Gaia status, upcoming data releases, mission extension

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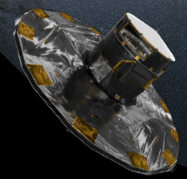
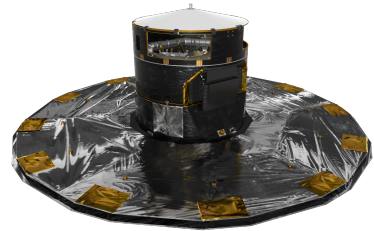


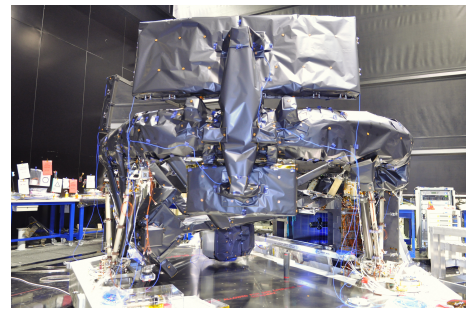
ESA/Gaia/DPAC

Gaia

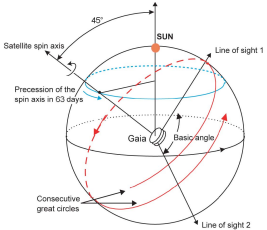
- Astrometry and spectrophotometry for >1 billion sources
- Radial velocities for >100 million sources
- Survey
  - Complete to $G = 20.7$ ($V = 20$–22)
  - Quasi-regular time-sampling over 5 years (~ 70 observations)
- Launch December 2013
- 5 years of nominal operations at L2
  - mission extended to end 2020 (+1.5 yr)

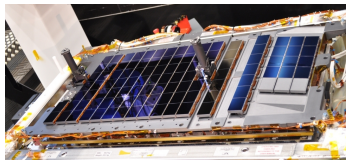
- Second data release April 25 2018
- Photometric alerts started in 2014
- Alerts on new solar system objects started end 2016

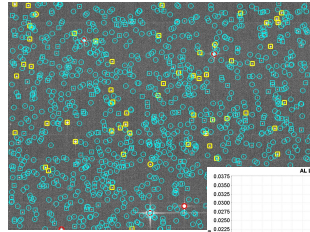


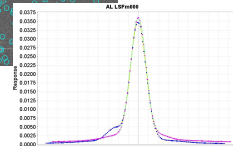


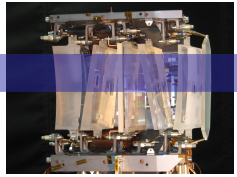
Gaia instruments and measurements

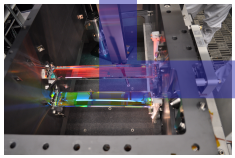


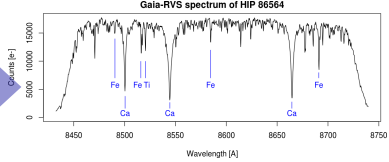


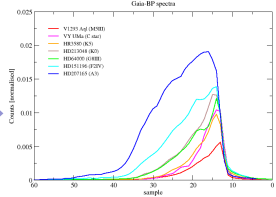


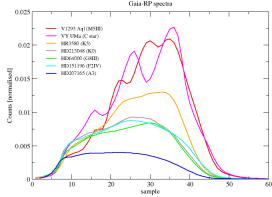






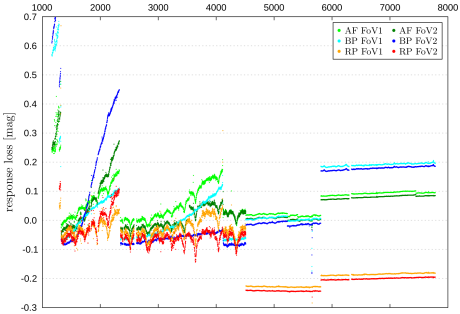


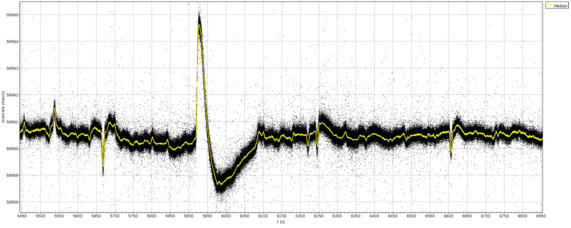


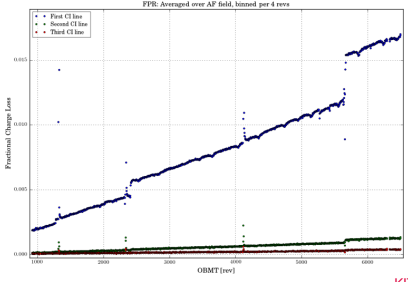


Mission status

- 55 months of data collected since July 25 2014
  - Gaia DR2 based on 22 months
- Operations nominal, with following issues
  - stray light, telescope focus evolution
  - basic angle variations, contamination
  - micro-meteoroids and micro-clanks
  - radiation damage
  - one transponder lost







GAIA DR2 INFO

Information on Gaia Data Release 2 contents, completeness and limitations.

GAIA DR2 PAPERS

Titles and links to papers describing the data processing and demonstrating the science potential of Gaia Data Release 2.

GAIA DR2 DOCUMENTATION

The full documentation for the second data release, both on webpages and with a downloadable PDF-file

GAIA DR2 DATA

Gaia Data Release 2 data is now available.

GAIA DATA CREDITS

When using Gaia data, please acknowledge the work of the people involved and provide credits and necessary citations.

GAIA DR2 KNOWN ISSUES

Issues with the Gaia DR2 data important for the users to know that were discovered after the release of data and documentation

TUTORIALS AND HELP

Help is available to guide you through the process of getting the data you need. Check out the tutorials as they are very instructive!

LEARN ADQL

Gaia Data Release 2 contains a lot of data. While downloading the data will be possible, you can also bring your code to the data and access the data in a smart way. You can use ADQL queries to extract the data and then download the resulting table.

GAIA DR2 VIRTUAL REALITY RESOURCES

An overview of some visualisations and virtual reality resources available for exploring the Gaia data.

GAIA DR2 MEDIA STORIES

Here links to a selection of media stories on Gaia Data Release 2 can be found.

GAIA DR2 IN-DEPTH STORIES

A selection of in-depth stories on the processing towards data release 2 and the science potential of the data.

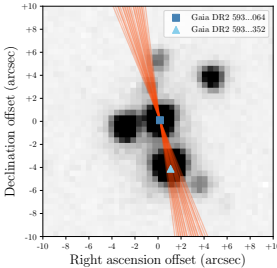
GAIA'S FAMILY PORTRAIT

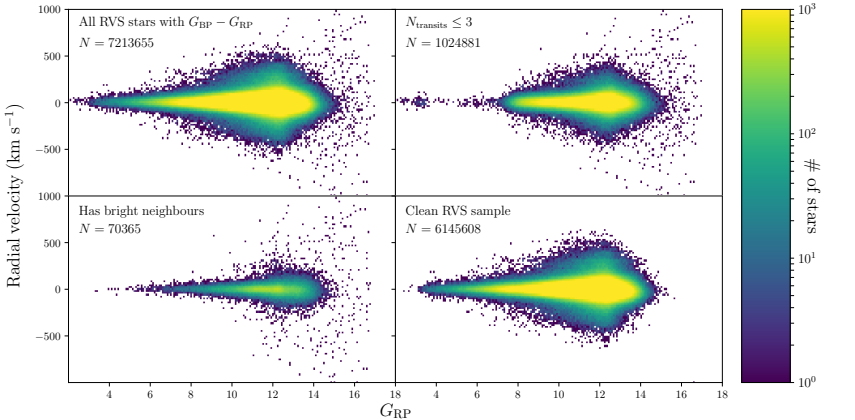
An interactive visualisation of the Gaia Data Release 2 Hertzsprung-Russell diagram

Gaia DR2 known issues

- https://www.cosmos.esa.int/web/gaia/dr2-known-issues
- Use of DR2 astrometry: see presentation slides by Lindegren et al.
  - guidelines on uncertainty inflation to get external uncertainty estimates
  - better astrometric quality indicator: renormalized unit weight error (RUWE)
    - quality indicators such as astrometric excess noise, gof, chi2: not recommended
  - electronic tables for RUWE calculation
  - spatial covariances and how to account for them
- Potentially spurious radial velocities in crowded regions
  - Concerns 70 365 sources for which overlaps with spectra of neighbouring sources may lead to wrong radial velocity
  - List available as online table
  - See Boubert et al., arXiv:1902.10460
- Recommendation on passbands to use for synthetic photometry
  - Use the response curves from Maíz-Apellániz & Weiler (https://doi.org/10.1051/0004-6361/201834051)
  - Recipe provided for use of these passbands with Gaia DR2 photometry

Gaia DR2 known issues





Boubert et al., 2019, arXiv:1901.10460

Contents of Gaia EDR3/DR3

Schedule

- Gaia EDR3 in third quarter of 2020
- Gaia DR3 second half 2021
- Both releases based on same input data and same source list
- **(E)DR3 contents on this slide and next are subject to successful processing and validation. Source numbers are preliminary estimates!**

Gaia EDR3 contents

- Astrometry
  - including new quality indicators: RUWE and source image quality descriptors
- Integrated G, $G_{\rm BP}$, $G_{\rm RP}$ photometry and corresponding passbands
- QSO host and galaxy morphological characterization (based on input list)
- Cross-match with external catalogues, Gaia-CRF, DR2-to-DR3 match table

Contents of Gaia EDR3/DR3

Gaia DR3 contents

- EDR3 contents
- Classification and astrophysical parameters for TBD subset of sources
- Radial velocities; goal is to include all sources to $G = 14$ (~ 40 million)
- Mean BP/RP/RVS spectra for TBD subset of sources
- Photometric variability characterization for ~ 10 million sources
- Astrometry for $\sim 100\,000$ minor planets; mean reflectance spectra for ~ 5000
- Catalogue of astrometric, spectroscopic, eclipsing binaries

Gaia DR4

- Final release for the nominal mission
  - schedule TBD
- Foreseen data products
  - Full astrometric, photometric, and radial-velocity catalogues
  - All available variable-star and non-single-star solutions
  - Source classifications (probabilities) plus multiple astrophysical parameters (derived from BP/RP, RVS, and astrometry) for stars, unresolved binaries, galaxies, and quasars
  - Catalogue of binaries and exo-planets
  - All epoch and transit data for all sources, including all BP/RP/RVS spectra

Overall gain in precision for DR3 and DR4: factors 1.2 and 1.7 with respect to DR2

- proper motions improve by factors 1.9 and 4.5

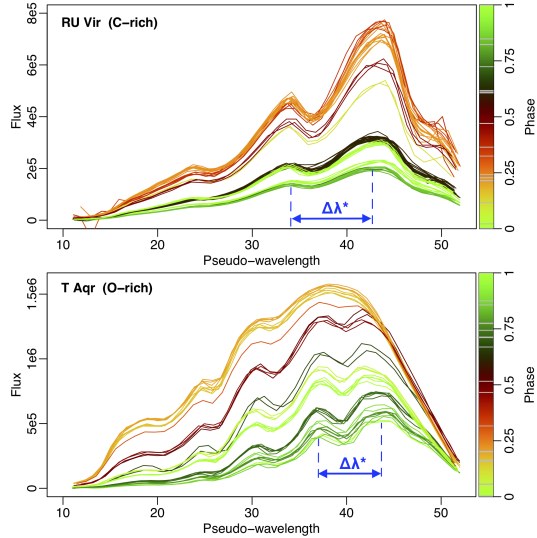
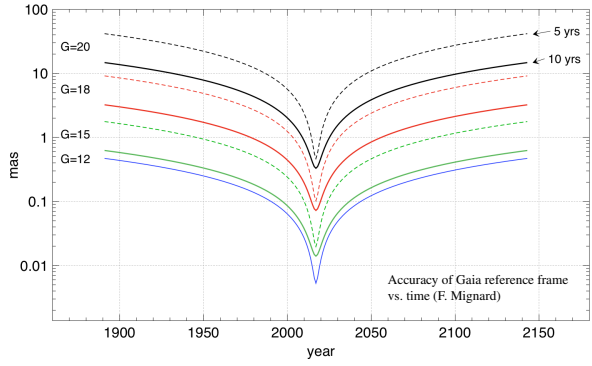


Image credits: ESA/Gaia/DPAC, Mowlavi et al.

Gaia extension

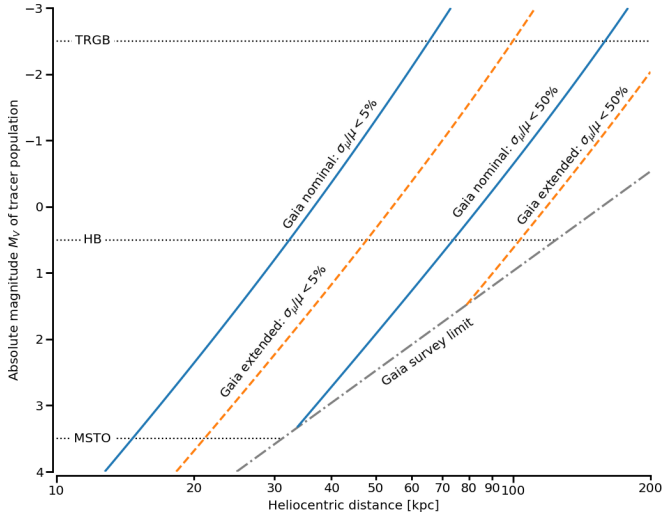
- Nominal Gaia mission ends mid-2019 after 5 years of measurements
- Hardware in good shape, only limiting factor is micro-propulsion fuel
  - mission can continue to end-2024 (± 0.5 yr)
- Proposal submitted to ESA for 5 year extension
  - approved to end 2020, preliminary approval to end 2022, submit proposal for 2023–2024 in 2020

- Parallaxes, photometry, radial velocities improve by 40% with respect to DR4
- Proper motions improve by factor of 2.8 with respect to DR4
  - Improvement of more complex motions (e.g., planets) up to factors of 20
- Accurate tangential motions over $22.6\times$ larger volume



Gaia extension

- Larger volume reached throughout the halo at given proper motion accuracy
- Uncover more streams
- Probe young and unmixed debris located beyond 20–30 kpc
- Calibration of spectrophotometric distance indicators on nearby samples ⇒ full gain in tangential motion performance



Your papers are the best argument for an extended Gaia mission

Gaia

- Please acknowledge the work by DPAC and ESA in your papers!
  - helps us argue the case for continued funding of the data processing
  - `https://gea.esac.esa.int/archive/documentation/credits.html`
- Communicate your Gaia results
  - https://www.cosmos.esa.int/web/gaia/communicating-your-results