

Gaia and young stars

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# Gaia instrument = 2 telescopes + 1 camera

Two telescopes  
( $1.45 \times 0.50 \text{ m}^2$ )

Rotation axis (6 h): each star is seen ~70  
times during 5-year lifetime

Optical bench  
(stable to 25 mK  
and 30 nm)

Focal plane  
camera with 106  
CCD detectors (~1  
billion pixels)

Superposition of  
fields of view

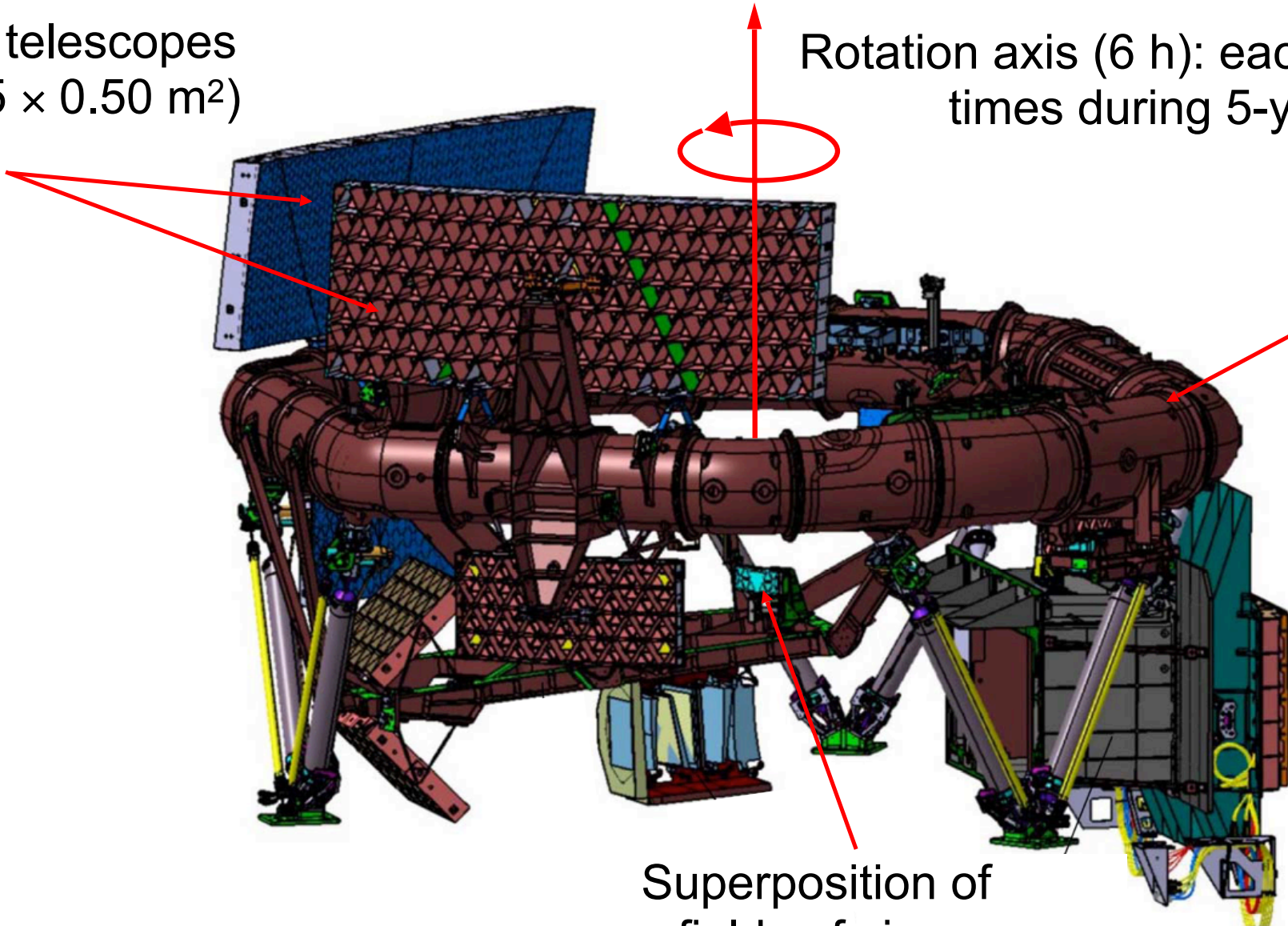




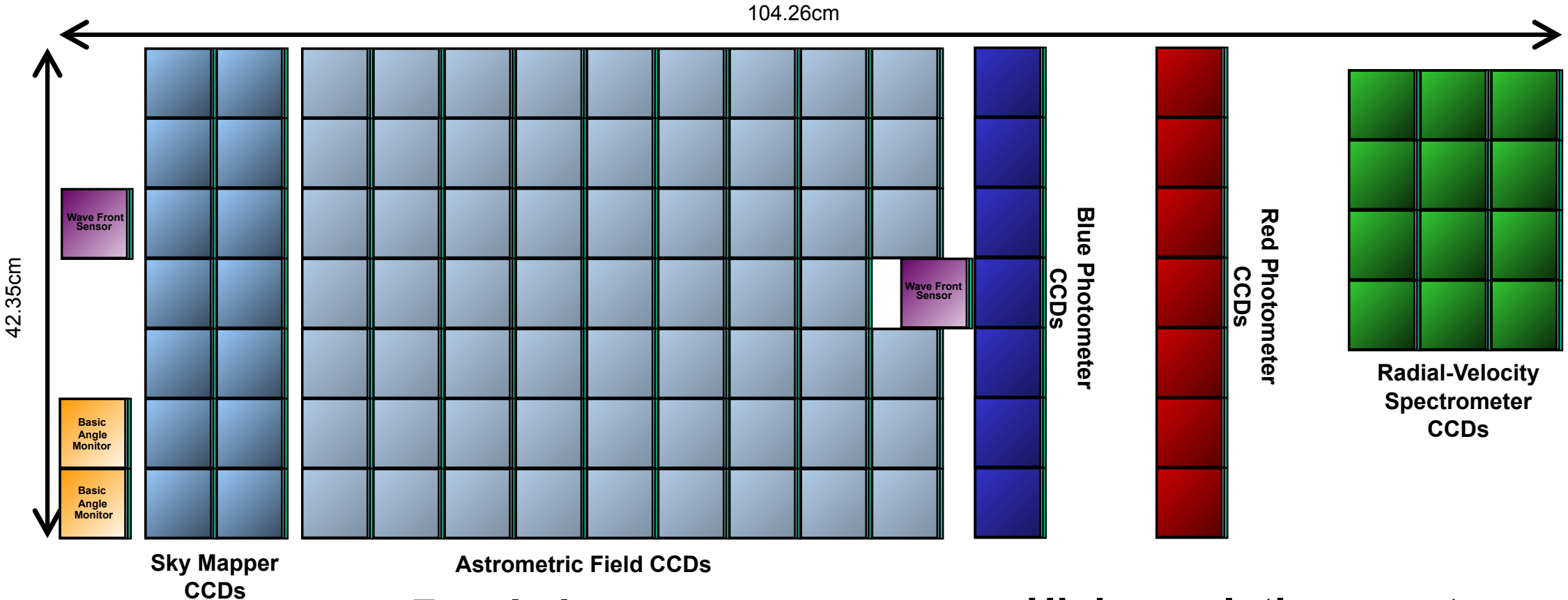


Figure courtesy Airbus DS



Star motion in 30 s

# Gaia focal plane



## Sky mappers: Focal plane:

- Detect all objects
- Reject cosmic rays
- Number of CCDs: 106 (938 million pixels)
- CCDs:  $4500 \times 1966$  pixels

## High-resolution spectroscopy



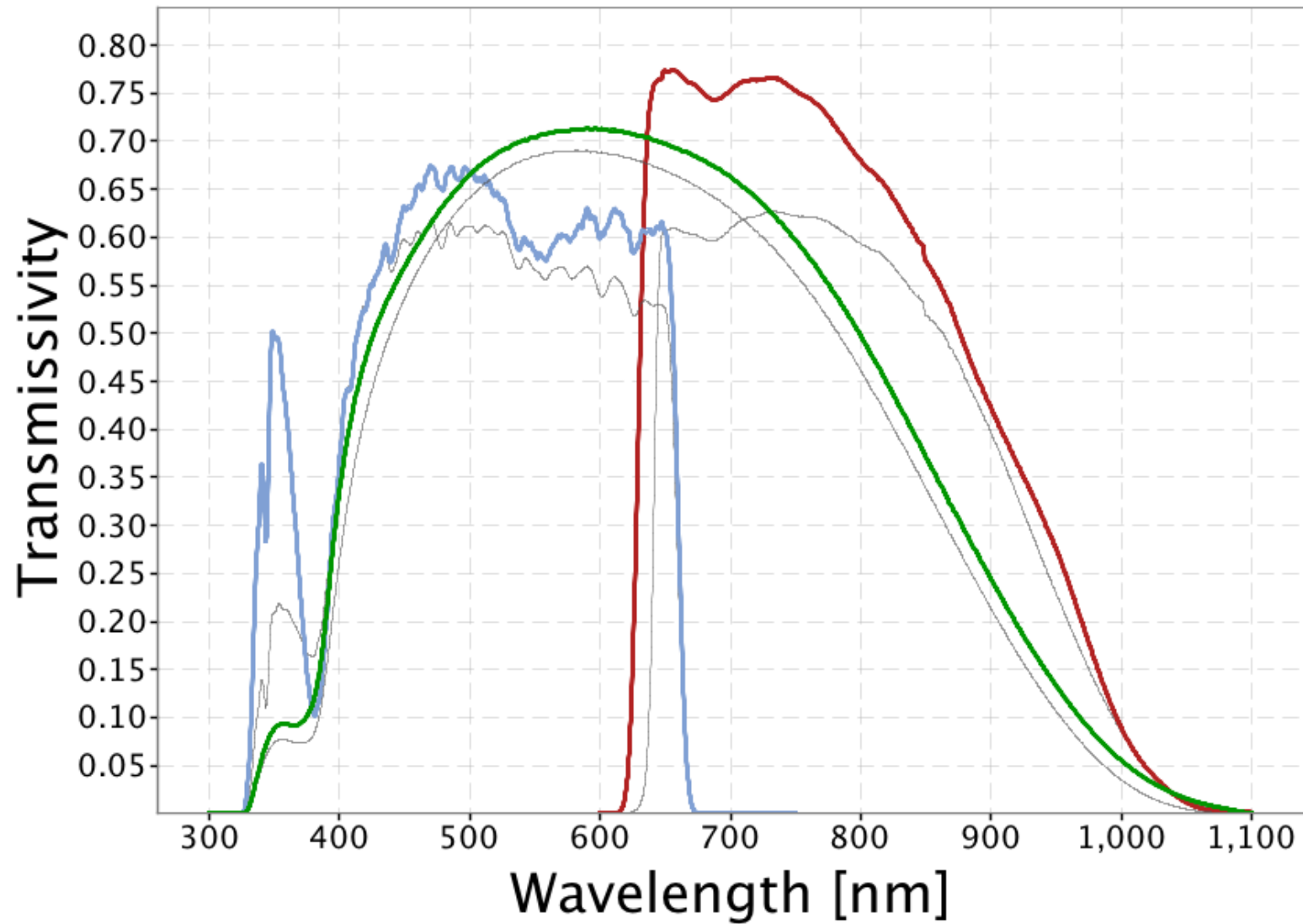




Figure courtesy Airbus DS

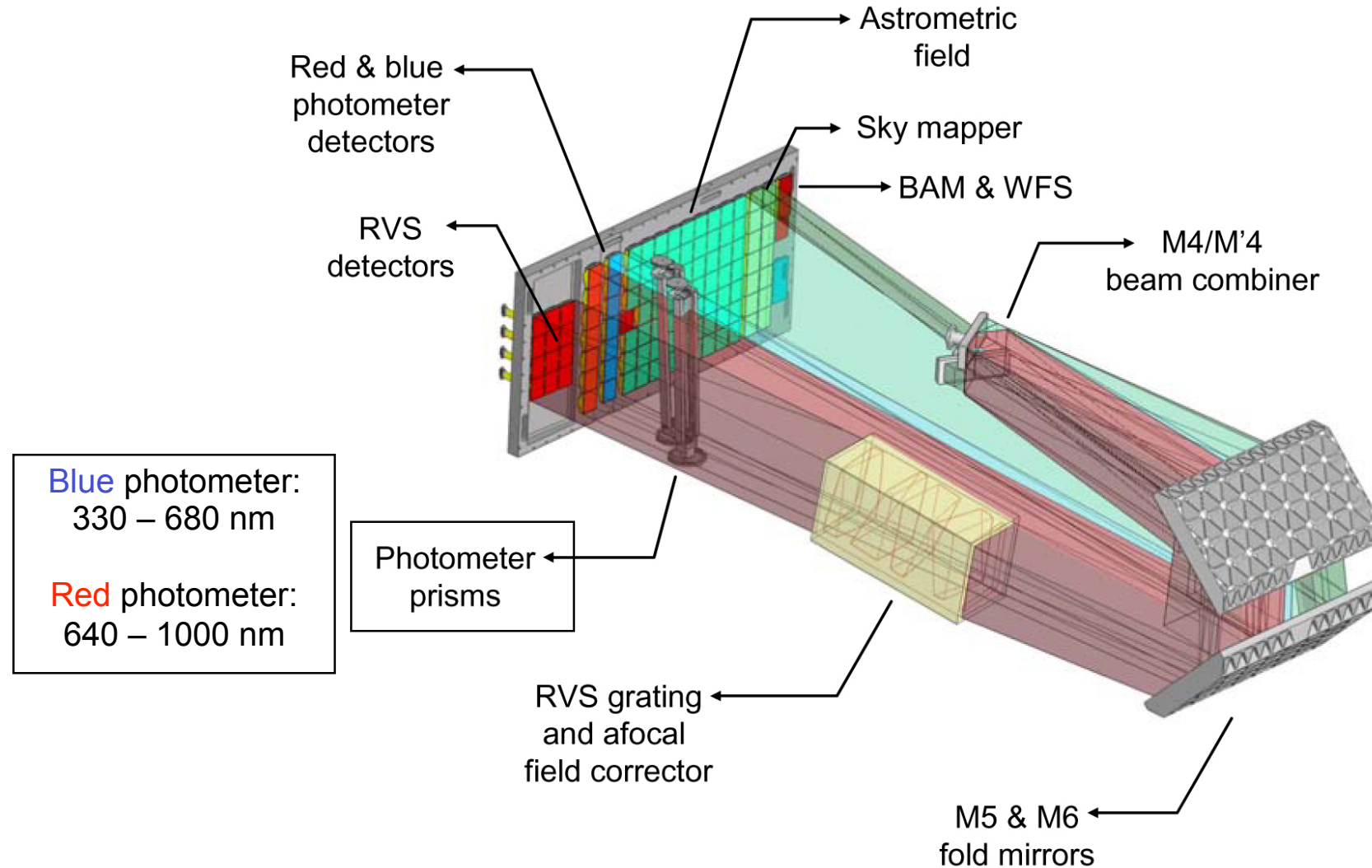


# Passbands





# Photometry Measurement Concept





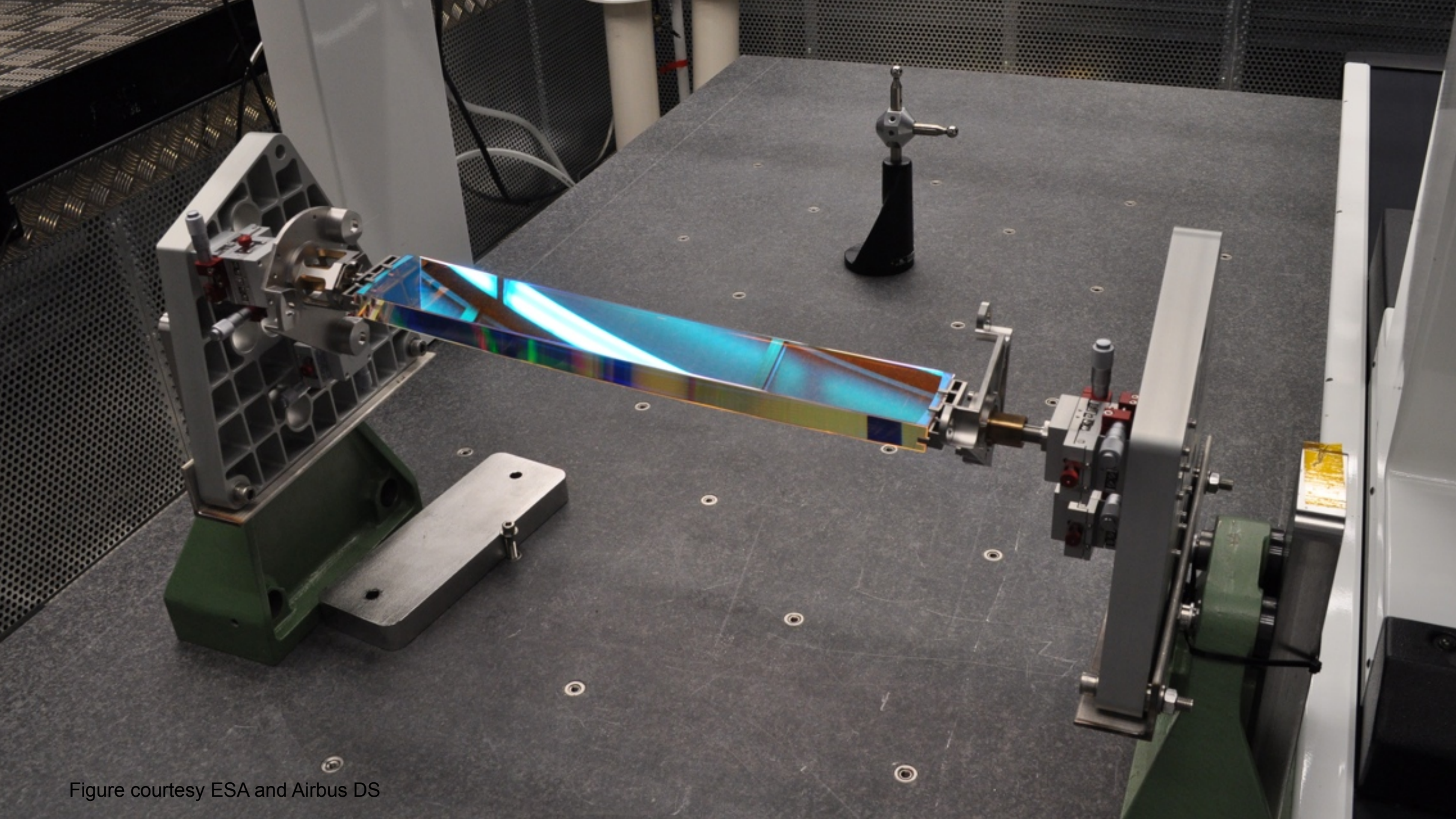


Figure courtesy ESA and Airbus DS



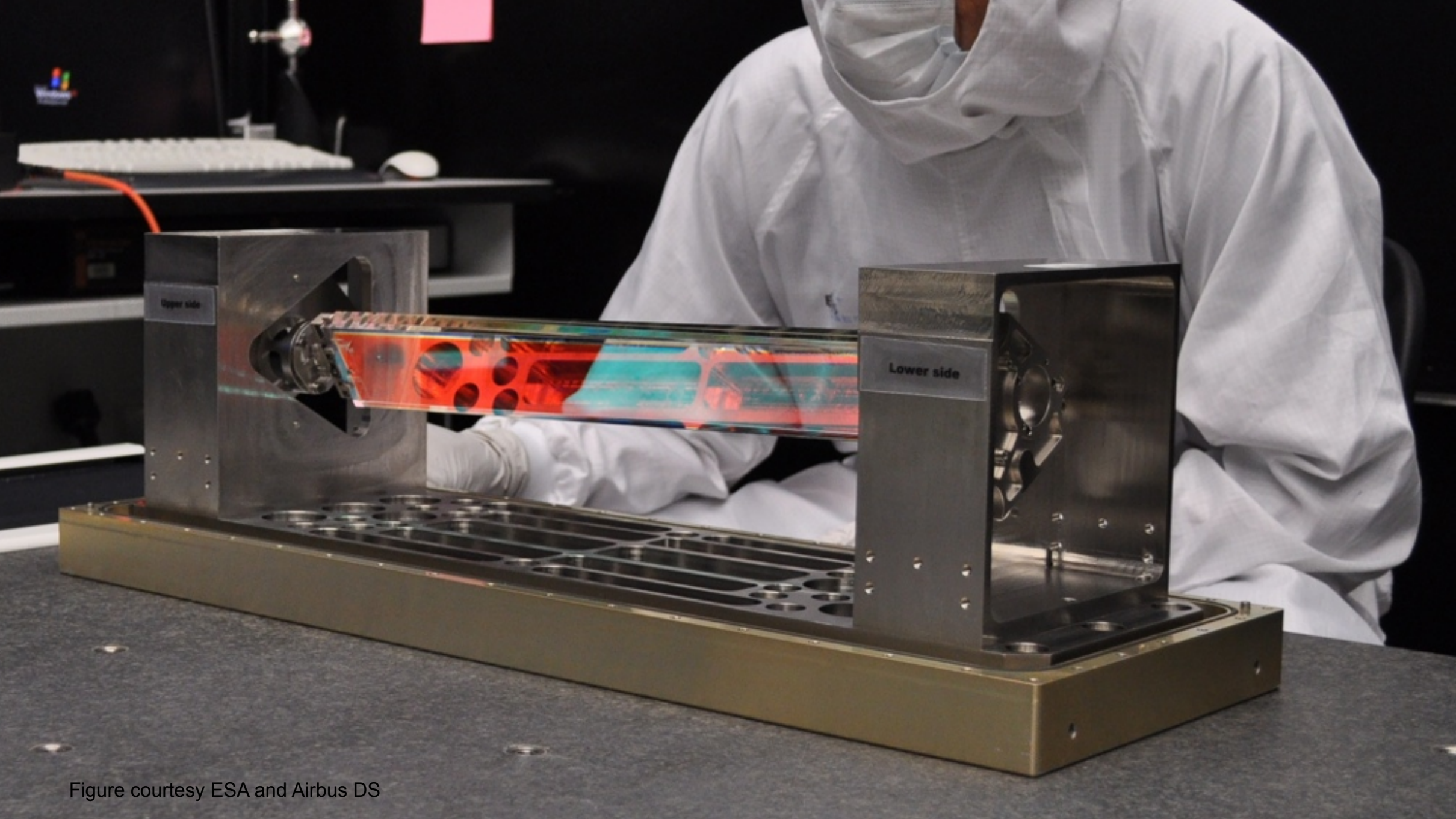


Figure courtesy ESA and Airbus DS



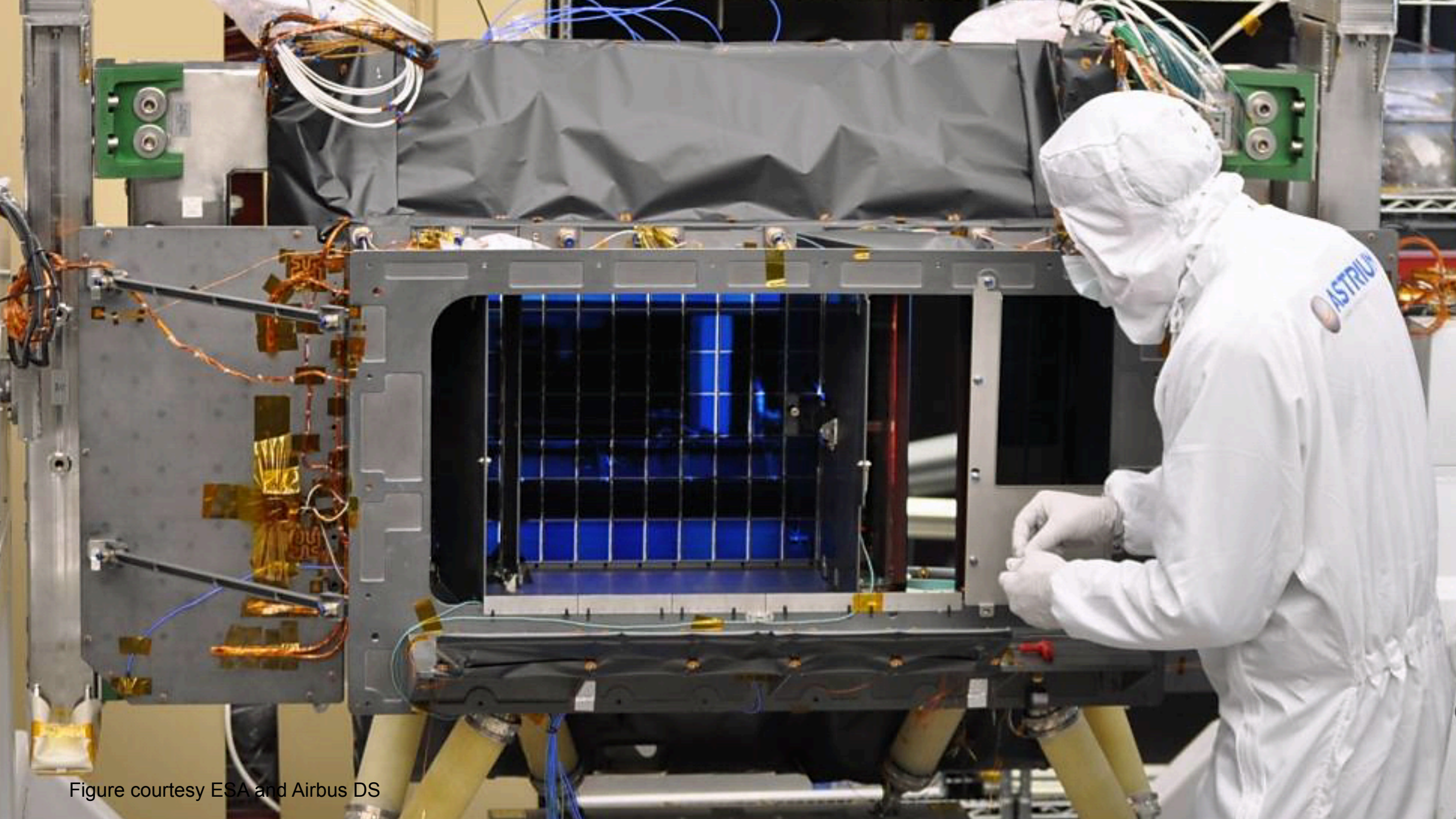
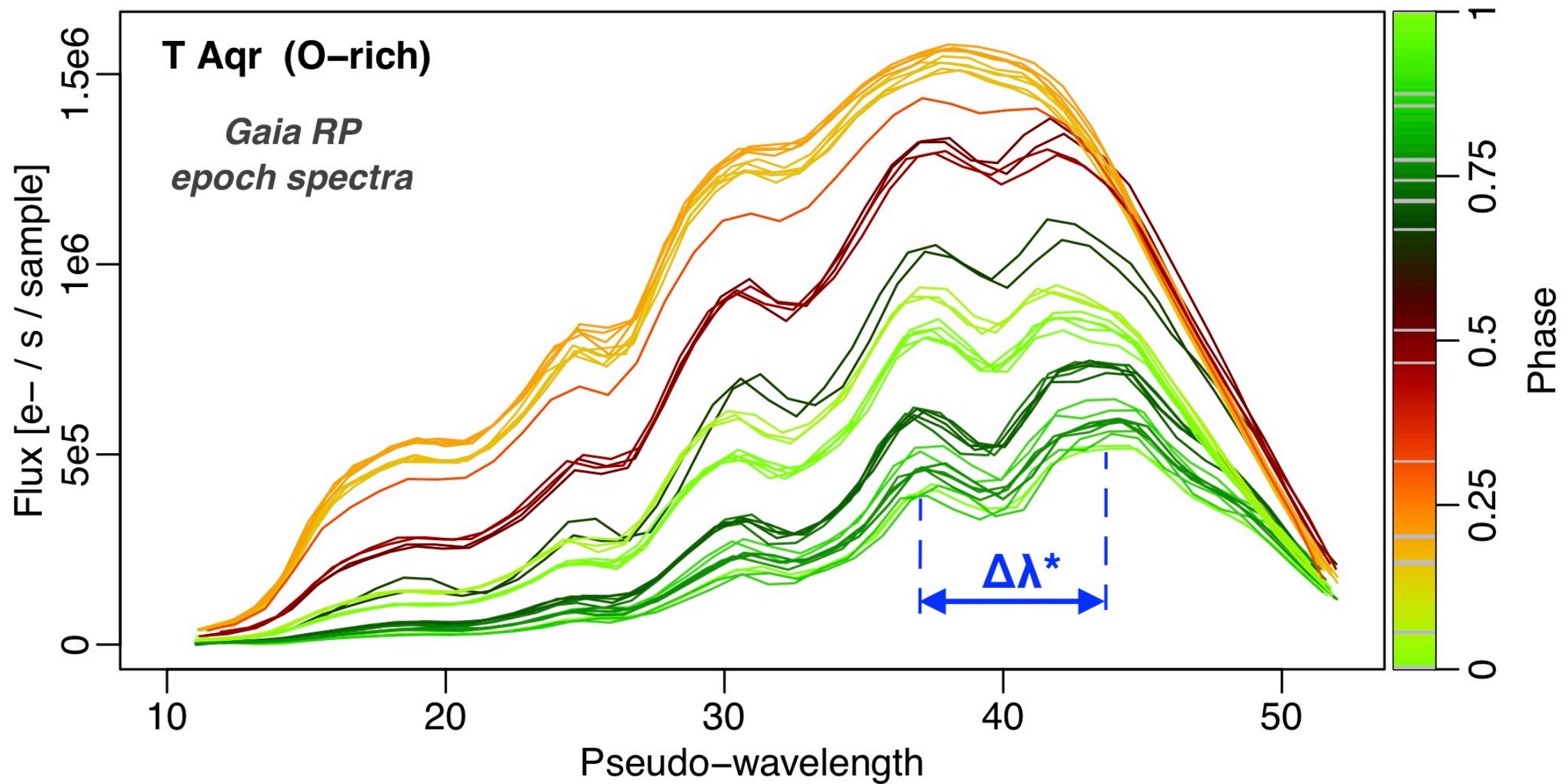


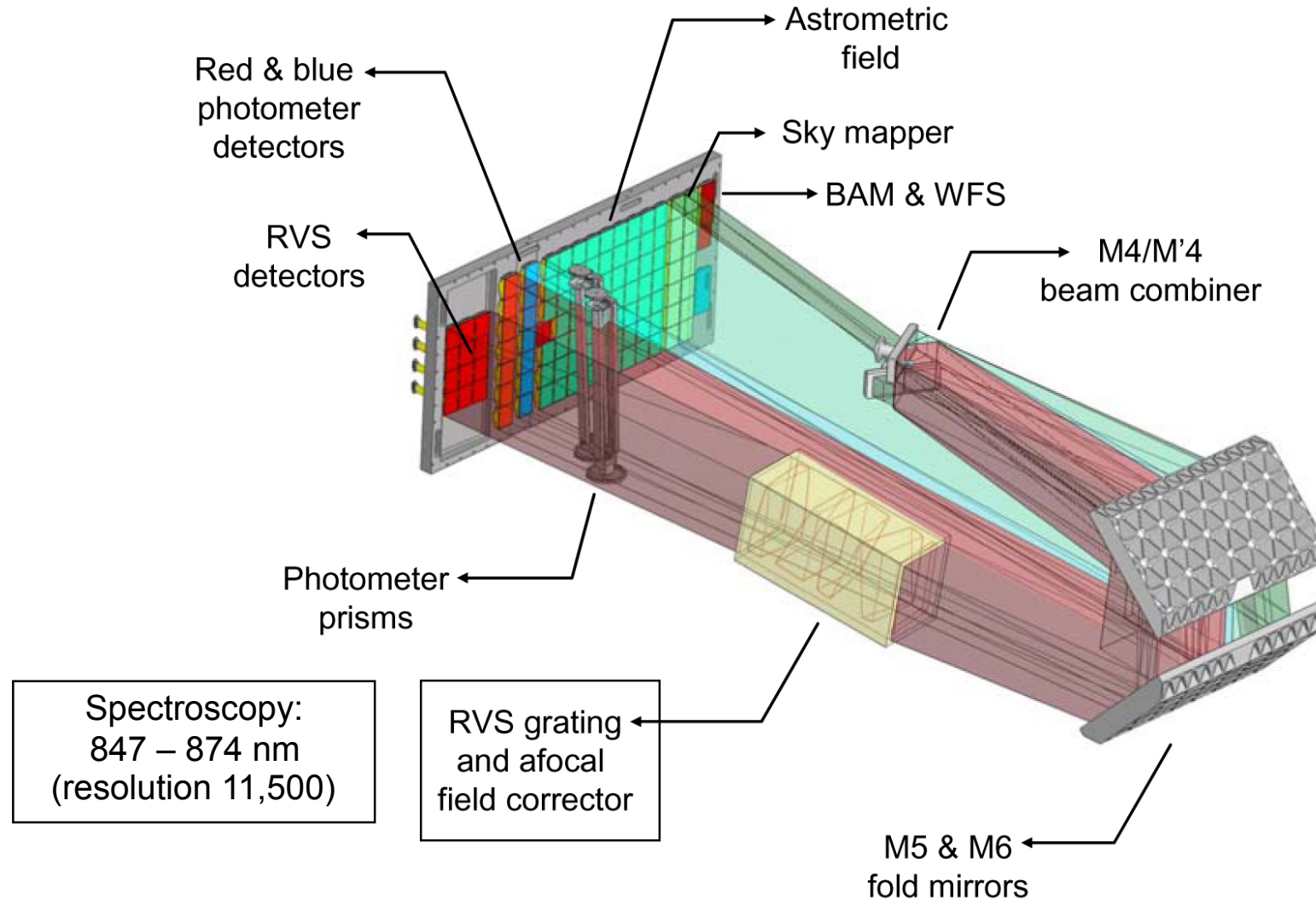
Figure courtesy ESA and Airbus DS

# Spectrophotometry



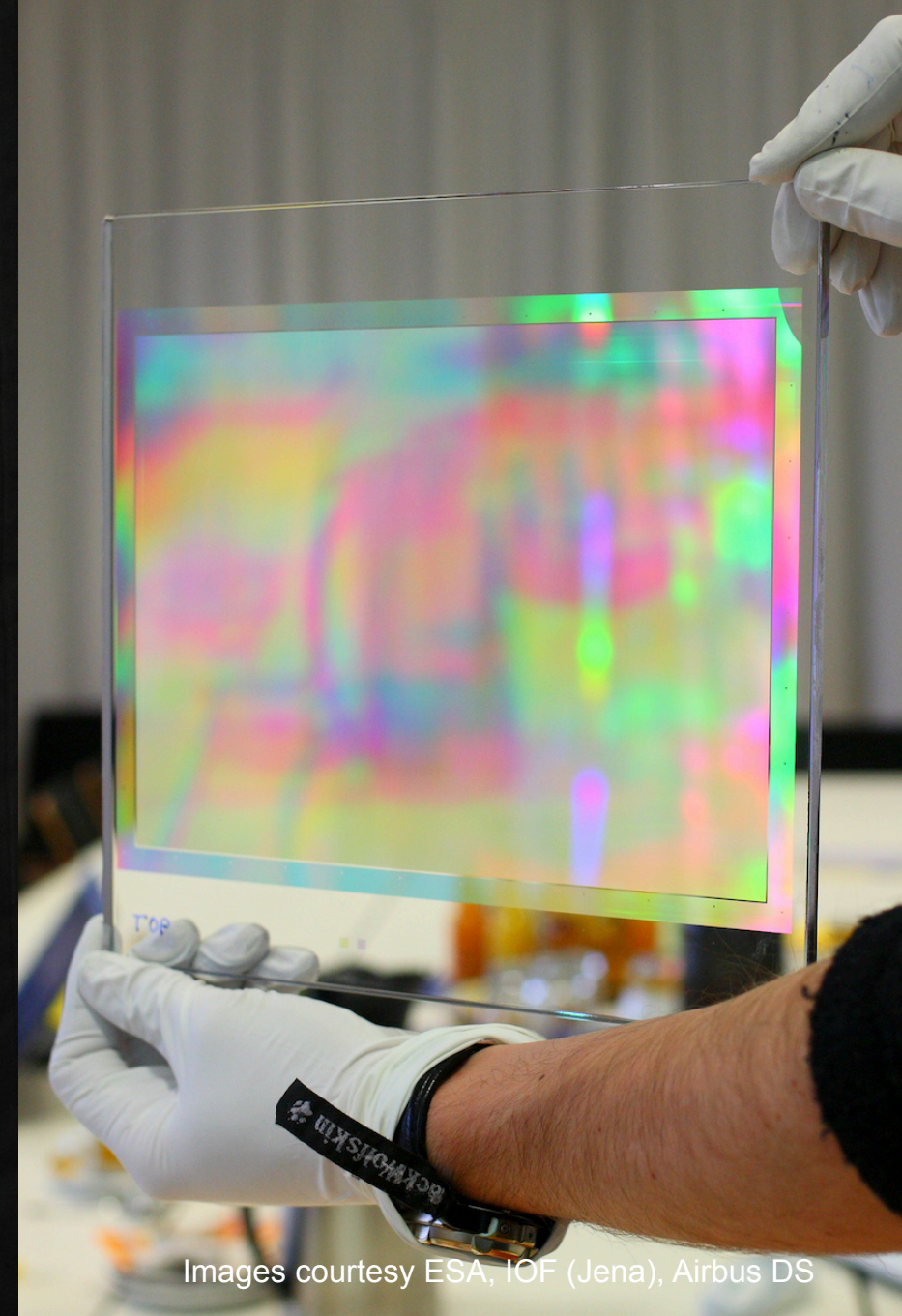
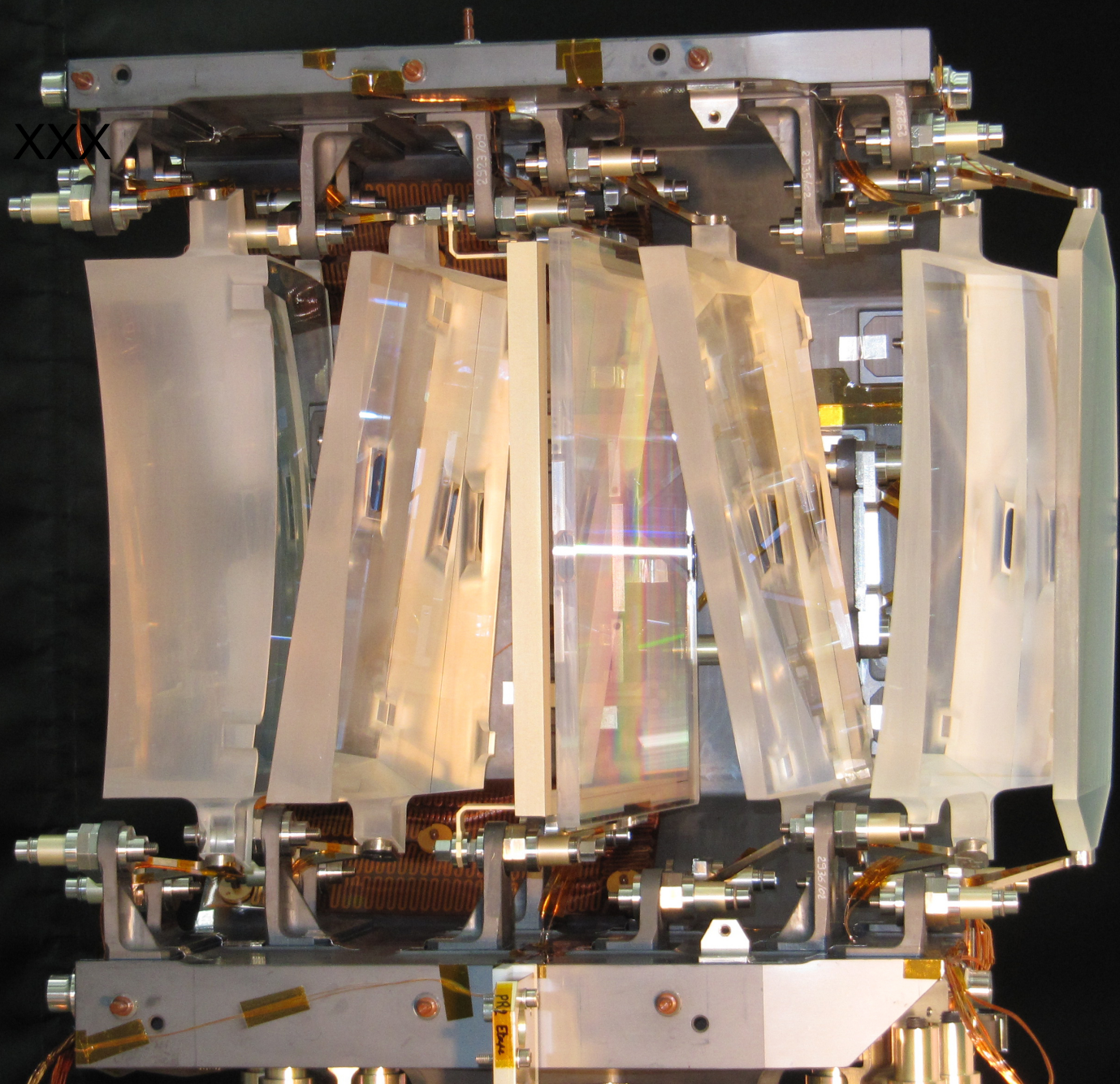


# Radial-Velocity Measurement Concept





XXX

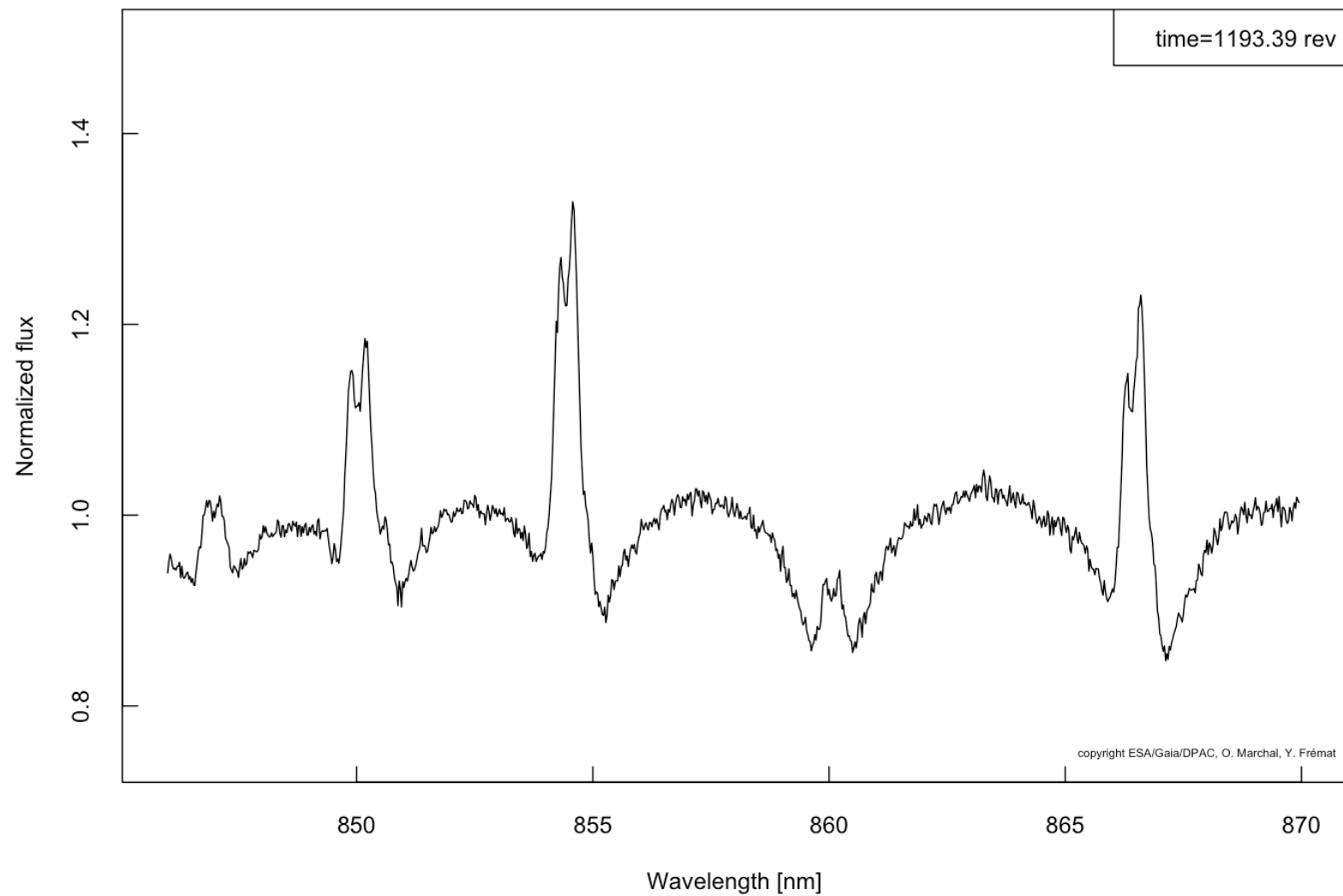


Images courtesy ESA, IOF (Jena), Airbus DS



# Spectroscopy

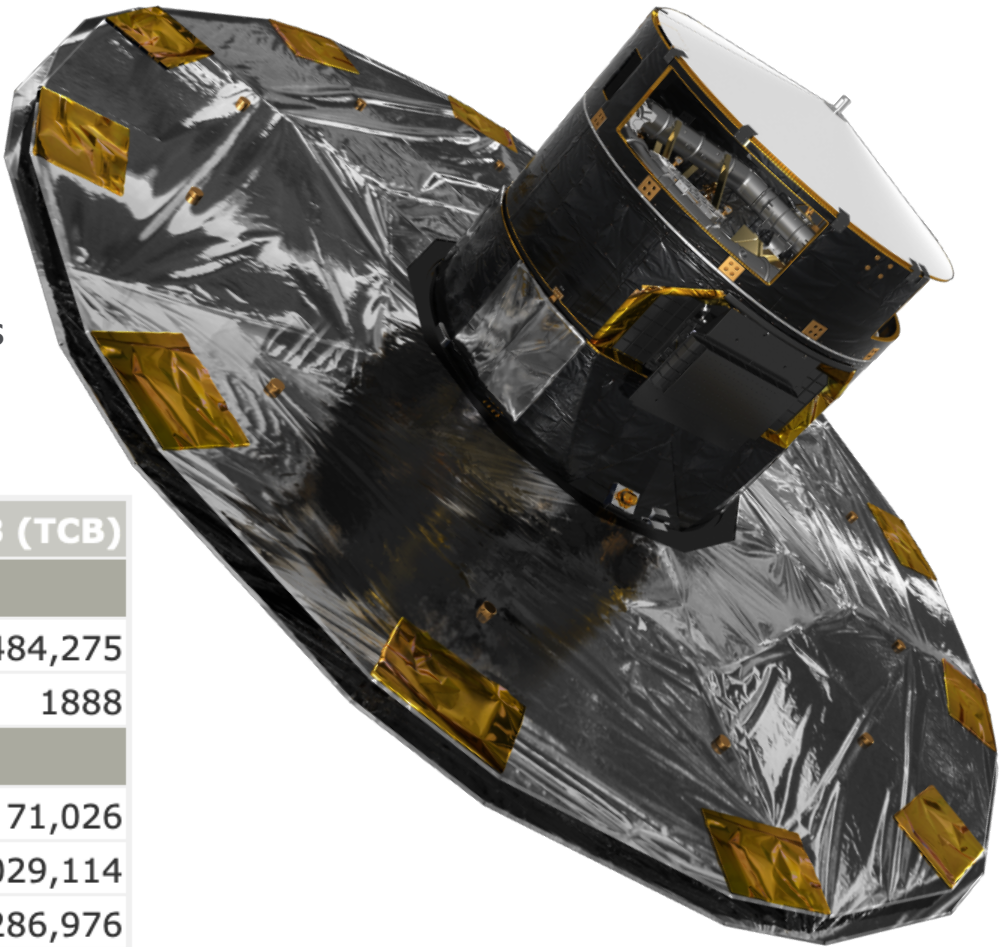
HIP50044



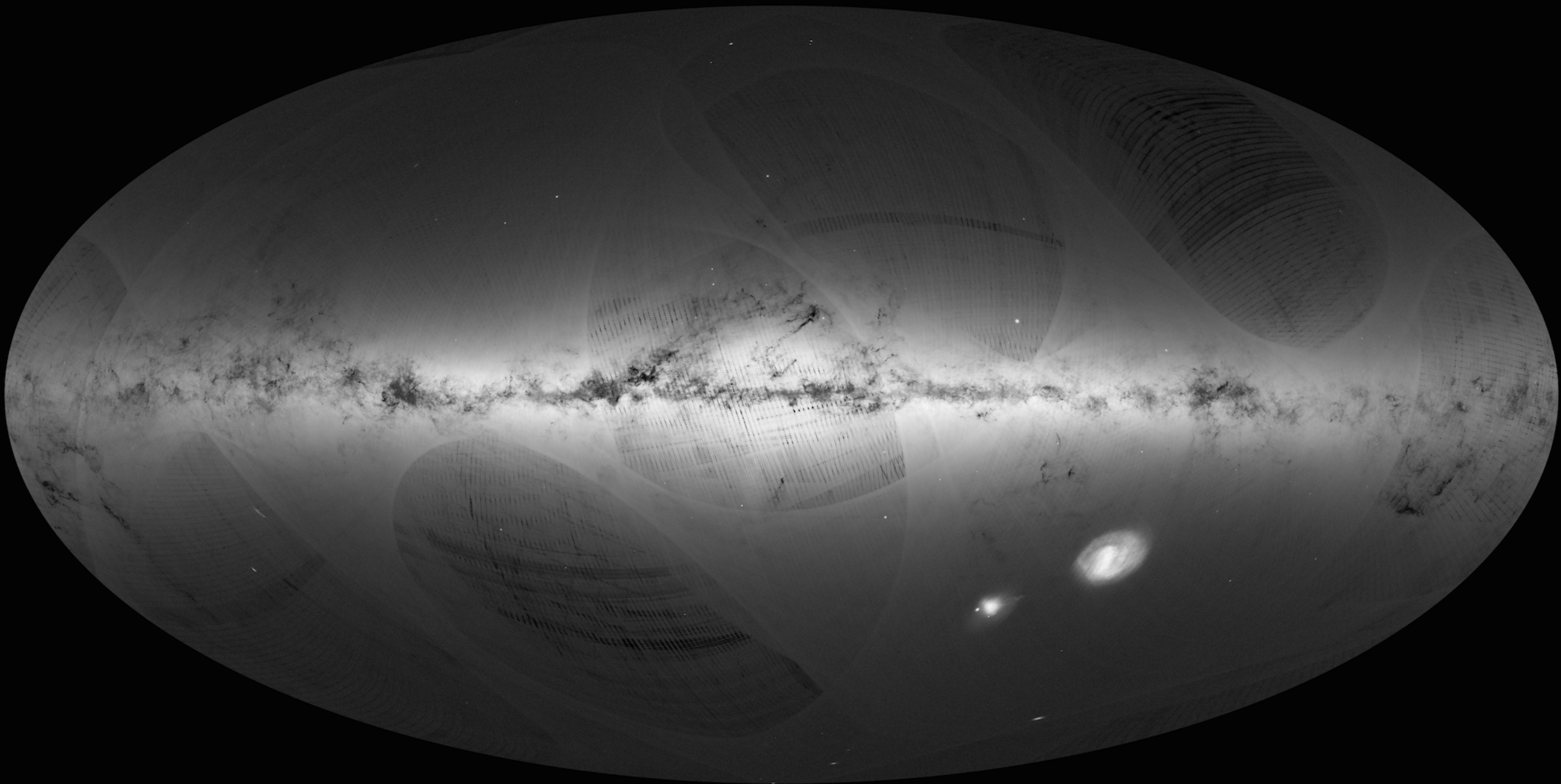
# Mission status

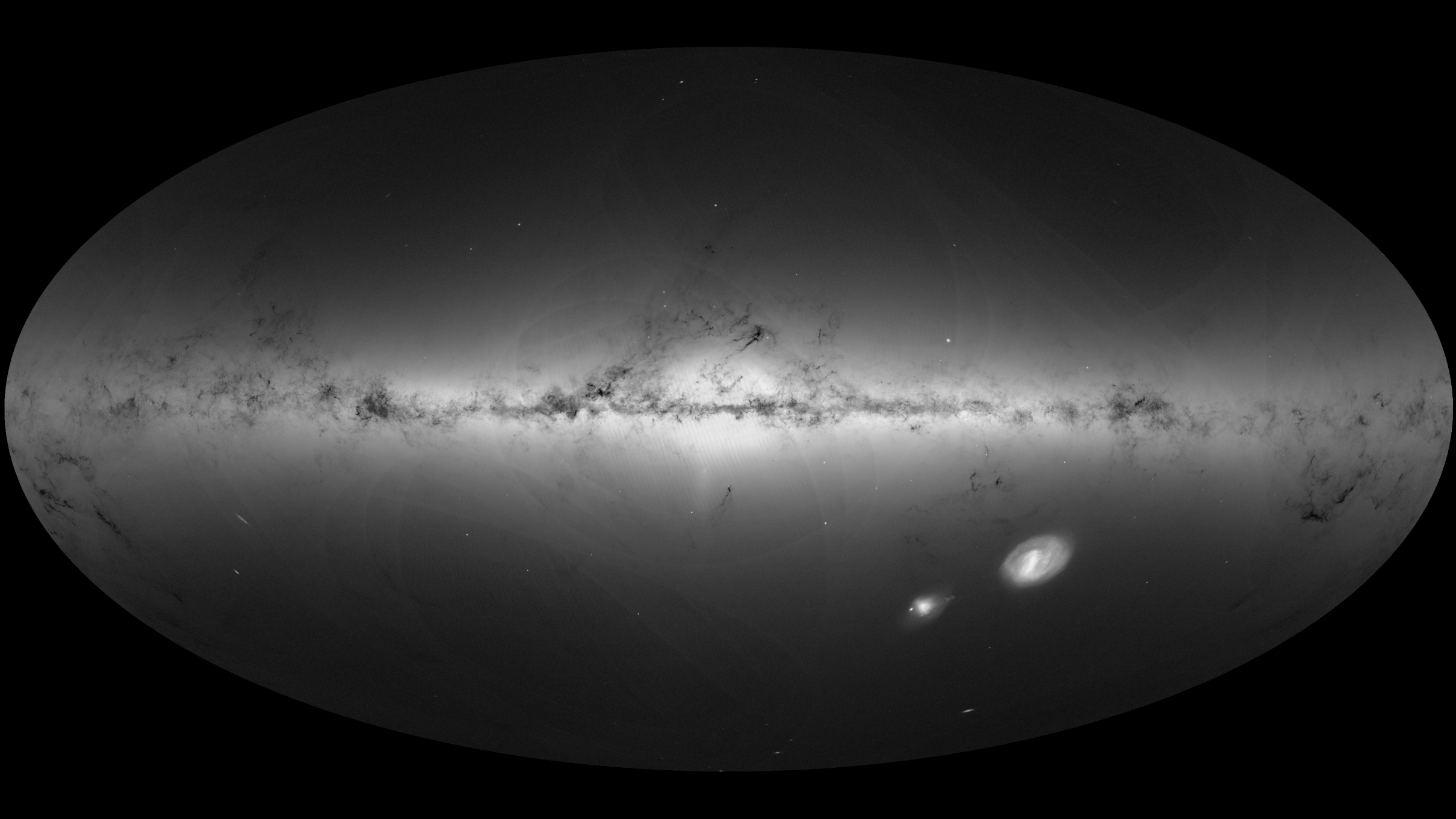
- Gaia in routine operations since 25 July 2014
  - Spacecraft operations are nominal
  - Data processing by DPAC in full speed
  - End of nominal mission 16 July 2019 with eclipse avoidance manoeuvre
- Extended mission till end-2024 when running out of consumables

CURRENT DATE AND TIME	2019-09-25T11:34:43 (TCB)
MISSION STATUS	
Satellite distance from Earth (in km)	1,484,275
Number of days having passed since 25 July 2014	1888
OPERATIONS DATA (collected since 2014/07/25)	
Volume of science data collected (in GB)	71,026
Number of object transits through the focal plane	135,177,029,114
Number of astrometric CCD measurements	1,332,459,286,976
Number of photometric CCD measurements	269,023,203,722
Number of spectroscopic CCD measurements	26,169,621,066
Number of object transits through the RVS instrument	8,756,275,195

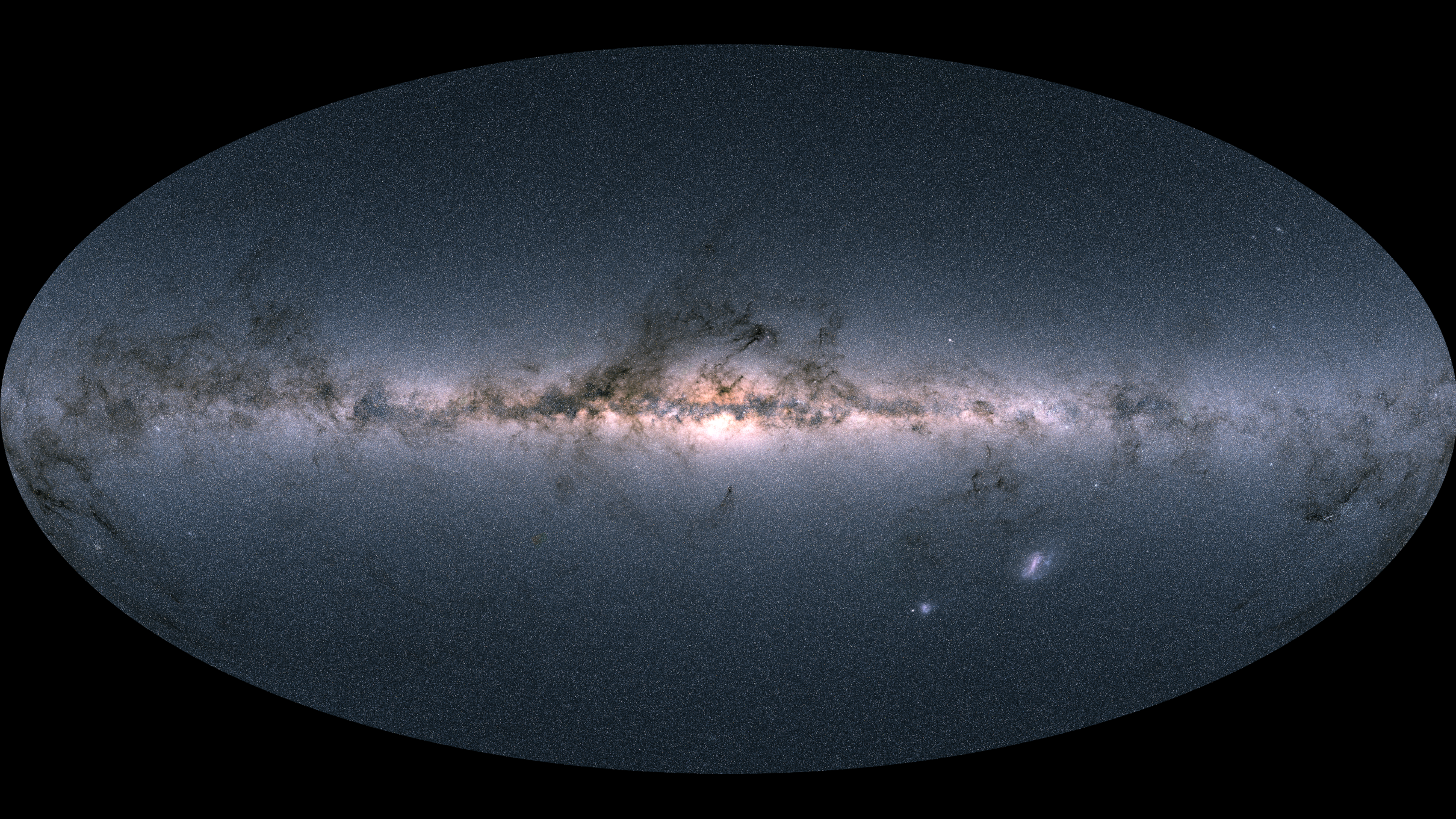




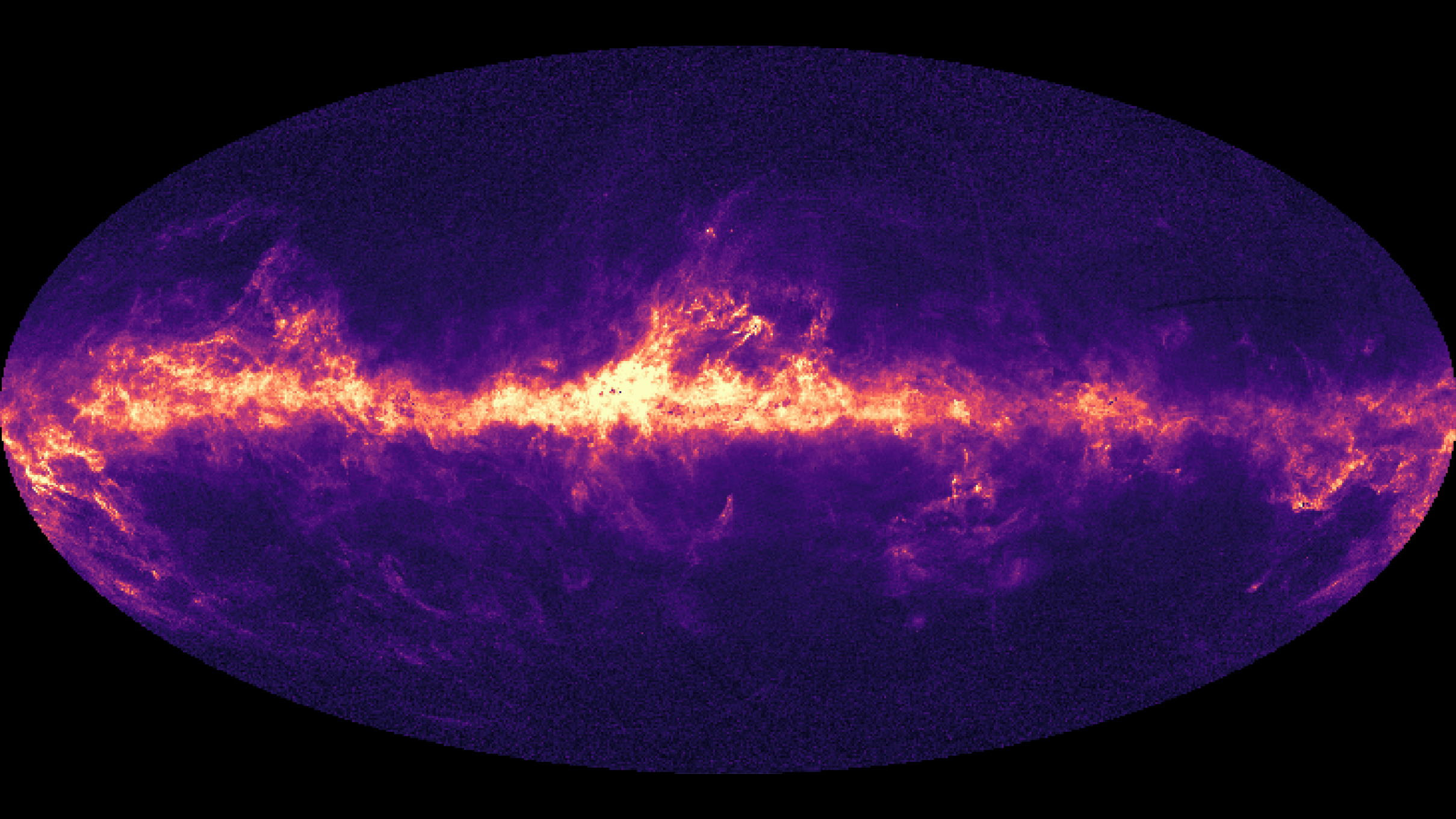




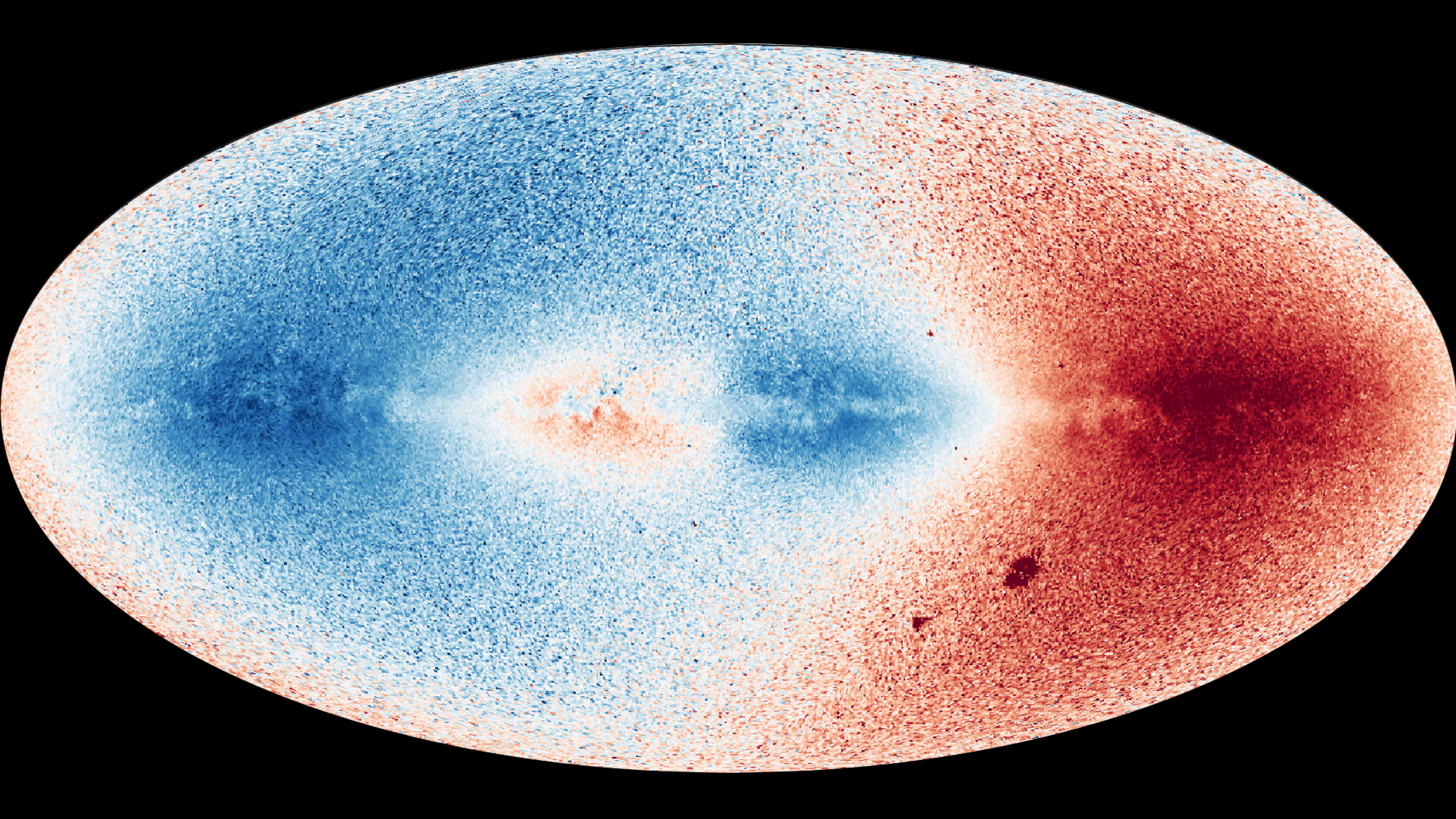














# Gaia DR2 in numbers



position & brightness on the sky

**1 692 919 135**

surface temperature  
**161 497 595**

red colour

**1 383 551 713**

blue colour

**1 381 964 755**

parallax and proper motion

**1 331 909 727**

radius & luminosity

**76 956 778**

amount of dust along  
the line of sight

**87 733 672**

radial velocity  
**7 224 631**

**14 099**

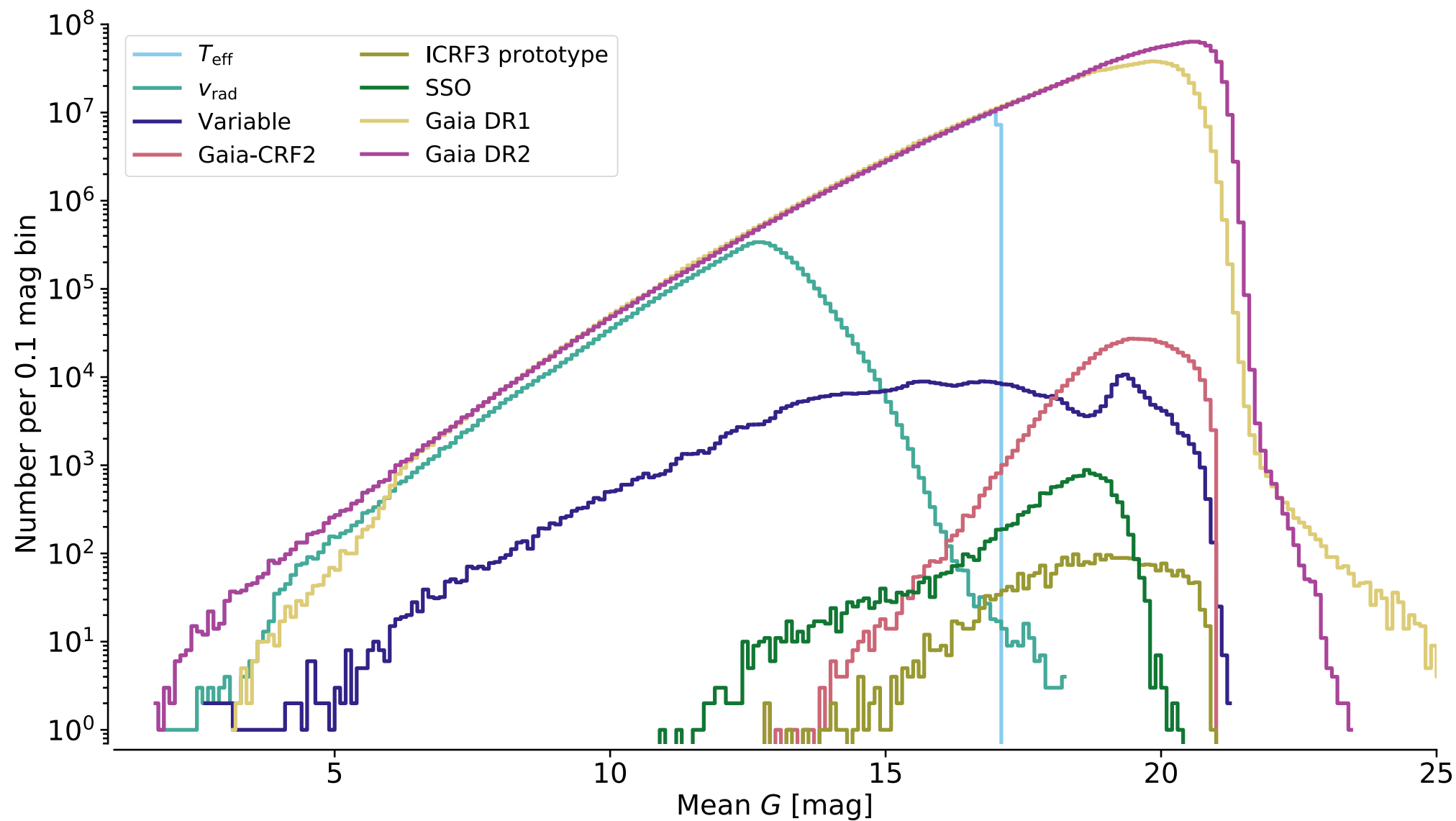
Solar System  
objects

**550 737**

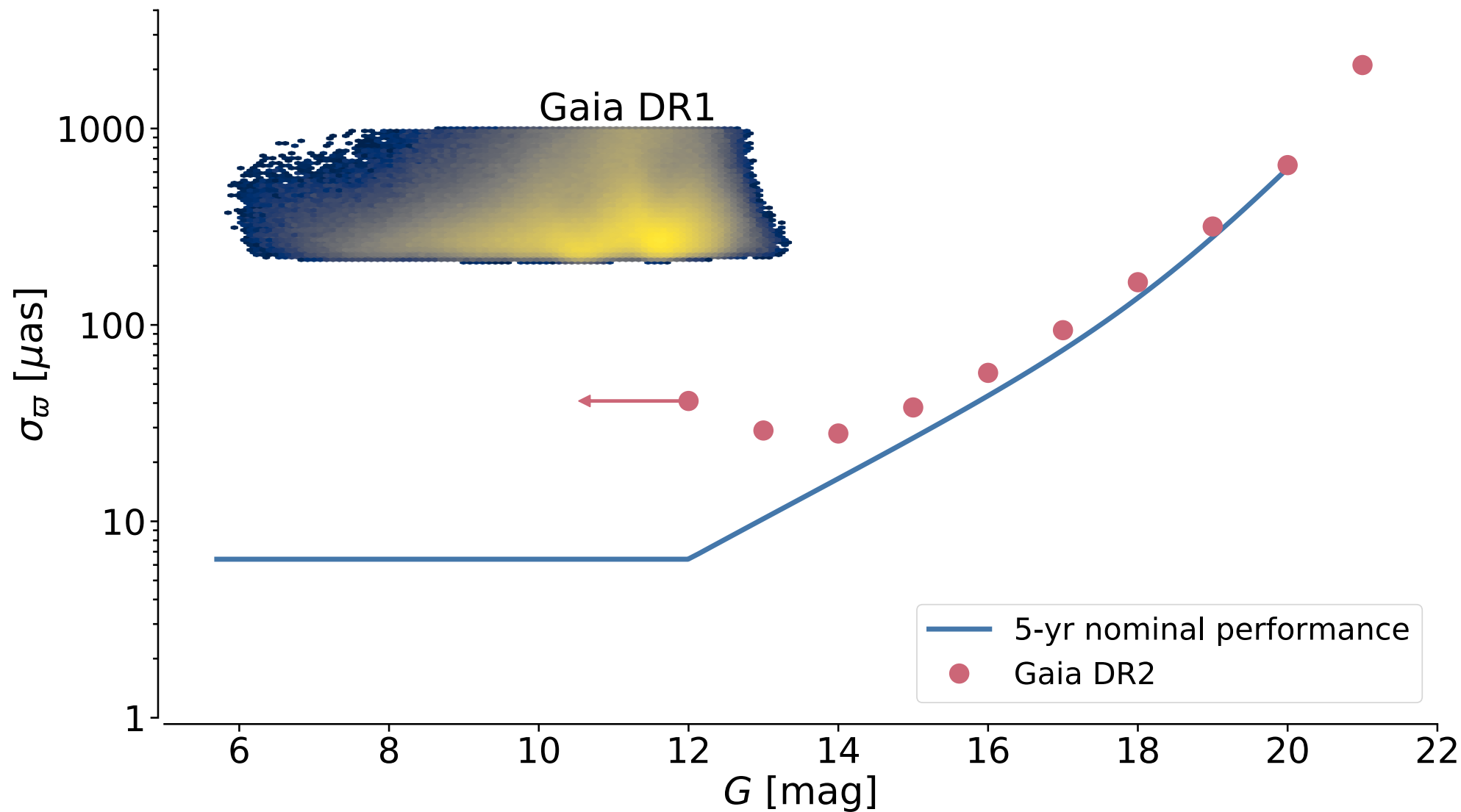
variable sources



# Gaia DR2

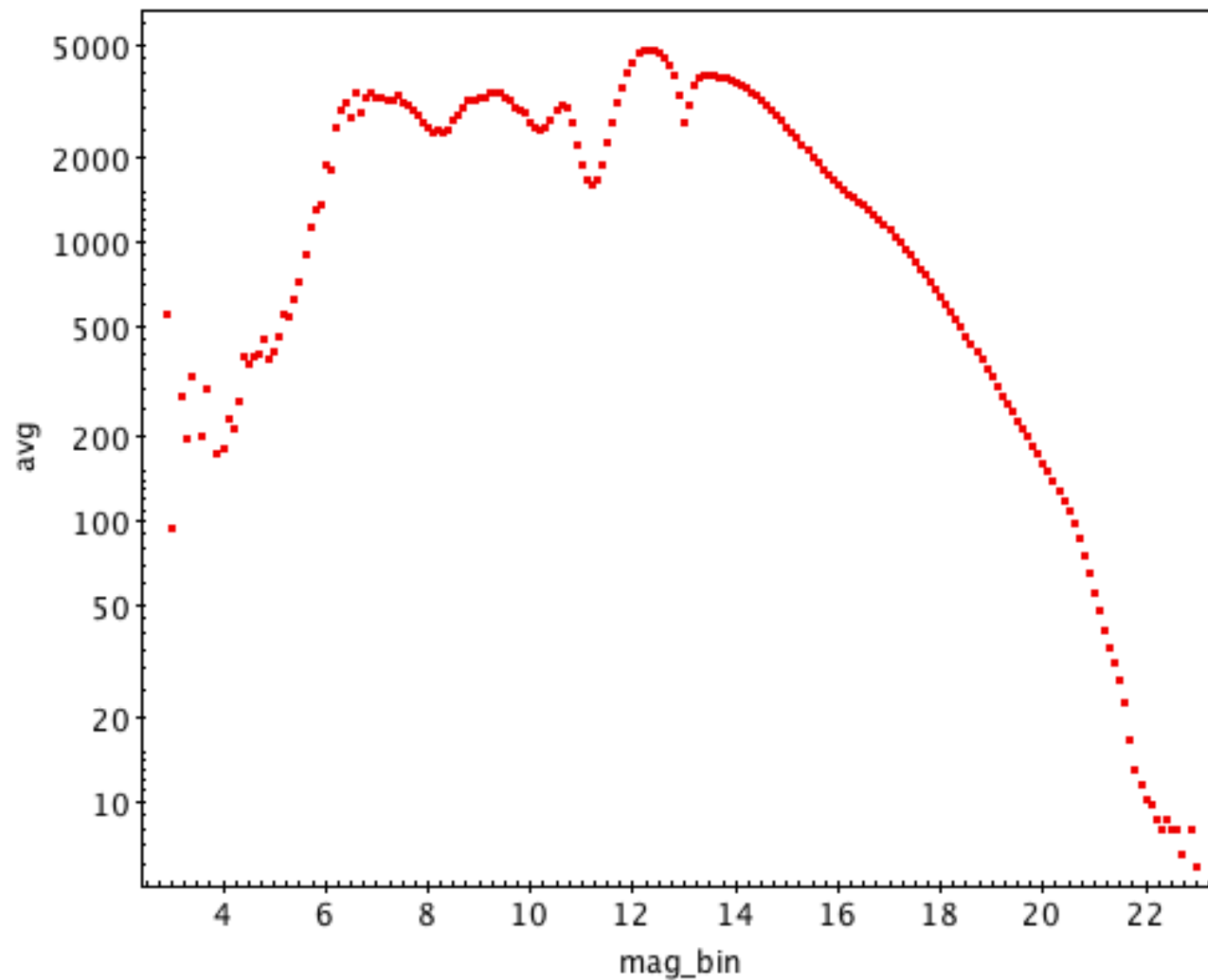


# Astrometric performance: parallax

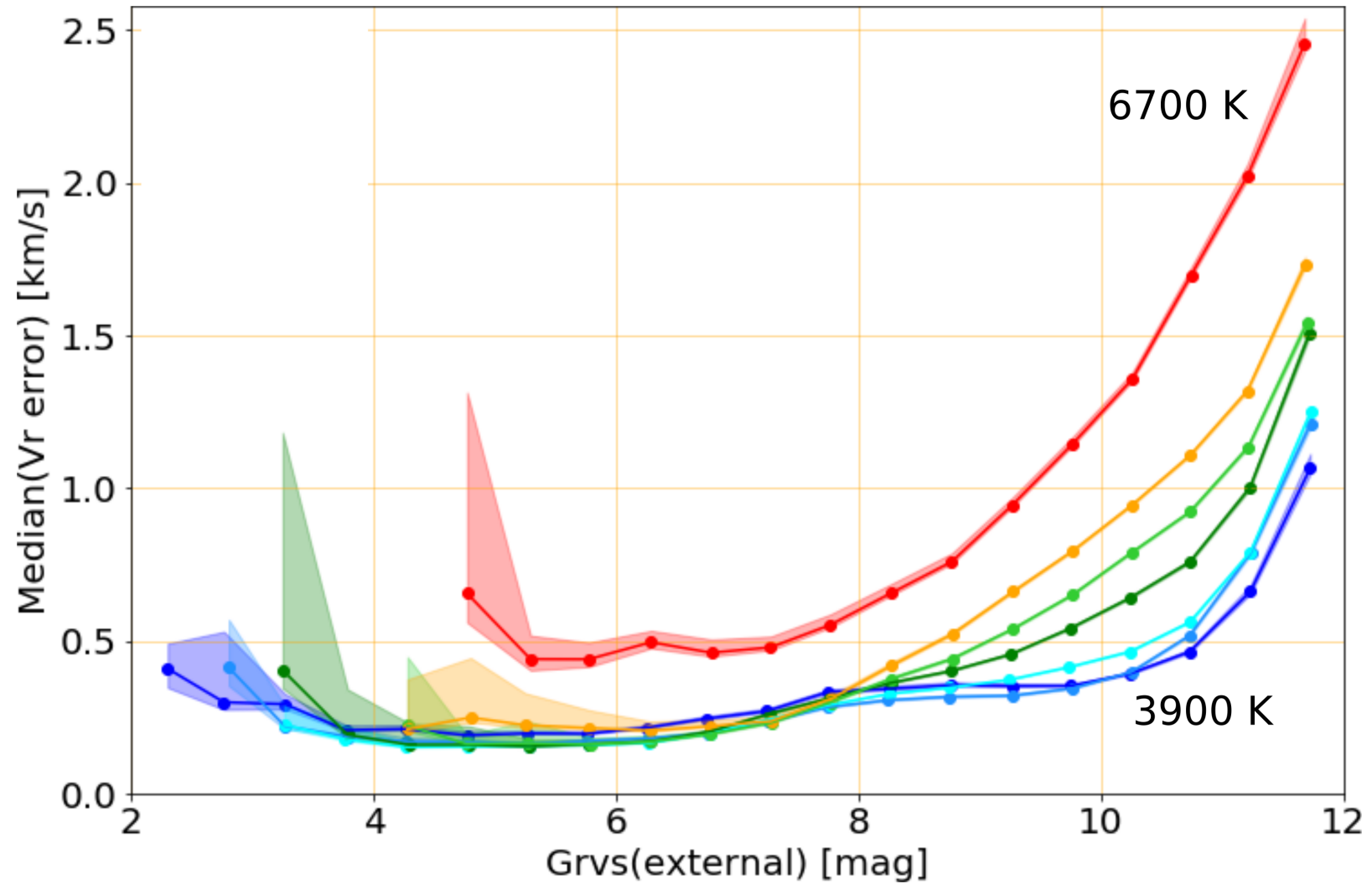




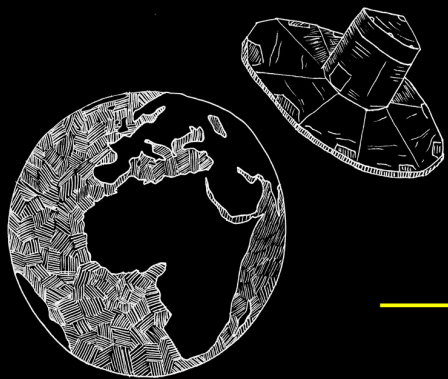
## Photometric G-band performance: average S/N



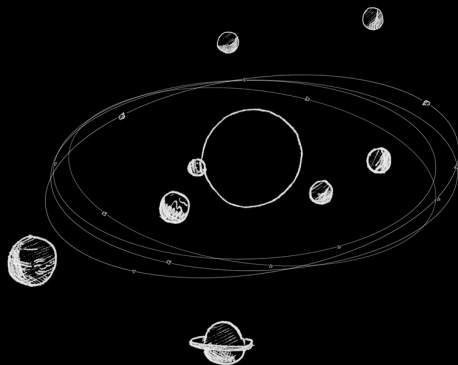
# Radial Velocity: precision



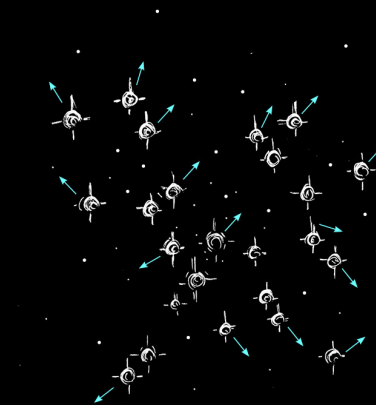




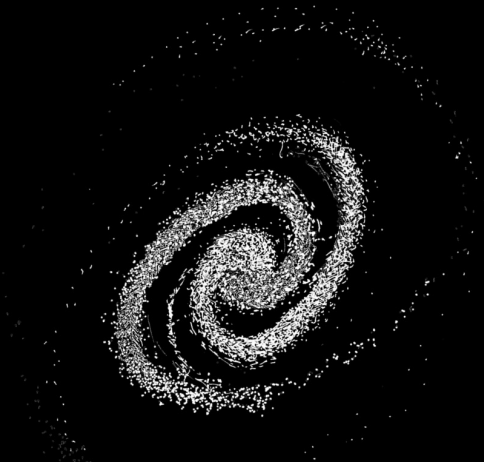
Earth & Gaia



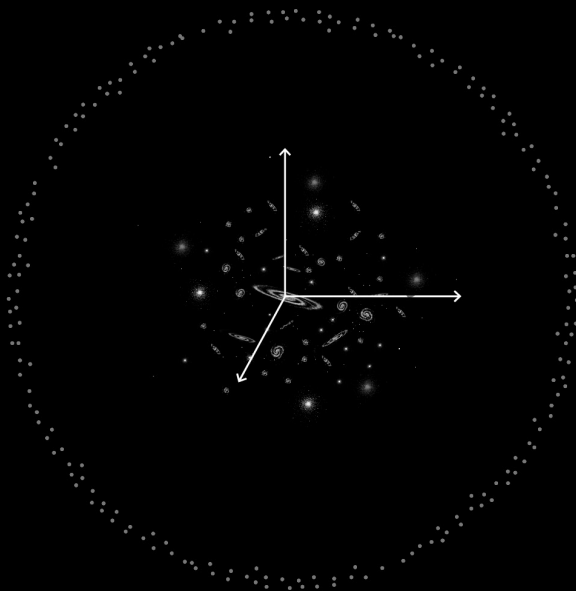
Solar System objects



Stars near the Sun



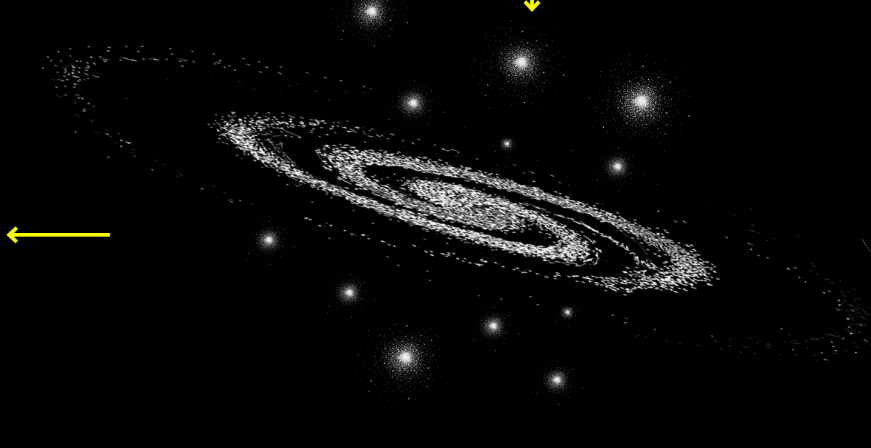
Milky Way: disc and bulge



Celestial reference frame: distant quasars



Nearby galaxies



Milky Way: halo and globular clusters

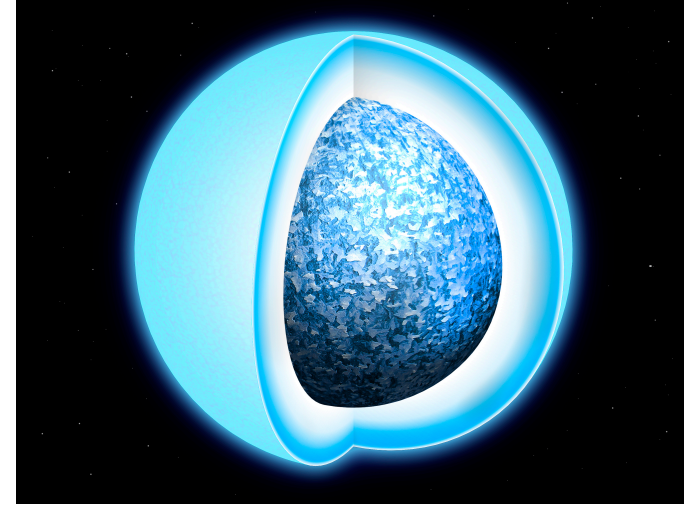
# Gaia DR2 science highlights

More than 1000 refereed papers

More than 300 arXiv preprints on the road ...

10 Nature articles (3 in main Nature journal relying fully on Gaia DR2 data)

Tremblay et al. 2019



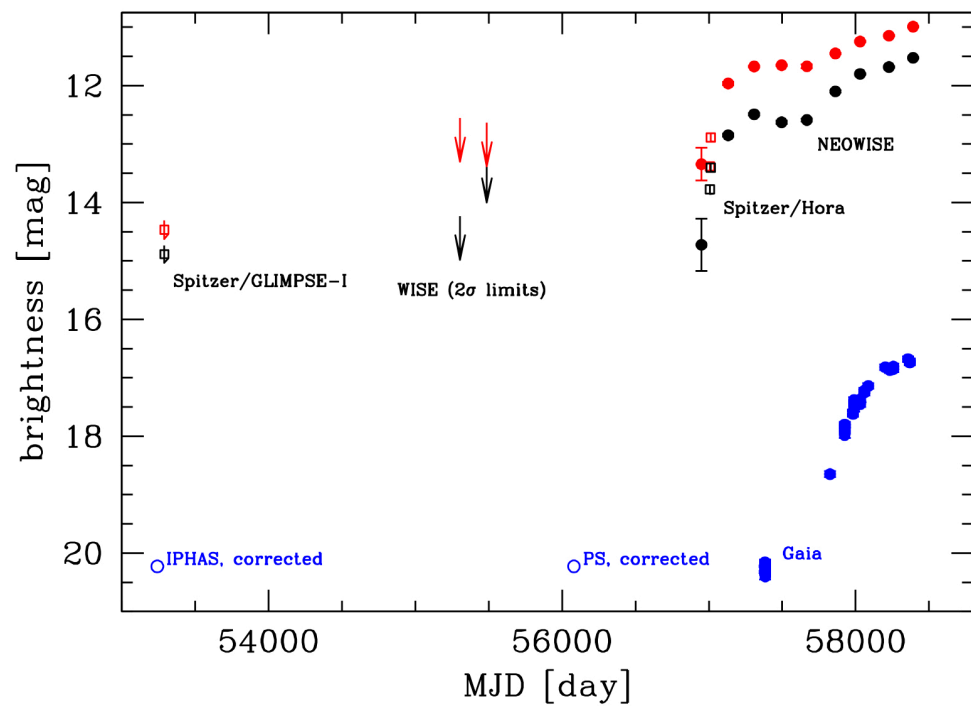
Helmi et al. 2018



Antoja et al. 2018

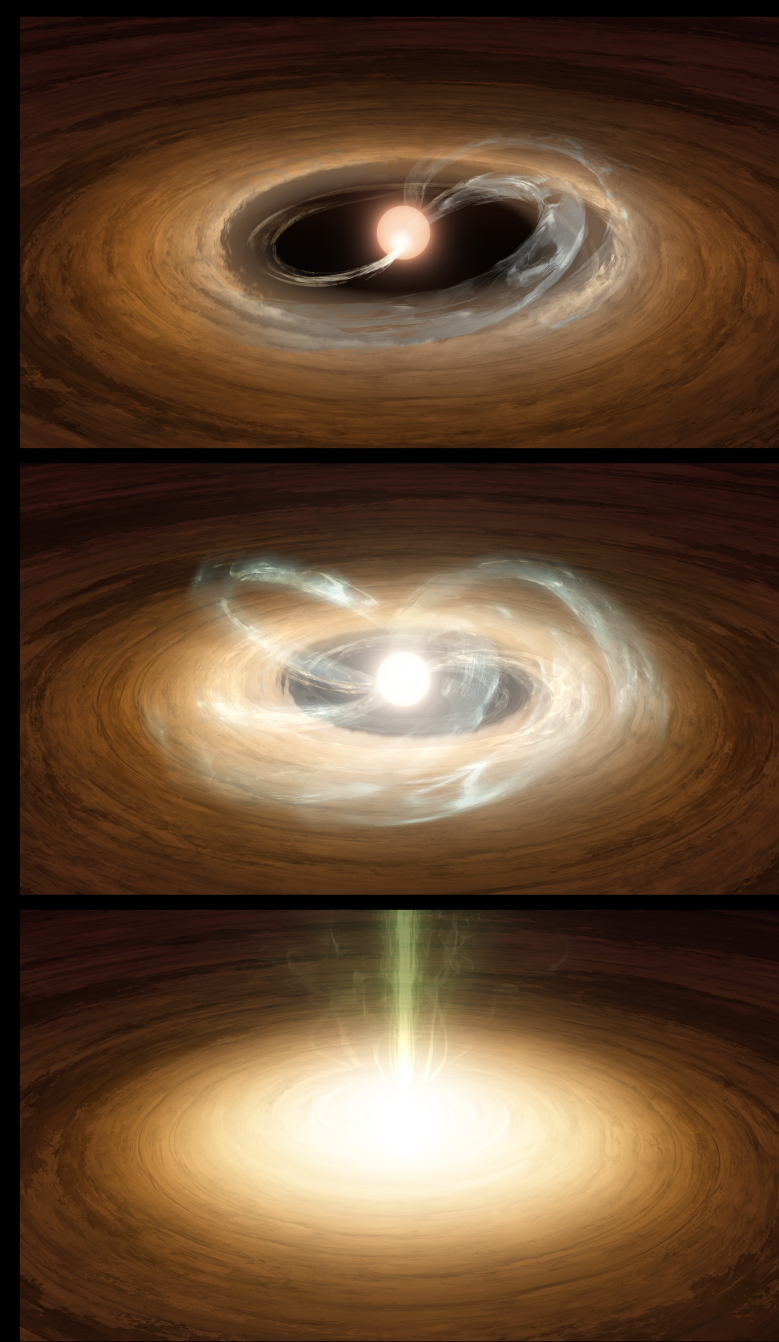


# FUOR outburst



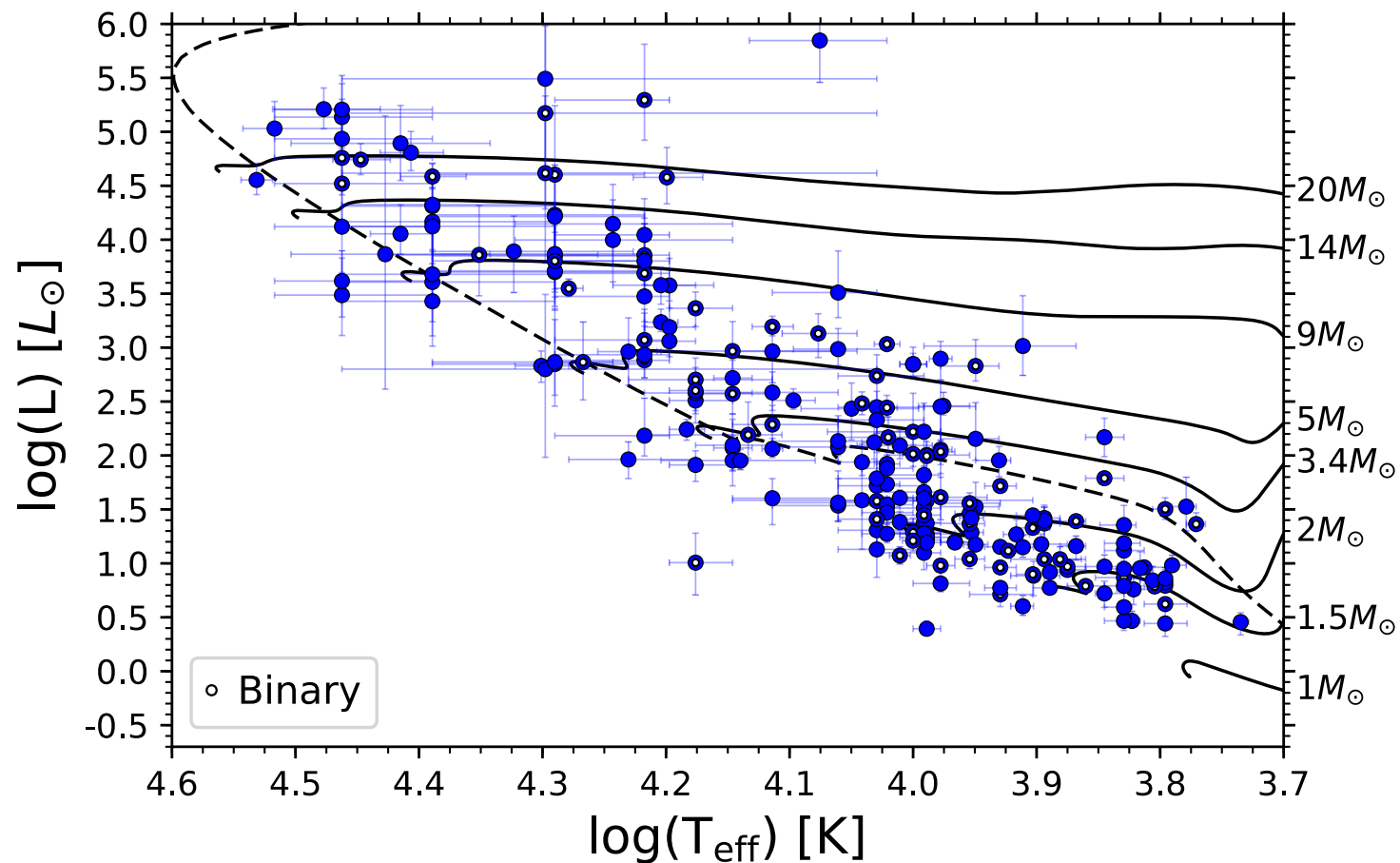
Hillenbrand et al. 2018

Image credit: Caltech/T Pyle (IPAC)



# HAEBEs as seen by Gaia

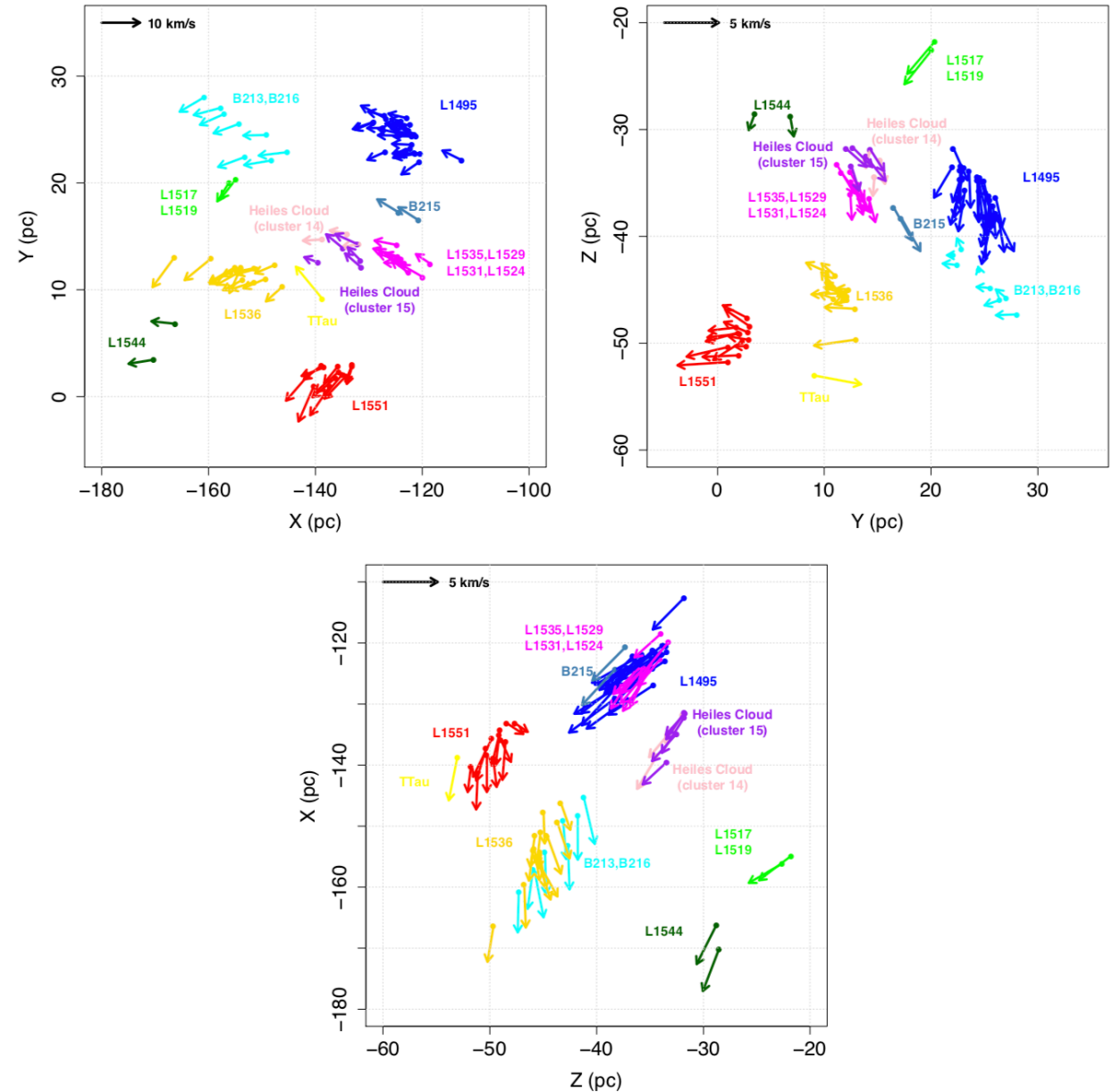
Vioque et al (2018)  
compiled Gaia  
DR2 info with  
literature data for  
252 HAEBEs to  
study the basic  
properties of the  
sample





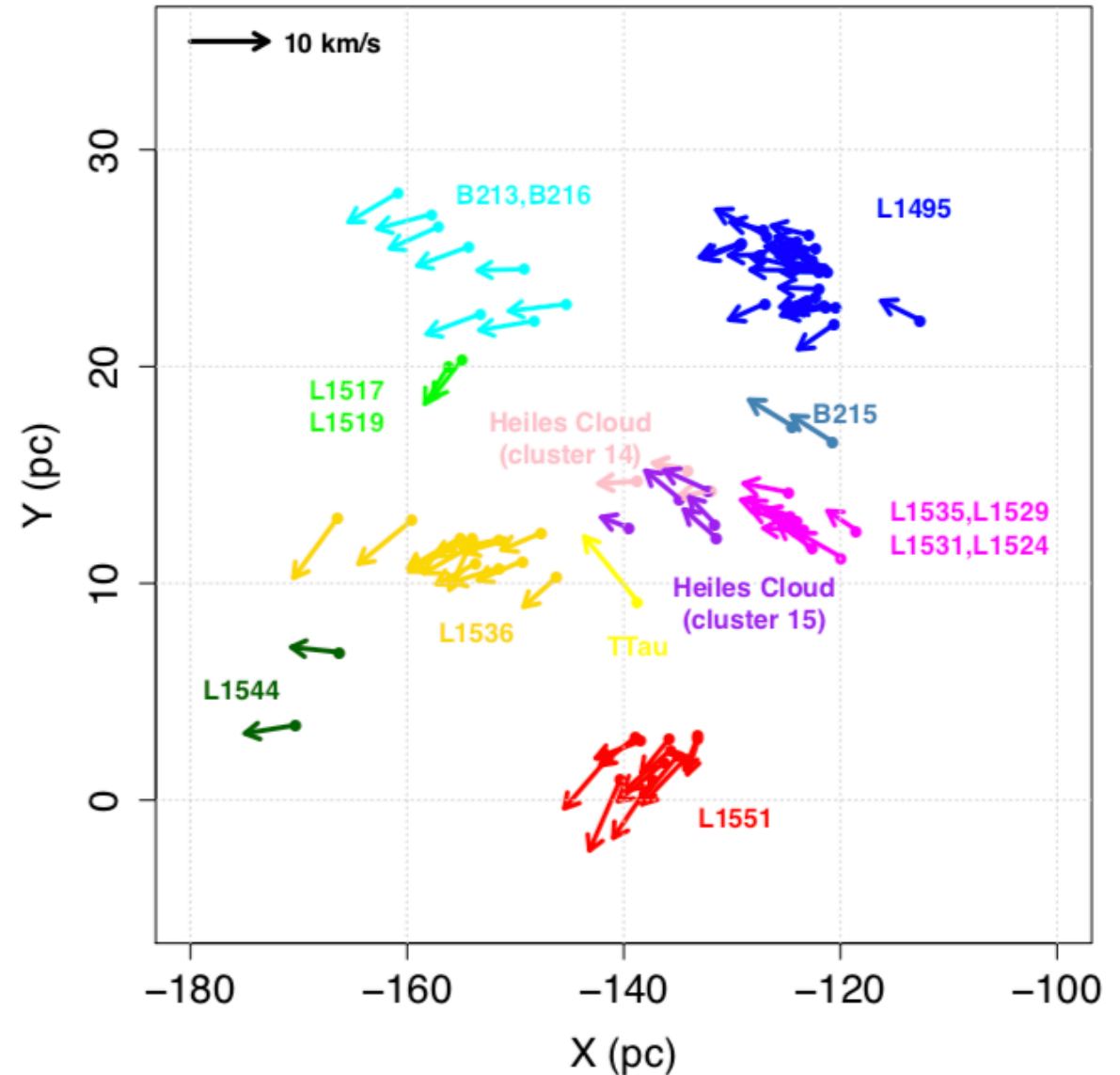
# Use of 3D info and kinematics

Galli et al. (2019) got 3D structure and group motions in Taurus by utilising proper motions



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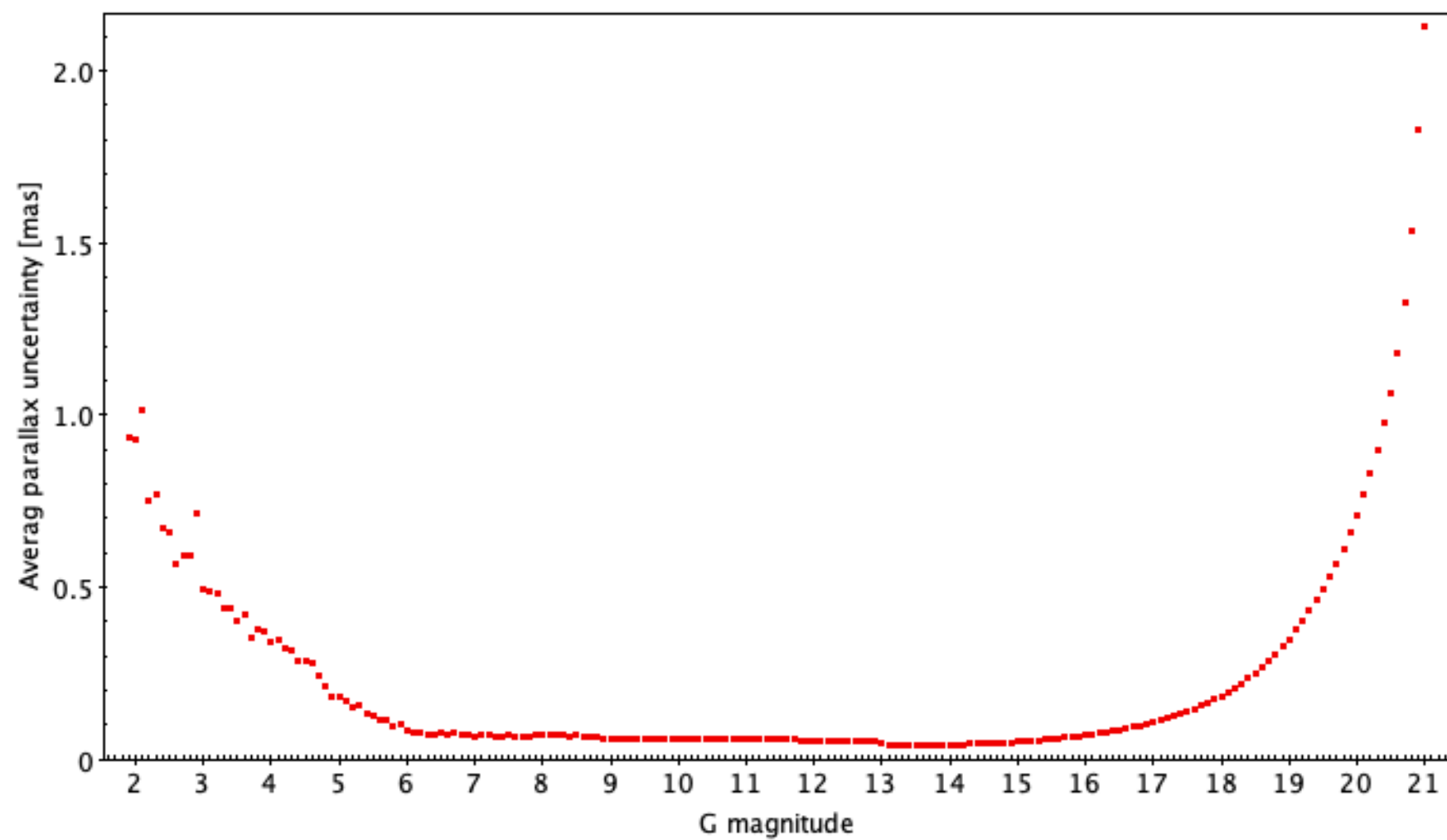


# A sample of UXORs and related objects

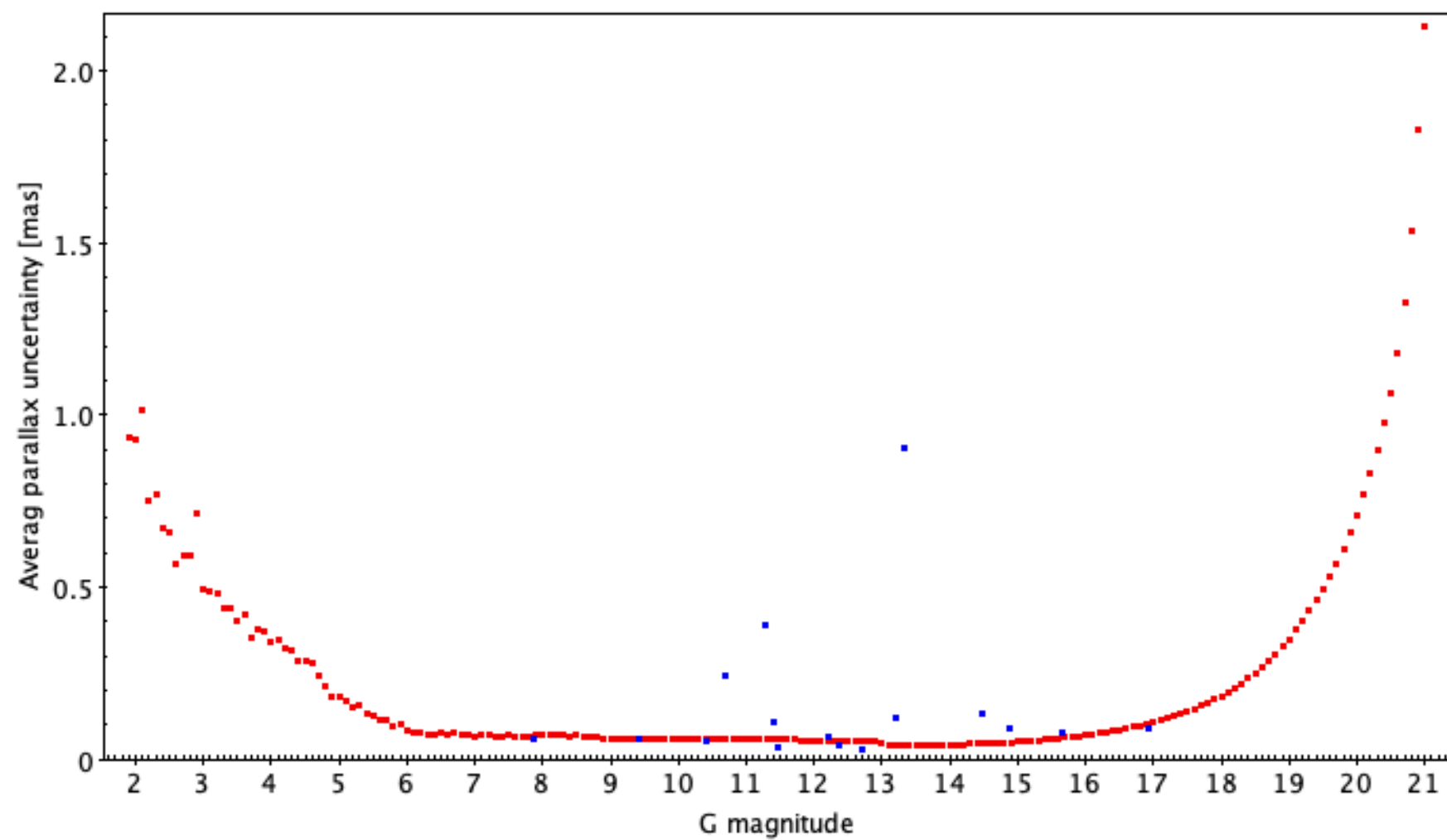
AA Tau, RW Aur, SU Aur, RY Tau, V582 Aur, RZ Psc, VX Cas, V1180 Cas, V517 Cyg, V1686 Cyg, GM Cep, BP Psc, UX Ori, HD37806, V582 Mon

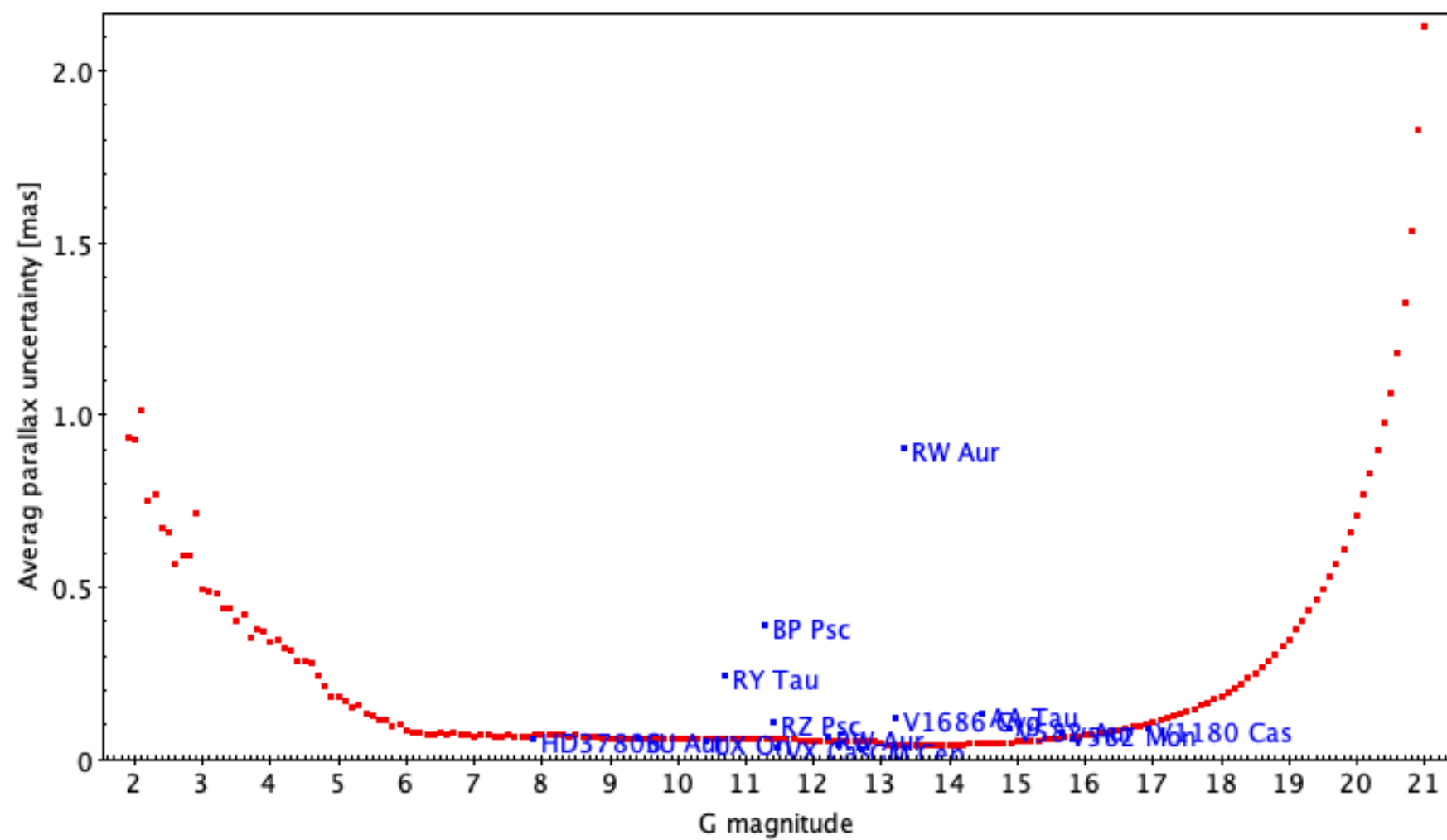
In Gaia DR2:

- Some astrophysical parameters, but better use literature values
- No radial velocities
- RW Aur binary resolved
- Light curves for: V582 Aur, V1180 Cas, V517 Cyg, V1686 Cyg, GM Cep

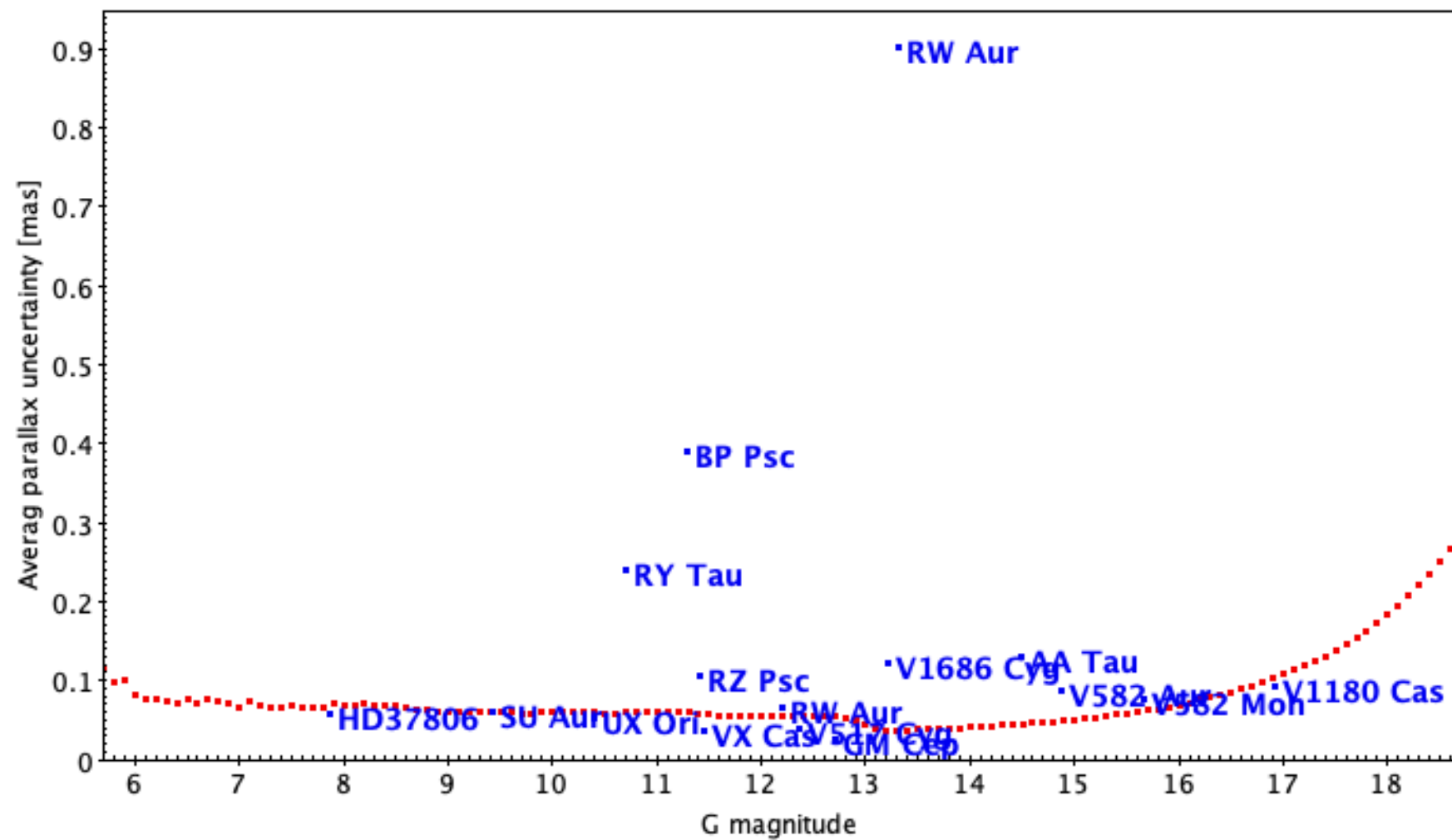


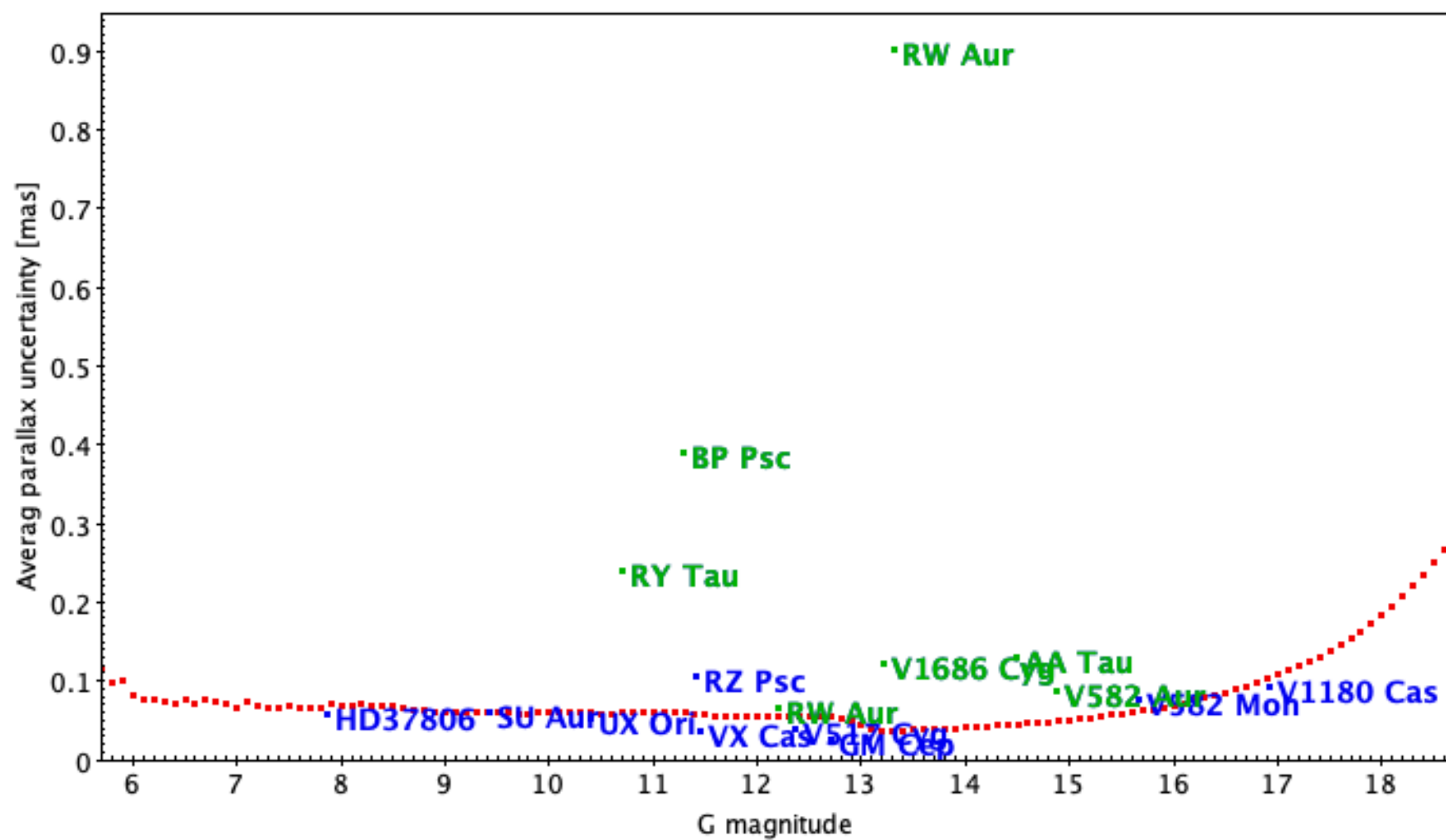


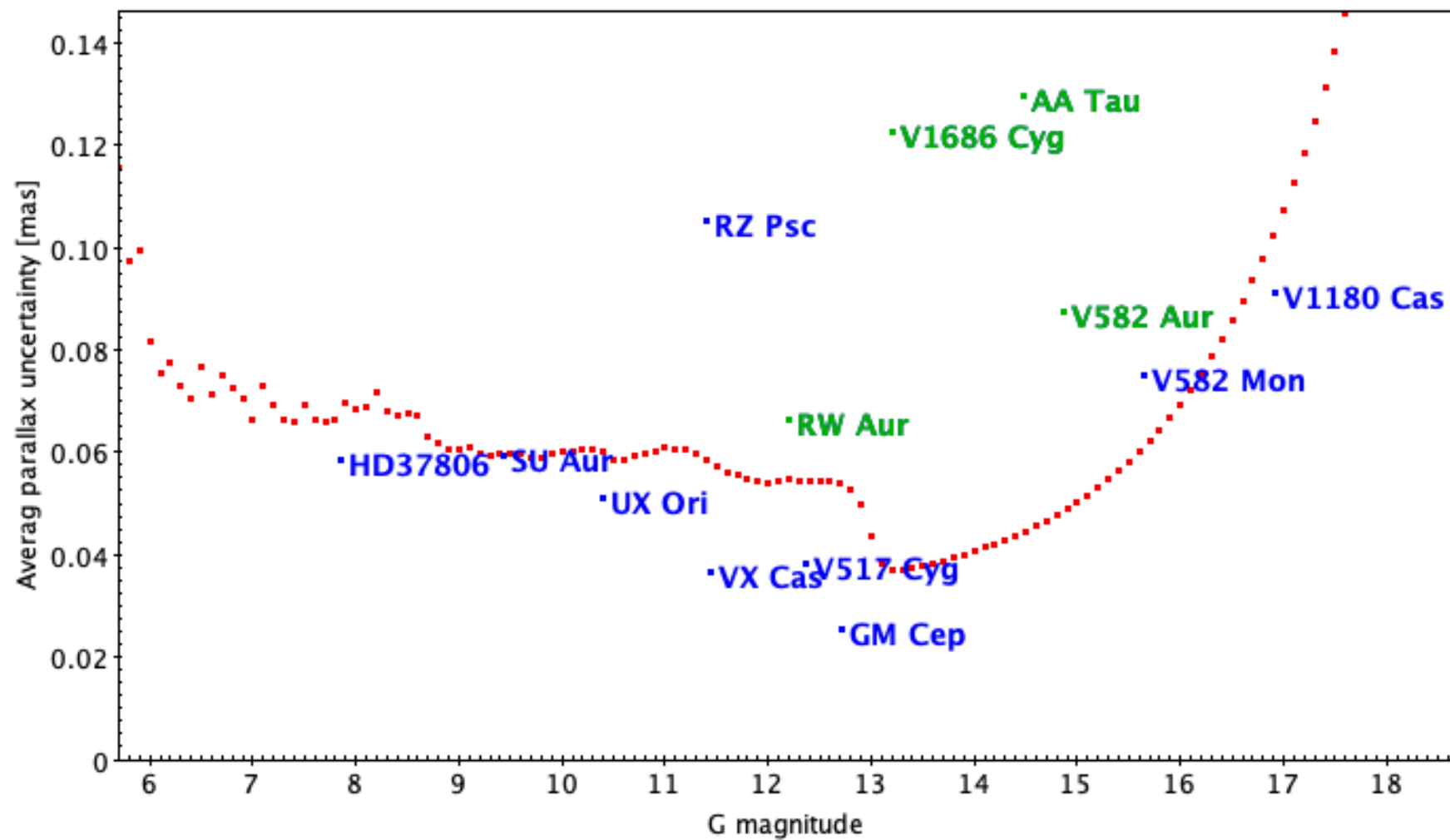




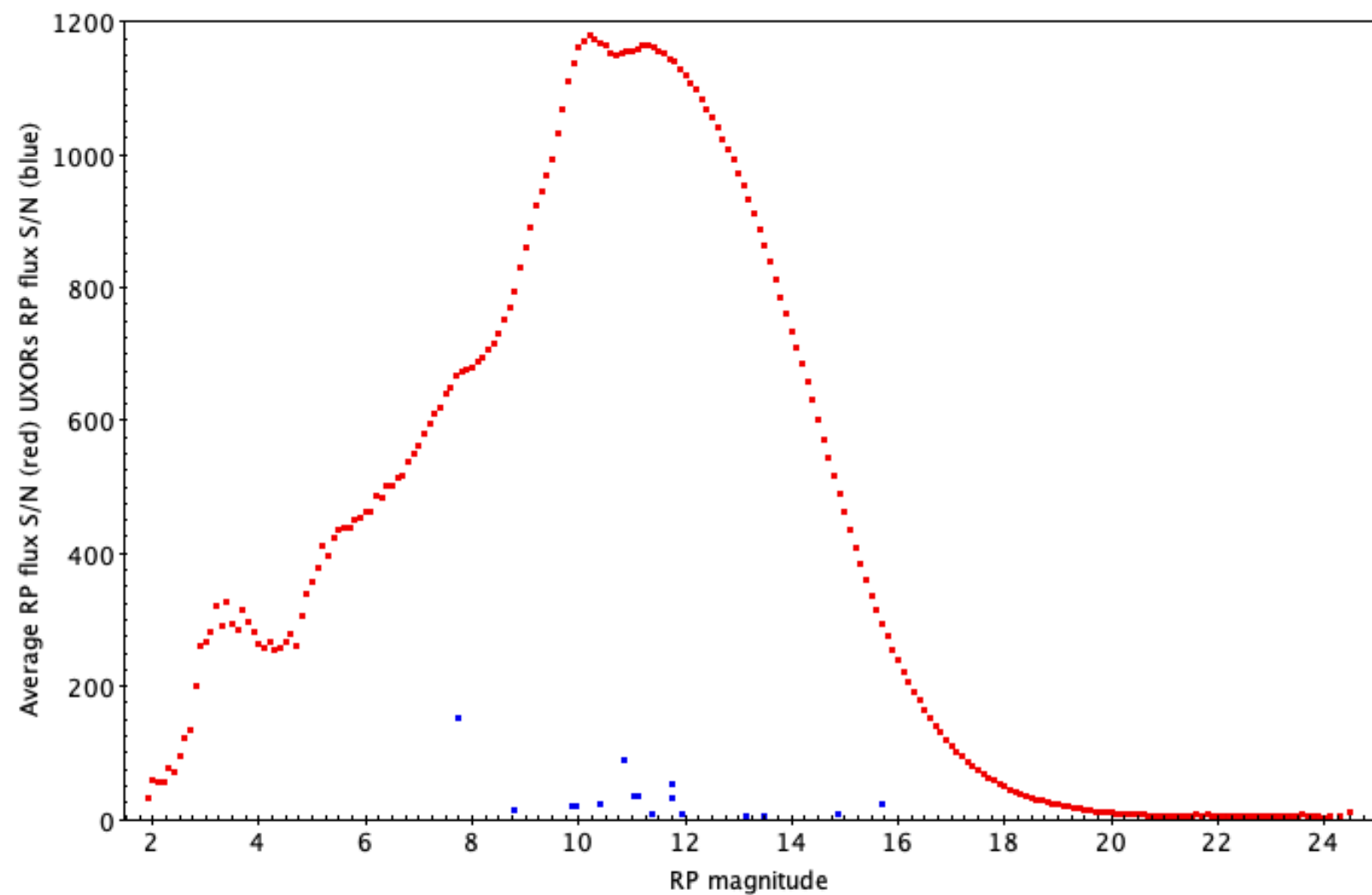


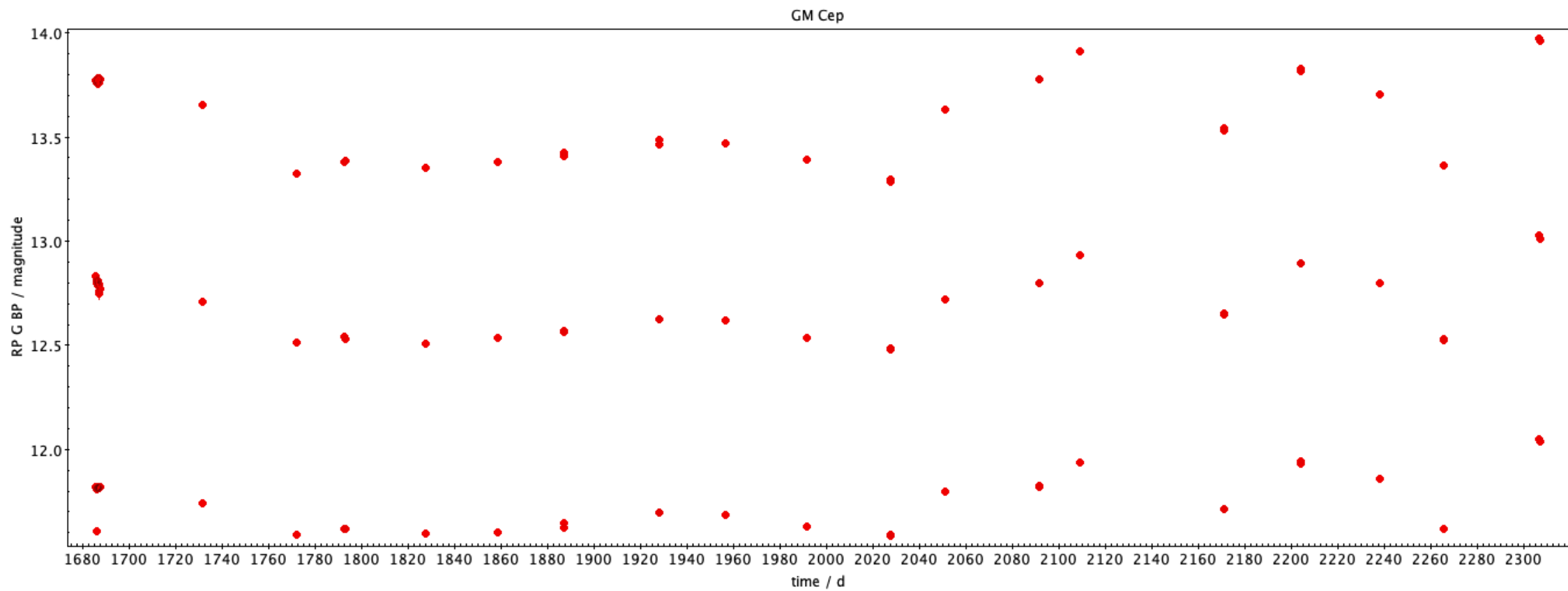




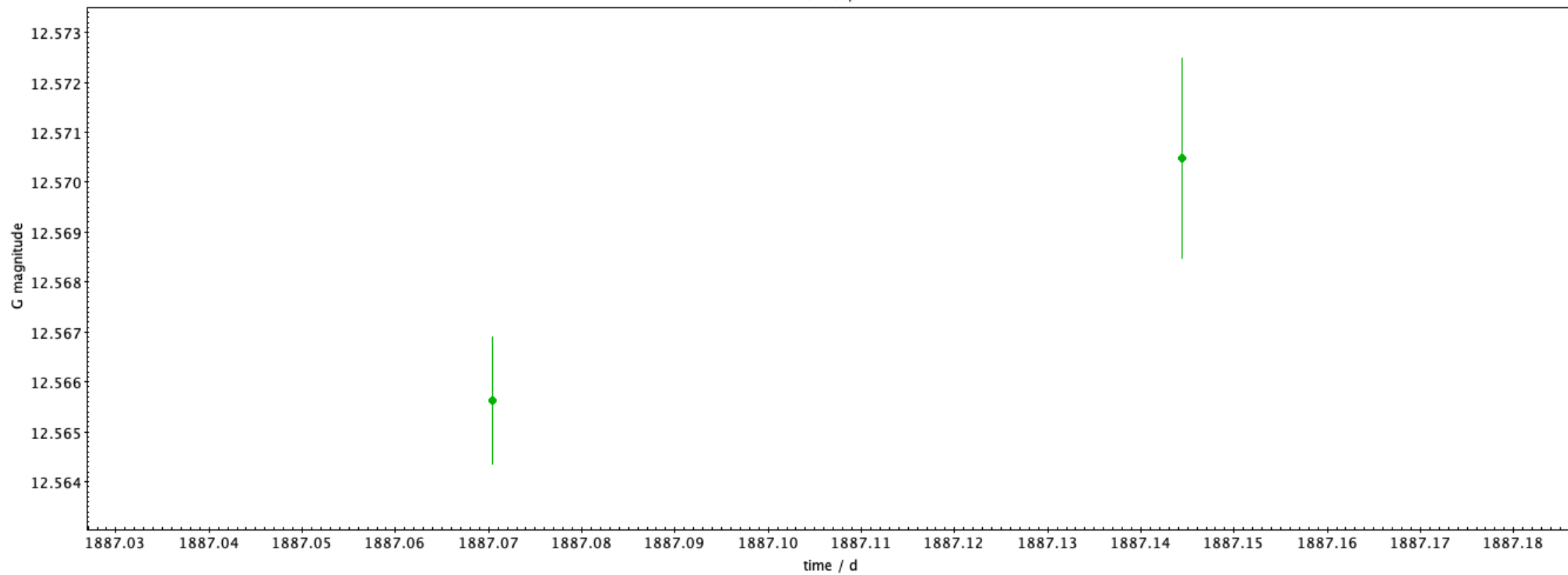








GM Cep

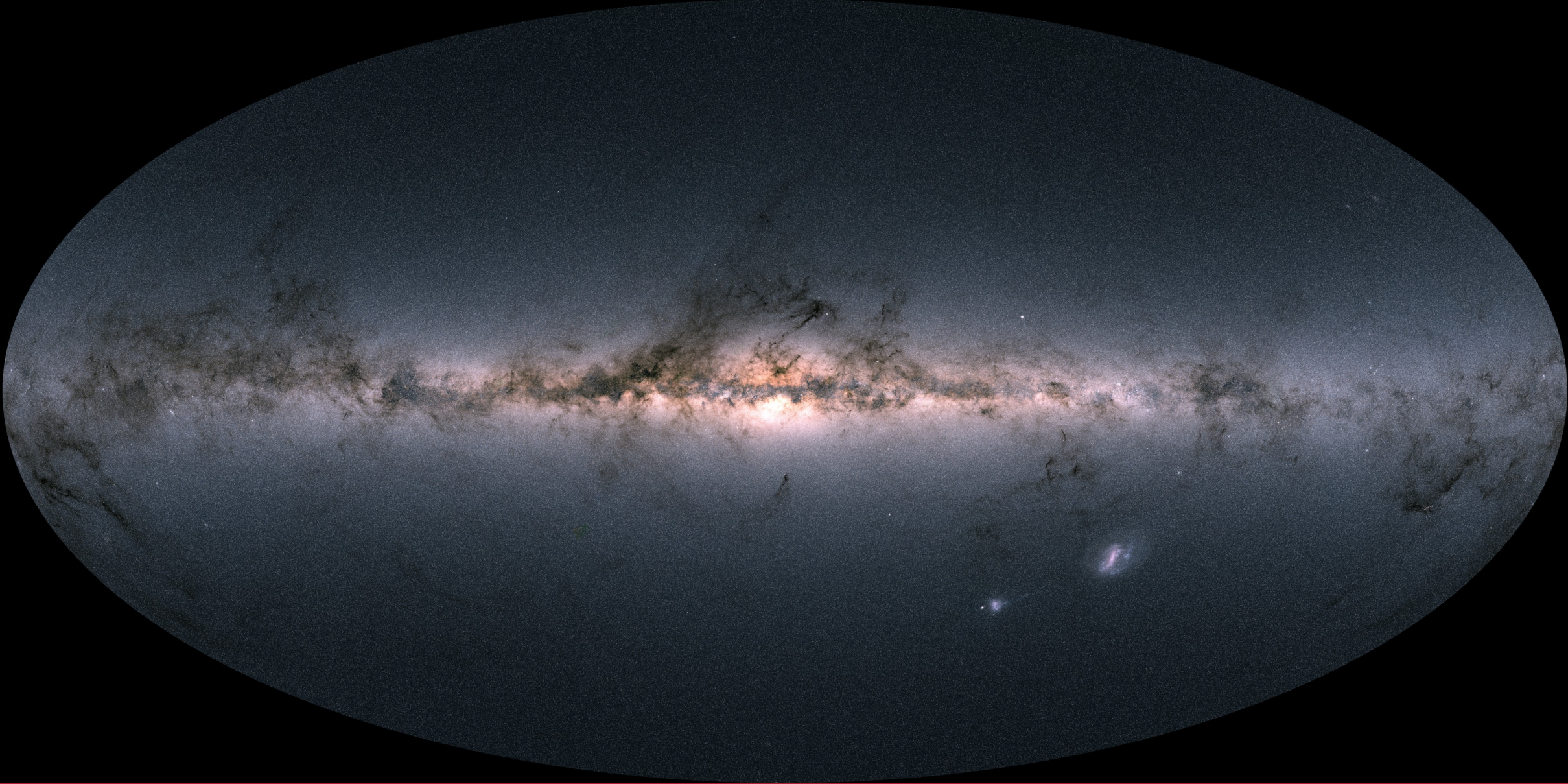




# Gaia DR3: 34 months of mission data

- Split into early and full Gaia DR3
  - Instead of waiting for everything to be ready, release ready data early
- Gaia EDR3 third quarter (Q3) 2020
  - Astrometry and (integrated) photometry
- Gaia DR3 second half (H2) 2021
  - Gaia EDR3 (no update)
  - Radial velocities (more due to fainter limit)
  - Variable objects (more due to longer time baseline)
  - Astrophysical parameters (based on spectra which are also to be released)
  - Results from (pre-selected list of) quasars and extended objects
  - Solar system objects (significantly more)
  - Non-single stars
  - Gaia Andromeda Photometric Survey





<https://www.cosmos.esa.int/web/gaia>