

Gaia Data Release 3

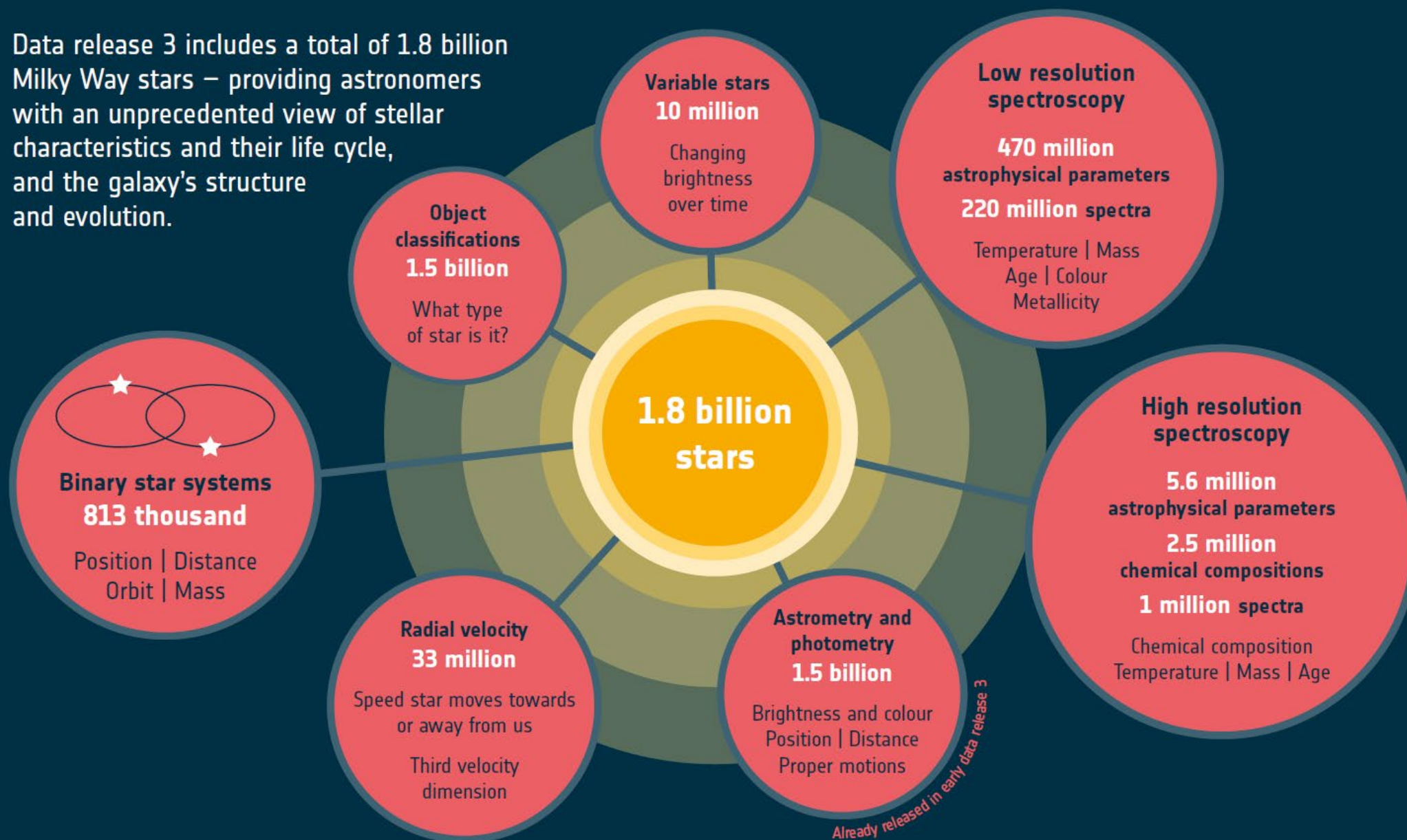
Gaia spectrophotometry

J.M. Carrasco en nombre
del equipo Gaia-UB

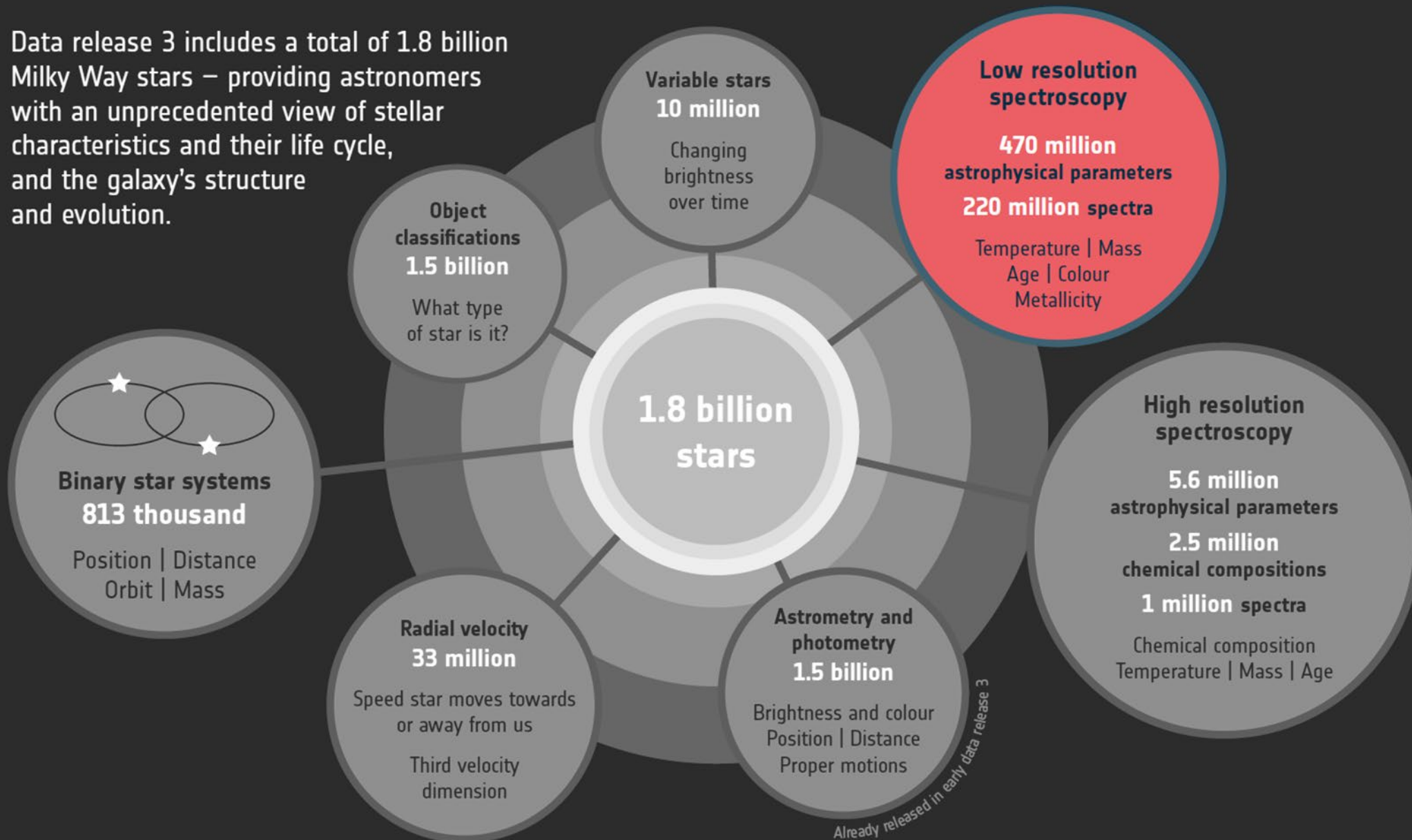
Airbus Space

ESA/Gaia/DPAC

Data release 3 includes a total of 1.8 billion Milky Way stars – providing astronomers with an unprecedented view of stellar characteristics and their life cycle, and the galaxy's structure and evolution.



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DR3 XP SPECTRA (cosmos.esa.int/web/gaia/dr3)



219,197,643 sources:

= $G < 17.65$ mag with $N_{\text{transits}} > 15$

- poor SSCs excluded

- 35K sources excluded needing extra processing

+ 500 sources used for calibration

+ 100K WD candidates

+ 100K QSOs

+ 17K galaxies

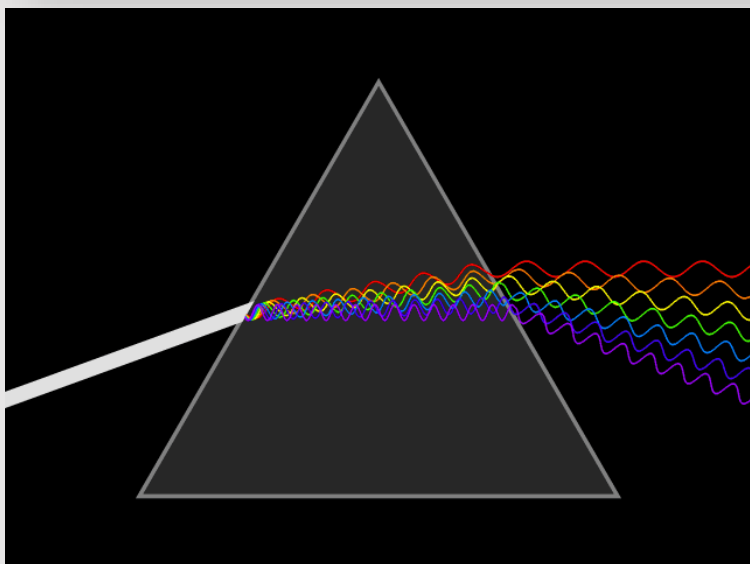
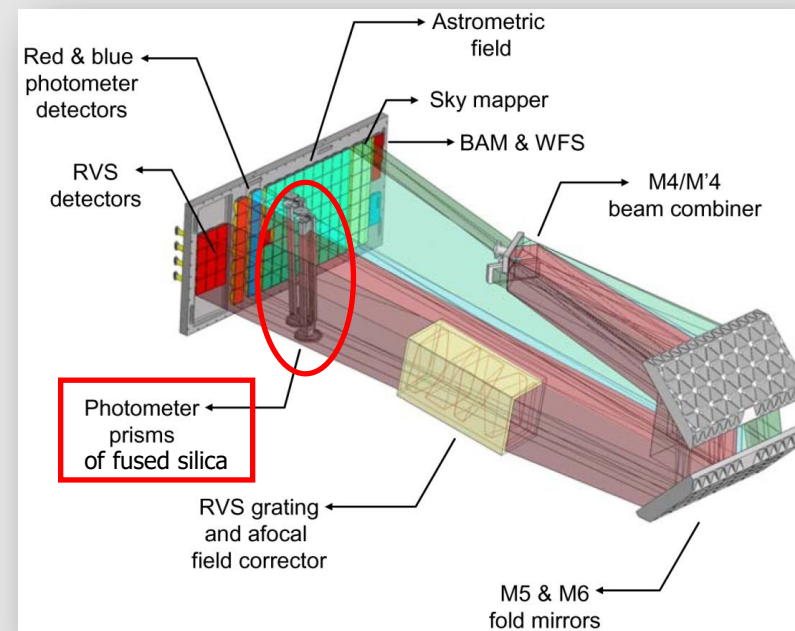
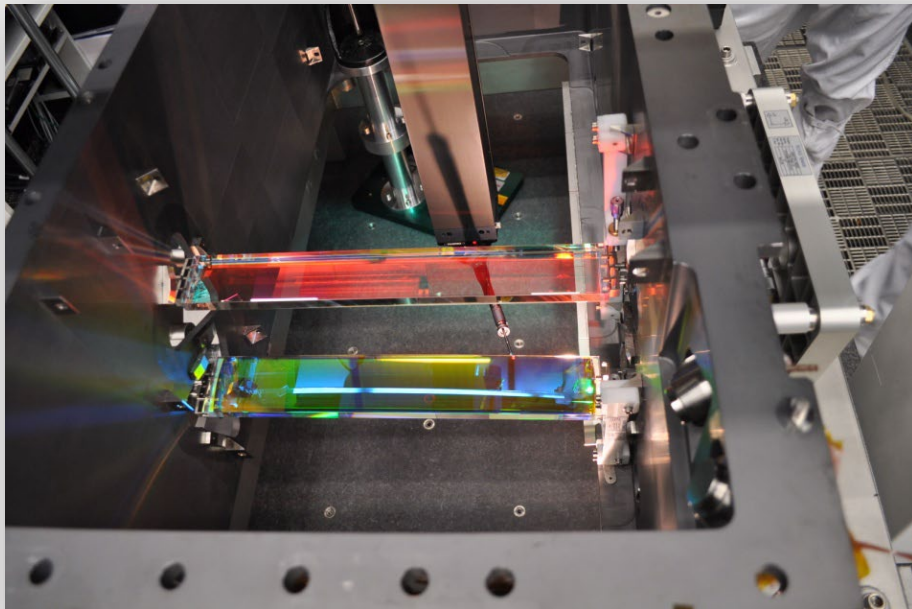
+ 19K Ultracool dwarfs

+ 900 sources representative of SOM neurons used by
Outlier Analysis

Gaia DR3 5405570973190252288 has only RP spectrum (not BP)

De Angelis et al (2022)

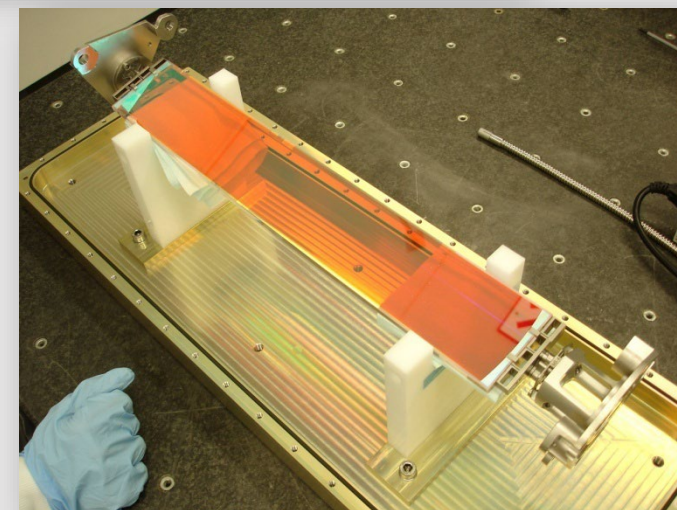
BP/RP SPECTROPHOTOMETERS



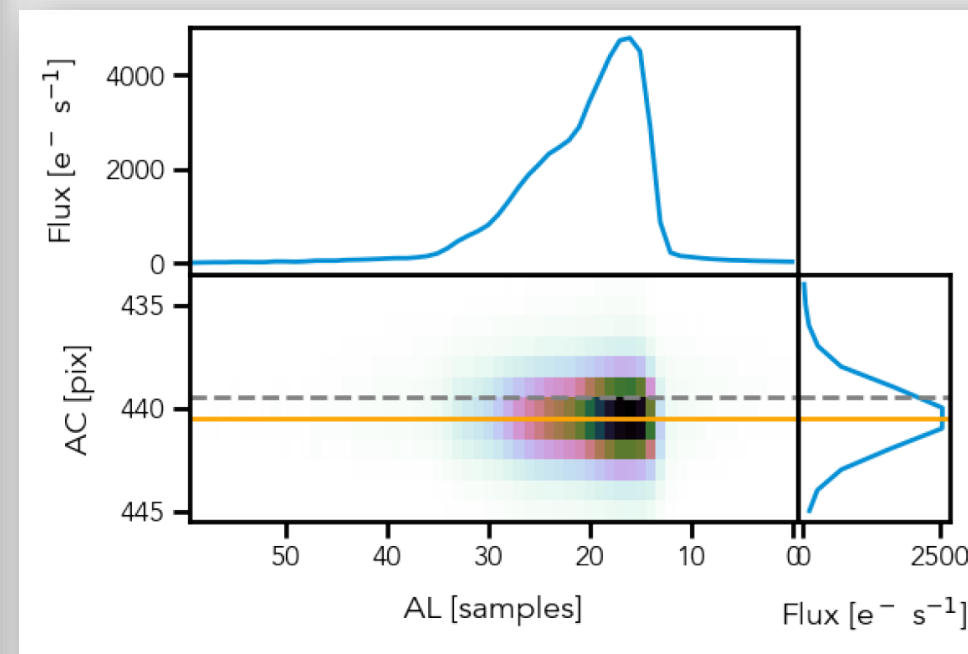
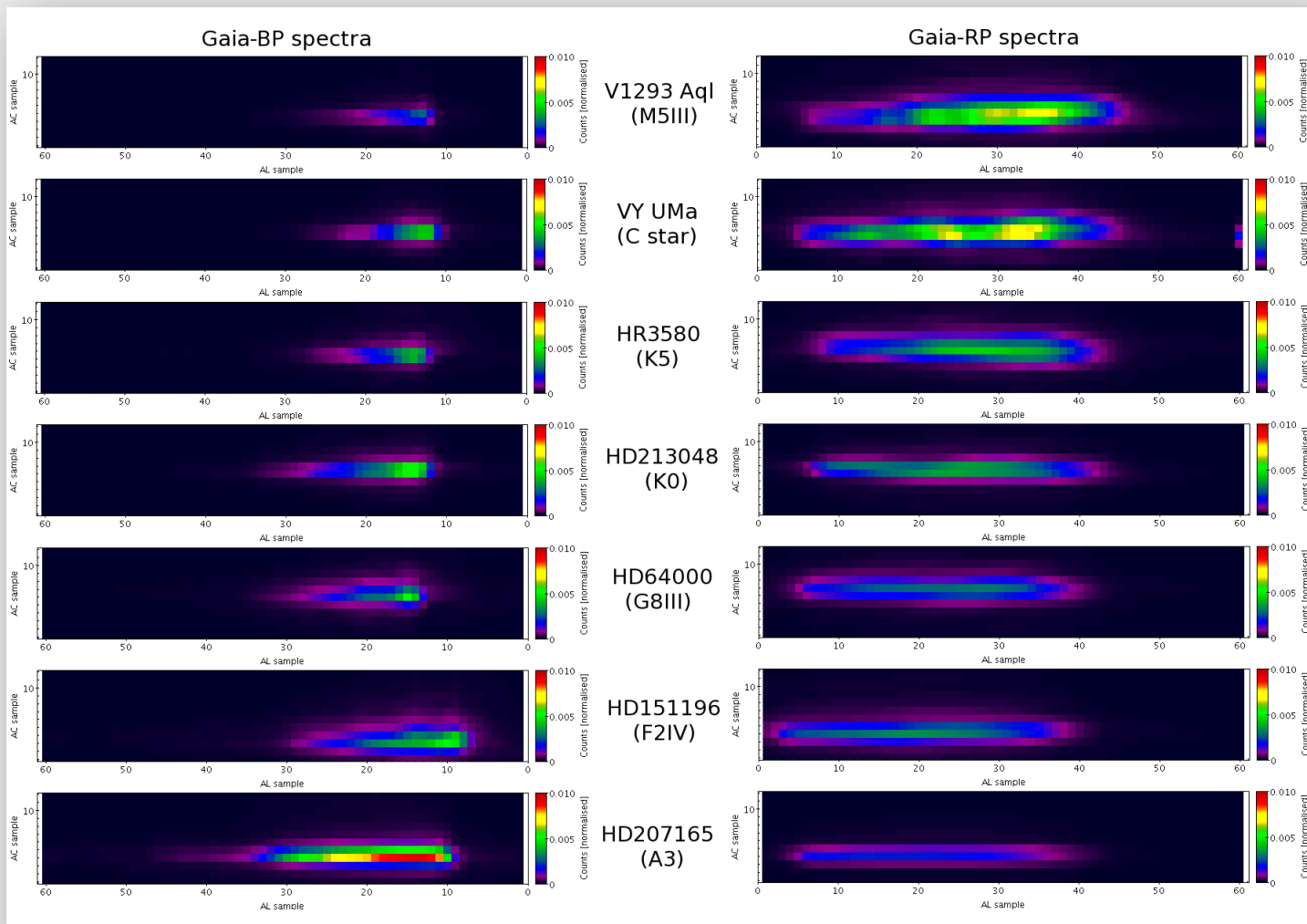
Figures courtesy of EADS-Astrium

Blue (BP):
330–680 nm

Red (RP):
640–1000 nm



FROM 2D TO 1D SPECTRA



INTERNAL & EXTERNAL XP SPECTRA

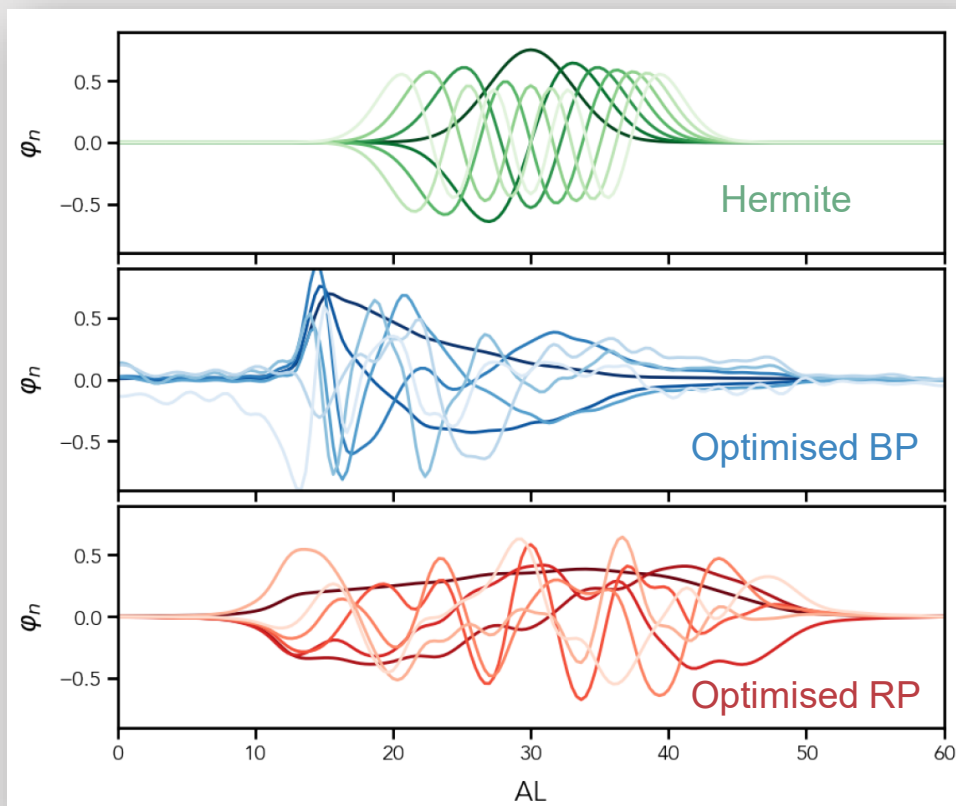


DESCRIBED AS A SET OF COEFFICIENTS

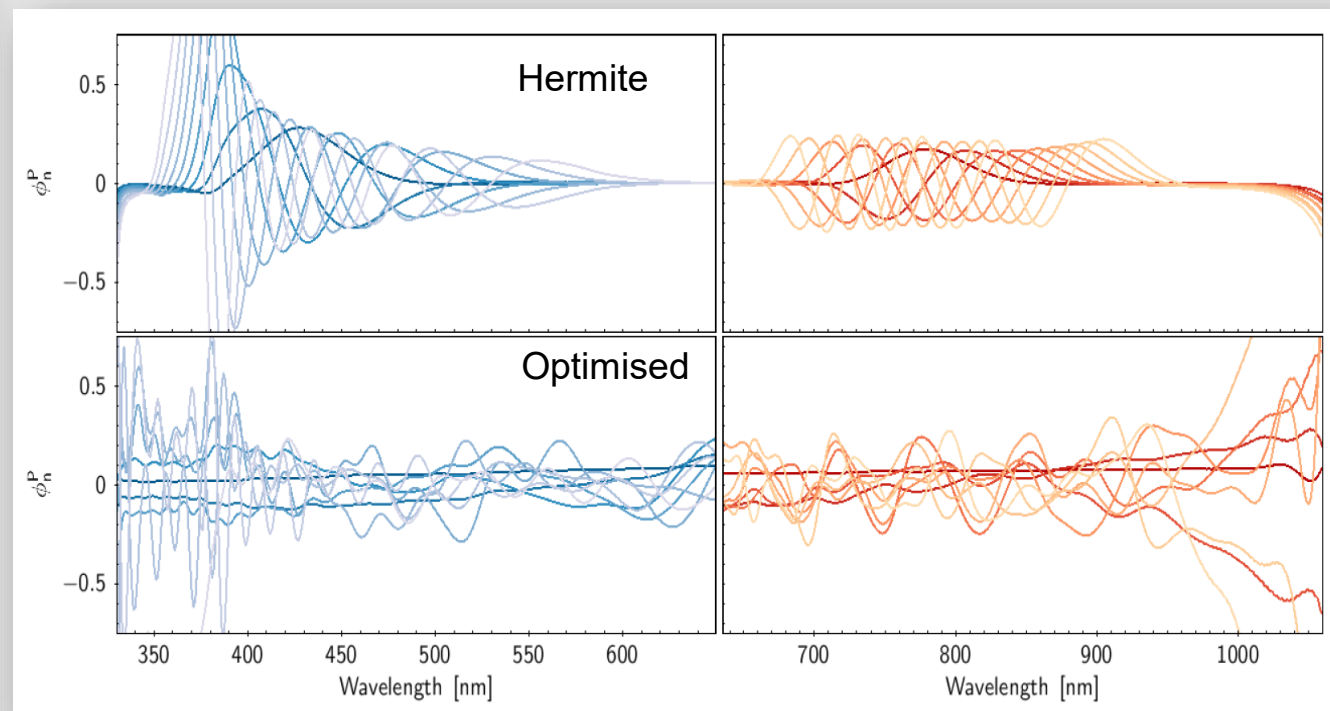
Same coefficients describe internal and external spectra using different basis functions

$$h_{s\mu}(u) = \sum_{n=0}^N b_{sn} \cdot \varphi_n(u)$$

Internal basis

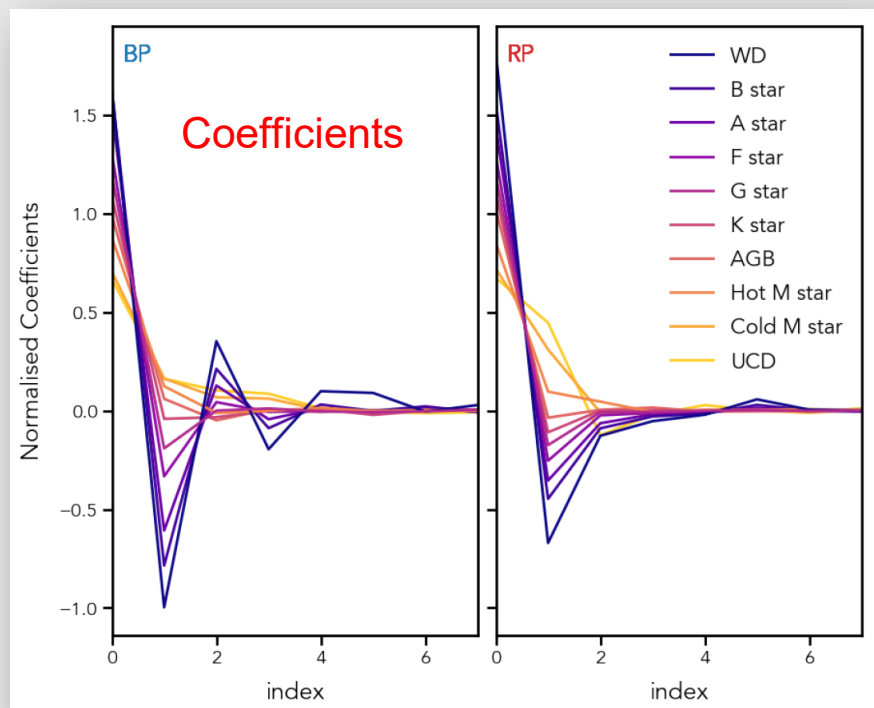


External basis

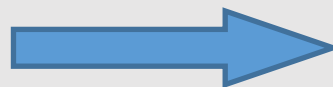


USE THE COEFFICIENTS!

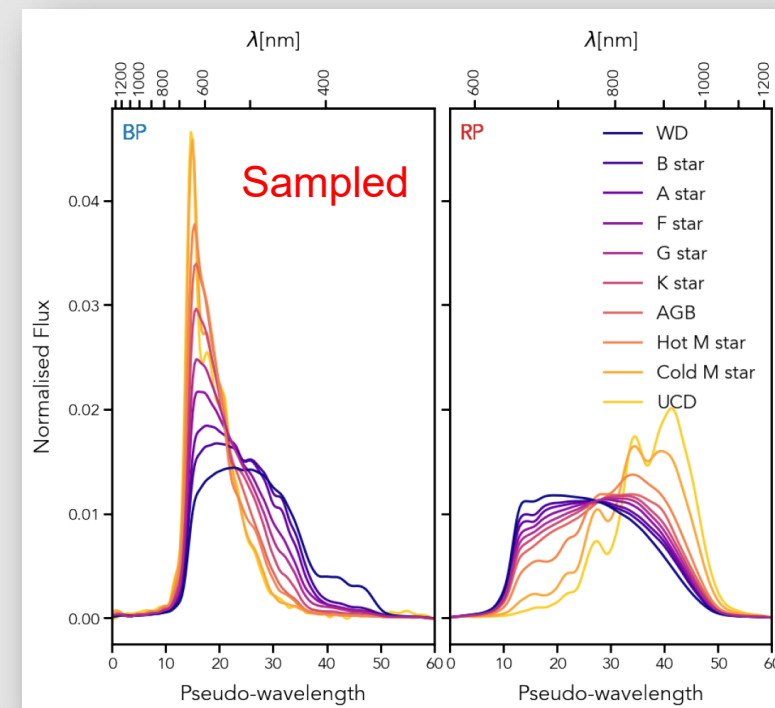
- All the information is contained in the source coefficients.
- Sampling spectra or deriving synthetic photometry implies information losses (and more correlations).
- Users are encouraged to use coefficients to derive astrophysical parameters or detect spectral features.



$$h_{s\mu}(u) = \sum_{n=0}^N b_{sn} \cdot \varphi_n(u)$$



De Angeli et al (2022)

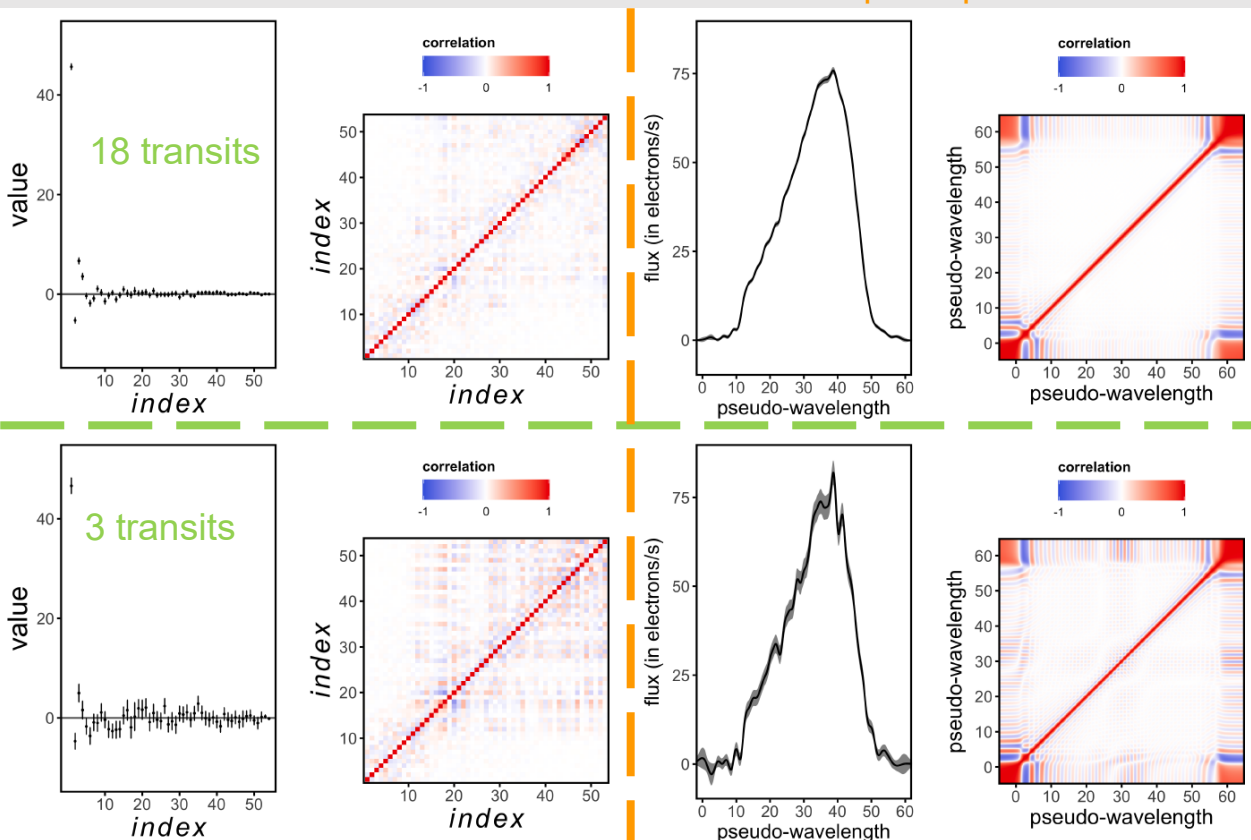


USE THE COEFFICIENTS!

When sampling the spectra from the source coefficients, more correlations are present.

Coefficients

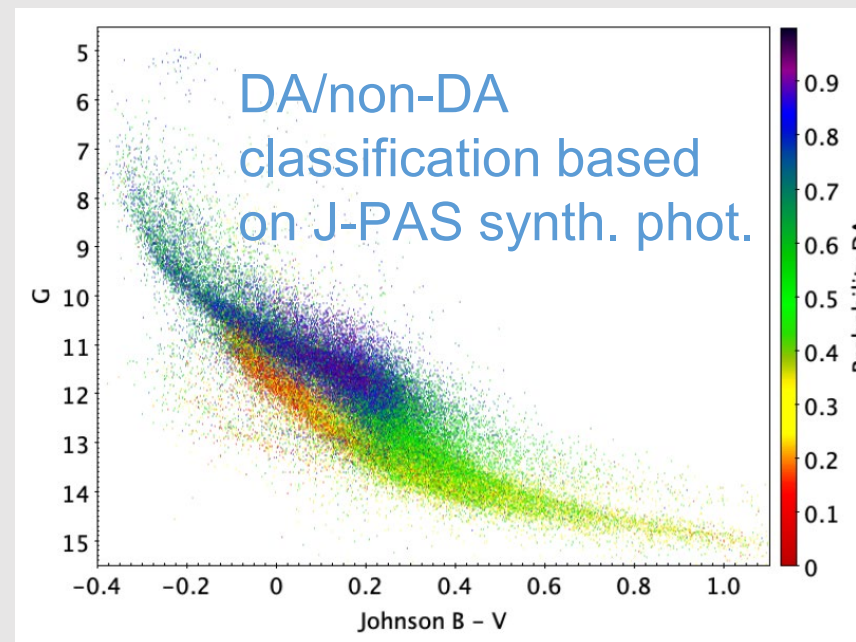
Sampled spectra



Synthetic photometry also loses (even more) information.

Input	$x = 0.5$	$x = 0.6$	$x = 0.7$
SDSS	2.45	0.86	0.30
J-PLUS	1.43	0.55	0.27
J-PAS	0.77	0.26	0.11
Source coefficients	0.50	0.15	0.03

% of non-DA sources with $P_{DA} > x$

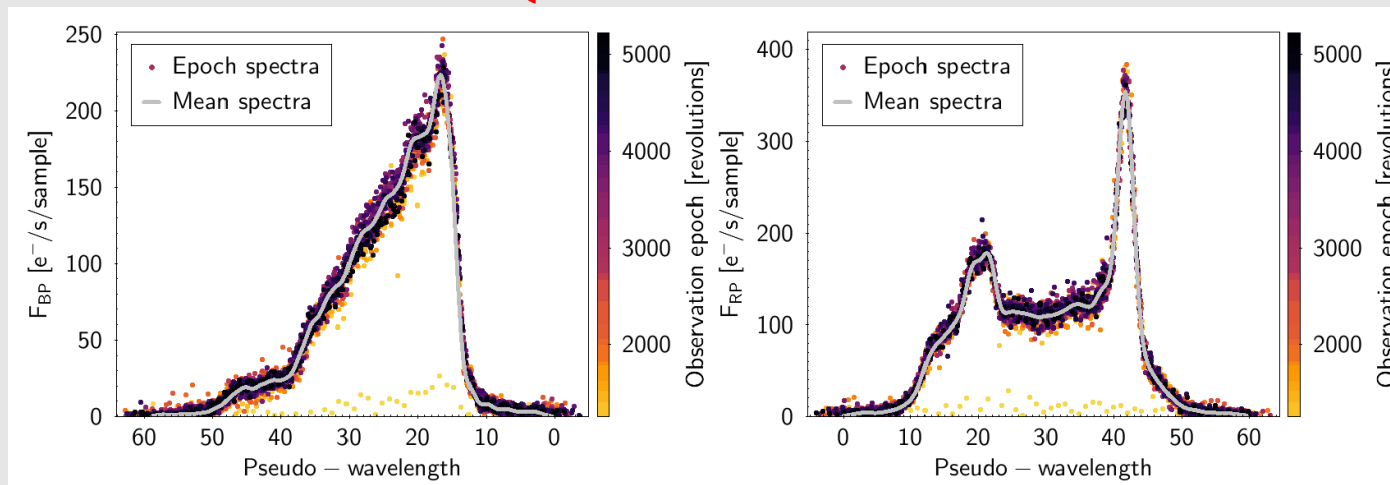


$G = 17.89$ mag, $G_{BP} - G_{RP} = 2.74$ mag De Angeli et al (2022)

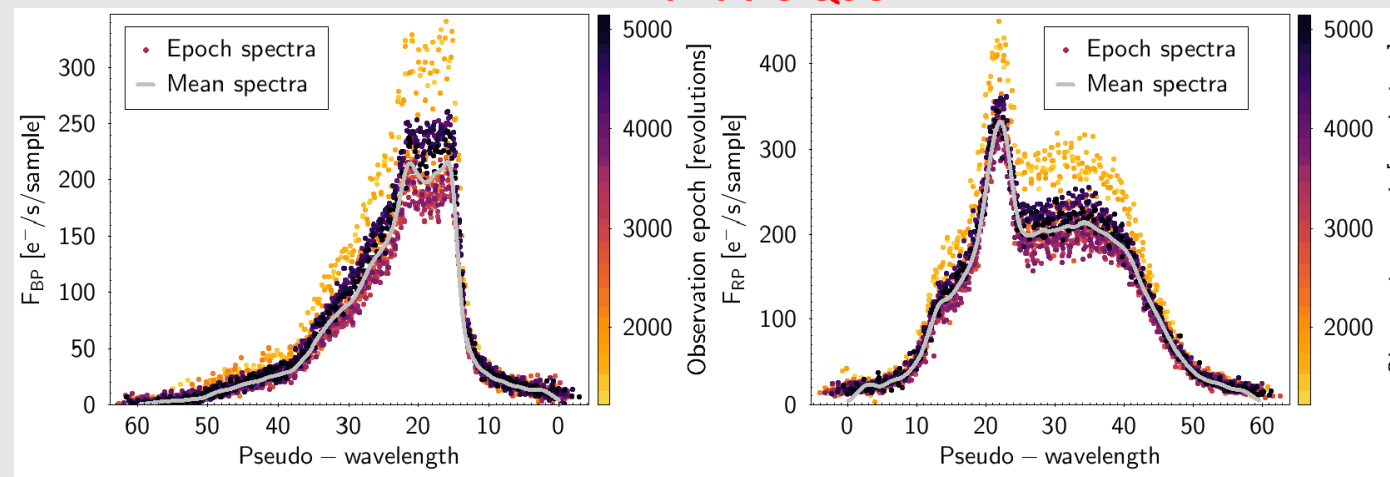
Montegriffo et al (2022)

SPECTRAL FEATURES IN XP SPECTRA

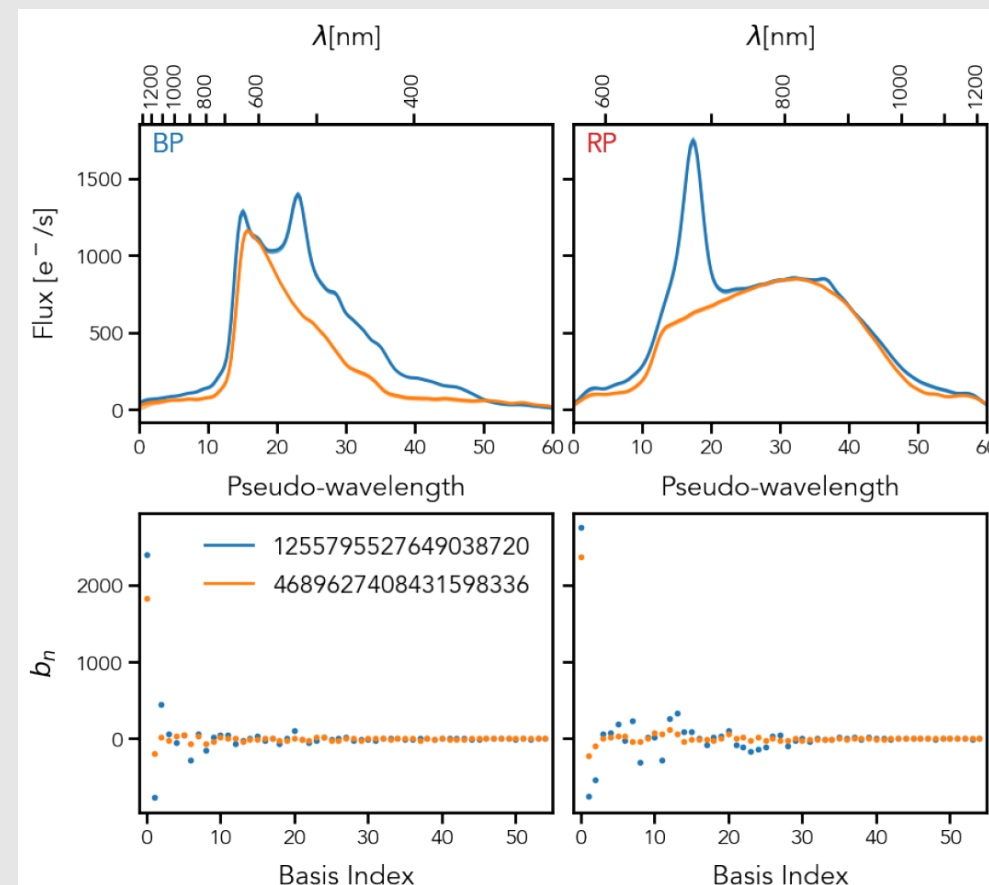
QSO from Gaia-CRF



Variable QSO

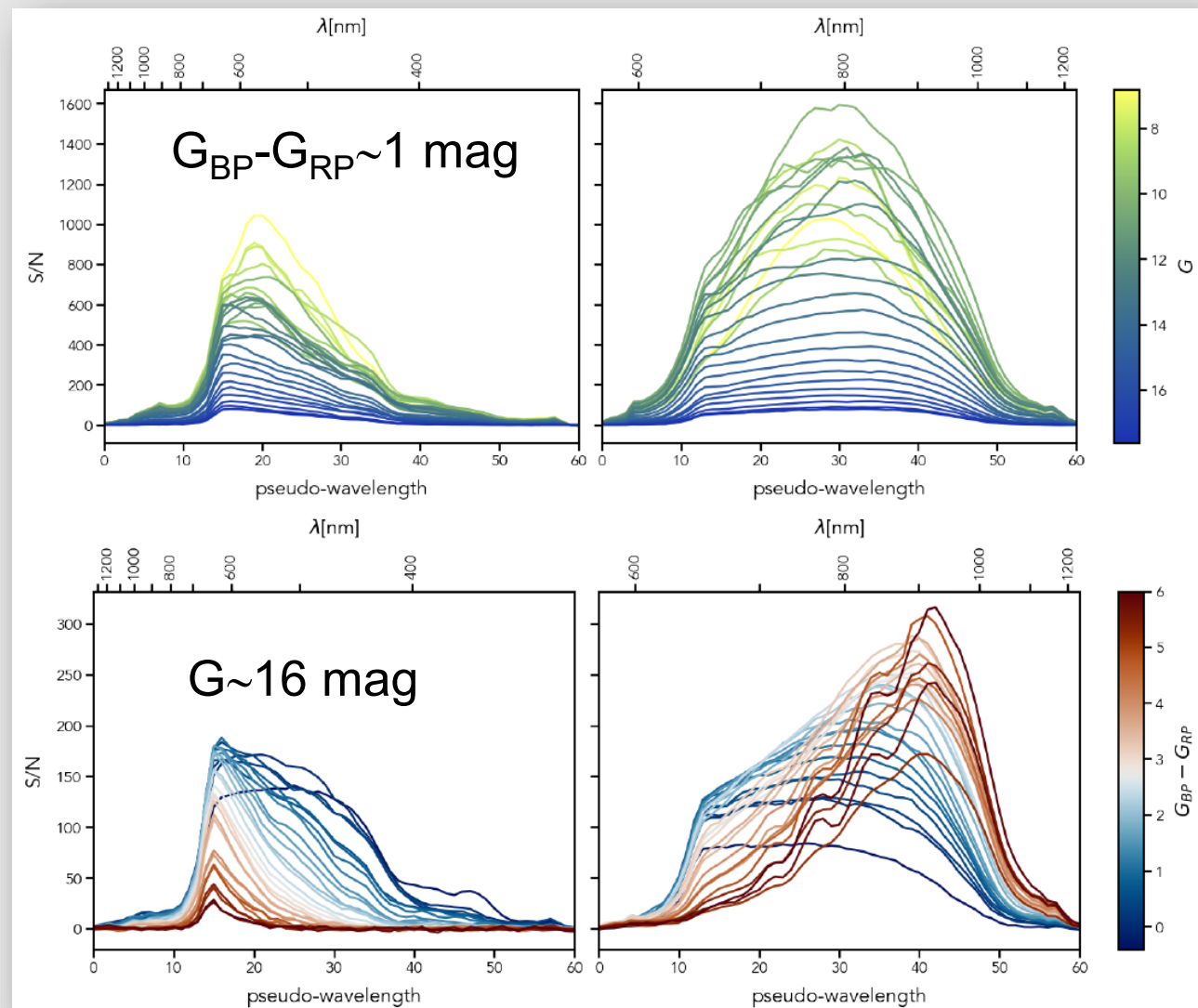
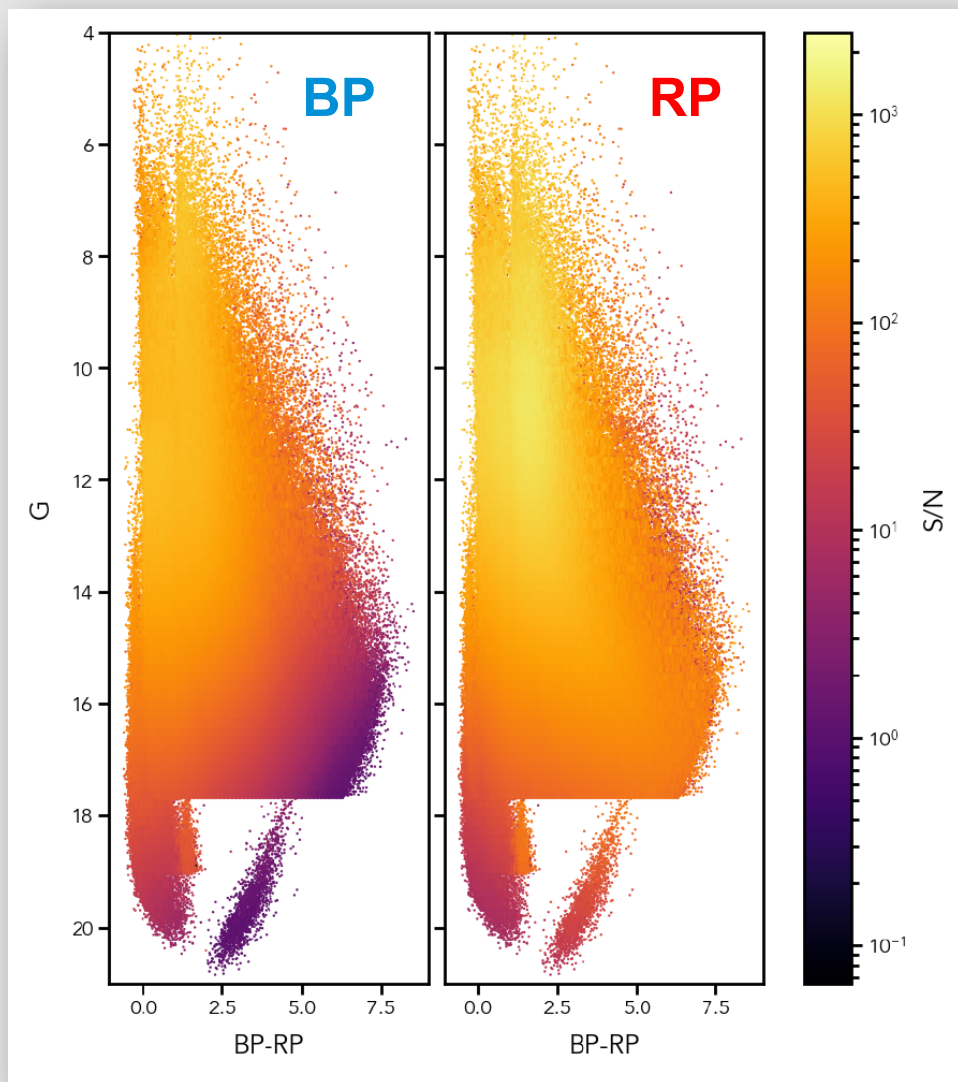


QSO from Gaia-CRF

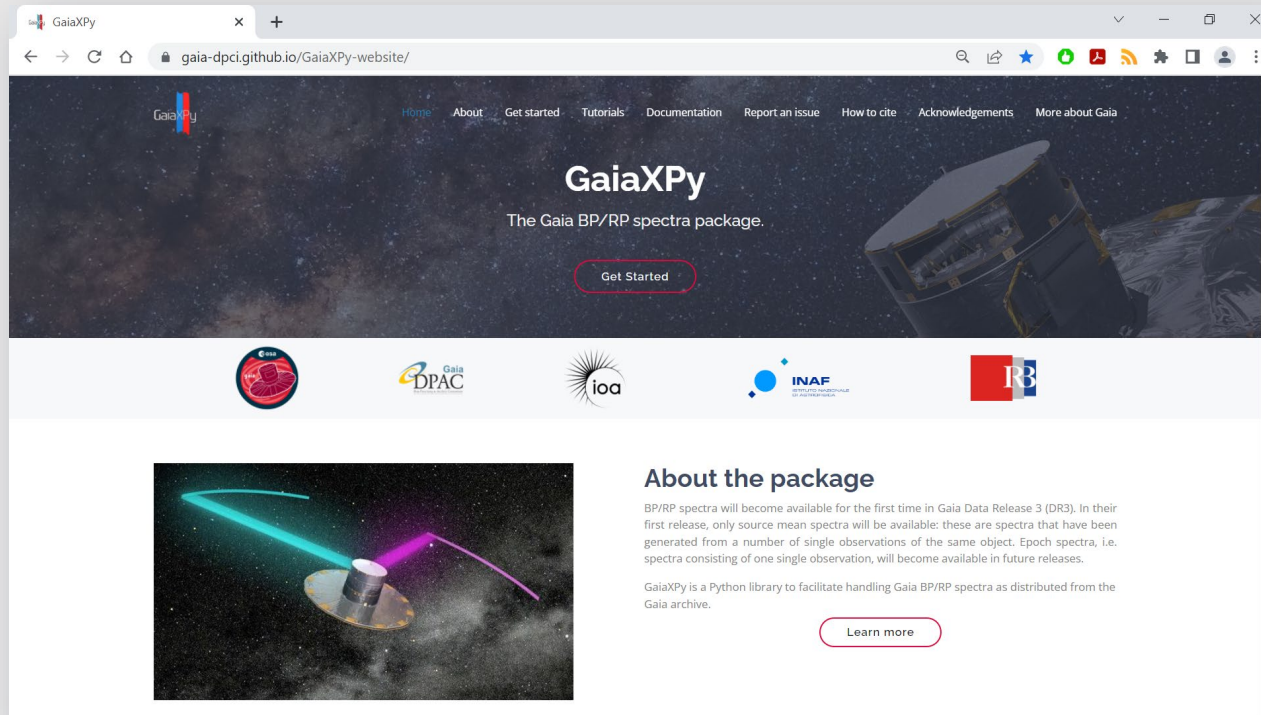


SIGNAL-TO-NOISE RATIO

De Angeli et al (2022)



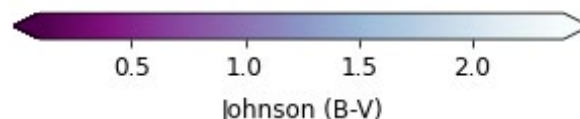
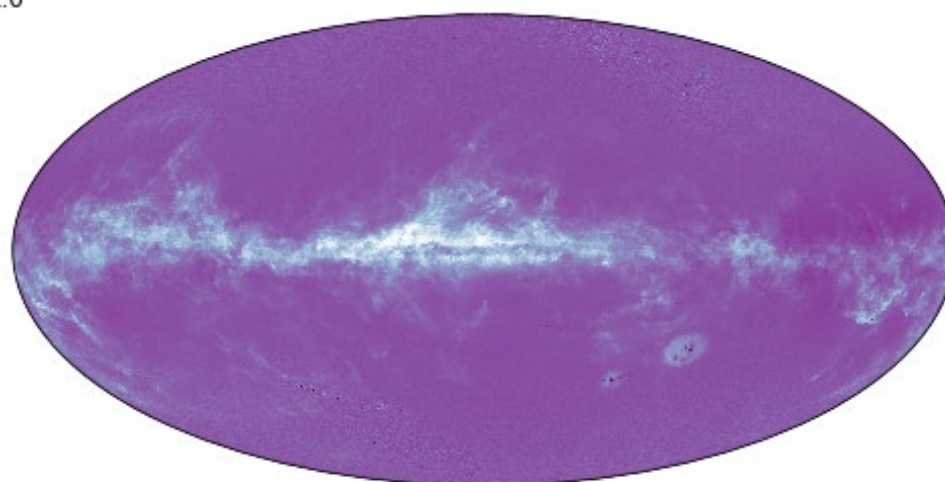
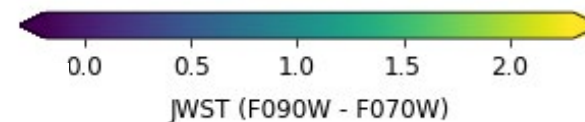
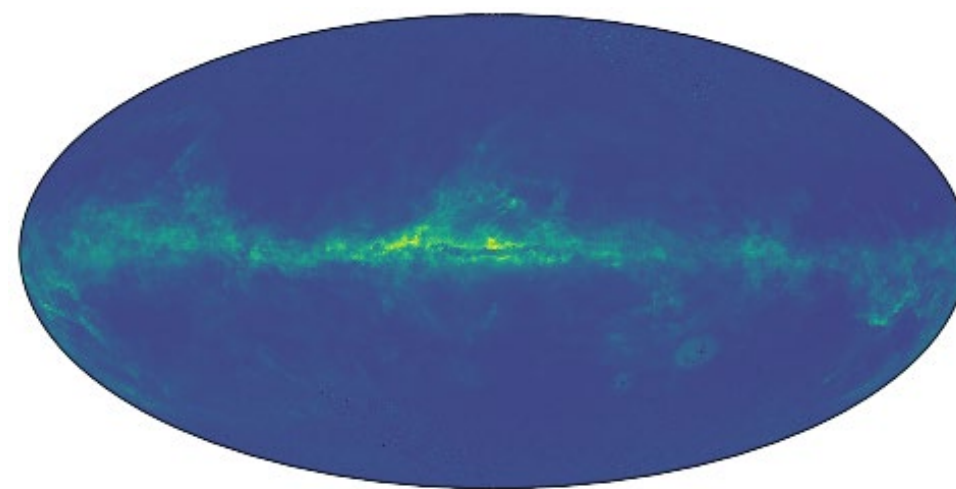
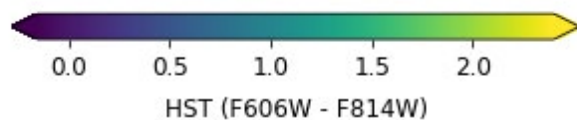
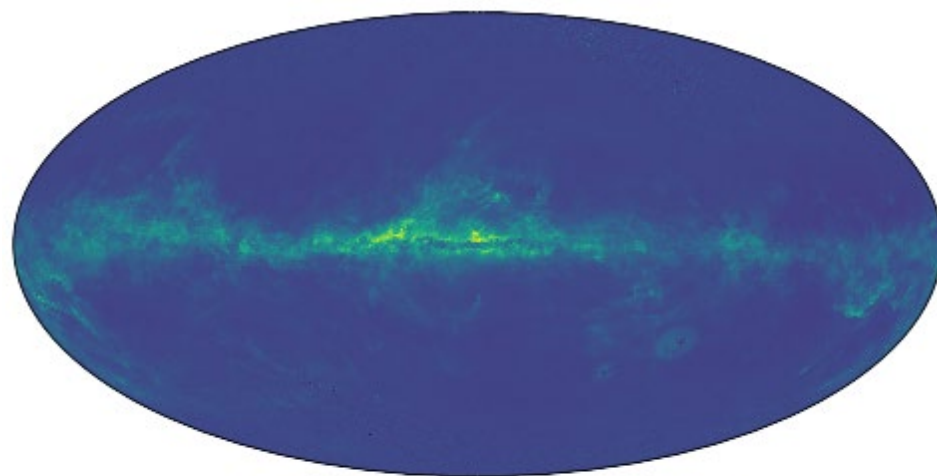
GAIAXPY (gaia-dpci.github.io/GaiaXPY-website)



- **Calibration:**
Coeffs $\longrightarrow$ absolute spec.
- **Conversion:**
Coeffs $\longrightarrow$ internal spec.
- **Generation:**
Coeffs $\longrightarrow$ synthetic phot.(*).
- **Simulation:**
SED $\longrightarrow$ source coeffs.

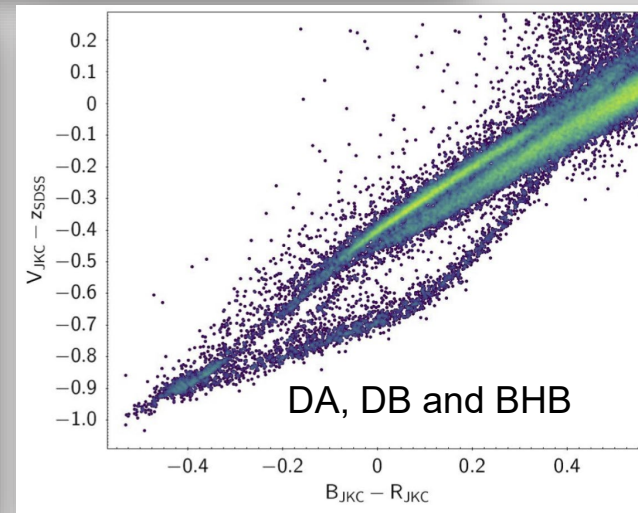
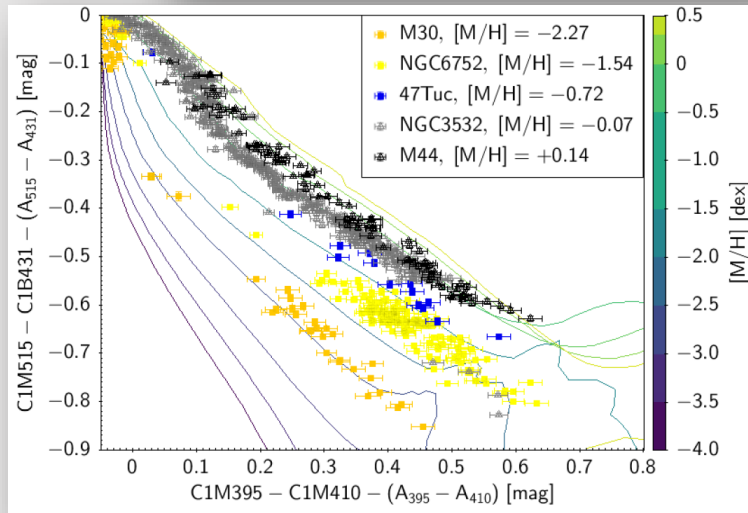
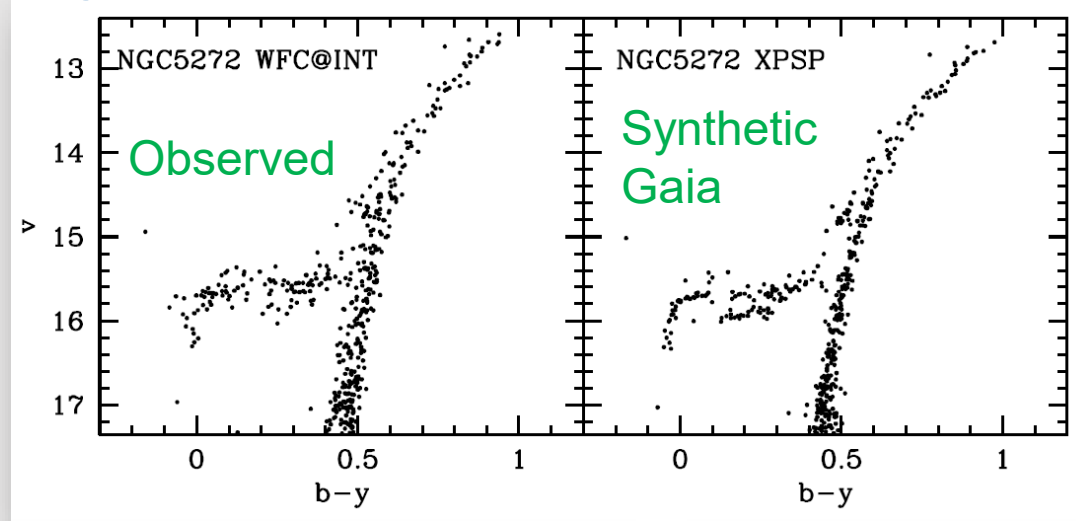
(*) Els_Custom_W09_S2, Euclid_VIS, Gaia_2, Gaia_DR3_Vega, Halpha_Custom_AB, H_Custom, Hipparcos_Tycho, HST_ACSWFC, HST_HUGS_Std, HST_WFC3UVIS, HST_WFPC2, IPHAS, JKC, JKC_Std, JPAS, JPLUS, JWST_NIRCAM, PanSTARRS1, PanSTARRS1_Std, Pristine, SDSS, SDSS_Std, Stromgren, Stromgren_Std, WFIRST.

THE GALAXY IN YOUR PREFERRED COLOURS



THE GALAXY IN YOUR PREFERRED COLOURS

Strömgren

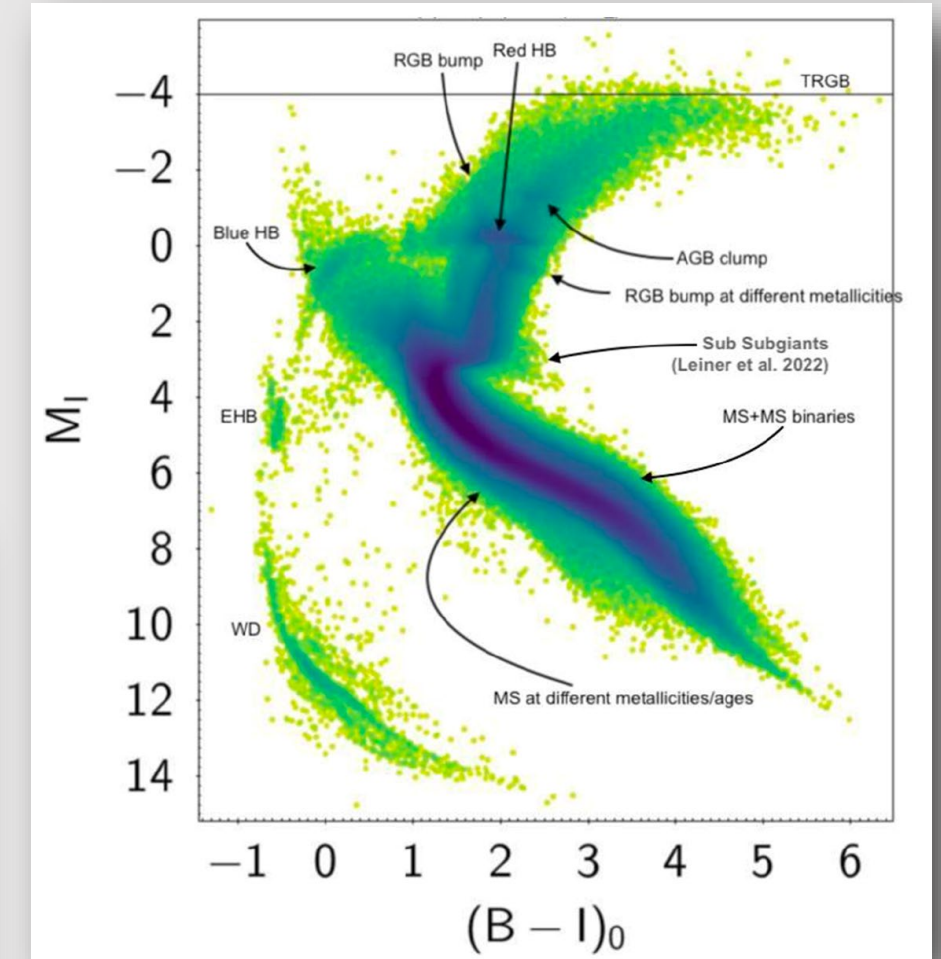


Gaia-2 (never built)

Combinations of systems



Johnson-Kron-Cousins



Montegriffo et al (2022)

MORE TO COME IN DR4

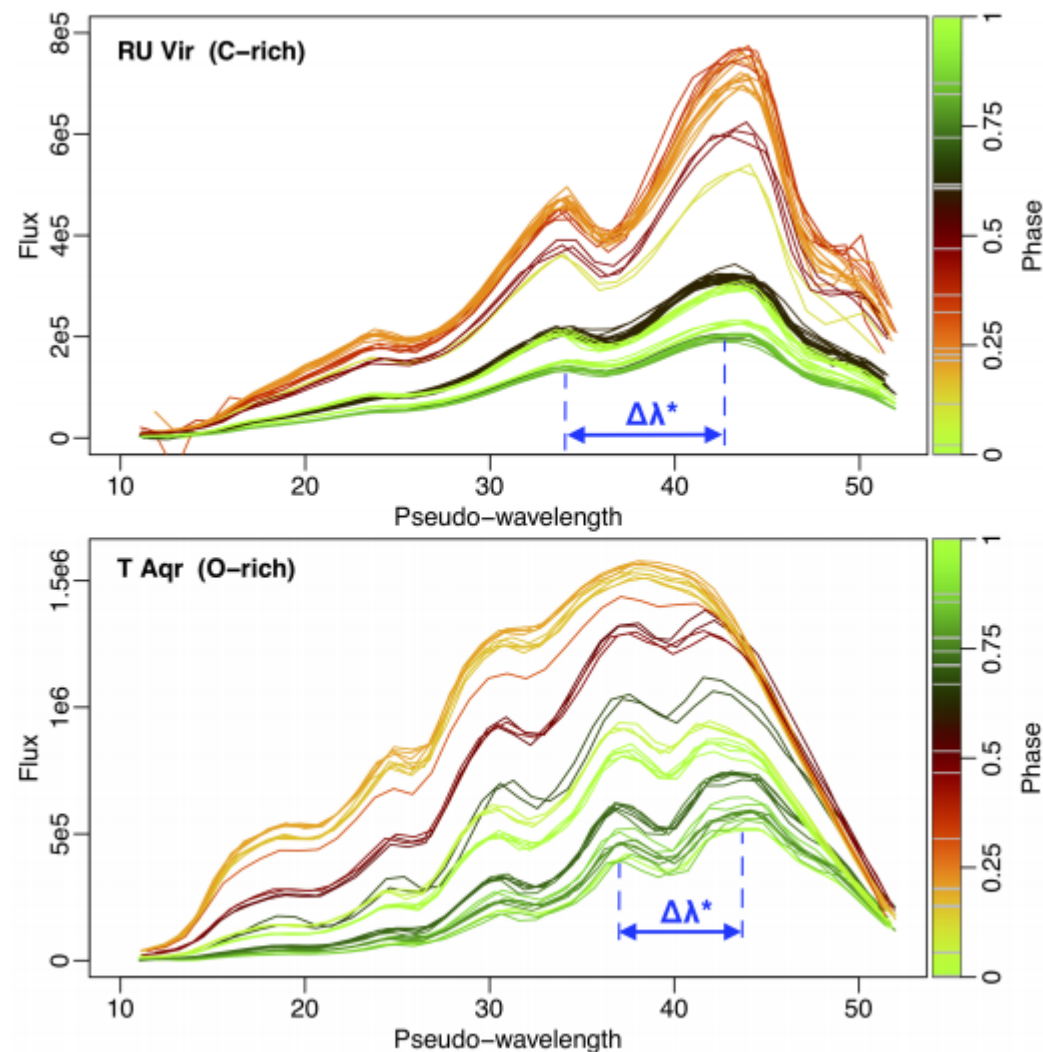
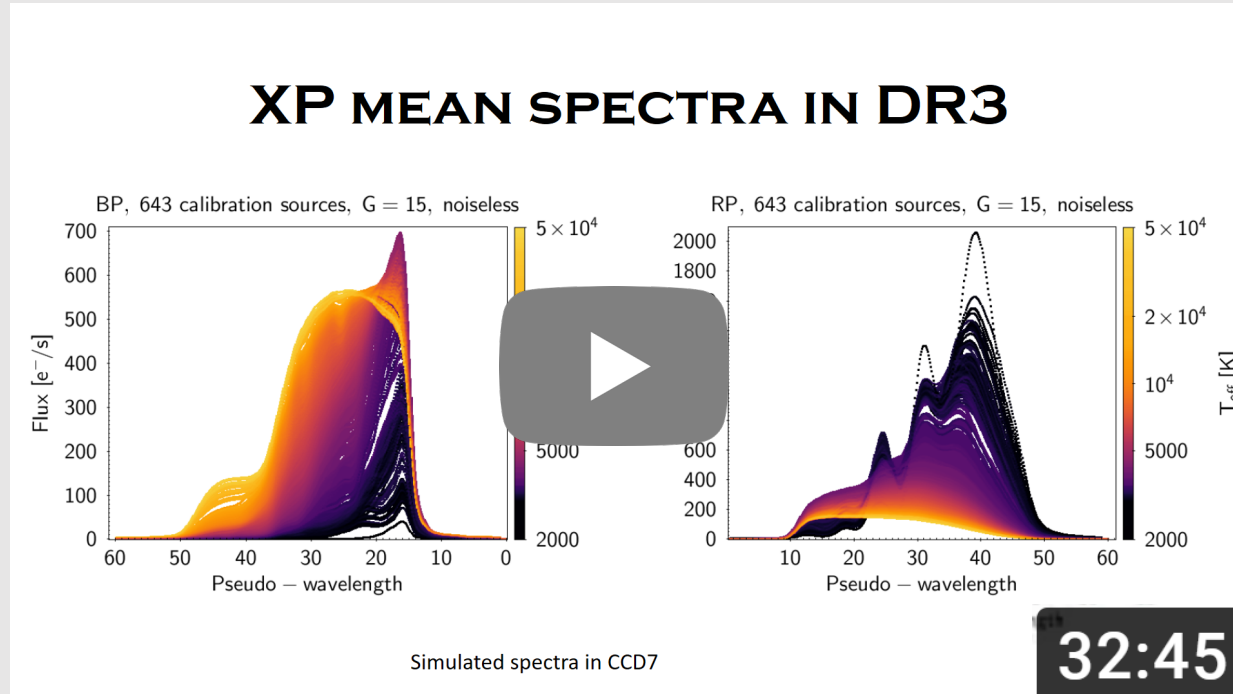


Image credits: ESA/Gaia/DPAC, Mowlavi et al.

- Full catalogue
- Better uncertainties: All nominal mission
- Epoch data

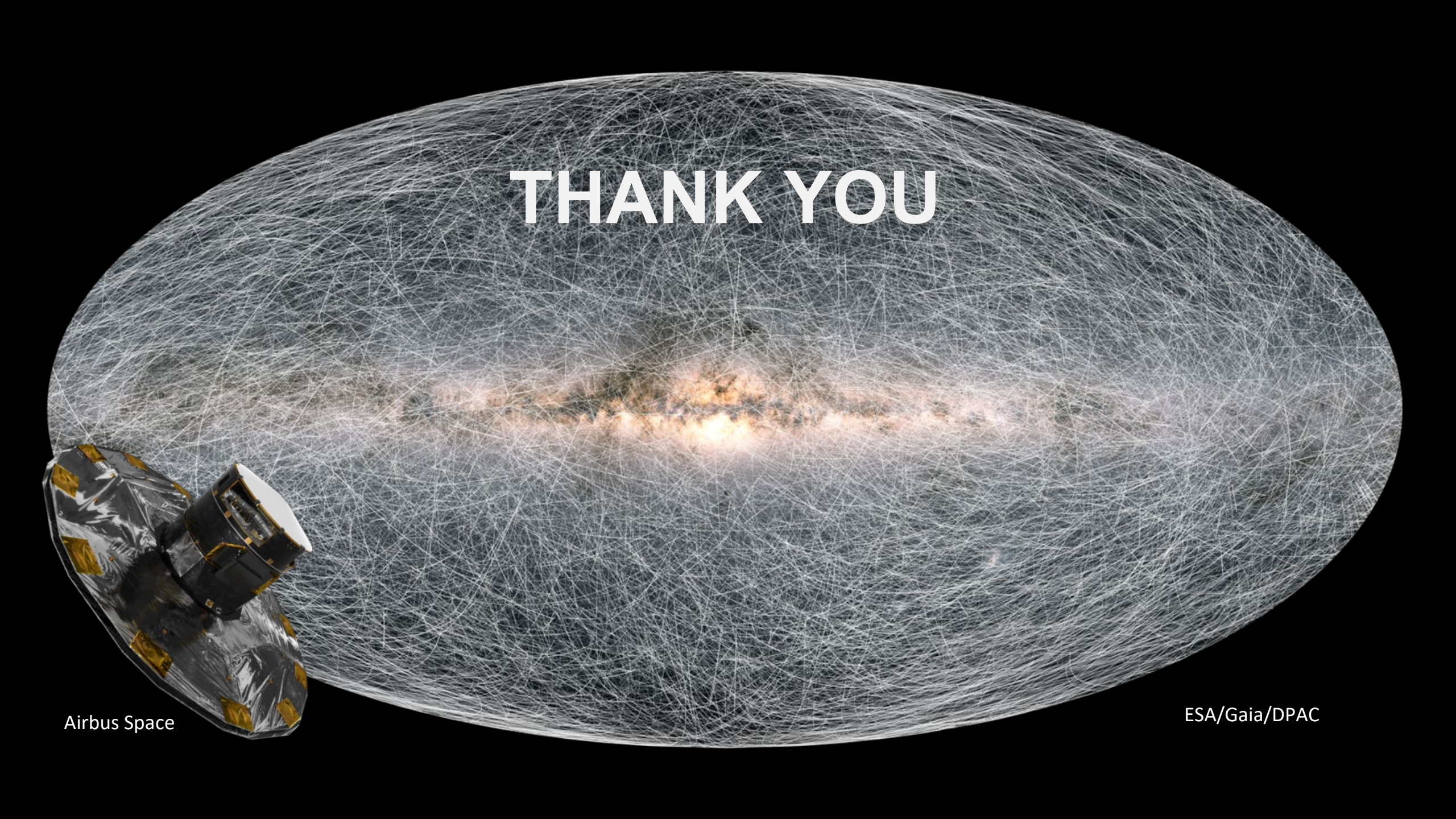
MORE INFORMATION



- Carrasco et al (2021)
- De Angeli et al (2022)
- Montegriffo et al (2022)
- Pancino et al (2021)
- Catalog tutorials and help pages

GaiaXPy and the Gaia spectrophotometry

<https://youtu.be/xBWVRrDLORY>



THANK YOU

Airbus Space

ESA/Gaia/DPAC