ESA uses cookies to track visits to our website only, no personal information is collected.
By continuing to use the site you are agreeing to our use of cookies.
Find out more about our cookie policy.
OK

GAIA DATA RELEASE 2 (GAIA DR2)

Gaia Data Release 2 was released on 25 April 2018 and is available through the Gaia Archive. A description of the contents of Gaia DR2 is given below.

CONTENTS OF GAIA DR2

- The five-parameter astrometric solution - positions on the sky (α, δ), parallaxes, and proper motions - for more than 1.3 billion (10^9) sources, with a limiting magnitude of G = 21 and a bright limit of G = 3. Parallax uncertainties are in the range of up to 0.04 milliarcsecond for sources at G < 15, around 0.1 mas for sources with G=17 and at the faint end, the uncertainty is of the order of 0.7 mas at G = 20. The corresponding uncertainties in the respective proper motion components are up to 0.06 mas yr^{-1} (for G < 15 mag), 0.2 mas yr^{-1} (for G = 17 mag) and 1.2 mas yr^{-1} (for G = 20 mag). The Gaia DR2 parallaxes and proper motions are based only on Gaia data; they do no longer depend on the Tycho-2 Catalogue.
- Median radial velocities (i.e. the median value over the epochs) for more than 7.2 million stars with a mean G magnitude between about 4 and 13 and an effective temperature ($T_{\rm eff}$) in the range of about 3550 to 6900 K. This leads to a full six-parameter solution: positions and motions on the sky with parallaxes and radial velocities, all combined with mean G magnitudes. The overall precision of the radial velocities at the bright end is in the order of 200-300 m s^{-1} while at the faint end the overall precision is approximately 1.2 km s^{-1} for a $T_{\rm eff}$ of 4750 K and about 2.5 km s^{-1} for a $T_{\rm eff}$ of 6500 K.
- An additional set of more than 361 million sources for which a two-parameter solution is available: the positions on the sky (α, δ) combined with the mean G magnitude. These sources have a positional uncertainty at G=20 of about 2 mas, at 2015.5.
- G magnitudes for more than 1.69 billion sources, with precisions varying from around 1 milli-mag at the bright (G<13) end to around 20 milli-mag at G=20. Please be aware that the photometric system for the G band in Gaia DR2 is different from the photometric system as used in Gaia DR1.
- $G_{\rm BP}$ and $G_{\rm RP}$ magnitudes for more than 1.38 billion sources, with precisions varying from a few milli-mag at the bright (G<13) end to around 200 milli-mag at G=20.
- Full passband definitions for G, BP and RP. These passbands are now available for download. A detailed description is given here.
- Epoch astrometry for 14,099 known solar system objects based on more than 1.5 million CCD observations. 96% of the along-scan (AL) residuals are in the range -5 to 5 mas, and 52% of the AL residuals are in the range of -1 to 1 mas. The transit observations are part of Gaia DR2 and have also been delivered to the Minor Planet Center (MPC).
- Subject to limitations (see below) the effective temperatures $T_{\rm eff}$ for more than 161 million sources brighter than 17th magnitude with effective temperatures in the range 3000 to 10,000 K. For a subset of about 87 million sources also the line-of-sight extinction A_G and reddening E(BP-RP) are given and for a part of this subset (around 76 million sources) the luminosity and radius are available as well.
- Classifications for more than 550,000 variable sources consisting of Cepheids, RR Lyrae, Mira and Semi-Regular Candidates as well as High-Amplitude Delta Scuti, BY Draconis candidates, SX Phoenicis Candidates and short time scale phenomena.
- Planned cross-matches between Gaia DR2 sources on the one hand and Hipparcos-2, Tycho-2, 2MASS PSC, SDSS DR9, Pan-STARRS1, GSC2.3, PPM-XL, AllWISE, and URAT-1 data on the other hand.

Below an overview of the planned Gaia Data Release 2 in numbers:

	# sources in Gaia DR2	# sources in Gaia DR1
Total number of sources	**1,692,919,135**	**1,142,679,769**
Number of 5-parameter sources	1,331,909,727	2,057,050
Number of 2-parameter sources	361,009,408	1,140,622,719
Sources with mean G magnitude	1,692,919,135	1,142,679,769
Sources with mean $G_{\rm BP}$-band photometry	1,381,964,755	-
Sources with mean $G_{\rm RP}$-band photometry	1,383,551,713	-
Sources with radial velocities	7,224,631	-
Variable sources	550,737	3,194
Known asteroids with epoch data	14,099	-
Gaia-CRF sources	556,869	2,191
Effective temperatures ($T_{\rm eff}$)	161,497,595	-
Extinction (A_G) and reddening (E($G_{\rm BP}$-$G_{\rm RP}$))	87,733,672	-
Sources with radius and luminosity	76,956,778	-

The below table gives an overview of the distribution of Gaia Data Release 2 sources in G-band magnitude:

Percentile	All	5-parameter	2-parameter
0.135%	11.6	11.4	15.3
2.275%	15.0	14.7	18.5
15.866%	17.8	17.4	19.8
50%	19.6	19.3	20.6
84.134%	20.6	20.3	21.0
97.725%	21.0	20.8	21.2
99.865%	21.3	20.9	21.4

BACKGROUND OF THE DATA

Gaia DR2 data is based on data collected between 25 July 2014 (10:30 UTC) and 23 May 2016 (11:35 UTC), spanning a period of 22 months of data collection (or 668 days), as compared to Gaia DR1 which was based on observations collected in the first 14 months of Gaia's routine operational phase.

The reference epoch for Gaia DR2 is J2015.0 (compared to the J2015.0 epoch for Gaia DR1). Positions and proper motions are referred to the ICRS, to which the optical reference frame defined by Gaia DR2 is aligned. The time coordinate for Gaia DR2 results is the barycentric coordinate time (TCB).

GAIA SOURCE IDENTIFIERS

Sources in the Gaia Catalogue are all identified through the Gaia Source Identifier, i.e. the `source_id` field in the various tables in the Gaia Archive. The construction of the source identifiers is explained in the archive documentation (for Gaia DR1, see the data model section). In particular the `source_id` number contains rough information about the source position on the sky.

As explained in the announcement about the Gaia DR2 schedule, there are various reasons why the identifier of a specific source may change or disappear when going from the Gaia DR1 to the Gaia DR2 source list. Users of Gaia data should thus be aware that the source list for Gaia DR2 should be treated as independent from Gaia DR1.

For the same reason, Gaia source names have the data release number incorporated. Gaia source names are therefore constructed as follows:

```
Gaia DRn yyy...yy
```

Resulting in an example source ID: Gaia DR1 5425628298649940608 for some source in Gaia DR1.

A table to trace sources from Gaia DR1 to Gaia DR2 is provided given that source identifiers used in Gaia DR1 may have changed or disappeared in Gaia DR2. In future releases, the source list is expected to become progressively more stable.

LIMITATIONS OF GAIA DR2

SURVEY COMPLETENESS

- The Gaia DR2 catalogue is essentially complete between G=12 and G=17. However, the source list for the release is incomplete at the bright end and has an ill-defined faint magnitude limit, which depends on celestial position. Although the completeness at the bright end (G≤7) has improved, a fraction of the stars in that magnitude range are still missing from Gaia DR2.
- The combination of the Gaia scan law coverage and the filtering on data quality done prior to the publication of Gaia DR2 has resulted in regions of the sky with source density fluctuations that reflect the scan law pattern. In addition, gaps exist in the source distribution.
- The completeness near bright sources has improved but is still not perfect.
- The completeness for high proper motion stars has significantly improved with respect to Gaia DR1, but about 20 per cent of stars with proper motion >0.6 arcsec yr^{-1} are still missing.
- In dense areas on the sky (above some 400,000 stars per square degree) the magnitude limit of Gaia DR2 is as bright as G=18.
- The effective angular resolution of the survey has improved with respect to DR1 and is about 0.4 arcsec.

ASTROMETRY

- Parallax systematics exist depending on celestial position, magnitude, and colour, and are estimated to be below 0.1 mas. There is a significant average parallax zero-point of about -30 μas.
- A small proportion of sources with corrupted parallaxes is indicated by the occurence of apparently very significant large positive or negative values. The papers accompanying Gaia DR2 and the online documentation provide guidance on how to filter such sources from the scientific data analysis.
- The astrometric uncertainties listed in Gaia DR2 are derived from the formal errors resulting from the astrometric data treatment and unlike for Gaia DR1 these have not been externally calibrated. The uncertainties are known to be underestimated by ~7-10 per cent for faint sources (G>16) outside the Galactic plane, and by up to ~30 per cent for bright stars (G<12).
- The quality of the astrometry of sources brighter than a G magnitude of about 6 is generally inferior to the rest of the data.

PHOTOMETRY

- Near very bright sources, in crowded regions, and at the faint end (G>19) of the survey, the photometric measurements from the blue and red photometers suffer from an insufficiently accurate background estimation and from the lack of specific treatment of blending and decontamination from nearby sources. This leads to measured fluxes that are inconsistent between the G and the $G_{\rm BP}$ and $G_{\rm RP}$ bands in the sense that the sum of the flux values in the latter two bands may be significantly larger than that in G (whereas it is expected that for normal spectral energy distributions the sum of fluxes in $G_{\rm BP}$ and $G_{\rm RP}$ should be comparable to that in G). A quantitative indication of this effect is included in Gaia DR2 in the form of the so-called flux-excess factor. Please refer to the papers and the online documentation for guidance on how to use this quantity to clean samples of sources from lower quality photometry.

RADIAL VELOCITIES

- No radial velocities have been determined for objects identified as emission-line stars.
- Single-lined spectroscopic binaries have been treated as single stars and only a median radial velocity, together with information on the scatter in the underlying (yet unpublished) epoch radial velocities, is provided.
- No radial velocities have been determined for detected double-lined spectroscopic binaries: such objects are missing from Gaia DR2.
- The effective temperatures for the sources with radial velocities are in the range of about 3550 to 6900 K so there are no radial velocities for "cool" and "hot" stars.

ASTROPHYSICAL PARAMETERS

- The values of $T_{\rm eff}$, extinction A_G, reddening E($G_{\rm BP}$-$G_{\rm RP}$), radius, and luminosity were determined only from the three broad-band photometric measurements and the parallax on a star-by-star basis (parallax was not used for $T_{\rm eff}$ though). The strong degeneracy between $T_{\rm eff}$ and extinction/reddening when using the broad band photometry necessitates strong assumptions in order to estimate their values. One should thus be very careful in using these astrophysical parameters and refer to the papers and online documentation for guidance.

VARIABLE STARS

- Only a subset of the variable stars classified as a certain type were characterized in detail. Hence not every variable star appears in the more detailed vari_* tables and a fraction of the classifications may well be wrong.

SOLAR SYSTEM OBJECTS

- The Solar system object sample processed by DPAC has been pre-selected and is not a complete sample with respect to criteria like dynamics, type, category, etc.
- Bright objects (Gs≤10) have been removed because their astrometry at this stage is not good enough and impaired by calibration/systematic effects.
- G-band photometry is available for about half of the transits.

ACCESSING THE DATA

The Gaia Archive is the main point of access to the Gaia DR2 data, but the data is also served from our partner data centres (CDS, ASDC, ARI and AIP). Data can be extracted from the Gaia Archive by performing ADQL queries and downloading the corresponding results tables. The Gaia DR2 data set is also downloadable in compressed CSV-format, but be aware that the downloadable file set exceeds 550 GB.

PASSBANDS

Gaia DR2 passbands are offered to users as a record to understand how the Gaia DR2 magnitudes are computed, and to eventually reproduce analysis of data made by other DPAC Coordination Units. Another set of Gaia DR2 revised passbands are also available to the users now. Both sets of passbands are described in more detail here.

The passbands are available for download. Please consider carefully which set to use with your data.

DOCUMENTATION

Documentation is provided along with the second data release in the form of a downloadable PDF and a webpage in a similar way as was done for Gaia Data Release 1. Please visit the Gaia Archive to access this documentation.

DATA MODEL

The Gaia DR2 data model describes all tables together with the names and contents of the columns inside each table. This information is available from the Gaia Archive along with the release of the data.

DATA RELEASE PAPERS

Along with the data release documentation, several data processing papers have been published describing the specifics of the data processing and validation performed by the different coordination units in the Gaia Data Processing and Analysis Consortium (DPAC). There are also some papers on the performance verification of Gaia, providing basic demonstrations of the scientific potential of the Gaia DR2 catalogue.

The titles of the papers are listed below. More information on them is available here.

Description of the Gaia mission (spacecraft, instruments, survey and measurement principles)
Gaia Collaboration, Prusti, T., et al. (2016)

Gaia Data Release 2: Summary of the contents and survey properties
Gaia Collaboration, Brown, A.G.A., et al. (*arXiv*)

Gaia Data Release 2: The astrometric solution
Lindegren, L., et al. (*arXiv*)

Gaia Data Release 2: Calibration and mitigation of electronic offset effects in Gaia data
Hambly, N., et al. (*arXiv*)

Gaia Data Release 2: Processing of the photometric data
Riello, M., et al. (*arXiv*)

Gaia Data Release 2: The photometric content and validation
Evans, D.W., et al. (*arXiv*)

Gaia Data Release 2: The Gaia Radial Velocity Spectrometer
Cropper, M., et al. (*arXiv*)

Gaia Data Release 2: The catalogue of radial velocity standard stars
Soubiran, C., et al. (*arXiv*)

Gaia Data Release 2: Processing, validation and performance of the spectroscopic data
Sartoretti, P., et al. (*arXiv*)

Gaia Data Release 2: Properties and validation of the radial velocities
Katz, D., et al. (*arXiv*)

Gaia Data Release 2: Summary of variability processing and analysis results
Holl, B., et al. (arXiv)

Gaia Data Release 2: First stellar parameters from Apsis
Andrae, R., et al. (*arXiv*)

Gaia Data Release 2: Catalogue validation
Arenou, F., et al. (*arXiv*)

Gaia Data Release 2: Cross-match with external catalogues: algorithm and statistics
Marrese, P.M., et al. (*arXiv*)

Gaia Data Release 2: On the use of Gaia parallaxes
Luri, X., et al. (arXiv)

Gaia Data Release 2: The celestial reference frame (Gaia-CRF2)
Gaia Collaboration, Mignard, F., et al. (*arXiv*)

Gaia Data Release 2: Observational Hertzsprung-Russell diagrams
Gaia Collaboration, Babusiaux, C., et al. (*arXiv*)

Gaia Data Release 2: Observations of Solar System objects
Gaia Collaboration, Spoto, F., et al. (*arXiv*)

Gaia Data Release 2: Mapping the Milky Way disk kinematics
Gaia Collaboration, Katz, D., et al. (*arXiv*)

Gaia Data Release 2: The kinematics of globular clusters and dwarf galaxies around the Milky Way
Gaia Collaboration, Helmi, A., et al. (*arXiv*)

Gaia Data Release 2: Variable stars in the Colour-Magnitude Diagram
Gaia Collaboration, Eyer, L., et al. (*arXiv*)

MEDIA INFORMATION

The media kit with information on the Gaia mission and the contents of Gaia Data Release 2 can be found here.

last updated: 25/04/2018

Please consider the environment before printing