Gaia Focused Product Release: preliminary catalogue data model

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Abstract

The preliminary data model for the Gaia Focused Product Release (FPR) is described in the following pages. This draft corresponds to DPAC Data Model configuration item FPR_21.2.1 (at fprrc2). Note that this draft contains links to external resources (e.g. the body of the full documentation set for FPR) that are inactive presently. The document is provided for advance information and will be supported on a best–efforts basis only prior to the formal release.

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Datamodel description

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1.1 CROWDED_FIELD_SOURCE

Sources based on Service Interface Function (SIF) images of very dense regions in the sky. These sources build an add-on catalogue to the nominal Gaia catalogue. Nominal and SIF detections were not mixed to create these sources. These Sources are thus obtained from SIF image detections only. Sources already present in the nominal catalogue were removed from the SIF add-on catalogue.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

DESIGNATION : Unique source designation (unique across all Data Releases) (string)

A source designation, unique across all Gaia Data Releases, that is constructed from the prefix 'Gaia DRx ' or 'Gaia FPR ' followed by a string of digits corresponding to `source_id` (3 space–separated words in total). Note that the integer source identifier `source_id` is **not** guaranteed to be unique across Data Releases; moreover it is not guaranteed that the same astronomical source will always have the same `source_id` in different Data Releases. Hence the only safe way to compare source records between different Data Releases in general is to check the records of proximal source(s) in the same small part of the sky.

REGION_NAME : Name of the designated CrowdedField region in the sky (string)

String, that identifies the SIF CF region in the sky, this source is located in. Gaia observed 9 regions with SIF CF images. The corresponding String values are:

BAADE_S_WINDOW: Baade's Window (Bulge region)
SGR_I: Sagittarius window (Bulge region)
LMC: Large Magellanic Cloud, satellite galaxy of the Milky Way
SMC: Small Magellanic Cloud, dwarf irregular galaxy near the Milky Way
NGC104: (aka 47 Tucanae) in the constellation Tucana
NGC4372: (aka Caldwell 108) in the southern constellation of Musca
NGC5139: (aka Omega Centauri or Caldwell 80) in the constellation of Centaurus
NGC6121: (aka Messier 4) in the constellation of Scorpius
NGC6656: (aka Messier 22) in the constellation Sagittarius

SOURCE_ID : Unique source identifier (unique within a particular Data Release) providing the CrowdedField-nature of the source via location bit (long)

A unique numerical identifier of the source, encoding the approximate position of the source (roughly to the nearest arcmin), the provenance (data processing centre where it was created), a running number, and a component number following the construction conventions of those in the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`). Note that the Gaia DPAC Data Processing Code provenance value (in bits 33 to 35) is 6 for the crowded field image analysis pipeline, i.e. (source_id $>>$ 32) & 7 = 6 for sources in `crowded_field_sour`

REF_EPOCH : Reference epoch (double, Time[Julian Years])

Reference epoch to which the astrometric source parameters are referred, expressed as a Julian Year in TCB.

RA : Right ascension (double, Angle[deg])

Barycentric right ascension α of the source in ICRS at the reference epoch `ref_epoch`

RA_ERROR : Standard error of right ascension (float, Angle[mas])

Standard error $\sigma_{\alpha*} \equiv \sigma_{\alpha} \cos \delta$ of the right ascension of the source in ICRS at the reference epoch `ref_epoch`.

DEC : Declination (double, Angle[deg])

Barycentric declination δ of the source in ICRS at the reference epoch `ref_epoch`

DEC_ERROR : Standard error of declination (float, Angle[mas])

Standard error σ_δ of the declination of the source in ICRS at the reference epoch `ref_epoch`

PARALLAX : Parallax (double, Angle[mas])

Absolute stellar parallax ϖ of the source at the reference epoch `ref_epoch`

PARALLAX_ERROR : Standard error of parallax (float, Angle[mas])

Standard error σ_ϖ of the stellar parallax at the reference epoch `ref_epoch`

PARALLAX_OVER_ERROR : Parallax divided by its standard error (float)

Parallax divided by its standard error

PM : Total proper motion (float, Angular Velocity[mas yr^{-1}])

The total proper motion calculated as the magnitude of the resultant vector of the proper motion component vectors `pmra` and `pmdec`, i.e. $\texttt{pm}^2 = \texttt{pmra}^2 + \texttt{pmdec}^2$.

PMRA : Proper motion in right ascension direction (double, Angular Velocity[mas yr^{-1}])

Proper motion in right ascension $\mu_{\alpha*} \equiv \mu_\alpha \cos\delta$ of the source in ICRS at the reference epoch `ref_epoch`. This is the local tangent plane projection of the proper motion vector in the direction of increasing right ascension.

PMRA_ERROR : Standard error of proper motion in right ascension direction (float, Angular Velocity[mas yr^{-1}])

Standard error $\sigma_{\mu_{\alpha*}}$ of the local tangent plane projection of the proper motion vector in the direction of increasing right ascension at the reference epoch `ref_epoch`

PMDEC : Proper motion in declination direction (double, Angular Velocity[mas yr^{-1}])

Proper motion in declination μ_δ of the source at the reference epoch `ref_epoch`. This is the projection of the proper motion vector in the direction of increasing declination.

PMDEC_ERROR : Standard error of proper motion in declination direction (float, Angular Velocity[mas yr^{-1}])

Standard error $\sigma_{\mu\delta}$ of the proper motion component in declination at the reference epoch `ref_epoch`

RA_DEC_CORR : Correlation between right ascension and declination (float)

Correlation coefficient $\rho(\alpha, \delta)$ between right ascension and declination. This is a dimensionless quantity in the range [-1,+1].

RA_PARALLAX_CORR : Correlation between right ascension and parallax (float)

Correlation coefficient $\rho(\alpha, \varpi)$ between right ascension and parallax, a dimensionless quantity in the range [-1,+1].

RA_PMRA_CORR : Correlation between right ascension and proper motion in right ascension (float)

Correlation coefficient $\rho(\alpha, \mu_{\alpha*})$ between right ascension and proper motion in right ascension, a dimensionless quantity in the range [-1,+1].

RA_PMDEC_CORR : Correlation between right ascension and proper motion in declination (float)

Correlation coefficient $\rho(\alpha, \mu_\delta)$ between right ascension and proper motion in declination, a dimensionless quantity in the range [-1,+1].

DEC_PARALLAX_CORR : Correlation between declination and parallax (float)

Correlation coefficient $\rho(\delta, \varpi)$ between declination and parallax, a dimensionless quantity in the range [-1,+1].

DEC_PMRA_CORR : Correlation between declination and proper motion in right ascension

(float)

Correlation coefficient $\rho(\delta, \mu_{\alpha*})$ between declination and proper motion in right ascension, a dimensionless quantity in the range [-1,+1].

DEC_PMDEC_CORR : Correlation between declination and proper motion in declination (float)

Correlation coefficient $\rho(\delta, \mu_\delta)$ between declination and proper motion in declination, a dimensionless quantity in the range [-1,+1].

PARALLAX_PMRA_CORR : Correlation between parallax and proper motion in right ascension (float)

Correlation coefficient $\rho(\varpi, \mu_{\alpha*})$ between parallax and proper motion in right ascension, a dimensionless quantity in the range [-1,+1].

PARALLAX_PMDEC_CORR : Correlation between parallax and proper motion in declination (float)

Correlation coefficient $\rho(\varpi, \mu_\delta)$ between parallax and proper motion in declination, a dimensionless quantity in the range [-1,+1].

PMRA_PMDEC_CORR : Correlation between proper motion in right ascension and proper motion in declination (float)

Correlation coefficient $\rho(\mu_{\alpha*}, \mu_\delta)$ between proper motion in right ascension and proper motion in declination, a dimensionless quantity in the range [-1,+1].

N_SCANS : Number of CrowdedField scans of the source location (short)

Number of SIF scans or images covering the source location. When compared to the number of matched detections, it will allow to assess the quality/reliability of the source.

ASTROMETRIC_N_OBS_AL : Total number of observations in the along-scan (AL) direction (short)

Total number of AL observations (= CCD transits) used in the astrometric solution of the source, independent of their weight. Note that some observations may be strongly downweighted (see `astrometric_n_bad_obs_al`).

ASTROMETRIC_N_OBS_AC : Total number of observations in the across-scan (AC) direction (short)

Total number of AC observations (= CCD transits) used in the astrometric solution of the source, independent of their weight (note that some observations may be strongly downweighted). Nearly all sources having $G < 13$ will have AC observations from 2d windows, while fainter than that limit only $\sim 1\%$ of transit observations (the so–called 'calibration faint stars') are assigned 2d windows resulting in AC observations.

ASTROMETRIC_N_GOOD_OBS_AL : Number of good observations in the along-scan (AL) direction (short)

Number of AL observations (= CCD transits) that were not strongly downweighted in the astrometric solution of the source. Strongly downweighted observations (with downweighting factor $w < 0.2$) are instead counted in `astrometric_n_bad_obs_al`. The sum of `astrometric_n_good_o` and `astrometric_n_bad_obs_al` equals `astrometric_n_obs_al`, the total number of AL observations used in the astrometric solution of the source.

ASTROMETRIC_N_BAD_OBS_AL : Number of bad observations in the along-scan (AL) direction (short)

Number of AL observations (= CCD transits) that were strongly downweighted in the astrometric solution of the source, and therefore contributed little to the determination of the astrometric parameters. An observation is considered to be strongly downweighted if its downweighting factor $w < 0.2$, which means that the absolute value of the astrometric residual exceeds 4.83 times the total uncertainty of the observation, calculated as the quadratic sum of the centroiding uncertainty, excess source noise, and excess attitude noise.

ASTROMETRIC_GOF_AL : Goodness of fit statistic of model wrt along-scan observations (float)

Goodness-of-fit statistic of the astrometric solution for the source in the along-scan direction. This is the 'gaussianized chi-square', which for good fits should approximately follow a normal distribution with zero mean value and unit standard deviation. Values exceeding, say, $+3$ thus indicate a bad fit to the data.

This statistic is computed according to the formula

$$\texttt{astrometric\_gof\_al} = (9\nu/2)^{1/2}[\texttt{ruwe}^{2/3} + 2/(9\nu) - 1]$$

where `ruwe` is the renormalised unit weight error and

$$\nu = \texttt{astrometric\_n\_good\_obs\_al} - N$$

is the number of degrees of freedom for a source update. Here $N = 5$ for 2-parameter and 5-parameter solutions (respectively `astrometric_params_solved` = 3 or 31) and 6 for 6-parameter solutions (`astrometric_params_solved` = 95). Note that only 'good' (i.e. not strongly downweighted) observations are included in ν. For further details please see Lindegren et al. (2021).

ASTROMETRIC_CHI2_AL : AL chi-square value (float)

Astrometric goodness-of-fit (χ^2) in the AL direction.

χ^2 values were computed for the 'good' AL observations of the source, without taking into account the `astrometric_excess_noise` (if any) of the source. They do however take into account the attitude excess noise (if any) of each observation.

ASTROMETRIC_EXCESS_NOISE : Excess noise of the source (float, Angle[mas])

This is the excess noise ϵ_i of the source. It measures the disagreement, expressed as an angle, between the observations of a source and the best-fitting standard astrometric model (using five astrometric parameters). The assumed observational noise in each observation is quadratically increased by ϵ_i in order to statistically match the residuals in the astrometric solution. A value of 0 signifies that the source is astrometrically well-behaved, i.e. that the residuals of the fit statistically agree with the assumed observational noise. A positive value signifies that the residuals are statistically larger than expected.

The significance of ϵ_i is given by `astrometric_excess_noise_sig` (D). If $D \leq 2$ then ϵ_i is probably not significant, and the source may be astrometrically well-behaved even if ϵ_i is large.

The excess noise ϵ_i may absorb all kinds of modelling errors that are not accounted for by the observational noise (image centroiding error) or the excess attitude noise. Such modelling errors include LSF and PSF calibration errors, geometric instrument calibration errors, and part of the high-frequency attitude noise. These modelling errors are particularly important in the early data releases, but should decrease as the astrometric modelling of the instrument and attitude

improves over the years.

Additionally, sources that deviate from the standard five-parameter astrometric model (e.g. unresolved binaries, exoplanet systems, etc.) may have positive ϵ_i. Given the many other possible contributions to the excess noise, the user must study the empirical distributions of ϵ_i and D to make sensible cutoffs before filtering out sources for their particular application.

The excess source noise is further explained in Sections 3.6 and 5.1.2 of Lindegren et al. (2012).

ASTROMETRIC_EXCESS_NOISE_SIG : Significance of excess noise (float)

A dimensionless measure (D) of the significance of the calculated `astrometric_excess_noise` (ϵ_i). A value $D > 2$ indicates that the given ϵ_i is probably significant.

For good fits in the limit of a large number of observations, D should be zero in half of the cases and approximately follow the positive half of a normal distribution with zero mean and unit standard deviation for the other half. Consequently, D is expected to be greater than 2 for only a few percent of the sources with well-behaved astrometric solutions.

In the early data releases ϵ_i will however include instrument and attitude modelling errors that are statistically significant and could result in large values of ϵ_i and D. The user must study the empirical distributions of these statistics and make sensible cutoffs before filtering out sources for their particular application.

The excess noise significance is further explained in Section 5.1.2 of Lindegren et al. (2012).

ASTROMETRIC_PARAMS_SOLVED : Which parameters have been solved for? (byte)

The seven bits of `astrometric_params_solved` indicate which parameters have been estimated in AGIS for this source. A set bit means the parameter was updated, an unset bit means the parameter was not updated. The least-significant bit corresponds to `ra`. The table below shows the values of `astrometric_params_solved` for relevant combinations of the parameters.

The radial proper motion (μ_r) is formally considered to be one of the astrometric parameters of a source, and the sixth bit is therefore reserved for it. It is also in principle updatable in AGIS, but in practice it will always be computed from a spectroscopic radial velocity and the estimated parallax, in which case the bit is not set.

C is the `pseudocolour` of the source, i.e. the astrometrically estimated effective wavenumber.

astrometric_params_solved	ra	dec	parallax	pmra	pmdec	μ_r	C
$0000011_2 = 3$	✓	✓					
$0000111_2 = 7$	✓	✓	✓				
$0011011_2 = 27$	✓	✓		✓	✓		
$0011111_2 = 31$	✓	✓	✓	✓	✓		
$0111111_2 = 63$	✓	✓	✓	✓	✓	✓	
$1011111_2 = 95$	✓	✓	✓	✓	✓		✓

In practice all the sources in DR3 have only values of 3, 31 or 95 for the astrometric_params_solved, corresponding to two-parameter (position), five-parameter (position, parallax, and proper motion) and six-parameter (position, parallax, proper motion and astrometrically estimated effective wavenumber) solutions.

PSEUDOCOLOUR : Astrometrically estimated pseudocolour of the source (float, Misc[μm^{-1}])

Effective wavenumber of the source estimated in the final astrometric processing.

The pseudocolour is the astrometrically estimated effective wavenumber of the photon flux distribution in the astrometric (G) band, measured in μm^{-1}. The value in this field was estimated from the chromatic displacements of image centroids, calibrated by means of the photometrically determined effective wavenumbers (ν_{eff}) of primary sources.

The field is empty when chromaticity was instead taken into account using the photometrically determined ν_{eff} given in the field nu_eff_used_in_astrometry.

PSEUDOCOLOUR_ERROR : Standard error of the pseudocolour of the source (float, Misc[μm^{-1}])

Standard error $\sigma_{\text{pseudocolour}}$ of the astrometrically determined pseudocolour of the source.

RA_PSEUDOCOLOUR_CORR : Correlation between right ascension and pseudocolour (float)

Correlation coefficient $\rho(\alpha, \text{pseudocolour})$ between right ascension ra and pseudocolour, a dimensionless quantity in the range [-1,+1]

DEC_PSEUDOCOLOUR_CORR : Correlation between declination and pseudocolour (float)

Correlation coefficient $\rho(\delta, \text{pseudocolour})$ between declination dec and pseudocolour, a dimensionless quantity in the range [-1,+1]

PARALLAX_PSEUDOCOLOUR_CORR : Correlation between parallax and pseudocolour (float)

Correlation coefficient $\rho(\varpi, \texttt{pseudocolour})$ between `parallax` and `pseudocolour`, a dimensionless quantity in the range [-1,+1]

PMRA_PSEUDOCOLOUR_CORR : Correlation between proper motion in right asension and pseudocolour (float)

Correlation coefficient $\rho(\mu_{\alpha*}, \texttt{pseudocolour})$ between proper motion in right ascension `pmra` and `pseudocolour`, a dimensionless quantity in the range [-1,+1]

PMDEC_PSEUDOCOLOUR_CORR : Correlation between proper motion in declination and pseudocolour (float)

Correlation coefficient $\rho(\mu_{\delta}, \texttt{pseudocolour})$ between proper motion in declination `pmdec` and `pseudocolour`, a dimensionless quantity in the range [-1,+1]

ASTROMETRIC_MATCHED_TRANSITS : Matched FOV transits used in the AGIS solution (short)

The number of field–of–view transits matched to this source, counting only the transits containing CCD observations actually used to compute the astrometric solution.

This number will always be equal to or smaller than `matched_transits`, the difference being the FOV transits that were not used in the astrometric solution because of bad data or excluded time intervals.

VISIBILITY_PERIODS_USED : Number of visibility periods used in Astrometric solution (short)

Number of visibility periods used in the astrometric solution.

A visibility period is a group of observations separated from other groups by a gap of at least 4 days. A source may have from one to tens of field–of–view transits in a visibility period, but with a small spread in time, direction of scanning, and parallax factor. From one visibility period to the next these variables have usually changed significantly. A high number of visibility periods

is therefore a better indicator of an astrometrically well–observed source than a large number of field–of–view transits (`matched_transits` or `astrometric_matched_transits`) or CCD observations (`astrometric_n_obs_al`). A small value (e.g. less than 10) indicates that the calculated parallax could be more vulnerable to errors, e.g. from the calibration model, not reflected in the formal uncertainties. See Lindegren et al. (2018) for a discussion of this and other astrometric quality indicators.

ASTROMETRIC_SIGMA5D_MAX : The longest semi-major axis of the 5-d error ellipsoid (float, Angle[mas])

The longest principal axis in the 5-dimensional error ellipsoid.

This is a 5-dimensional equivalent to the semi-major axis of the position error ellipse and is therefore useful for filtering out cases where one of the five parameters, or some linear combination of several parameters, is particularly ill-determined. It is measured in mas and computed as the square root of the largest singular value of the scaled 5×5 covariance matrix of the astrometric parameters. The matrix is scaled so as to put the five parameters on a comparable scale, taking into account the maximum along-scan parallax factor for the parallax and the time coverage of the observations for the proper motion components. If C is the unscaled covariance matrix, the scaled matrix is SCS, where $S = \mathrm{diag}(1, 1, \sin\xi, T/2, T/2)$, $\xi = 45°$ is the solar aspect angle in the nominal scanning law, and T the time coverage of the data used in the solution.

`astrometric_sigma5d_max` is given for all the solutions, as its size is one of the criteria for accepting or rejecting the 5 or 6-parameter solution. In case of a 2- parameter solution (`astrometric_params_solved` = 3) it gives the value for the rejected 5 or 6-parameter solution, and can then be arbitrarily large.

MATCHED_TRANSITS : The number of transits matched to this source (short)

The total number of field–of–view transits matched to this source.

IPD_GOF_HARMONIC_AMPLITUDE : Amplitude of the IPD GoF versus position angle of scan (float)

This statistic measures the amplitude of the variation of the Image Parameter Determination (IPD) goodness–of–fit (GoF; reduced chi-square) as function of the position angle of the scan direction. A large amplitude indicates that the source has some non-isotropic spatial structure, for example a binary or galaxy, that is at least partially resolved by Gaia. The phase of the variation is given by the parameter `ipd_gof_harmonic_phase`.

Let ψ be the position angle of the scan direction. The following expression is fitted to the IPD GoF for the accepted AF observations of the source:

$$\ln(\text{GoF}) = c_0 + c_2 \cos(2\psi) + s_2 \sin(2\psi)$$

The amplitude and phase of the variation are calculated as

$$\texttt{ipd\_gof\_harmonic\_amplitude} = \sqrt{c_2^2 + s_2^2}$$

$$\texttt{ipd\_gof\_harmonic\_phase} = \frac{1}{2} \text{atan2}(s_2, c_2) \quad (+\, 180°)$$

where atan2 returns the angle in degrees. In the last expression 180 is added for negative values, so that `ipd_gof_harmonic_phase` is always between 0 and 180°. Only the AF observations accepted by the astrometric solution are used to compute the amplitude and phase, thus for example outliers and observations in the early Ecliptic Pole Scanning Law phase are not used.

The GoF variation is modelled as a periodic function of 2ψ because a source with fixed structure is normally expected to give fits of similar quality when scanned in opposite directions (ψ differing by 180°). See `ipd_gof_harmonic_phase` for the interpretation of the phase.

IPD_GOF_HARMONIC_PHASE : Phase of the IPD GoF versus position angle of scan (float, Angle[deg])

This statistic measures the phase of the variation of the IPD GoF (reduced chi-square) as function of the position angle of the scan direction. See the description of `ipd_gof_harmonic_amplitude` for details on the computation of the phase.

The interpretation of this parameter is non-trivial because of the complex interaction between the source structure and the IPD. At least the following different scenarios could occur:

- For a binary with separation $\lesssim 0.1$ arcsec the GoF is expected to be higher when the scan is along the arc joining the components than in the perpendicular direction, in which case `ipd_gof_harmonic_phase` should indicate the position angle of the binary modulo 180°. Such a binary will normally have negligible `ipd_frac_multi_peak` (less than a few per cent).

- For a resolved binary the GoF may instead have a minimum when the scan is along the arc joining the two components, in which case `ipd_gof_harmonic_phase` differs from the position angle of the binary (modulo 180°) by approximately $\pm 90°$. Such a binary will normally have a large `ipd_frac_multi_peak`.

- For a bright binary ($G \lesssim 13$) the GoF refers to the fitting of a two-dimensional PSF, which could further complicate the intrepretation.

- For a galaxy with elongated intensity distribution, the IPD may give a smaller GoF when the scan is along the major axis of the image, resulting in an offset of approximately $\pm 90°$ between the `ipd_gof_harmonic_phase` and the position angle of the major axis (modulo 180°).

SCAN_DIRECTION_STRENGTH_K1 : Degree of concentration of scan directions across the source (float)

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` quantify the distribution of AL scan directions across the source. `scan_direction_strength_k1` (and similarly 2,3,4) are the absolute value of the trigonometric moments $m_k = \langle \exp(ik\theta) \rangle$ for $k = 1, 2, 3, 4$ where θ is the position angle of the scan and the mean value is taken over the `astrometric_n_good_obs_al` observations contributing to the astrometric parameters of the source. θ is defined in the usual astronomical sense: $\theta = 0$ when the FoV is moving towards local North, and $\theta = 90°$ towards local East.

N.B. When `astrometric_n_obs_ac` > 0 the scan direction attributes are not provided at Gaia DR3. Hence for all sources brighter than G ≈ 13, and for a tiny fraction of fainter sources ($\approx 1\%$), these 8 scan direction fields will be NULL.

The `scan_direction_strength_k1...4` are numbers between 0 and 1, where 0 means that the scan directions are well spread out in different directions, while 1 means that they are concentrated in a single direction (given by the corresponding `scan_direction_mean_k1...4`).

The different orders k are statistics of the scan directions modulo $360°/k$. For example, at first order ($k = 1$), $\theta = 10°$ and $\theta = 190°$ count as different directions, but at second order ($k = 2$) they are the same. Thus, `scan_direction_strength_k1` is the degree of concentration when the sense of direction is taken into account, while `scan_direction_strength_k2` is the degree of concentration without regard to the sense of direction. A large value of `scan_direction_stren` indicates that the scans are concentrated in two nearly orthogonal directions.

SCAN_DIRECTION_STRENGTH_K2 : Degree of concentration of scan directions across the source (float)

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_strength_k1` for further details.

SCAN_DIRECTION_STRENGTH_K3 : Degree of concentration of scan directions across

the source (float)

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_strength_k1` for further details.

SCAN_DIRECTION_STRENGTH_K4 : Degree of concentration of scan directions across the source (float)

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_strength_k1` for further details.

SCAN_DIRECTION_MEAN_K1 : Mean position angle of scan directions across the source (float, Angle[deg])

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source. `scan_direction_mean_k1` (and similarly for $k = 2, 3, 4$) is $1/k$ times the argument of the trigonometric moments $m_k = \langle \exp(ik\theta) \rangle$, where θ is the position angle of the scan and the mean value is taken over the `astrometric_n_good_obs_al` observations contributing to the astrometric parameters of the source. θ is defined in the usual astronomical sense: $\theta = 0$ when the FoV is moving towards local North, and $\theta = 90°$ towards local East.

N.B. When `astrometric_n_obs_ac > 0` the scan direction attributes are not provided at Gaia DR3. Hence for all sources brighter than G $\approx$ 13, and for a tiny fraction of fainter sources ($\approx 1\%$), these 8 scan direction fields will be NULL.

`scan_direction_mean_k1` (and similarly for $k = 2, 3, 4$) is an angle between $-180°/k$ and $+180°/k$, giving the mean position angle of the scans at order k.

The different orders k are statistics of the scan directions modulo $360°/k$. For example, at first order ($k = 1$), $\theta = 10°$ and $\theta = 190°$ count as different directions, but at second order ($k = 2$) they are the same. Thus, `scan_direction_mean_k1` is the mean direction when the sense of direction is taken into account, while `scan_direction_mean_k2` is the mean direction without regard to the sense of the direction. For example, `scan_direction_mean_k1` = 0 means that the scans preferentially go towards North, while `scan_direction_mean_k2` = 0 means that they preferentially go in the North-South direction, and `scan_direction_mean_k4` = 0 that they preferentially go either in the North-South or in the East-West direction.

SCAN_DIRECTION_MEAN_K2 : Mean position angle of scan directions across the source (float, Angle[deg])

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_mean_k1` for further details.

SCAN_DIRECTION_MEAN_K3 : Mean position angle of scan directions across the source (float, Angle[deg])

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_mean_k1` for further details.

SCAN_DIRECTION_MEAN_K4 : Mean position angle of scan directions across the source (float, Angle[deg])

The `scan_direction_strength_k1...4` and `scan_direction_mean_k1...4` attributes quantify the distribution of AL scan directions across the source.

See the description for attribute `scan_direction_mean_k1` for further details.

ASTROMETRIC_PRIMARY_FLAG : Primary or secondary (boolean)

Flag indicating if this source was used as a primary source (`true`) or secondary source (`false`). Only primary sources contribute to the estimation of attitude, calibration, and global parameters. The estimation of source parameters is otherwise done in exactly the same way for primary and secondary sources.

PHOT_G_N_OBS : Number of observations contributing to G photometry (short)

Number of observations (CCD transits) that contributed to the G mean flux (`phot_g_mean_flux`) and mean flux error (`phot_g_mean_flux_error`).

PHOT_G_MEAN_FLUX : G-band mean flux (double, Flux[$e^- \ s^{-1}$])

Mean flux in the G-band.

PHOT_G_MEAN_FLUX_ERROR : Error on G-band mean flux (float, Flux[$e^- \ s^{-1}$])

Standard deviation of the G-band fluxes divided by the square root of the number of observations (phot_g_n_obs).

PHOT_G_MEAN_FLUX_OVER_ERROR : G-band mean flux divided by its error (float)

Mean flux in the G-band phot_g_mean_flux divided by its error phot_g_mean_flux_error.

PHOT_G_MEAN_MAG : G-band mean magnitude (float, Magnitude[mag])

Mean magnitude in the G band. This is computed from the G-band mean flux (phot_g_mean_flux) applying the magnitude zero-point in the Vega scale (see Sect. **??** and references therein).

No error is provided for this quantity as the error distribution is only symmetric in flux space. This converts to an asymmetric error distribution in magnitude space which cannot be represented by a single error value.

PHOT_G_FLUX_UWV : Unit weight variance of fluxes (double)

The unit weight variance of the flux values. See Sect. **??** and references therein for a rigorous mathematical definition.

PHOT_G_FLUX_MEDIAN : Median flux (float, Flux[$e^- \ s^{-1}$])

Median of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_SKEWNESS : Measure of the skewness of the flux distribution (float)

Measure of the skewness of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_KURTOSIS : Measure of the kurtosis of the flux distribution (float)

Kurtosis of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_MAD : MAD of the flux distribution (float, Flux[e$^-$ s^{-1}])

Median Absolute Deviation (MAD) of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_FIRST_QUARTILE : First quartile of the flux distribution (float, Flux[e$^-$ s^{-1}])

First (25%) quartile of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_THIRD_QUARTILE : Third quartile of the flux distribution (float, Flux[e$^-$ s^{-1}])

Third (75%) quartile of the flux distribution.

When an insufficient number of observations are available to compute these quantities, the corresponding field will be set to Float.NaN.

PHOT_G_FLUX_MIN : Minimum flux value (float, Flux[e$^-$ s^{-1}])

Minimum flux value.

PHOT_G_FLUX_MAX : Maximum flux value (float, Flux[e$^-$ s^{-1}])

Maximum flux value.

PHOT_PROC_MODE : Photometry processing mode (byte)

This flag indicates the photometric calibration process used for the source. For nominal processing, this process is determined by the availability of colour information derived from the internally calibrated mean BP and RP source spectra. The following values are defined for Gaia DR3:

- 0: this corresponds to the 'gold' photometric dataset. Sources in this dataset have complete colour information.

- 1: this corresponds to the 'silver' photometric dataset. Sources in this dataset have incomplete colour information and therefore were calibrated using an iterative process that estimated the missing colour information from the source mean G and either BP or RP photometry (depending on which band had full colour information available) using empirical relationships derived from the gold dataset.

- 2: this corresponds to the 'bronze' photometric dataset. Sources in this dataset had insufficient colour information and therefore were calibrated using default colour information derived from the gold dataset.

- 16: this data was not produced with the nominal PhotPipe code, but with a dedicated photometric overlap calibration performed for SIF CF Focussed Product Release using calibrated DR3 sources as reference.

Because the process of generating the mean BP and RP spectra and the process of producing mean BP and RP integrated photometry are very different and have different requirements it is possible for gold sources to be missing any of the bands, i.e. gold does not imply anything about the availability of mean G, BP and RP photometry. Similarly for silver and bronze sources it is possible to have photometry available in any bands (and possible combinations).

More details about the different calibration procedures are available in Chapter 5 of the Gaia DR3 on-line documentation, in Riello et al. (2021) and in Section Sect. **??** and references therein.

L : Galactic longitude (double, Angle[deg])

Galactic Longitude of the object at reference epoch `ref_epoch`.

B : Galactic latitude (double, Angle[deg])

Galactic Latitude of the object at reference epoch `ref_epoch`.

ECL_LON : Ecliptic longitude (double, Angle[deg])

Ecliptic Longitude of the object at reference epoch `ref_epoch`, obtained from the equatorial coordinates using the transformation defined in Volume 1, Section 1.5.3 of ESA (1997).

Note that in the transformation applied here the ICRS origin is shifted in the equatorial plane from Γ by $\phi = 0.05542$ arcsec, positive from Γ to the ICRS origin (Chapront et al. 2002). The ICRS has an unambiguous definition with an origin in the ICRF equator defined by the realisation of the ICRF. The ecliptic system is less well-defined, potentially depending on additional conventions in dynamical theories. The transformation employed here corresponds to the inertial mean ecliptic with obliquity and Γ defined by reference to the ICRS equator. Both the obliquity and the position of Γ on the ICRS equator with respect to the ICRS origin have been obtained from Lunar Laser Ranging measurements. This has no time dependence – there is no secular variation of the obliquity and no precession – and it simply defines the relative situation of the various planes at J2000.

ECL_LAT : Ecliptic latitude (double, Angle[deg])

Ecliptic Latitude of the object at reference epoch `ref_epoch`. For further details see the description for attribute `ecl_lon`.

1.2 INTERSTELLAR_MEDIUM_PARAMS

This is the main table of DIB parameters from DIB-Spec, derived from spectra binned in galactic latitude, longitude and distance.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit https://gaia.esac.esa.int/decoder/solnDecoder.jsp

HEALPIX : HEALPix identification (int)

The pixel number determined by a level 5 HEALPix scheme, which is one of the two identifiers of the DIB-Spec bin voxel. Each voxel is defined by a HEALPix number (level 5) made in the equatorial system and the central heliocentric distance (dc).

LC : Central galactic longitude of voxel (float, Angle[deg])

Galactic longitude of the centre of the DIB-Spec voxel.

BC : Central galactic latitude of voxel (float, Angle[deg])

Galactic latitude of the centre of the DIB-Spec voxel.

DC : Central heliocentric distance of voxel (float, Length & Distance[kpc])

Heliocentric distance of the centre of the DIB-Spec voxel. The distance is defined as the inverse of parallax.

N_TARGETS : Number of target stars in a voxel (int)

Number of target stars used in each DIB-Spec voxel to make the stacked interstellar medium (ISM) spectrum.

SNR : SNR of the stacked ISM spectrum at 862.0 nm (float)

Signal-to-noise ratio measured in the stacked ISM spectrum in each DIB-Spec voxel between 860.2 and 861.2 nm, defined as the mean value of flux divided by the standard deviation of the flux.

EW8620 : DIB equivalent width at 862.0 nm (float, Length & Distance[nm])

Equivalent width of the DIB at 862.0 nm in each DIB-Spec voxel.

It is defined from a Gaussian model $f(\lambda, p_0, p_1, p_2) = p_0 \times \exp\left(-\frac{(\lambda-p_1)^2}{2p_2^2}\right)$ where p_0 and p_2 are the depth and width of the DIB profile, p_1 is the central wavelength and λ is the wavelength. The latter is the parameter `lambda` in the interstellar medium spectra table.

EW8620_LOWER : Lower confidence level (16%) of DIB equivalent width at 862.0 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the equivalent width of the DIB at 862.0 nm in each DIB-Spec voxel.

The confidence interval has been evaluated by numerical integration of the spectra, while the ew8620 has been computed by an analytical solution. This inconsistency between the calculation of the EW and their upper and lower levels implies that sometimes `ew8620 < ew8620_lower` or `ew8620 > ew8620_upper`, even if the upper and lower values are consistent with each other. We recommend application of the scaling factor of 1.003 to `ew8620_lower` and `ew8620_upper`, see Gaia Collaboration et al. (2023b).

EW8620_UPPER : Upper confidence level (84%) of DIB equivalent width at 862.0 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the equivalent width of the DIB at 864.8 nm in each DIB-Spec voxel.

The confidence interval has been evaluated by numerical integration of the spectra, while the ew8620 has been computed by an analytical solution. This inconsistency between the calculation

of the EW and their upper and lower levels implies that sometimes `ew8620 < ew8620_lower` or `ew8620 > ew8620_upper`, even if the upper and lower values are consistent with each other. We recommend application of the scaling factor of 1.003 to `ew8620_lower` and `ew8620_upper`, see Gaia Collaboration et al. (2023b).

FLAGS8620 : Quality flag of DIB parameters at 862.0 nm (int)

Quality flag of the DIB parameters at 862.0 nm in each DIB-Spec voxel. 0 is the best value and 5 is the worst. The exact definition of the quality flags can be found in Gaia Collaboration et al. (2023b).

P08620 : p0 parameter at 862.0 nm (float)

Depth parameter of the DIB at 862 nm in each DIB-Spec voxel, see parameter `ew8620` for details.

P08620_LOWER : Lower confidence level (16%) of p0 parameter at 862.0 nm (float)

Lower confidence level (16%) of the p0 parameter (depth) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P08620_UPPER : Upper confidence level (84%) of p0 parameter at 862.0 nm (float)

Upper confidence level (84%) of the p0 parameter (depth) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P18620 : p1 parameter at 862.0 nm (float, Length & Distance[nm])

Central wavelength (p1 parameter) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P18620_LOWER : Lower confidence level (16%) of p1 parameter at 862.0 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the p1 parameter (central wavelength) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P18620_UPPER : Upper confidence level (84%) of p1 parameter at 862.0 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the p1 parameter (central wavelength) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P28620 : p2 parameter at 862.0 nm (float, Length & Distance[nm])

Width (p2 parameter) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

P28620_LOWER : Lower confidence level (16%) of p2 parameter at 862.0 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the p2 parameter (width) of the DIB at 862.0nm in each DIB-Spec voxel, see parameter `p08620` for details.

P28620_UPPER : Upper confidence level (84%) of p2 parameter at 862.0 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the p2 parameter (width) of the DIB at 862.0 nm in each DIB-Spec voxel, see parameter `p08620` for details.

EW8648 : DIB equivalent width at 864.8 nm (float, Length & Distance[nm])

Equivalent width of the DIB at 864.8 nm in each DIB-Spec voxel.

It is defined from a Lorentzian model $f(\lambda, p_0, p_1, p_2) = \frac{-(p_0 p_2^2)}{(\lambda-p_1)^2 + p_2^2}$ where p_0 and p_2 are the depth and width of the DIB profile, p_1 is the central wavelength and λ is the wavelength. The latter is the parameter `lambda` in the interstellar medium spectra table.

EW8648_LOWER : Lower confidence level (16%) of DIB equivalent width at 864.8 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the equivalent width of the DIB at 864.8 nm in each DIB-Spec voxel.

The confidence interval has been evaluated by numerical integration of the spectra, while the ew8648 has been computed by an analytical solution. This inconsistency between the calculation of the EW and their upper and lower levels implies that sometimes `ew8648 < ew8648_lower` or `ew8648 > ew8648_upper`, even if the upper and lower values are consistent with each other. We recommend application of the scaling factor of 1.258 to `ew8648_lower` and `ew8648_upper`, see Gaia Collaboration et al. (2023b).

EW8648_UPPER : Upper confidence level (84%) of DIB equivalent width at 864.8 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the equivalent width of the DIB at 864.8 nm in each DIB-Spec voxel.

The confidence interval has been evaluated by numerical integration of the spectra, while the ew8648 has been computed by an analytical solution. This inconsistency between the calculation of the EW and their upper and lower levels implies that sometimes `ew8648 < ew8648_lower` or `ew8648 > ew8648_upper`, even if the upper and lower values are consistent with each other. We recommend application of the scaling factor of 1.258 to `ew8648_lower` and `ew8648_upper`, see Gaia Collaboration et al. (2023b).

FLAGS8648 : Quality flag of DIB parameters at 864.8 nm (int)

Quality flag of the DIB parameters at 864.8 nm in each DIB-Spec voxel. 0 is the best value and 5 is the worst. The exact definition of the quality flags can be found in Gaia Collaboration et al. (2023b).

P08648 : p0 parameter at 864.8 nm (float)

Depth (p0 parameter) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P08648_LOWER : Lower confidence level (16%) of p0 parameter at 864.8 nm (float)

Lower confidence level (16%) of the p0 parameter (depth) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P08648_UPPER : Upper confidence level (84%) of p0 parameter at 864.8 nm (float)

Upper confidence level (84%) of the p0 parameter (depth) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P18648 : p1 parameter at 864.8 nm (float, Length & Distance[nm])

Central wavelength (p1 parameter) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P18648_LOWER : Lower confidence level (16%) of p1 parameter at 864.8 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the p1 parameter (central wavelength) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P18648_UPPER : Upper confidence level (84%) of p1 parameter at 864.8 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the p1 parameter (central wavelength) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P28648 : p2 parameter at 864.8 nm (float, Length & Distance[nm])

Width (p2 parameter) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P28648_LOWER : Lower confidence level (16%) of p2 parameter at 864.8 nm (float, Length & Distance[nm])

Lower confidence level (16%) of the p2 parameter (width) of the DIB at 864.8 nm in each DIB-Spec voxel, see parameter `ew8648` for details.

P28648_UPPER : Upper confidence level (84%) of p2 parameter at 864.8 nm (float, Length & Distance[nm])

Upper confidence level (84%) of the p2 parameter (width) of the DIB at 864.8 nm of the DIB-Spec bin, see parameter `ew8648` for details.

DIBCONT_A0 : Slope a0 of the global continuum fit of the full stacked spectrum (float)

The coefficient a_0 (slope) of the global fit to the continuum of the stacked spectrum. The continuum is defined as $a_0\lambda + a_1$ where λ is the wavelength given in parameter lambda in the interstellar_medium_spectra table.

DIBCONT_A0_LOWER : Lower confidence level (16%) of the slope a0 of the global continuum fit (float)

Lower confidence level (16%) of the dibcont_a0 parameter in each DIB-Spec voxel, see parameter dibcont_a0 for details.

DIBCONT_A0_UPPER : Upper confidence level (84%) of the slope a0 of the global continuum fit (float)

Upper confidence level (84%) of the dibcont_a0 parameter in each DIB-Spec voxel, see parameter dibcont_a0 for details.

DIBCONT_A1 : Intercept a1 of the global continuum fit of the full stacked spectrum (float)

The coefficient a_1 (intercept) of the global fit to the continuum of the stacked spectrum, see parameter dibcont_a0 for details.

1.3 INTERSTELLAR_MEDIUM_SPECTRA

Table of the stacked Interstellar Medium Spectra

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

HEALPIX : The HEALPix Identification (int)

The pixel number determined by a level 5 HEALPix scheme, which is one of the two identifiers of the DIB-Spec bin voxel. Each voxel is defined by a HEALPix number (level 5) made in the equatorial system and the central heliocentric distance (dc).

LC : Central galactic longitude of voxel (float, Angle[deg])

Galactic longitude of the centre of the DIB-Spec voxel.

BC : Central galactic latitude of voxel (float, Angle[deg])

Galactic latitude of the centre of the DIB-Spec voxel.

DC : Central heliocentric distance of voxel (float, Length & Distance[kpc])

Heliocentric distance of the centre of the DIB-Spec voxel. The distance is defined as the inverse of parallax.

LAMBDA : Wavelength (float, Length & Distance[Å])

Wavelength of the interstellar medium stacked spectrum.

FLUX : Normalised flux (float)

Median value of the normalised flux of the interstellar medium stacked spectrum corresponding to wavelength `lambda`.

FLUX_UNCERTAINTY : Uncertainty in the flux parameter (float)

Uncertainty value of the parameter `flux`. It is defined as the mean value of the flux errors on the individual spectra used to construct the stacked spectrum, divided by the square root of the number of spectra.

1.4 LENS_CANDIDATES

This table contains the sources identified as possible gravitational lens candidates based on an analysis of the observations in the neighbourhood of a list of sources selected from a compilation of quasar candidates. Information about the catalogues from which these quasars proceed is given in the table of lens catalogue names.

For each `source_id`, a list of components found around that source is tabulated, together with some information about their position and flux as derived from the cluster of observations associated with each of them. These individual observations are provided in `lens_observations`.

A separate table `lens_outliers` compiles all those observations that could not be associated with a component around a given `source_id`, and that have therefore been discarded from the analysis.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivo-cally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source cat-alogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

NAME : The name of the gravitational lens candidate (string)

The gravitational lens candidate name, in the form DR3Gaiahhmmss.sss+/-ddmmss.ss, where hhmmss.sss and ddmmss.ss are the right ascension and declination respectively.

FLAG : GravLens flag (byte)

This flag provides information about the processing or scientific quality of the results of the

GravLens chain for the source of interest. The flag checks two conditions:

1. Whether the magnitude difference between the brightest and the faintest component of the system is larger than 5 mag.

2. Whether the number of outlier observations (tabulated in `lens_outlier`) is larger than the number of valid observations (tabulated in `lens_observation`).

The flag then is coded in the following way:

- 0 when none of the conditions above are met.

- 1 when the first condition is met but not the second.

- 10 when the second condition is met but not the first.

- 11 when both conditions are met.

N_COMPONENTS : Number of components (int)

Number of components around the `source_id` obtained from the clustering algorithm applied in a fixed radius.

COMPONENT_ID : Index of the component for this source_id (int)

An index used to identify the various components found around this source_id. This number varies between 1 and `n_components`.

N_OBS_COMPONENT : Number of valid observations used for this component (short)

Number of valid observations used for this `component_id`.

COMPONENT_FLAG : Component object flag (byte)

This flag provides information about the processing or scientific quality of the results of the GravLens chain on the component level. The flag checks two conditions:

1. Whether `ra_std_component` > 100 mas or `dec_std_component` > 100 mas.

2. Whether `g_mag_std_component` > 0.4 mag.

The flag then is coded in the following way:

- 0 when none of the conditions above are met.

- 1 when the first condition is met but not the second.

- 10 when the second condition is met but not the first.

- 11 when both conditions are met.

RA_COMPONENT : Mean right ascension of the component (double, Angle[deg])

The mean right ascension of the cluster of observations associated with this component within a fixed radius. The individual right ascensions as decoded from the transit_ids are stored in `lens_observations`.

RA_STD_COMPONENT : Standard deviation of the right ascension of the component (float, Angle[mas])

The standard deviation of right ascension measurements (multiplied by cos (`dec_std_component`)) for the cluster of observations associated with this component within a fixed radius. The individual right ascensions as decoded from the transit_ids are stored in `lens_observations`.

DEC_COMPONENT : Mean declination of the clusters of measurements (double, Angle[deg])

The mean declination of the cluster of observations associated with this component within a fixed radius. The individual declinations as decoded from the transit_ids are stored in `lens_observations`.

DEC_STD_COMPONENT : Standard deviation of the declination measurements (float, Angle[mas])

The standard deviation of declination measurements for the cluster of observations associated with this component within a fixed radius. The individual declinations as decoded from the transit identifiers are stored in `lens_observations`.

G_FLUX_COMPONENT : Mean G flux of the component (double, Flux[e$^-$ s^{-1}])

Mean G-band flux value for all observations belonging to this component. Note that this value may be missing in some cases.

G_FLUX_COMPONENT_ERROR : Uncertainty of the mean flux value for this component (float, Flux[e$^-$ s^{-1}])

Uncertainty of the mean G-band flux value for this component. Note that this value may be missing in some cases.

G_MAG_COMPONENT : Mean onboard G magnitude of the component (float, Magnitude[mag])

Mean VPU onboard G-band magnitude for the observations belonging to this component.

G_MAG_STD_COMPONENT : Standard deviation of the onboard G magnitude of the component (float, Magnitude[mag])

Standard deviation of the VPU onboard G-band magnitudes for the observations belonging to this component.

1.5 LENS_CATALOGUE_NAME

This table provides the list of input catalogues that have been used to select any given source that was analysed by the Gravitational Lens module and published in the lens candidate table.

Each source may have been cross-matched to more than one catalogue and therefore can have several entries in the table.

For the FPR, the catalogues considered for this selection are mostly external, although sources identified by DPAC based on the classification performed by other processing have also been included here.

Each catalogue is assigned a `catalogue_id`. For the FPR the following applies:

- 1: Ducourant+2022 Ducourant et al. (2023)
- 2: Gravitational Lens data base (Ducourant+2023): Ducourant (2023)
- 3: Gravitational Lens candidates (Krone-Martins+2023): Gaia Collaboration et al. (2023a)
- 4: Milliquas 7.5b Flesch (2021)
- 5: Milliquas 7.5 Flesch (2021)
- 6: Milliquas 7.4d Flesch (2021)
- 7: Milliquas 7.4c Flesch (2021)
- 8: Milliquas 7.1b Flesch (2019)
- 9: Milliquas 7.0 Flesch (2019)
- 10: Milliquas 6.4 Flesch (2019)
- 11: Assef R90 Assef et al. (2018)
- 12: Shu+2019 Shu et al. (2019)
- 13: Assef C75 Assef et al. (2018)
- 14: Sergei Klioner, private communication, 2022.

Further details on these catalogues are given in Ducourant+2023.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well

as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (unique within a particular Data Release) (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

CATALOGUE_ID : The unique identifier for the catalogue(s) used to select the sources in the gravitational lenses analysis (byte)

Each catalogue used to select the sources analysed by the gravitational lens module is assigned a unique ID. The corresponding catalogues are listed in the description of the `lens_catalogue_name` table, and further details are given in the FPR documentation.

1.6 LENS_OBSERVATION

This table contains the observations associated with the components found in the lens candidates table.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

COMPONENT_ID : Index of the component for this source_id (int)

An index used to identify the various components found around this source_id. This number varies between 1 and `lens_candidates.n_components`.

OBSERVATION_ID : Counter for the observations of each component (int)

A sequential counter that uniquely identifies the observations belonging to a given component.

RA_OBS : Right ascension of each individual observation belonging to this component, as decoded from the transit_id (double, Angle[deg])

Right ascension of each individual observation belonging to this component, as decoded from the `transit_id`.

DEC_OBS : Declination of each individual observation belonging to this component, as de-

coded from the transit_id (double, Angle[deg])

Declination of each individual observation belonging to this component, as decoded from the `transit_id`.

G_FLUX_OBS : Flux value of each individual observation belonging to this component (double, Flux[e$^-$ s^{-1}])

Flux value of each individual observation belonging to this component. Note that this value may be missing in some cases.

G_FLUX_OBS_ERROR : Flux error value of each individual observation belonging to this component (float, Flux[e$^-$ s^{-1}])

Flux error value of each individual observation belonging to this component. Note that this value may be missing in some cases.

G_MAG_OBS : Onboard G magnitudes of each individual observation belonging to this component (float, Magnitude[mag])

Onboard G-band magnitude of each individual observation belonging to this component.

EPOCH_OBS : Epoch of the individual observation belonging to this component (double, Time[Barycentric JD in TCB $-$ 2 455 197.5 (day)])

Epoch of the individual observation belonging to this component, given as Julian Days in TCB at the Barycentre, minus 2 455 197.5 days.

1.7 LENS_OUTLIER

This table contains the individual observations that have been discarded from the analysis of the gravitational lenses around the list of source_ids tabulated in the lens candidate table. These are observations that could not be associated with any of the components assigned to the source of interest.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

OUTLIER_ID : Counter for the outliers of each component (int)

A sequential counter that uniquely identifies the outliers belonging to a given component.

RA_OBS : Right ascension of each individual outlier observation (double, Angle[deg])

Right ascension of each individual outlier observation, as decoded from the `transit_id`.

DEC_OBS : Declination of each individual outlier observation (double, Angle[deg])

Declination of each individual outlier observation, as decoded from the `transit_id`.

G_FLUX_OBS : Flux value of each individual outlier observation (double, Flux[e^- s^{-1}])

G-band flux value of each individual outlier observation. Note that this value may be missing in some cases.

G_FLUX_OBS_ERROR : Flux error value of each individual outlier observation (float, Flux[e^- s^{-1}])

G-band flux error value of each individual outlier observation. Note that this value may be missing in some cases.

G_MAG_OBS : Onboard G magnitudes of each individual outlier observation (float, Magnitude[mag])

Onboard G-band magnitude of each individual outlier observation.

EPOCH_OBS : Epoch of the individual outlier observation (double, Time[Barycentric JD in TCB $-$ 2 455 197.5 (day)])

Epoch of the individual outlier observation, given as Julian Days in TCB at the Barycentre, minus 2 455 197.5 days.

1.8 SSO_OBSERVATION

> Solar System object observations. Each table line contains data obtained during the transit of the source on a single CCD, during a single transit. The corresponding epoch is provided. Data not varying within the transit are repeated identically for all single observations of that transit.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`). Note in particular that these identifiers are by convention negative for SSOs.

DENOMINATION : standard MPC denomination of the asteroid (string)

Name of the object. It follows the Minor Planet Centre convention for the minor planets and natural satellites of the planets.

TRANSIT_ID : Transit Identifier (long)

The `transit_id` is a unique identifier assigned to each detected (and confirmed) source as it transits the Gaia focal plane. Each time a given source is detected as Gaia scans and re-scans the sky a new `transit_id` will be created to badge that apparition. Hence the along–scan time and the across–scan position along with the telescope in which the source was detected are used to form a unique integer with which to label the transit.

The several features of a detection that are encoded in `transit_id` can be easily retrieved using bit masks (&) and shifts (>>) as follows:

- On-Board Mission Time line [ns]
  = 204800 * ((transit_id >> 17) & (0x000003FFFFFFFFFF))

- Field-of-view = 1 + (transit_id >> 15) & 0x03 [1 for 'preceding' and 2 for 'following' fields-of-view respectively]

- CCD row = (transit_id >> 12) & 0x07 [dimensionless, in the range 1 to 7]

- Across-scan 'reference acquisition pixel' in strip AF1 = (transit_id) & 0x0FFF [pixels] (this is the across-scan centre of the AF1 window and is odd if immediately below the mid-point of the window and even if immediately above)

where the bit mask prefix '0x' denotes hexadecimal.

For further details see Portell et al. (2020). For convenience a decoder for transit_id is available on-line at

```
https://gaia.esac.esa.int/decoder/transitidDecoder.jsp
```

OBSERVATION_ID : Observation Identifier (long)

Identifier at single CCD level of the observation of a Solar System object. It is unique, and obtained from a combination of transit_id and an integer number representing the CCD strip: observation_id = transit_id x 10 + AF CCD number.

NUMBER_MP : Minor Planet number (long)

Minor planet number attributed by the Minor Planet Centre (MPC). It is set to zero for the natural planetary satellites.

EPOCH : Gaia-Centric epoch TCB(Gaia) (double, Time[Gaia-Centric JD in TCB − 2 455 197.5 (day)])

Gaia-Centric epoch TCB(Gaia) in JD corresponding to the time of crossing of the fiducial line of the CCD (mid exposure). This is the epoch to which the target coordinates and the position/velocity of Gaia are referred. To avoid loss of precision the reference time J2010.0 has been subtracted.

EPOCH_ERR : Error in Gaia-Centric epoch (double, Time[day])

The error in the Gaia-Centric epoch (for both `epoch` and `epoch_utc`).

EPOCH_UTC : Gaia-Centric TCB epoch converted to UTC (double, Time[Gaia-Centric JD in UTC − 2 455 197.5 (day)])

Gaia-Centric epoch in UTC in JD-J2010.0 corresponding to right ascension and declination obtained from the conversion of TCB(Gaia) to UTC.

RA : Right ascension of the source (double, Angle[deg])

ICRS right ascension of the source as observed by Gaia at `epoch`, corrected for full relativistic aberration but not for relativistic light deflection in the gravitational field of the Solar System.

DEC : Declination of the source (double, Angle[deg])

ICRS declination of the source as observed by Gaia at `epoch`, corrected for full relativistic aberration but not for relativistic light deflection in the gravitational field of the Solar System.

RA_ERROR_SYSTEMATIC : Standard error of right ascension, systematic (double, Angle[mas])

Uncertainty on right ascension, systematic component (assumed to be constant during a transit), multiplied by cos of declination.

DEC_ERROR_SYSTEMATIC : Standard error of declination, systematic (double, Angle[mas])

Standard error for declination, systematic component (assumed to be constant during a transit).

RA_DEC_CORRELATION_SYSTEMATIC : Correlation of ra and dec errors, systematic (double)

Correlation of `ra_error_systematic` and `dec_error_systematic`.

RA_ERROR_RANDOM : Standard error of right ascension, random (double, Angle[mas])

Uncertainty on right ascension, random component, multiplied by cos of declination.

DEC_ERROR_RANDOM : Standard error of declination, random (double, Angle[mas])

Standard error for declination, random component.

RA_DEC_CORRELATION_RANDOM : Correlation of ra and dec errors, random (double)

Correlation of ra and dec uncertainty, random component.

X_GAIA : Barycentric x position of Gaia (double, Length & Distance[AU])

Barycentric equatorial J2000 (ICRS) x position of Gaia at the epoch of the observation.

Y_GAIA : Barycentric y position of Gaia (double, Length & Distance[AU])

Barycentric equatorial J2000 y position (ICRS) of Gaia at the epoch of the observation.

Z_GAIA : Barycentric z position of Gaia (double, Length & Distance[AU])

Barycentric equatorial J2000 z position (ICRS) of Gaia at the epoch of observation.

VX_GAIA : Barycentric x velocity of Gaia (double, Velocity[AU day^{-1}])

Barycentric equatorial J2000 (ICRS) x velocity of Gaia at the epoch of the observation.

VY_GAIA : Barycentric y velocity of Gaia (double, Velocity[AU day^{-1}])

Barycentric equatorial J2000 (ICRS) y velocity of Gaia at the epoch of observation.

VZ_GAIA : Barycentric z velocity of Gaia (double, Velocity[AU day^{-1}])

Barycentric equatorial J2000 (ICRS) z velocity of Gaia at the epoch of observation.

X_GAIA_GEOCENTRIC : Geocentric x position of Gaia (double, Length & Distance[AU])

Geocentric equatorial J2000 x position of Gaia at the epoch of observation, in a reference aligned to ICRS.

Y_GAIA_GEOCENTRIC : Geocentric y position of Gaia (double, Length & Distance[AU])

Geocentric equatorial J2000 y position of Gaia at the epoch of observation in a reference aligned to ICRS.

Z_GAIA_GEOCENTRIC : Geocentric z position of Gaia (double, Length & Distance[AU])

Geocentric equatorial J2000 z position of Gaia at the epoch of observation in a reference aligned to ICRS.

VX_GAIA_GEOCENTRIC : Geocentric x velocity of Gaia (double, Velocity[AU day^{-1}])

Geocentric equatorial J2000 x velocity of Gaia at the epoch of observation in a reference aligned to ICRS.

VY_GAIA_GEOCENTRIC : Geocentric y velocity of Gaia (double, Velocity[AU day^{-1}])

Geocentric equatorial J2000 y velocity of Gaia at the epoch of observation in a reference aligned to ICRS.

VZ_GAIA_GEOCENTRIC : Geocentric z velocity of Gaia (double, Velocity[AU day^{-1}])

Geocentric equatorial J2000 z velocity of Gaia at the epoch of observation in a reference aligned to ICRS.

POSITION_ANGLE_SCAN : Position angle of the scanning direction (double, Angle[deg])

Position angle of the scan direction at the epoch of observation in the equatorial reference frame. 0 = North direction, $\pi/2$ = increasing right ascension, pi = South, $3\pi/2$ = decreasing right ascension. It is defined as the angle between the AL direction and the direction to the North Pole, at the SSO position, after applying the correction for aberration. As a consequence of this correction for aberration, the AC direction is not strictly perpendicular to the AL direction.

ASTROMETRIC_OUTCOME_CCD : Result of processing the CCDs (int)

Result of the astrometric processing of the individual CCDs in the transit. Values presently defined:

1 Good position derived.

11 No position derived, because no centroid could be determined.

12 Position rejected a priori, because previous studies have shown that it is unreliable.

24 Position rejected, because this CCD has some samples that have been eliminated.

25 Position rejected, because this CCD is affected by an AOCS update.

26 Position rejected, because this CCD is affected by a non-nominal gating.

29 Position rejected, because of more than one reason, combination of codes 21–26.

32 Position rejected as outlier, because this position does not fit on the regression line.

35 Position rejected, because it does not fulfill the magnitude-uncertainty relation, see documentation.

39 Position rejected, because the value of the distance to last charge injection event recorded for the relevant CCD is invalid.

40 Position rejected, because the epoch corresponds to known bad attitude, see documentation.

41 Position rejected, because no attitude or no calibration is available for the epoch of observation.

ASTROMETRIC_OUTCOME_TRANSIT : Result of processing the transit (int)

Result of the astrometric processing of the transit. Values defined at present are:

1 The transit contains at least one good position.

2 Positions derived, but less consistent than expected. This means that the criterion to reject outliers had to be relaxed to find an unambiguous set of consistent positions.

5 Positions derived, but outlier rejection was not possible because of dramatic loss of precision.

6 Positions derived, but no future field angles in RP/BP, because no attitude is available for the future epochs (reference epoch + 45, 50 and 55 seconds).

FOV : Field of view (byte)

Field of view (0 = preceding, 1 = following)

IS_REJECTED : Flag indicating if rejected by the orbital fit (boolean)

This flag indicates if the observation was considered as an outlier by the orbital fit. This happens if the post–fit residuals are above a given threshold (provided in the DR3 documentation), in which case the flag is set to `true`.

1.9 SSO_SOURCE

This table contains data related to Solar System objects observed by Gaia. The quantities in the table are derived from data reduction and are associated with single objects.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit https://gaia.esac.esa.int/decoder/solnDecoder.jsp

SOURCE_ID : Source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see gaiadr3.gaia_source.source_id). Note in particular that these identifiers are by convention negative for SSOs.

NUM_OF_OBS : number of observations (int)

Number of CCD-level observations of the asteroid that appear in the sso_observation table.

NUMBER_MP : Minor Planet number (long)

Minor planet number attributed by the Minor Planet Centre (MPC). It is set to zero for the natural planetary satellites.

DENOMINATION : standard MPC denomination of the asteroid (string)

Name of the object. It follows the Minor Planet Centre convention for the minor planetsand natural planetary satellites.

EPOCH_STATE_VECTOR : TCB epoch for the state vector (double, Time[Julian Date (day)])

Reference epoch of the state vector, mid-point of the time interval spanned by the observations of the Solar System Object (TCB). It is expressed in days, with origin at the epoch JD2457907.5 TCB.

ORBITAL_ELEMENTS_VAR_COVAR_MATRIX : var-covar matrix on elliptical elements at reference Epoch (double[21] array)

Covariance uncertainty matrix of the osculating orbit at reference epoch (`epoch_state_vector`) (heliocentric). In the order, the values correspond to the following elements of the matrix, representing the upper triangle (indices are given):

- 00 = variance(a)

- 01 = co-variance(a, e)

- 02 = co-variance(a, i)

- 03 = co-variance(a, node)

- 04 = co-variance(a, peri)

- 05 = co-variance(a, M0)

- 11 = variance(e)

- 12 = co-variance(e, i)

- 13 = co-variance(e, node)

- 14 = co-variance(e, peri)

- 15 = co-variance(e, M0)

- 22 = variance(i)

- 23 = co-variance(i, node)

- 24 = co-variance(i, peri)

- 25 = co-variance(i, M0)

- 33 = variance(node)

- 34 = co-variance(node, peri)

- 35 = co-variance(node, M0)

- 44 = variance(peri)

- 45 = co-variance(peri, M0)

- 55 = variance(M0)

where the abbreviations and their units are:

- a (au); semi-major axis

- e (adimesional); eccentricity

- i (rad); inclination

- node (rad); longitude of the ascending node

- peri (rad); argument of periastron

- M0 (rad); mean anomaly

H_STATE_VECTOR : Heliocentric State Vector at reference Epoch (double[6] array, StateVector[au, au d^{-1}])

Initial conditions position and velocity (state vector) in cartesian coordinates at reference epoch (`epoch_state_vector`) (heliocentric, ICRF). Units are au for positions, and au/day for velocities.

H_STATE_VECTOR_VAR_COVAR_MATRIX : Covariance matrix of the State Vector (double[21] array)

Covariance uncertainty matrix of the state vector (`h_state_vector`) at reference epoch (`epoch_state_v` heliocentric, in the ICRF).

1.10 VARI_EPOCH_RADIAL_VELOCITY

This table contains the epoch radial velocity data points for a sub-set of variable stars. Each entry is a radial velocity in the solar barycentric reference frame for a given object and observation time.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit https://gaia.esac.esa.int/decoder/solnDecoder.jsp

SOURCE_ID : Unique source identifier (unique within a particular Data Release) (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see gaiadr3.gaia_source.source_id).

TRANSIT_ID : Transit unique identifier (long)

The transit_id is a unique identifier assigned to each detected (and confirmed) source as it transits the Gaia focal plane. Each time a given source is detected as Gaia scans and re-scans the sky a new transit_id will be created to badge that apparition. Hence the along–scan time and the across–scan position along with the telescope in which the source was detected are used to form a unique integer with which to label the transit.

The several features of a detection that are encoded in transit_id can be easily retrieved using bit masks (&) and shifts (>>) as follows:

- On-Board Mission Time line [ns]
  = 204800 * ((transit_id >> 17) & (0x000003FFFFFFFFFF))

- Field-of-view = 1 + (transit_id >> 15) & 0x03 [1 for 'preceding' and 2 for 'following' fields-of-view respectively]

- CCD row = (transit_id >> 12) & 0x07 [dimensionless, in the range 1 to 7]

- Across-scan 'reference acquisition pixel' in strip AF1 = (`transit_id`) & 0x0FFF [pixels] (this is the across-scan centre of the AF1 window and is odd if immediately below the mid-point of the window and even if immediately above)

where the bit mask prefix '0x' denotes hexadecimal.

For further details see Portell et al. (2020). For convenience a decoder for `transit_id` is available on-line at

`https://gaia.esac.esa.int/decoder/transitidDecoder.jsp`

RV_OBS_TIME : Observing time of the transit (double, Time[Barycentric JD in TCB − 2 455 197.5 (day)])

Observation time of the radial velocity in the solar barycentric reference frame. It corresponds to the mean of the observation times of the three CCDs used to collect spectra in the RVS during that transit.

RADIAL_VELOCITY : Barycentric radial velocity (double, Velocity[km s^{-1}])

Radial velocity in the solar barycentric frame for the transit of interest.

RADIAL_VELOCITY_ERROR : Barycentric radial velocity error (double, Velocity[km s^{-1}])

Error on the radial velocity for the transit of interest.

REJECTED_BY_VARIABILITY : Rejected by DPAC variability processing (or variability analysis) (boolean)

Indicates whether the radial velocity at this transit was rejected by the DPAC variability processing (or variability analysis)

1.11 VARI_LONG_PERIOD_VARIABLE

This table describes the Long Period Variable stars.

Some entries can be NaN when absent.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

FREQUENCY : Frequency from G FoV time series (double, Frequency[day^{-1}])

Frequency found for the Long-Period Variable star from the cleaned G FoV time series.

FREQUENCY_ERROR : Uncertainty on the frequency from G FoV time series (float, Frequency[day^{-1}])

Uncertainty on the frequency found for the Long-Period Variable star from the cleaned G FoV time series.

AMPLITUDE : Variability amplitude based on the best-fit model to the G FoV time series (float, Magnitude[mag])

Half peak-to-peak variability amplitude of the fundamental component of the best-fit Fourier series model (up to three harmonics) to the cleaned G FoV time series of the Long-Period Variable using the published frequency.

MEDIAN_DELTA_WL_RP : Median of the pseudo-wavelength separations between the two highest peaks in RP spectra (float)

Median among all G_{RP} epoch spectra of the pseudo-wavelength separations between the two highest peaks in the G_{RP} spectra. It is set to Null when the spectrum does not allow an automatic identification of two maxima. This value is used in the definition of the is_cstar parameter.

IS_CSTAR : Flag to mark C-stars (Boolean)

The parameter is_cstar is set to TRUE if a star has been identified as a C-star based on the value of the median_delta_wl_rp parameter derived from the G_{RP} spectrum shape. It is set to FALSE if it is an O-rich star. It is set to NULL when the shape of the spectrum cannot allow an automatic classification between these two types of LPVs. A note on S-type stars: the method cannot classify correctly the nature of these stars. As a consequence, they may have the is_cstar flag set to either TRUE or FALSE.

FREQUENCY_RV : Frequency from radial velocity time series (double, Frequency[day^{-1}])

Frequency found for the Long-Period Variable star from the cleaned radial velocity time series.

FREQUENCY_RV_ERROR : Uncertainty on the frequency from radial velocity time series (float, Frequency[day^{-1}])

Uncertainty on the frequency found for the Long-Period Variable star from the cleaned radial velocity time series.

AMPLITUDE_RV : Variability amplitude based on the best-fit model to the radial velocity time series (float, Velocity[km s^{-1}])

Half peak-to-peak variability amplitude of the fundamental component of the best-fit Fourier series model (up to three harmonics) to the cleaned radial velocity time series of the Long-Period Variable using the published frequency.

FLAG_RV : Flag identifying a top-quality subsample (Boolean)

Flag indicating that the period derived from the cleaned radial velocity time series is compatible with the periods from the cleaned G FoV, G_{BP}, and G_{RP} photometric time series.

1.12 VARI_RAD_VEL_STATISTICS

Statistical parameters of radial velocity time series using only transits retained and not rejected (see the relevant rejection flag in the epoch radial velocity variability table).

Note that NaN will be reported when the parameter value is missing or cannot be calculated.

Columns description:

SOLUTION_ID : Solution Identifier (long)

All Gaia data processed by the Data Processing and Analysis Consortium comes tagged with a solution identifier. This is a numeric field attached to each table row that can be used to unequivocally identify the version of all the subsystems that were used in the generation of the data as well as the input data used. It is mainly for internal DPAC use but is included in the published data releases to enable end users to examine the provenance of processed data products. To decode a given solution ID visit `https://gaia.esac.esa.int/decoder/solnDecoder.jsp`

SOURCE_ID : Unique source identifier (long)

A unique single numerical identifier of the source obtained from the Gaia DR3 main source catalogue (for a detailed description see `gaiadr3.gaia_source.source_id`).

NUM_SELECTED_RV : Total number of radial velocity transits selected for variability analysis (short)

The number of processed observations for variability analyses of this source, using only transits not rejected, see `rejected_by_variability` column in `vari_epoch_radial_velocity`.

MEAN_OBS_TIME_RV : Mean observation time for radial velocity transits (double, Time[Barycentric JD in TCB $-$ 2 455 197.5 (day)])

 Name: The mean observation time

 Output: Let y_i be a time series of size N at times t_i. The mean $\bar{t}$ is defined as

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_i.$$

TIME_DURATION_RV : Time duration of the time series for radial velocity transits (float, Time[day])

Name: The time duration of the time series

Output: Let y_i be a time series of size N at times t_i, with $i = 1$ to N. The time duration of the time series is equal to $t_N - t_1$.

MIN_RV : Minimum radial velocity (float, Velocity[km s^{-1}])

Name: The minimum value of the time series

Output: Let y_i be a time series of size N at times t_i, with $i = 1$ to N. The minimum value of the time series is defined as:

$$min(y_i) \, \forall i \in (1, N)$$

MAX_RV : Maximum radial velocity (float, Velocity[km s^{-1}])

Name: The maximum value of the time series

Output: Let y_i be a time series of size N at times t_i, with $i = 1$ to N. The maximum value of the time series is defined as:

$$max(y_i) \, \forall i \in (1, N)$$

MEAN_RV : Mean radial velocity (float, Velocity[km s^{-1}])

Name: The mean of the time series

Output: Let y_i be a time series of size N. The mean $\overline{y}$ is defined as

$$\overline{y} = \frac{1}{N} \sum_{i=1}^{N} y_i.$$

MEDIAN_RV : Median radial velocity (float, Velocity[km s^{-1}])

Name: The median of the time series

Output: The 50th percentile unweighted value.

Let y_i be a time series of size N ordered such as $y_{(1)} \leq y_{(2)} \leq \cdots \leq y_{(N)}$. The m-th (per cent) percentile P_m is defined for $0 < m \leq 100$ as follows:

$$P_m = \begin{cases} y_{(1)} & \text{if } 0 < m < 100/N, \\ y_{(i)} & \text{if } Nm/100 - i = 0, \\ y_{(i+1)} & \text{otherwise.} \end{cases}$$

RANGE_RV : Difference between the highest and lowest radial velocity transits (float, Velocity[km s^{-1}])

Name: The range of the time series

Output: Let y_i be a time series, $y_{\max}$ its largest element, and $y_{\min}$ its smallest element, then the range is defined as

$$R = y_{\max} - y_{\min}$$

STD_DEV_RV : Square root of the unweighted radial velocity variance (float, Velocity[km s^{-1}])

Name: The square root of the unbiased unweighted variance.

Output: Let y_i be a time series of size N. The unweighted standard deviation $\hat{\sigma}$ is defined as the square root of the sample-size unbiased unweighted variance:

$$\hat{\sigma} = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (y_i - \overline{y})^2}.$$

SKEWNESS_RV : Standardized unweighted radial velocity skewness (float)

Name: The standardised unbiased unweighted skewness.

Output: Let y_i be a time series of size $N > 2$. The sample-size unbiased unweighted skewness moment $\mathcal{E}$ is defined as:

$$\mathcal{E} = \frac{N}{(N-1)(N-2)} \sum_{i=1}^{N} (y_i - \overline{y})^3.$$

The standardized unbiased skewness E is defined as:

$$E = \frac{\mathcal{E}}{\hat{\sigma}^3}$$

where $\hat{\sigma}$ is the square root of the unbiased unweighted variance around the unweighted mean. While $\mathcal{E}$ is an unbiased estimate of the population value, E becomes unbiased in the limit of large N.

KURTOSIS_RV : Standardized unweighted radial velocity kurtosis (float)

Name: The standardised unbiased unweighted kurtosis.

Output: Let y_i be a time series of size $N > 3$. The sample-size unbiased unweighted kurtosis cumulant $\mathcal{K}$ is defined as:

$$\mathcal{K} = \frac{N(N+1)}{(N-1)(N-2)(N-3)} \sum_{i=1}^{N} (y_i - \overline{y})^4 - \frac{3}{(N-2)(N-3)} \left[\sum_{i=1}^{N} (y_i - \overline{y})^2 \right]^2 .$$

The standardized unbiased kurtosis K is defined as:

$$K = \frac{\mathcal{K}}{\hat{\sigma}^4}$$

where $\hat{\sigma}^2$ is the unbiased unweighted variance around the unweighted mean. While $\mathcal{K}$ is an unbiased estimate of the population value, K becomes unbiased in the limit of large N.

MAD_RV : Median Absolute Deviation (MAD) for radial velocity transits (float, Velocity[km s^{-1}])

Name: The Median Absolute Deviation (MAD)

Output: Let y_i be a time series of size N. The MAD is defined as the median of the absolute deviations from the median of the data, scaled by a factor of $1/\Phi^{-1}(3/4) \approx 1.4826$ (where Φ^{-1} is the inverse of the cumulative distribution function for the standard normal distribution), so that the expectation of the scaled MAD at large N equals the standard deviation of a normal distribution:

$$\text{MAD} = 1.4826 \, \text{median}\{|y_i - \text{median}\{y_j, \forall j \in (1, N)\}|, \forall i \in (1, N)\}.$$

ABBE_RV : Abbe value for radial velocity transits (float)

Name: The Abbe value

Output: Let $\{t_i, y_i\}$ be a time-sorted time series of size N, such that $t_i < t_{i+1}$ for all $i < N$. The Abbe value $\mathcal{A}$ is defined as

$$\mathcal{A} = \frac{\sum_{i=1}^{N-1}(y_{i+1} - y_i)^2}{2\sum_{i=1}^{N}(y_i - \bar{y})^2}$$

where $\bar{y}$ is the unweighted mean.

IQR_RV : Interquartile range for radial velocity transits (float, Velocity[km s^{-1}])

Name: The Interquartile Range (IQR)

Output: The difference between the (unweighted) 75th and 25th percentile values: IQR= $P_{75} - P_{25}$.

Let y_i be a time series of size N ordered such as $y_{(1)} \leq y_{(2)} \leq \cdots \leq y_{(N)}$. The m-th (per cent) percentile P_m is defined for $0 < m \leq 100$ as follows:

$$P_m = \begin{cases} y_{(1)} & \text{if } 0 < m < 100/N, \\ y_{(i)} & \text{if } Nm/100 - i = 0, \\ y_{(i+1)} & \text{otherwise.} \end{cases}$$

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