

*Forum de l'Action Fédératrice Gaia de
l'Observatoire de Paris
16 Septembre 2016, Meudon*

Spectroscopie Gaia 2017

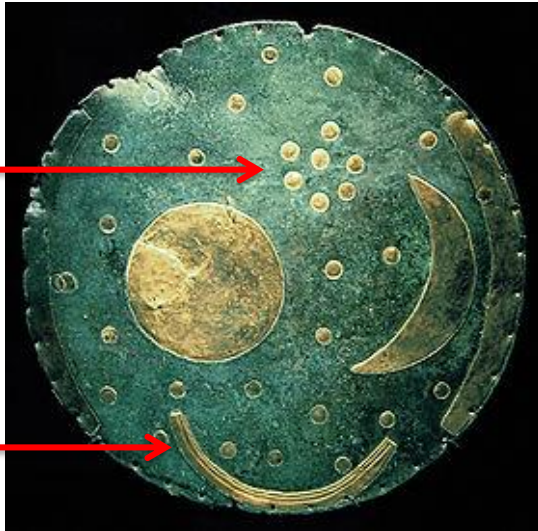
5 millions d'excès de vitesse

*D. Katz, P. Sartoretti, O. Marchal
R. Haigron, P. Panuzzo, G. Plum*



Gaia Data Releases

Nebra sky disc



Pleiades

Milky-Way (?)

Data Release 1

14 September 2016

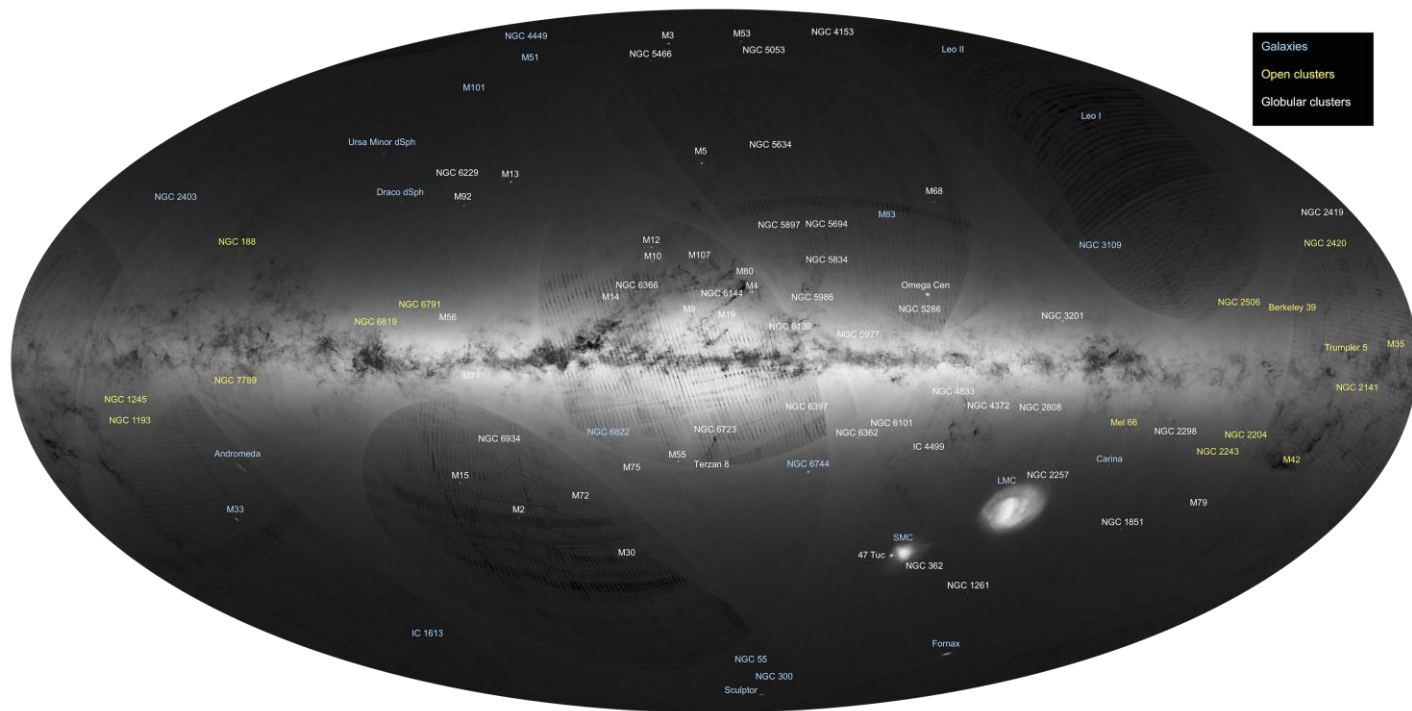
- Distances, pm: $2 \cdot 10^6$ stars
- Positions: 10^9 sources
- G-mag: 10^9 sources
- Cepheids: 599
- RR Lyrae: 2595



Data Release 2

Autumn 2017

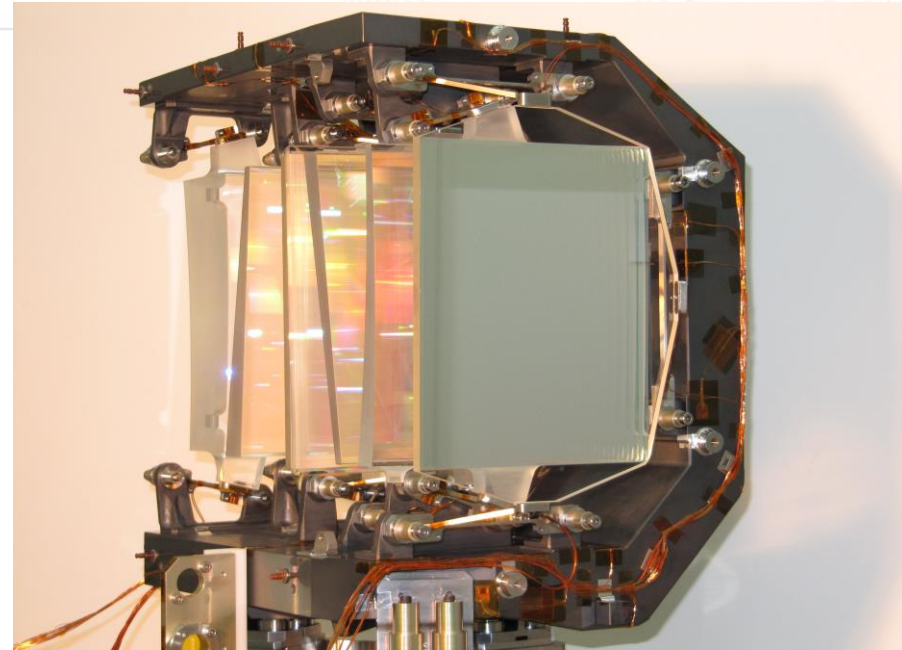
- 5 astrometric param $> 10^9$ sources
- Bp / Rp magnitudes
- **Mean radial velocities Grvs < 12**



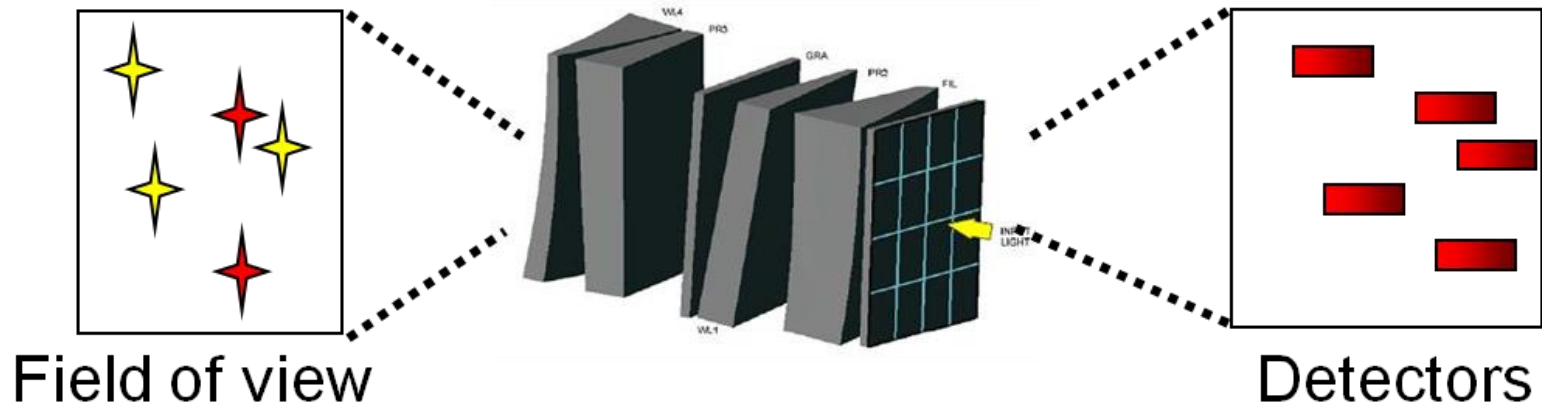
1. A quick look at the RVS instrument
2. Astrophysical content of the RVS spectra
3. RVS data processing: to DR2 and beyond

The Radial Velocity Spectrometer instrument

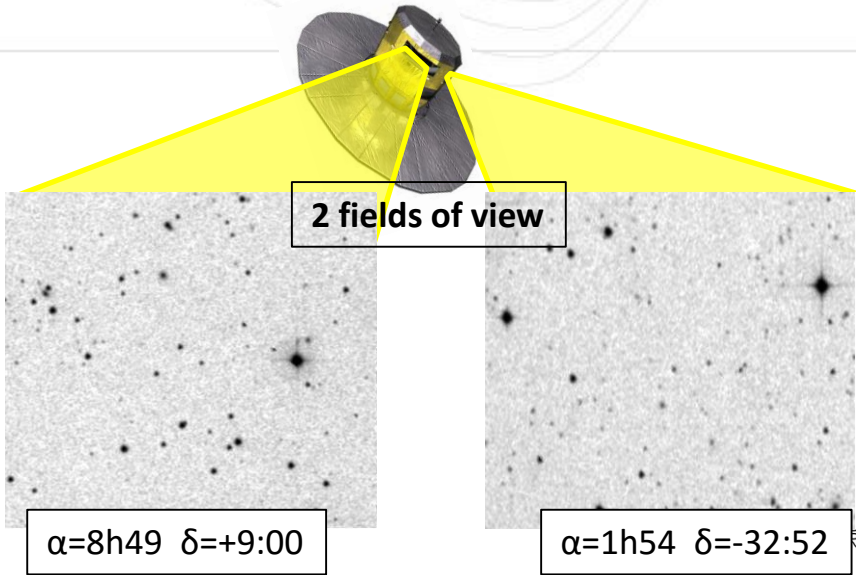
- $R = \lambda / \Delta\lambda = 11\,500$
- λ in [845, 872] nm
- Full sky survey Grvs < 16.2
- 40 epochs



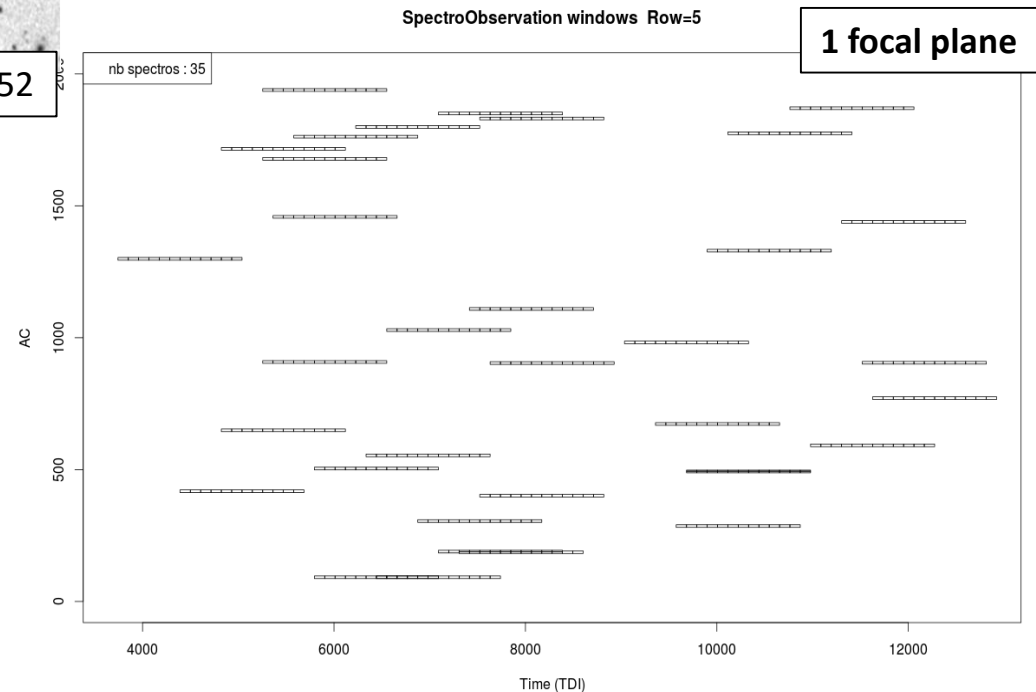
- **Integral field spectrograph**



29 May 2015 – 04:55 UTC



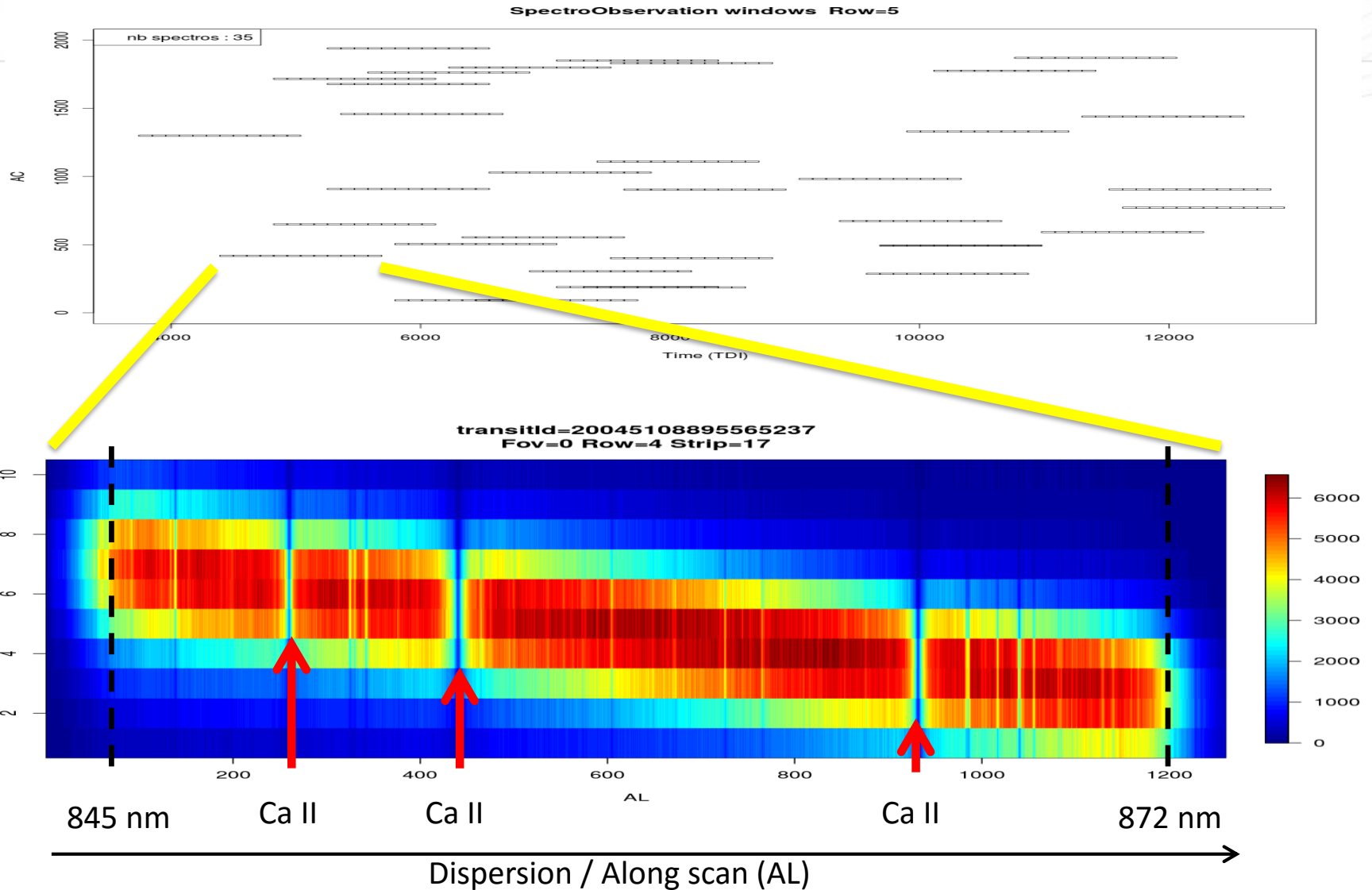
- All luminous sources produce a spectrum
- Convolved by spatial extension (non-pt-src)
- 2 fields of view imaged on a single focal plane



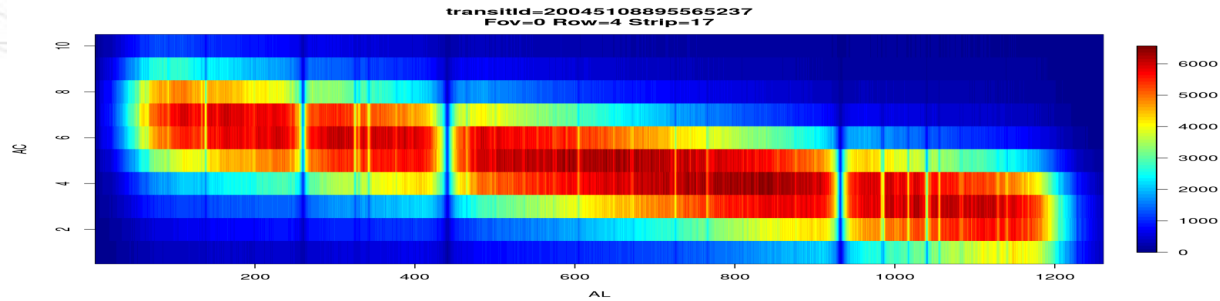
- Limited telemetry ($1.5 \cdot 10^6$ km to go)
- Windows allocated/read: Grvs < 16.2
- Neighbouring sources: window overlap
- Windows transmitted when ground contact

Focal plane reconstruction and image: **O. Marchal**

Raw spectrum

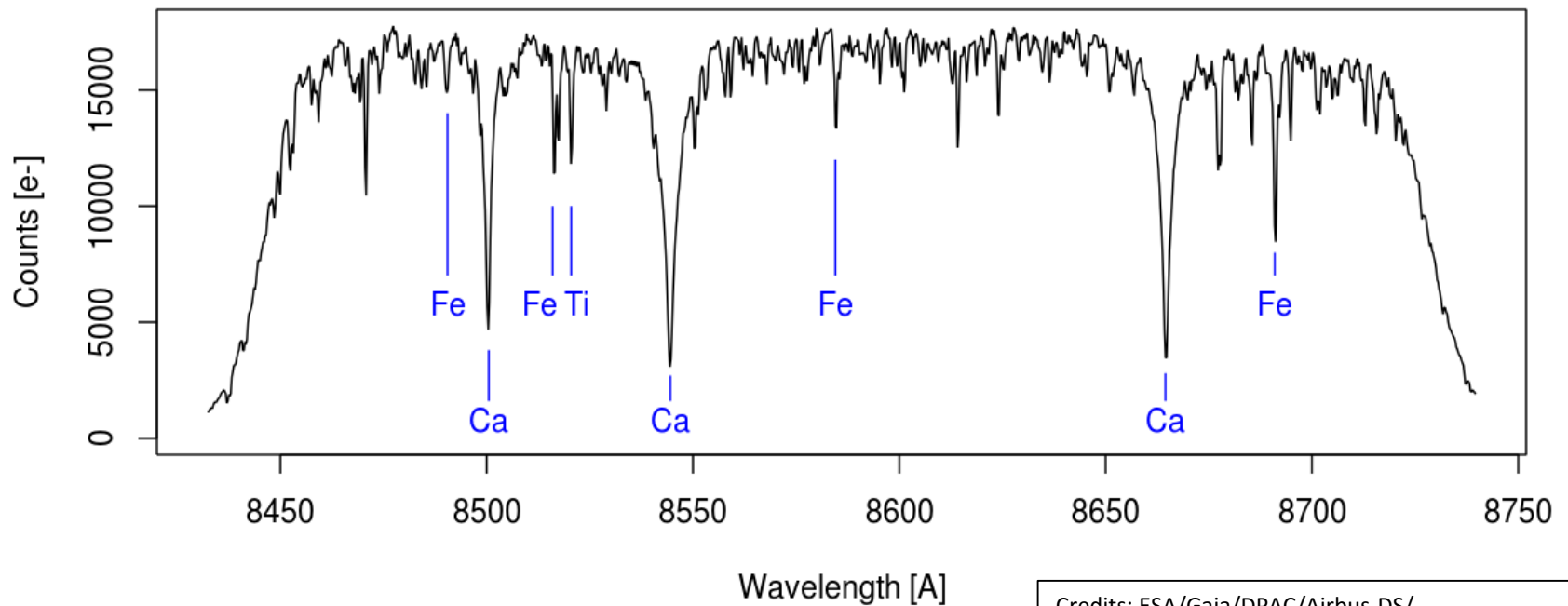


Extracted Spectrum

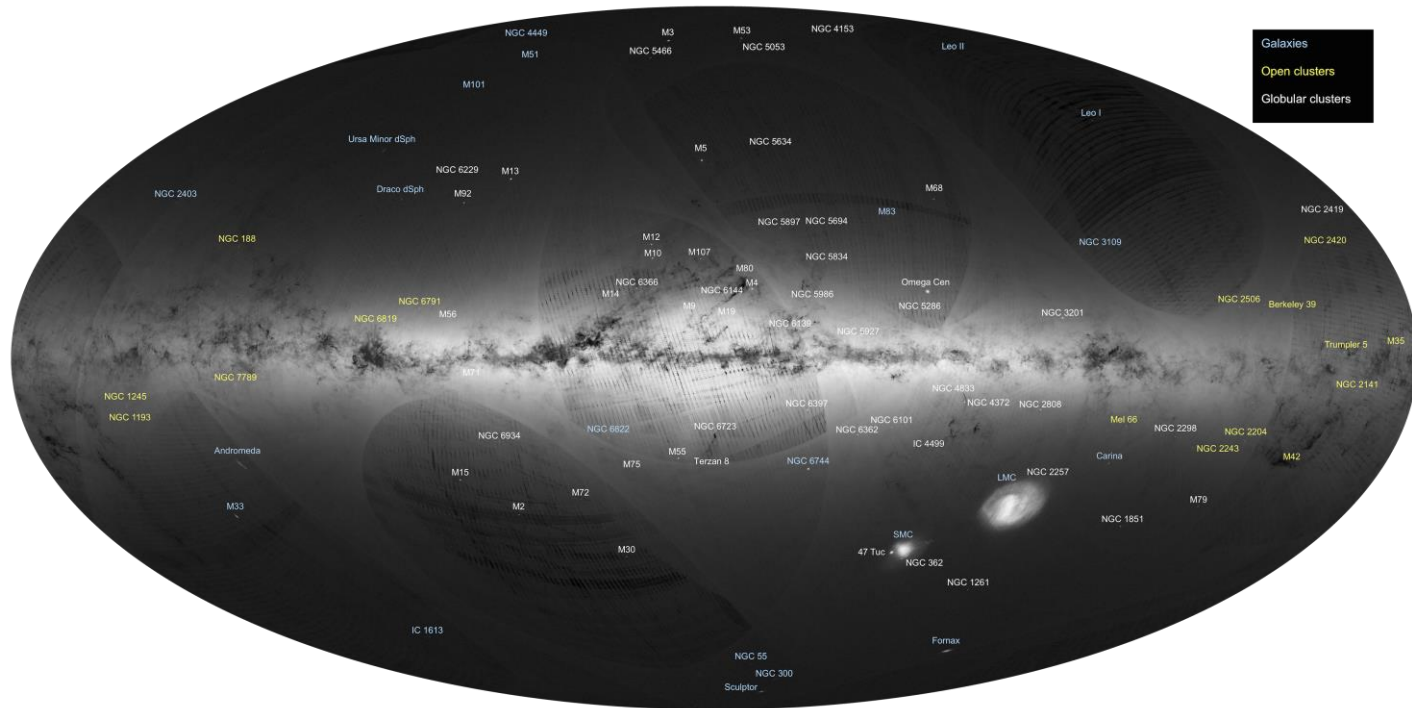


Gaia-RVS spectrum of HIP 86564

K5 V = 6.64

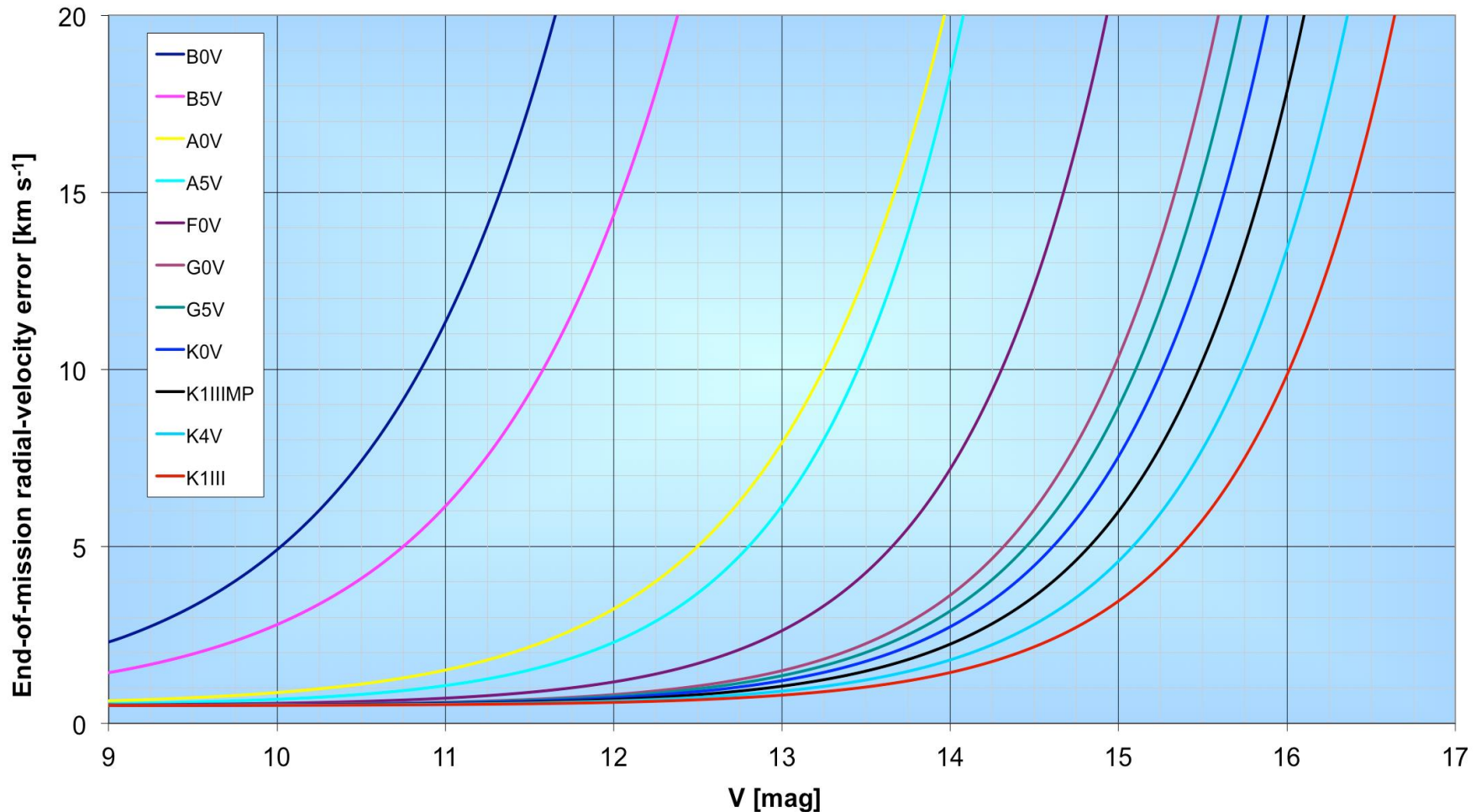


Credits: ESA/Gaia/DPAC/Airbus-DS/
David Katz, Olivier Marchal and Caroline Soubiran



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Radial velocities

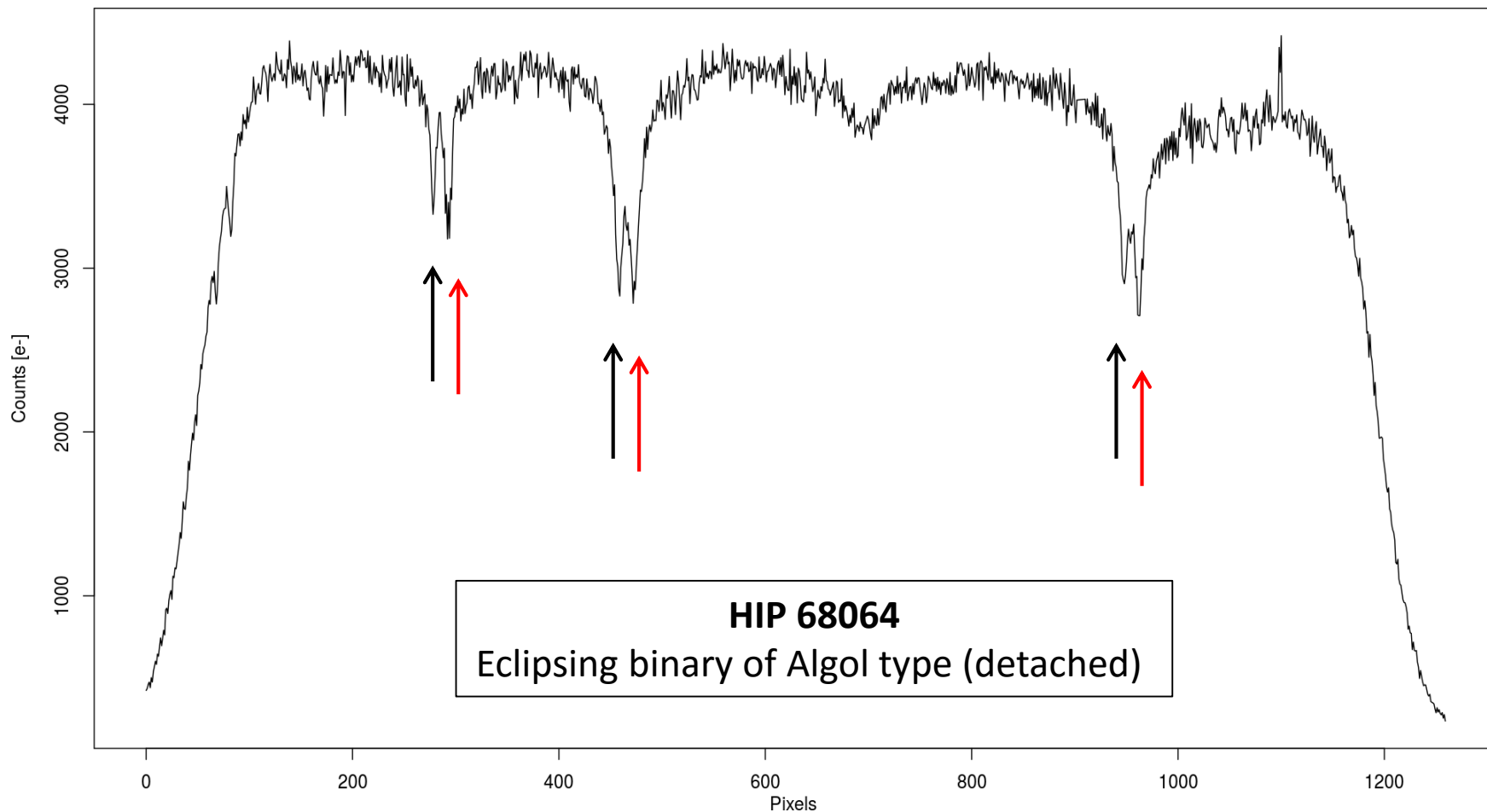


Bright stars:

- Pre-launch specification : 1 km/s
- Current precision : 0.5 km/s

Radial velocity: spectroscopic binaries (SB2)

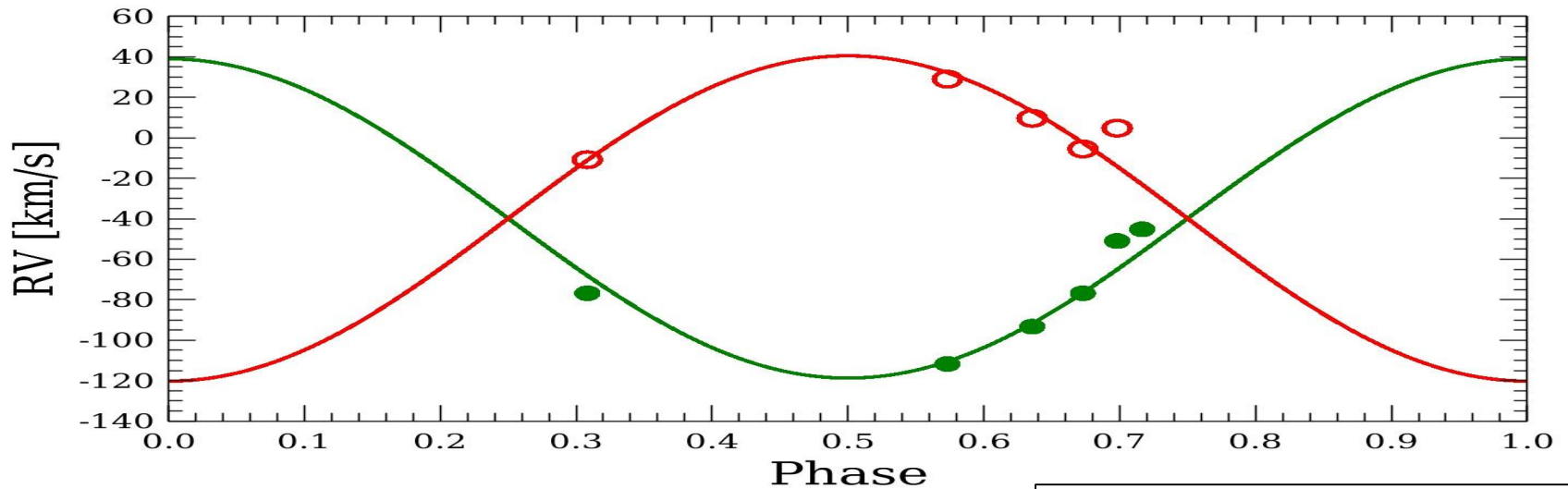
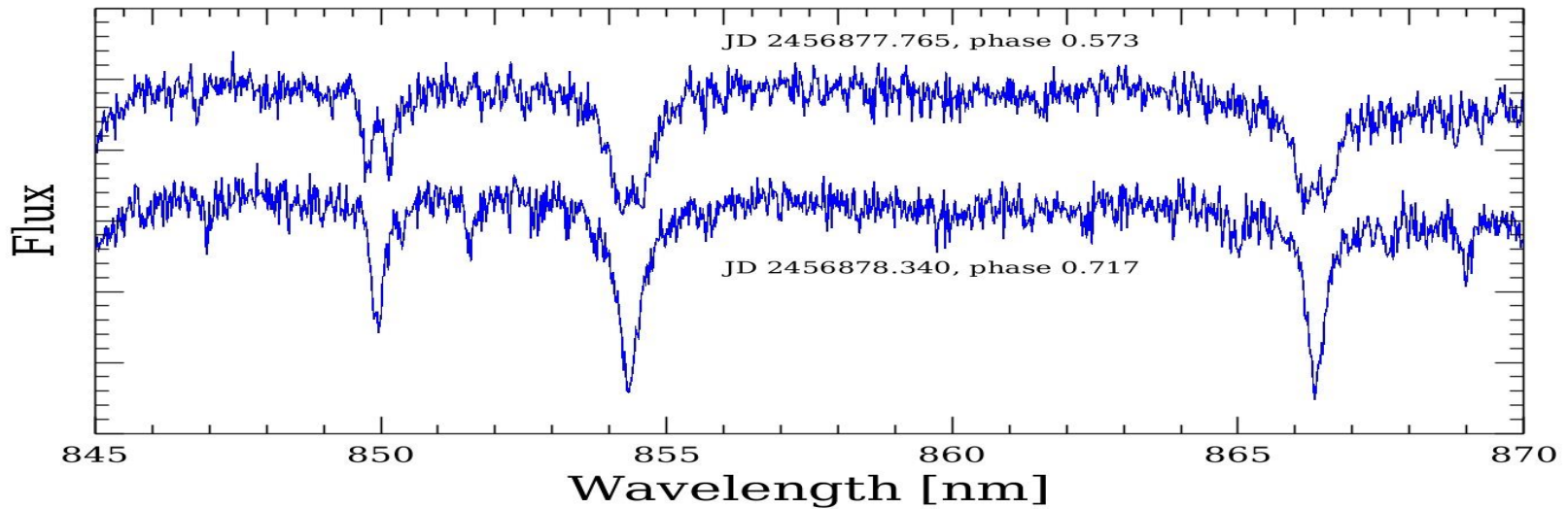
HIP 68064 (V=6.79)



credits: ESA/Gaia/DPAC/CU6/Observatoire de Paris-Meudon/Olivier Marchal & David Katz

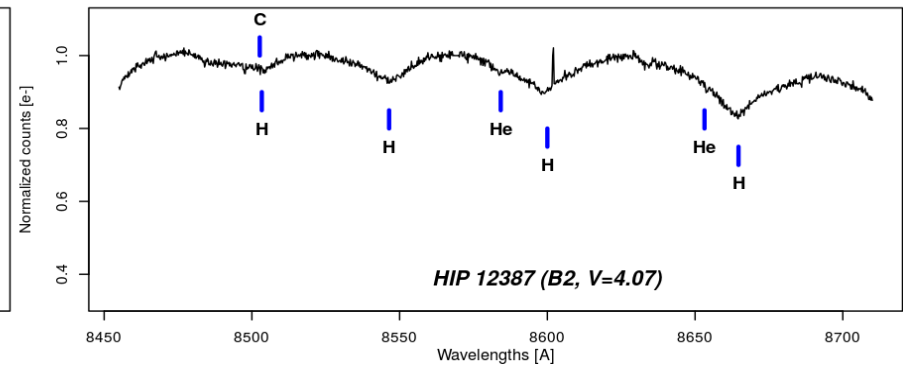
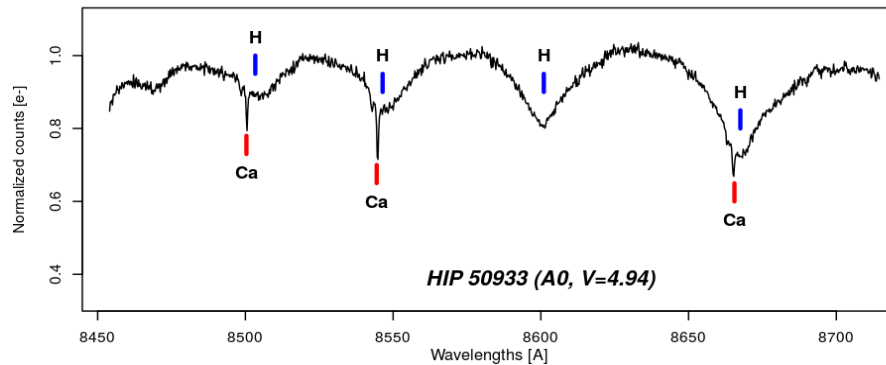
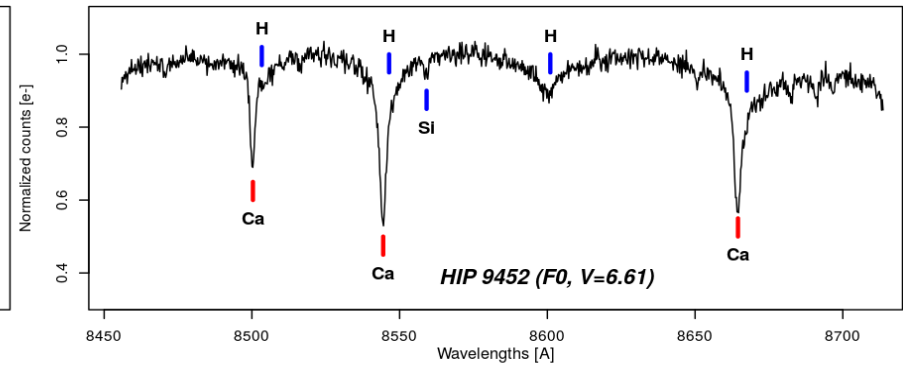
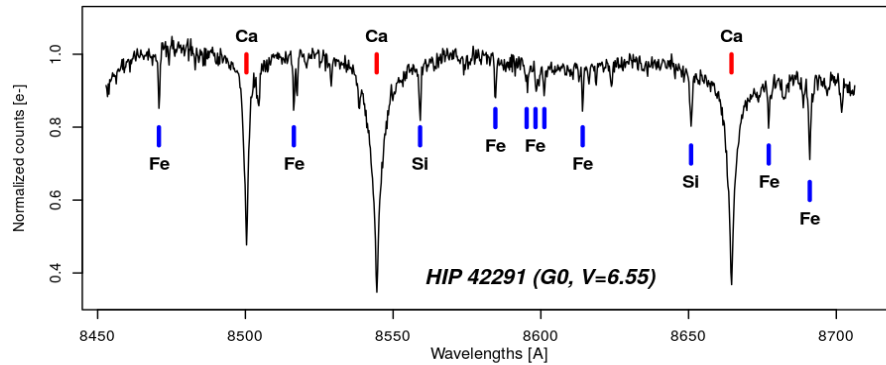
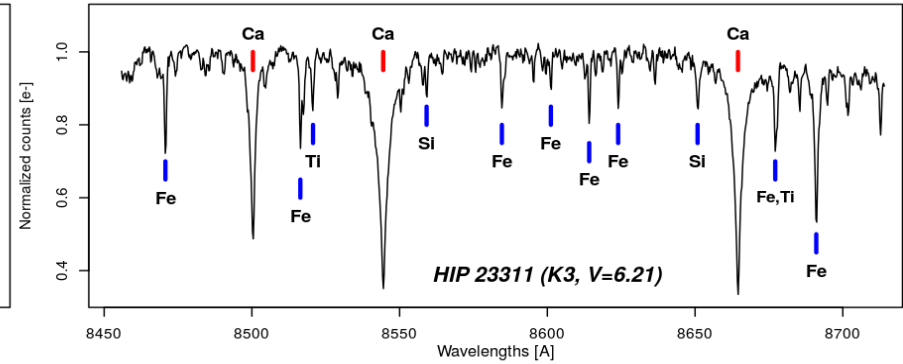
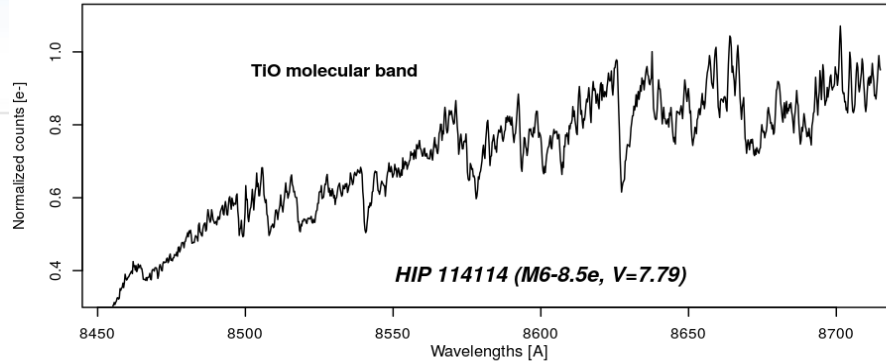
Radial velocities: spectroscopic binaries (SB2)

HIP 70674

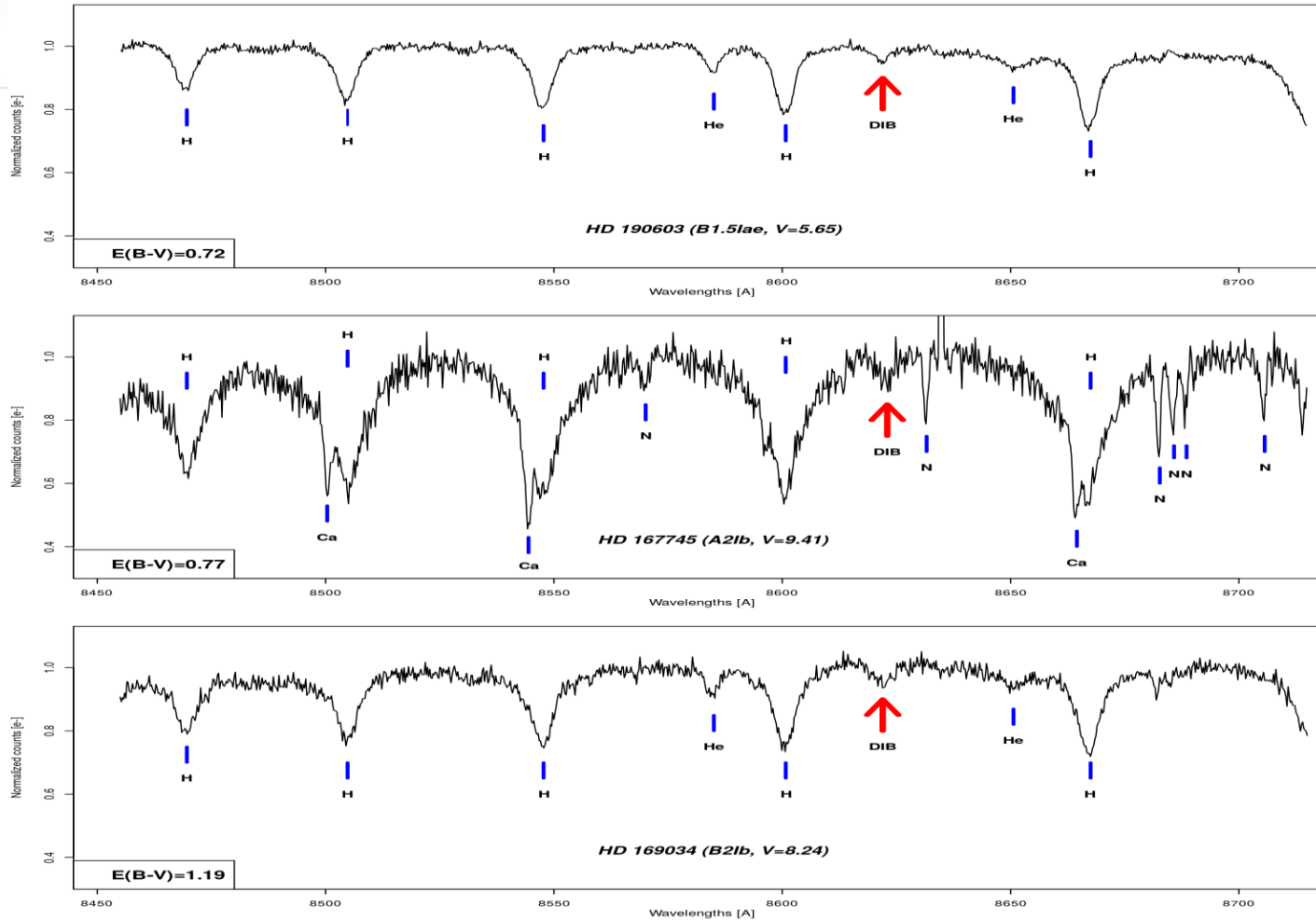


credits: ESA/Gaia/DPAC/CU6/Observatoire de Paris-Meudon/Yassine Damerджи & Pasquale Panuzzo

APs: Temperature, Metallicity, Chemistry, etc...



Interstellar reddening



RVS will contribute to the determination of the reddening down to $V \sim 12-13$

BP/RP will provide information for fainter targets

credits: ESA/Gaia/DPAC/CU6/Observatoire de Paris-Meudon/Olivier Marchal, Carine Babusiaux & David Katz

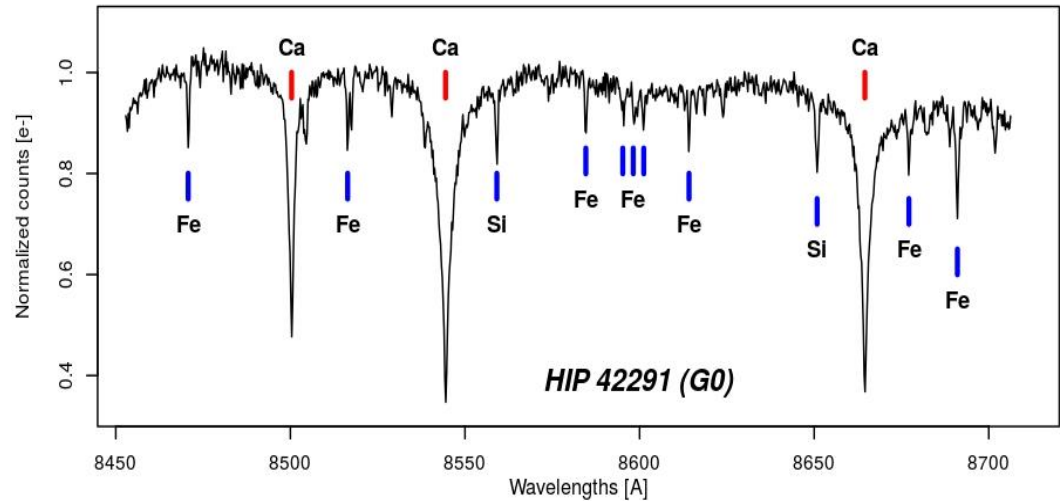
Diffuse Interstellar Band(DIB): 8620 Å

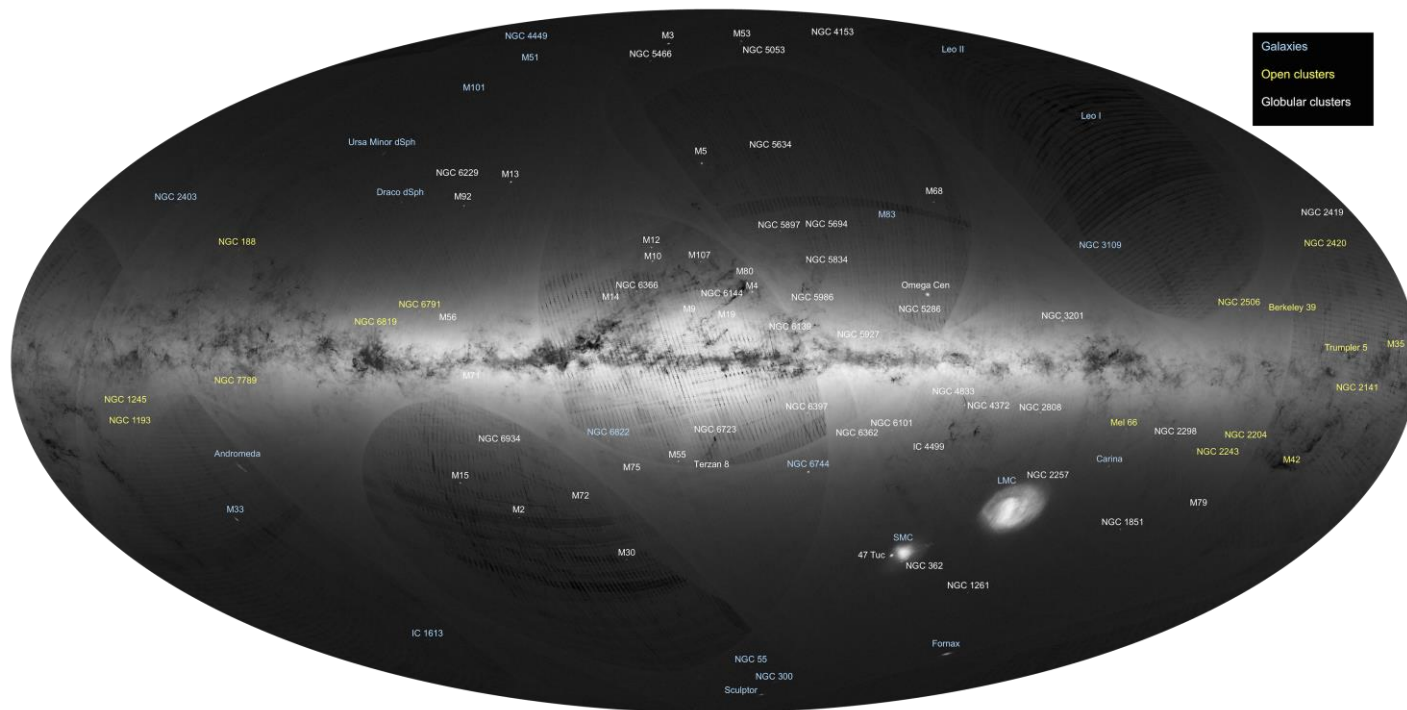
Correlates with E(B-V): $E(B-V) = 2.72 \times EW$ (Ång)

Munari, Tomasella, Fiorucci et al., 2008, A&A, 488, 969

Additional scientific content ...

- Projected rotational velocity ($v \sin i$)
- Emission lines stars
- Variable stars
- Etc...





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3. RVS data processing: to DR2 and beyond

On-ground processing



Deep space radio antenna
at Malargüe (Argentina)
Credits ESA – S. Marti

- Start of routine phase 25 July 2014
- First 2.5 years mission **10 billions** RVS spectra

**Data Processing and
Analysis Consortium
(DPAC)**

Coordination Unit 3: Core proc.

- Initial data treatments
- Satellite attitude
- Astrometry

Coordination Unit 6: Spectroscopic processing

- RVS calibration
- Spectra extraction & cleaning
- Derivation: V_r , $v \sin i$, binarity, variability

**Management
Observatoire de Paris – GEPI
since 2001**

Coordination Unit 4: Object proc.

- Multiple stars

Coordination Unit 7: Variability

- Variable stars

Coordination Unit 8:

Astrophysical parameters

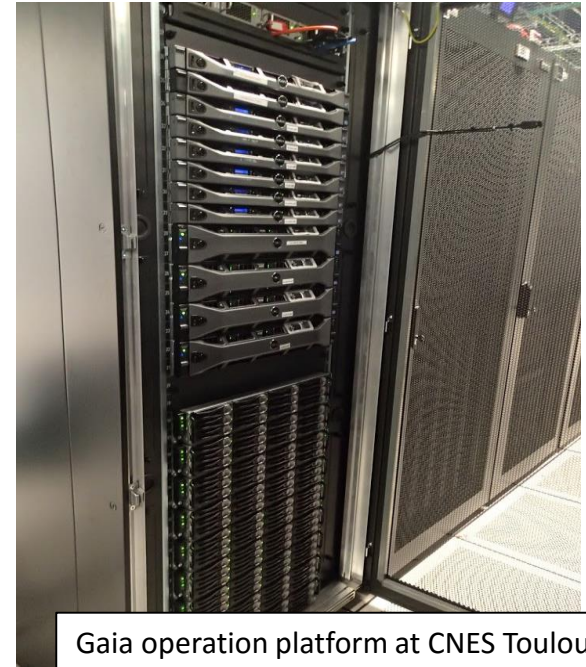
- APs: T_{eff} , \log , $[\text{Fe}/\text{H}]$, $[\text{X}/\text{Fe}]$

Coordination Unit 9: Catalogue access

- Data validation

CU6 processing overview

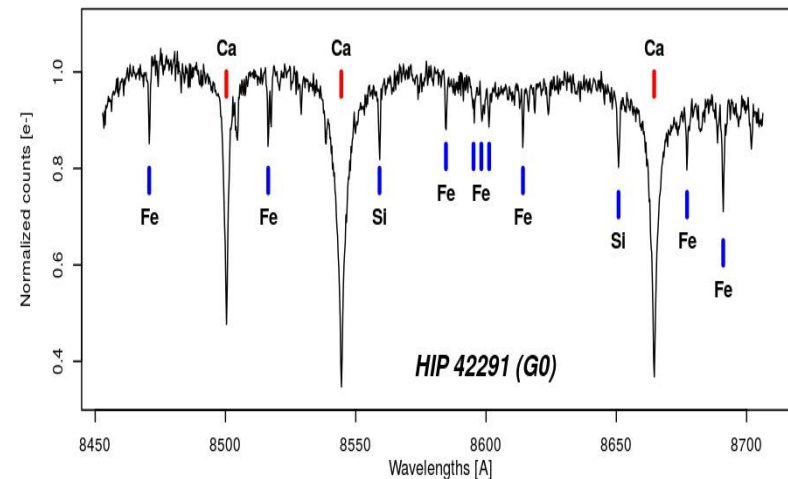
- Software developed in Observatoire de Paris – GEPI and partner institutes: MSSL, Brussels, Liège, AIP and Geneva.
- Software integrated in CNES Toulouse, where the data are processed:
 - Daily pipeline
 - Global pipeline
- Daily pipeline
 - Regular detailed check of the RVS good health
 - Early instrument calibrations
 - Experiment new functionalities
 - Regular runs on small data volume (24h / run)
- Global pipeline
 - Produce **data release** content
 - Robust and stable version of the module
 - Global (re-)processing on large data volume: **14 months data in DR2**



Gaia operation platform at CNES Toulouse
87 servers - 2016 cores

CU6 processing status and DR2

- Daily processing
 - commissioning phase in 2015
 - nominal "routine" processing since January 2016
 - about **200 nominal runs**
 - about **1 to 1.5 millions** spectra processed per run: Grvs < 14
 - about **300 000 to 500 000 Vr** derived per run
 - about **250 millions** spectra processed since January 2016
- Global processing: **data release 2**
 - Limiting magnitude: Grvs = 12
 - un-truncated spectra
 - "non-variable" stars
 - **15 millions** spectra processed during the summer
 - **1 million** mean radial velocities derived
 - DR2: **14 months long**
 - **3 to 5 millions** mean radial velocities expected
 - For comparison: RAVE DR5 520 000 spectra & 460 000 stars



Beyond DR2...

- Global processing: data release 3 (2018)
 - Limiting magnitude Grvs = 14
 - Truncated spectra
 - Refined calibration model (PSF)
 - 30 to 50 millions mean Vr expected
- Global processing: final release
 - 100 millions mean Vr expected
 - Several 100 millions individual Vr expected

