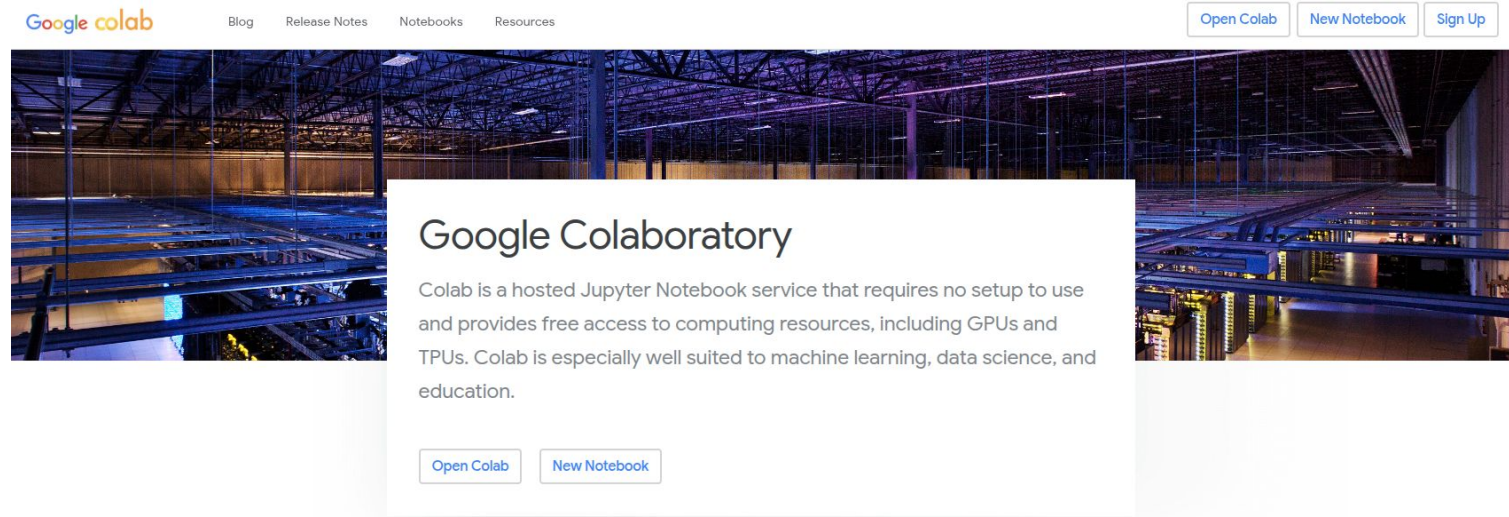
Gaia Catalogue Résumé

- **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”

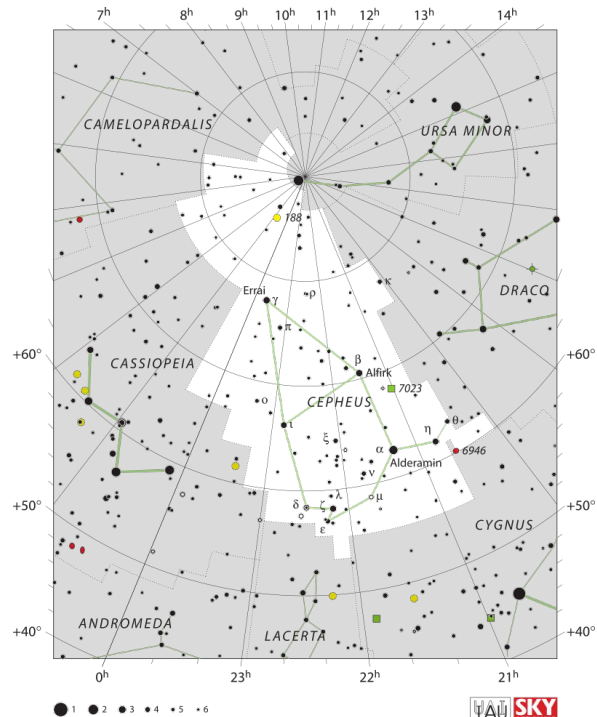
The image shows a Google Colab notebook titled "Astro_I_serie_14.ipynb". The left sidebar contains a "Fichiers" (Files) panel. In the code cell, the following commands are visible:

```
[5] !pip install fitsio  
Requirement already satisfied: fitsio in /usr/local/lib/python3.11/dist-packages (1.2.6)  
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from fitsio) (2.0.2)  
  
[6] import numpy as np  
import matplotlib.pyplot as plt  
import fitsio  
import glob
```

Two red arrows originate from the text above. One arrow points to the "Fichiers" icon in the left sidebar. The other arrow points to the "Importer" button in the "Fichiers" panel, which is highlighted in blue and contains the text "Analysez vos fichiers avec du code écrit par Gemini".

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