

Status of the Gaia mission

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gaia

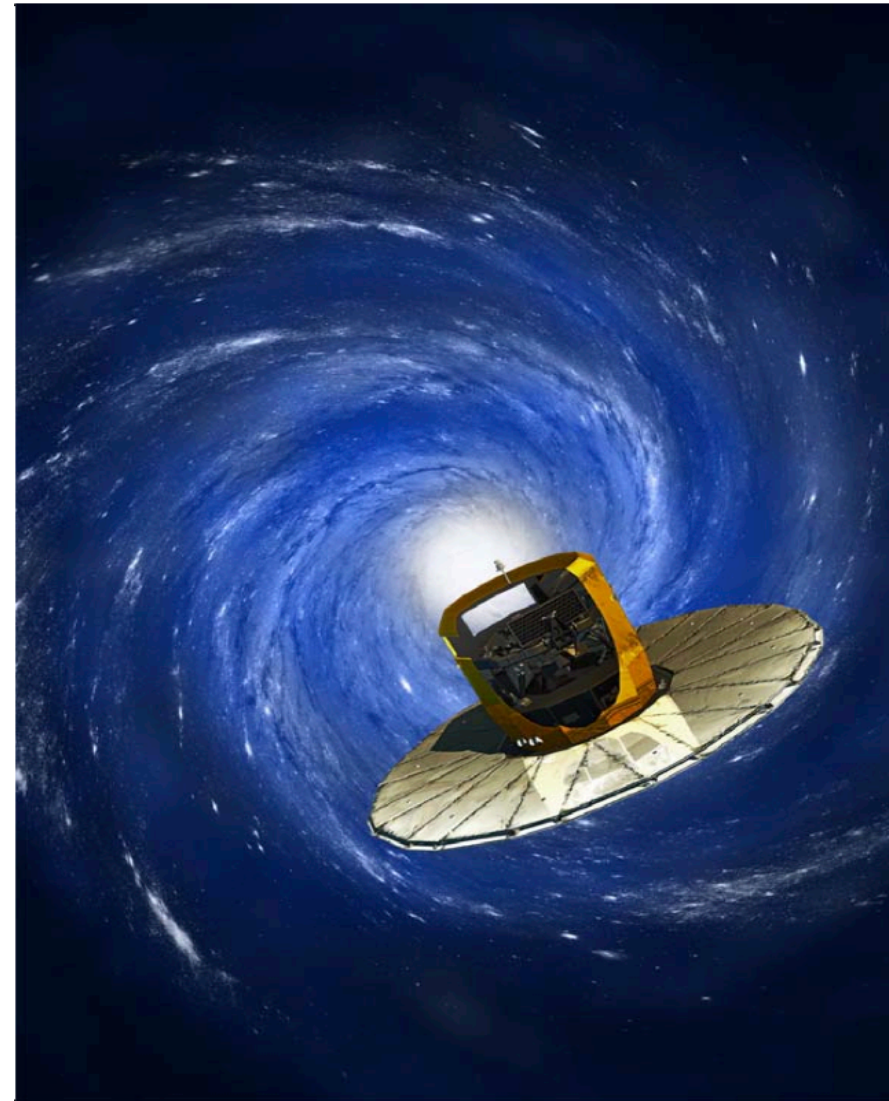
SRS Lund

2021 March 16



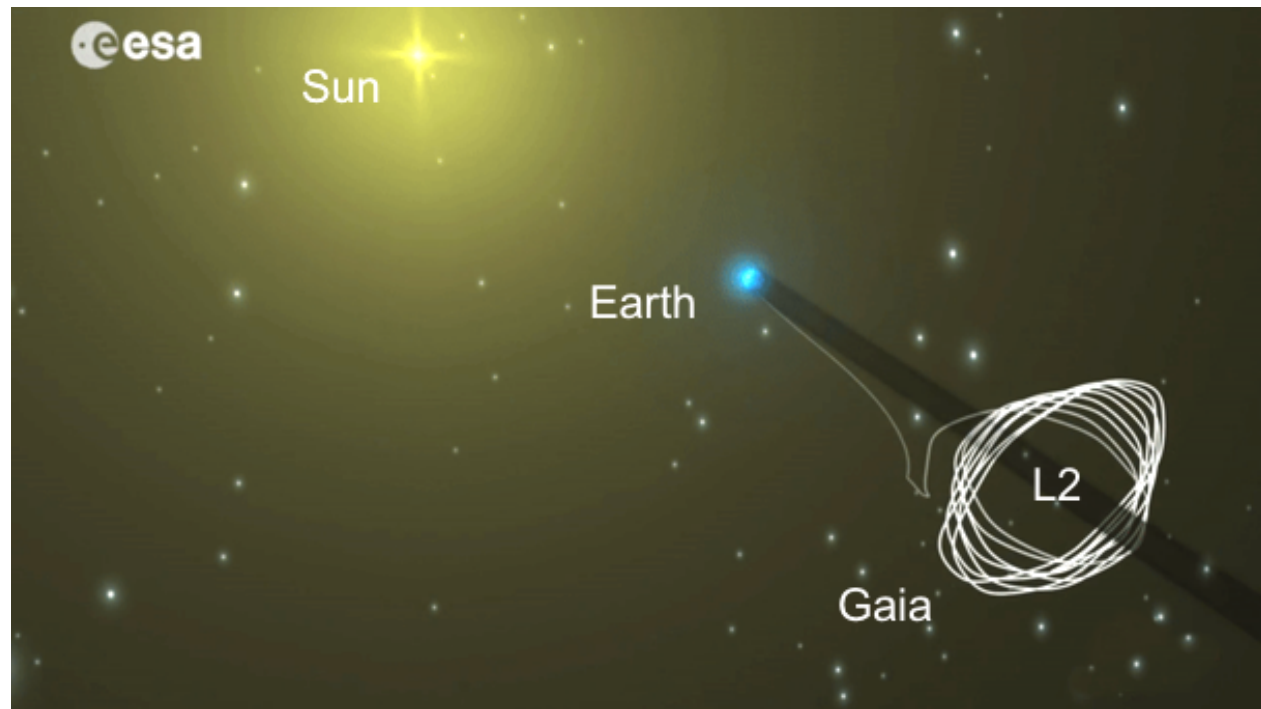
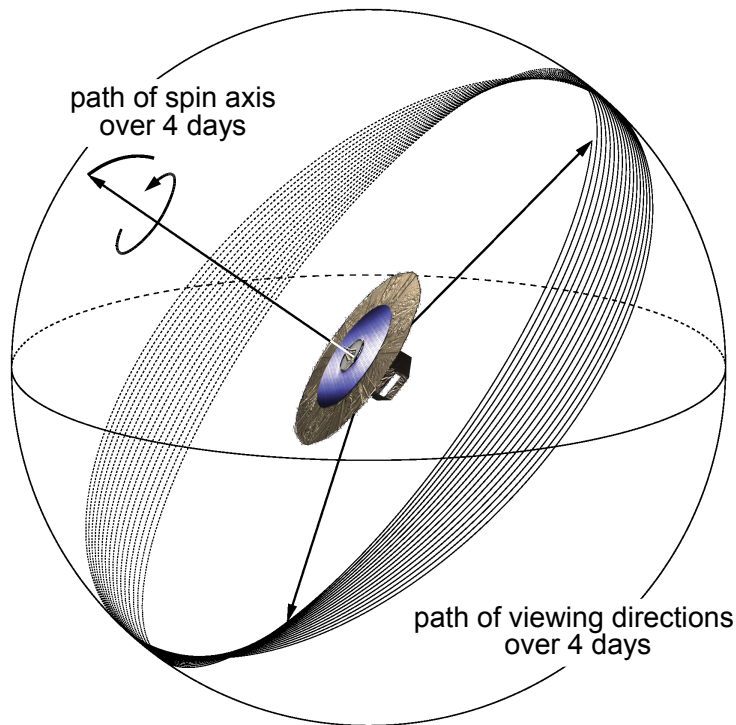
Gaia - The mission

- Astrometric and spectrophotometric data for > 1 billion objects
- Radial velocities for > 100 million objects
- Survey
 - ▶ Autonomous on-board detection of "point" sources (res $\sim 0.1''$)
 - ▶ Complete for $G = 6$ to 20.7
- Science objectives
 - ▶ Solar system
 - ▶ Stellar astrophysics
 - ▶ Structure and formation of the Galaxy
 - ▶ Cosmology
 - ▶ Reference frame and fundamental physics



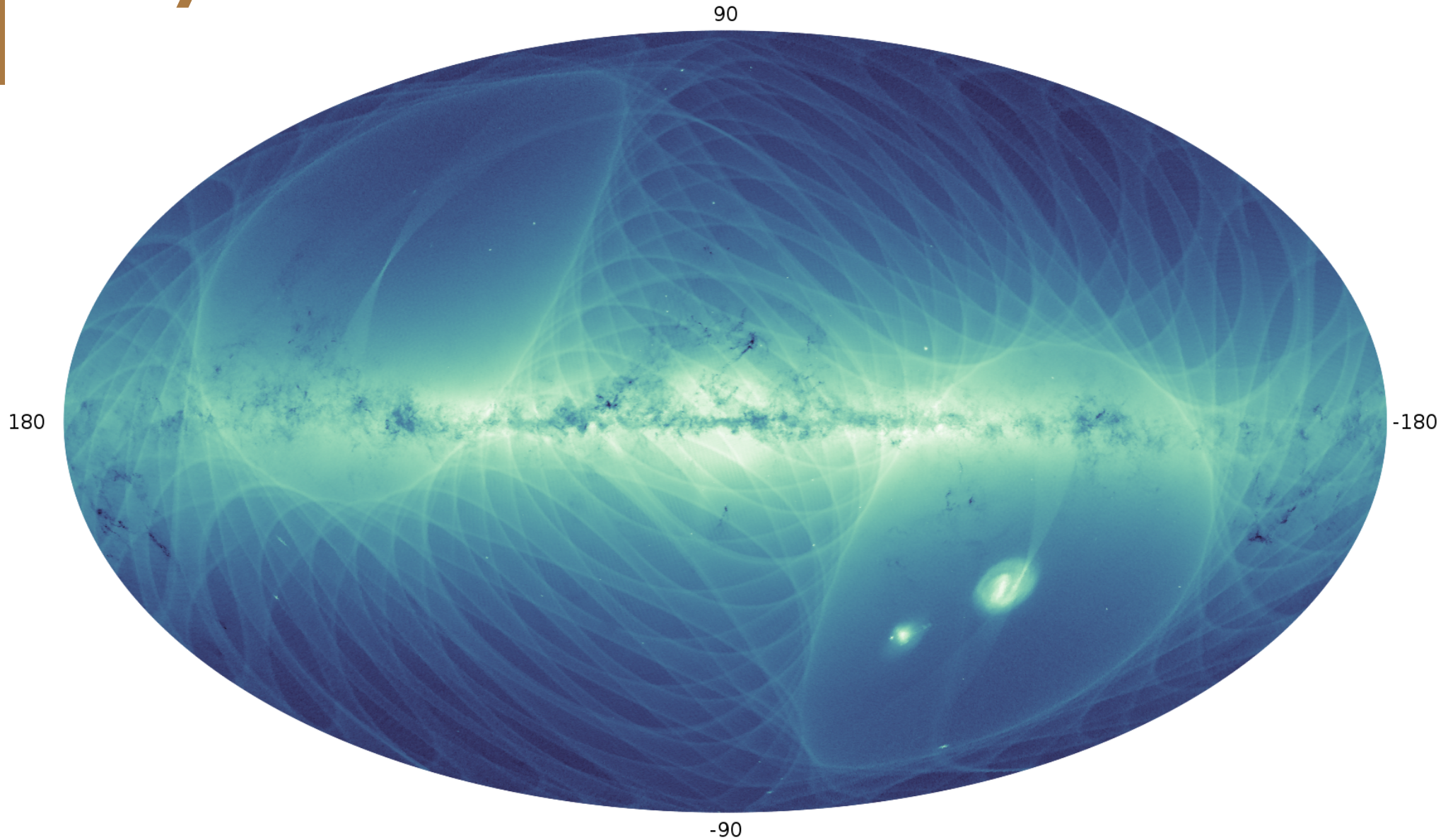
Gaia - Launch and operations

- Launched by ESA in December 2013
- Up to 10 years of operation at L2



- Scanning observation mode
 - ▶ Full sky coverage
 - ▶ ~14 visits per year
 - ▶ Quasi-irregular time sampling
 - ▶ Two telescopes set at a fixed "basic angle" (106.5 degrees)

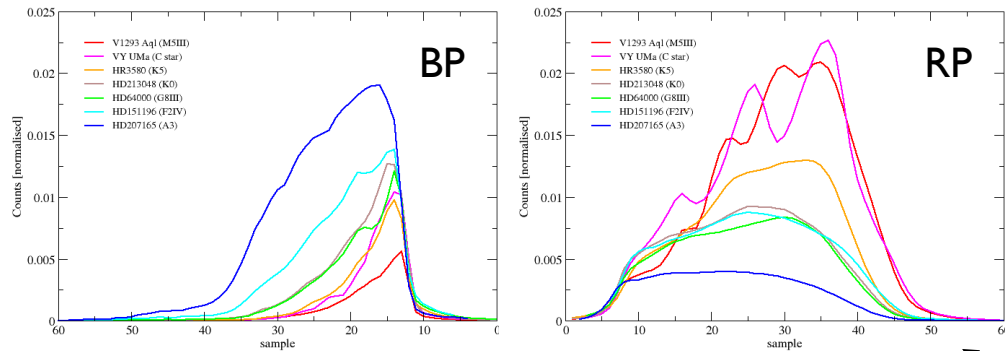
5.5 years of Gaia observations



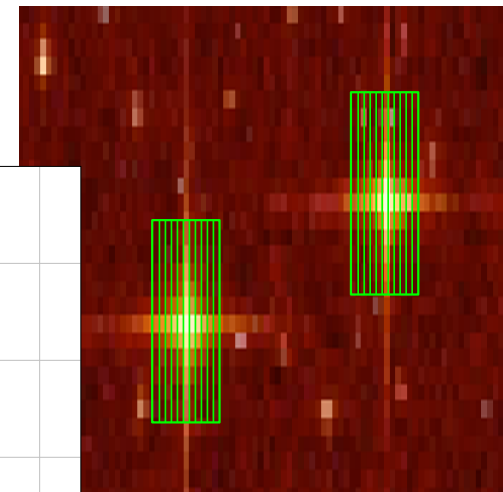
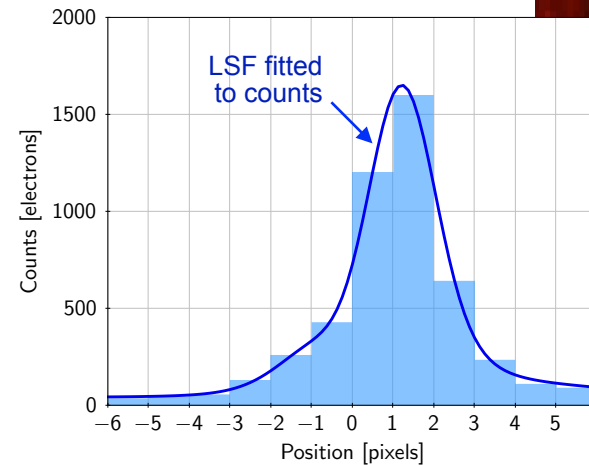
142 billion detections processed at the Data Processing Centre of Barcelona using a total of 750,000 CPU hours of the MareNostrum supercomputer

Gaia - Data products

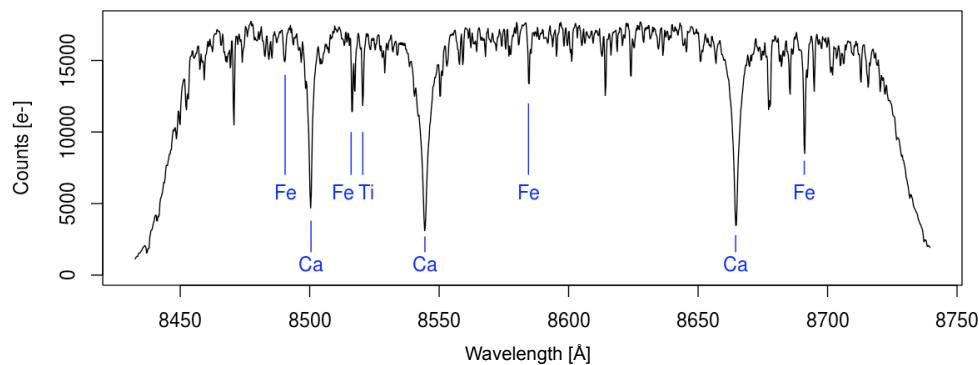
integrated photometry (G_{BP} , G_{RP}),
low-dispersion spectra



astrometry, G



radial velocities, spectra



Red & blue
photometer
detectors

RVS
detectors

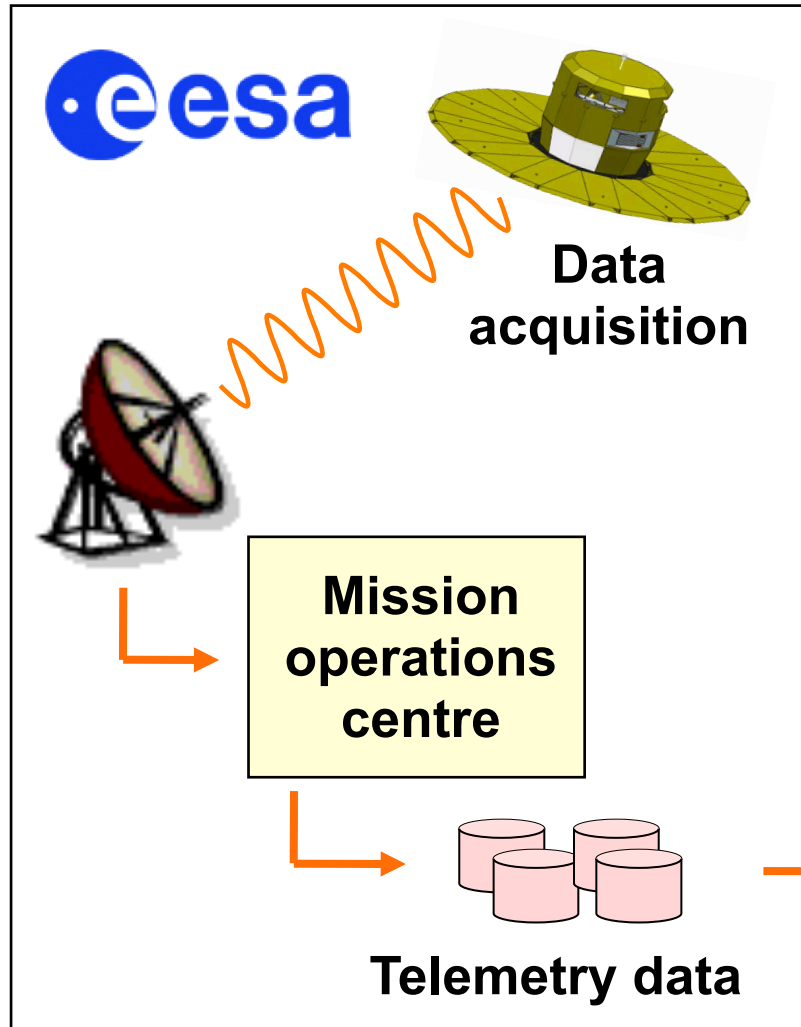
Astrometric
field

Sky mapper (detection)

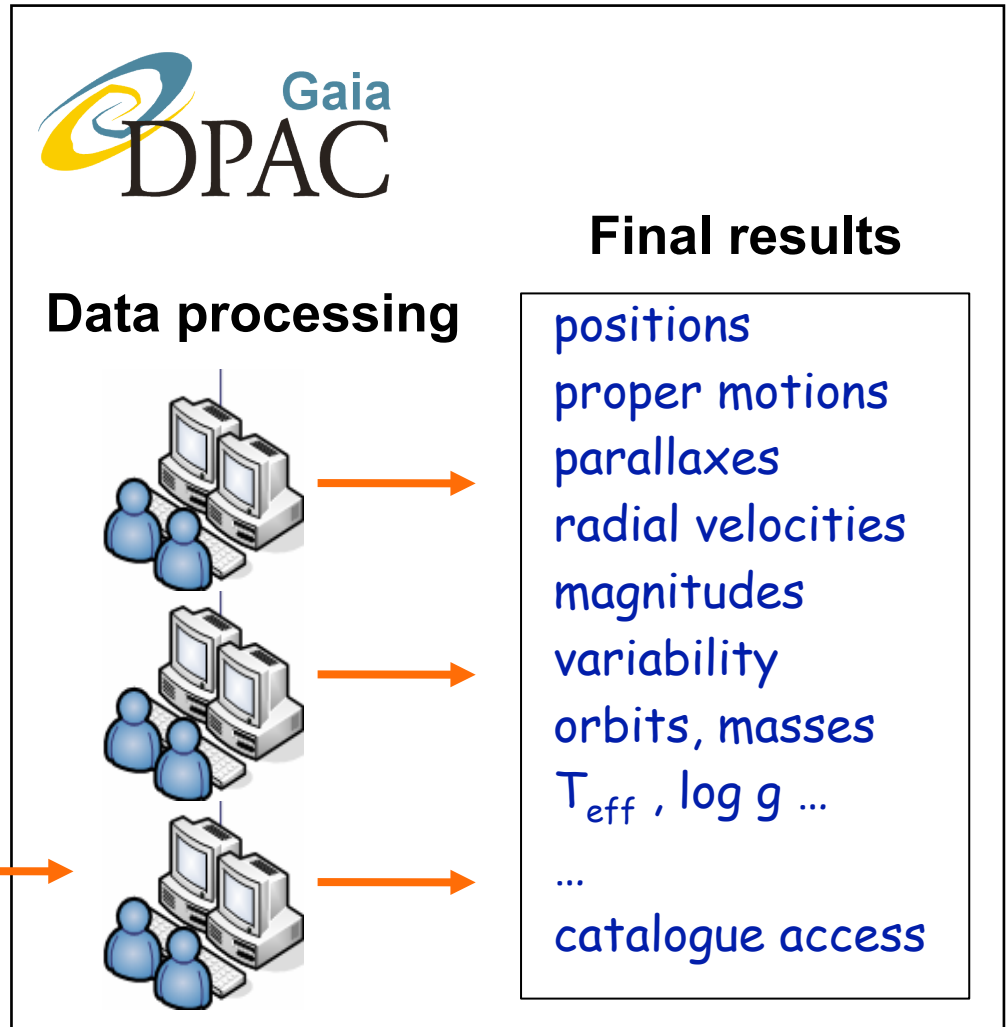
- time series
- object classification and analysis (binaries, etc.)
- astrophysical parameters

ESA and DPAC responsibilities

European Space Agency

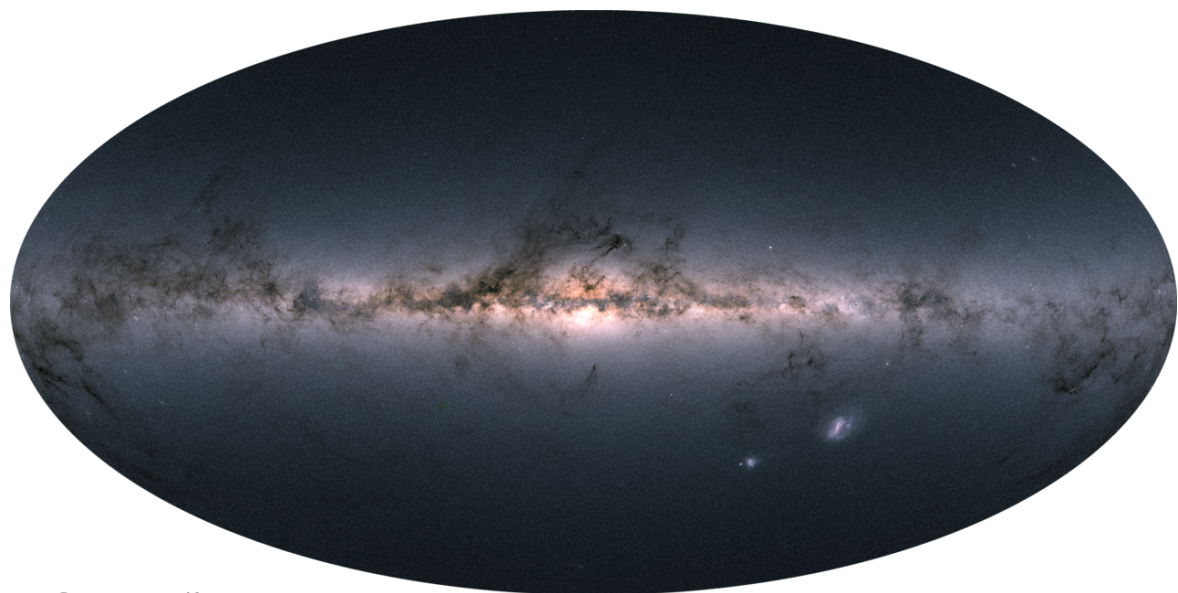


Gaia Data Processing and Analysis Consortium (DPAC)

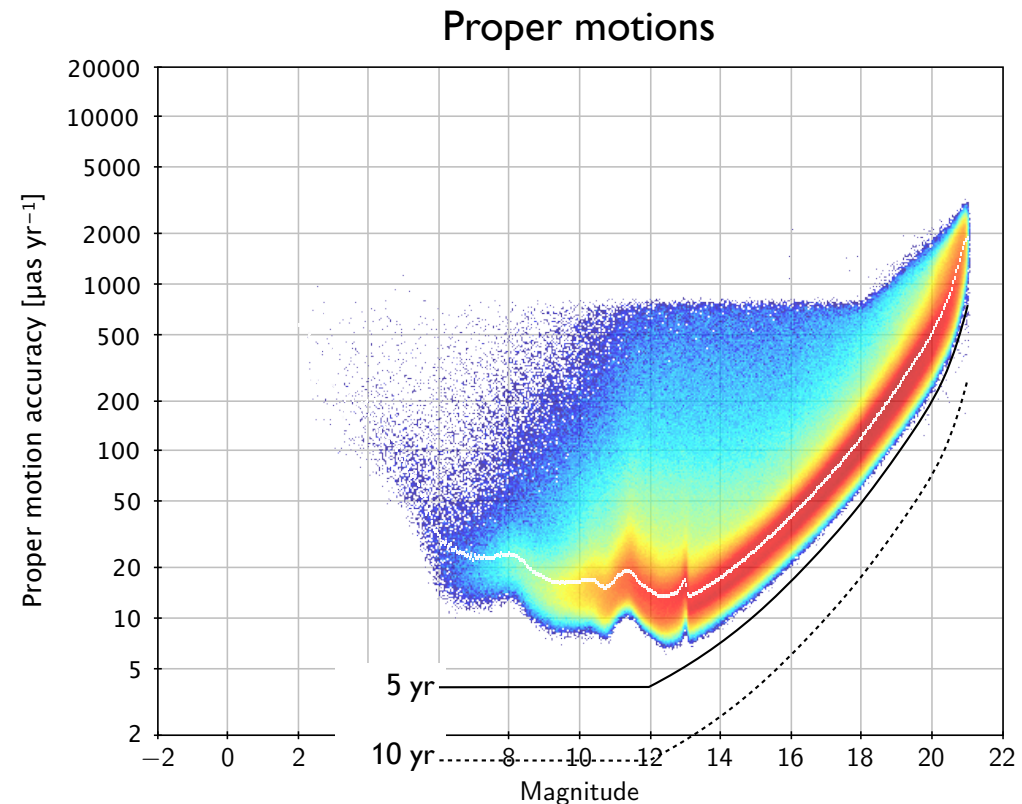
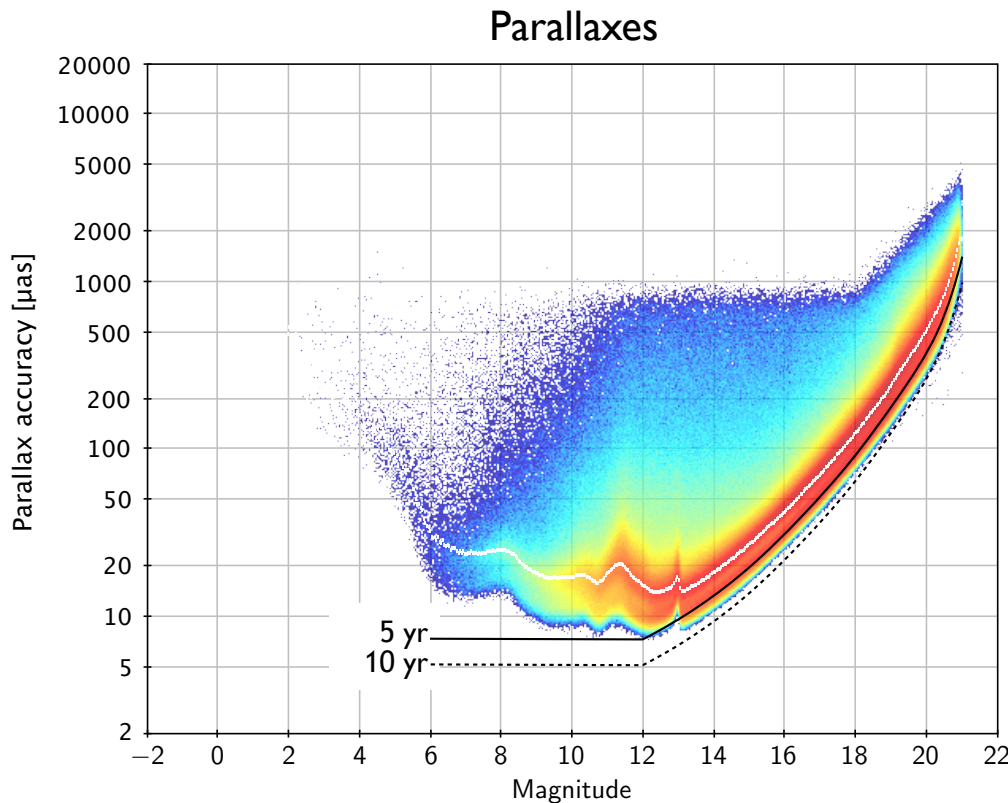


Gaia - Data releases

- Early DR3 (3 Dec 2020)
 - ▶ Astrometry, G, G_{BP}, G_{RP} (1.5 billion sources)
 - ▶ Radial velocities from DR2 (7.2 million, $G < 12$)
- DR3 (2022)
 - ▶ Deeper RV survey (~ 30 million, $G < 14$)
 - ▶ BP/RP/RVS spectra
 - ▶ Non-single stars, extended objects
 - ▶ Astrometry for 10^5 solar system bodies
 - ▶ ~ 5000 asteroid reflectance spectra
 - ▶ GAPS = Gaia Andromeda Photometric Survey (light curves)
- DR4 - full release for nominal mission
- DR5 - full release for nominal + extended mission



Astrometric precision of (E)DR3



Coloured distribution: actual uncertainties in EDR3 and DR3 (white line = median)
Black curves: extrapolated median uncertainties for DR4 and DR5

Swedish involvement in Gaia/DPAC

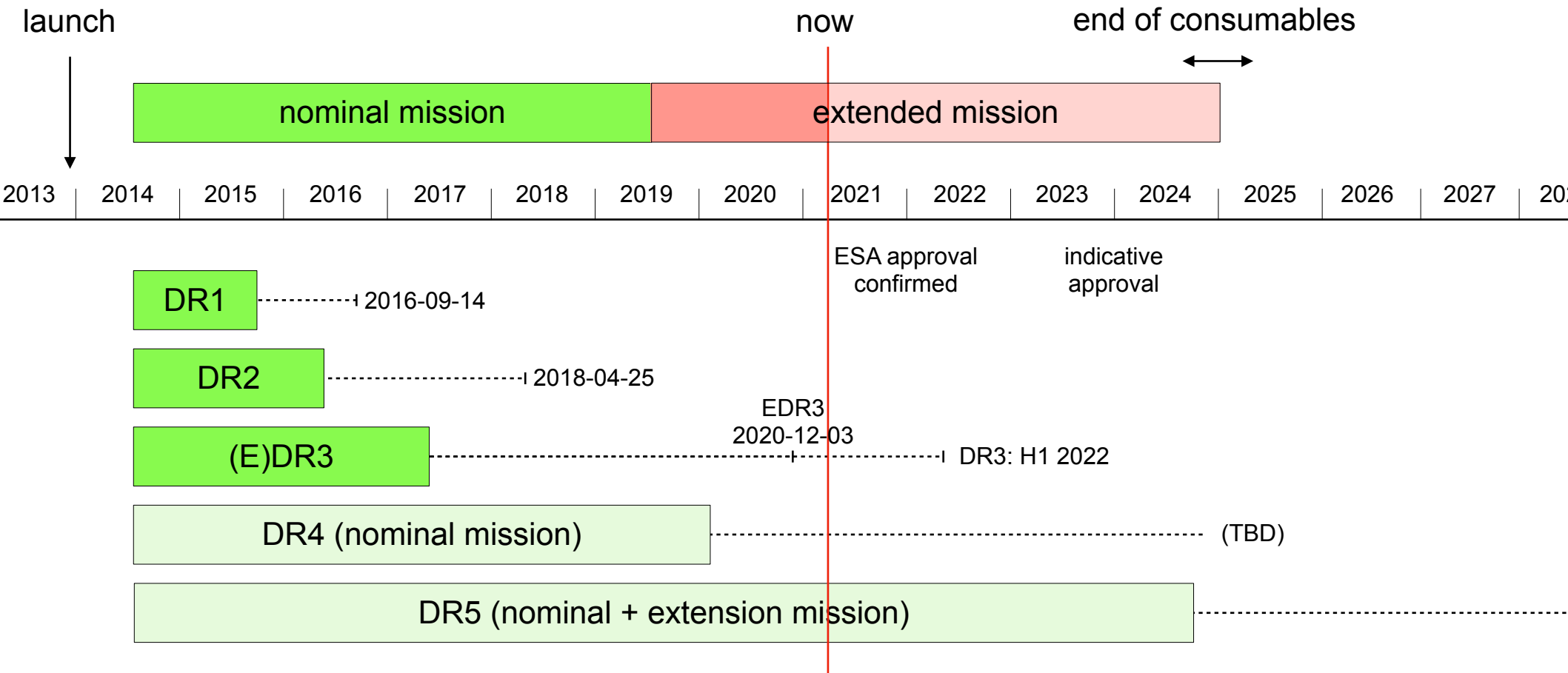
- Lund:

- David Hobbs, Paul McMillan, Lennart Lindegren (staff)
- Eero Vaher, Daniel Mikkola (PhD students)
- the astrometric solution (models, algorithms, software, analysis)
- scientific exploitation of Gaia data
- LL is a member of the Gaia Science Team

- Uppsala:

- Ulrike Heiter, Andreas Korn, Bengt Edvardsson (staff)
- Alvin Gavel (PhD student)
- training, validation, and calibration of software to derive basic stellar astrophysical parameters (surface temperatures and gravities, chemical composition, masses and ages) from Gaia observations
- provide grids of synthetic observables (stellar fluxes and spectra) for training purposes and establish a set of Gaia benchmark stars
- AK represents CU8 as beta tester in CU9

The future: DR3 and beyond



Summary

- Gaia is doing extremely well and may continue operating till 2025
- Only 3 years of data have been analysed - 5 available, up to 5 more to come (e.g. proper motions will be 3-6 times better)
- >4000 peer-reviewed papers using Gaia data since launch (3-5 per day on arXiv astro-ph)
- The difficult analysis (μ as accuracy, binaries, spectra, ...) is still ahead of us
- Important that DPAC can continue with strong national support well beyond the end-of-mission (~2025)