
# Gaia DR3: Gaia CRF3 cross-match table

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# Abstract

The table definition for the Gaia CRF3 cross-match table that is to be included at Gaia Data Release 3, and published in isolation also, is described in the following pages.

# Contents

# Datamodel description

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# 1 Auxiliary tables

## 1.1 GAIA_CRF3_XM

This table contains the full cross-match information for the Gaia-CRF3 sources. The Gaia-CRF3 sources were selected from the cross-matches with 17 external QSO catalogues as detailed below (three of which are parts of ICRF3 described in the first paper). For each Gaia-CRF3 source the information in which external catalogue this source was found and which name(s) this source has in those external catalogues is provided. The table allows the user to get all sources from an external catalogue that are in Gaia-CRF3.

The external catalogues from which the Gaia-CRF3 sources were compiled are:

- The third realization of the International Celestial Reference Frame by very long baseline interferometry (Charlot et al. 2020)
- A New Version of the OCARS Catalog of Optical Characteristics of Astrometric Radio Sources (Malkin 2018) (the catalogue downloaded from `http://www.gaoran.ru/english/as/ac_vlbi/#OCARS` on 17 June 2020)
- Identification of 1.4 Million Active Galactic Nuclei in the Mid-Infrared using WISE Data (Secrest et al. 2015)
- The WISE AGN Catalog (Assef et al. 2018)
- The Million Quasars (Milliquas) Catalogue, v6.4 (Flesch 2019) with the v6.5 (2020) update
- The Sloan Digital Sky Survey Quasar Catalog: Fourteenth data release (Pâris et al. 2018)
- LQAC-5: The fifth release of the Large Quasar Astrometric Catalogue. A compilation of 592 809 objects with 398 697 Gaia counterparts (Souchay et al. 2019)
- The Large Sky Area Multi-object Fiber Spectroscopic Telescope (LAMOST) Quasar Survey: The Fourth and Fifth Data Releases

(Yao et al. 2019) – see also `https://nadc.china-vo.org/data/article/20190107155838`

- The large quasar reference frame (LQRF). An optical representation of the ICRS (Andrei et al. 2009)
- The 2dF QSO Redshift Survey - XII. The spectroscopic catalogue and luminosity function (Croom et al. 2004)
- The 5th edition of the Roma-BZCAT (Massaro et al. 2015)
- 2WHSP: A multi-frequency selected catalogue of high energy and very high energy $\gamma$-ray blazars and blazar candidates (Chang et al. 2017)
- ALMA photometry of extragalactic radio sources (Bonato et al. 2019)
- Catalogues of active galactic nuclei from Gaia and unWISE data (Shu et al. 2019)
- Quasar and galaxy classification in Gaia Data Release 2 (Bailer-Jones et al. 2019)

**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 where 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** : Gaia source identifier (long)

A unique single numerical identifier of the source obtained from `gaia_source` encoding the approximate position (roughly to the nearest arcmin), the provenance (data processing centre where it was created), a running number, and a component number.

The approximate equatorial (ICRS) position is encoded using the nested HEALPix scheme at level 12 (Nside = 4096), which divides the sky into $\simeq 200$ million pixels of about 0.7 arcmin$^2$.

The source ID consists of a 64-bit integer, least significant bit = 1 and most significant bit = 64, comprising:

- a HEALPix index number (sky pixel) in bits 36 - 63; by definition the smallest HEALPix index number is zero.
- a 3-bit Data Processing Centre code in bits 33 - 35; for example `MOD(source_id / 4294967296, 8)` can be used to distinguish between sources initialised via the Initial Gaia Source List by the Torino DPC (code = 0) and sources otherwise detected and assigned by Gaia observations (code $> 0$)
- a 25-bit plus 7 bit sequence number within the HEALPix pixel in bits 1 - 32 split into:
  - a 25 bit running number in bits 8 – 32; the running numbers are defined to be positive, i.e. never zero
  - a 7-bit component number in bits 1 – 7

This means that the HEALpix index at level 12 of a given source is contained in the most significant bits. HEALpix index of level 12 and lower can thus be retrieved as follows:

- HEALpix index at level 12 = source_id / 34359738368
- HEALpix index at level 11 = source_id / 137438953472
- HEALpix index level 10 = source_id / 549755813888
- HEALpix index at level $n$ = source_id / $(2^{35} \times 4^{(12-n)})$ = source_id / $2^{(59-2n)}$

Additional details can be found in the Gaia DPAC public document *Source Identifiers — Assignment and Usage throughout DPAC* (document code GAIA–C3–TN–ARI–BAS–020) available from `https://www.cosmos.esa.int/web/gaia/public-dpac-documents`

**ICRF3SX** : The flag describing if the Gaia-CRF3 source was found in ICRF3 S/X (boolean)

The flag describing if the Gaia-CRF3 source was found in ICRF3 S/X (Charlot et al. 2020).

**ICRF3K** : The flag describing if the Gaia-CRF3 source was found in ICRF3 K (boolean)

The flag describing if the Gaia-CRF3 source was found in ICRF3 K (Charlot et al. 2020).

**ICRF3XKA** : The flag describing if the Gaia-CRF3 source was found in ICRF3 X/Ka (boolean)

The flag describing if the Gaia-CRF3 source was found in ICRF3 X/Ka (Charlot et al. 2020).

**ICRF_NAME** : The ICRF name of the source (string)

The ICRF name for this source (Charlot et al. 2020).

**IERS_NAME** : The IERS name of the source (string)

The IERS name for this source (Charlot et al. 2020).

**OCARS** : The flag describing if the Gaia-CRF3 source was found in OCARS (boolean)

The flag describing if the Gaia-CRF3 source was found in OCARS (Malkin 2018).

**OCARS_NAME** : The name for this source in OCARS (string)

The name for this source in OCARS (Malkin 2018) – the catalogue downloaded from `http://www.gaoran.ru/english/as/ac_vlbi/#OCARS` on 19 June 2020.

**AW15** : The flag describing if the Gaia-CRF3 source was found in allWISE (boolean)

The flag describing if the Gaia-CRF3 source was found in AllWISE (Secrest et al. 2015).

**AW15_NAME** : The name for this source in allWISE (string)

The name for this source in AllWISE (Secrest et al. 2015).

**R90** : The flag describing if the Gaia-CRF3 source was found in the catalogue R90 (boolean)

The flag describing if the Gaia-CRF3 source was found in the catalogue R90 (Assef et al. 2018).

**R90_NAME** : The name for this source in R90 (string)

The name for this source in R90 (Assef et al. 2018).

**M65** : The flag describing if the Gaia-CRF3 source was found in Milliquas v6.5 (boolean)

The flag describing if the Gaia-CRF3 source was found in Milliquas (Flesch 2019) v6.5 (2020) update.

**M65_NAME** : The name for this source in Milliquas v6.5 (string)

The name for this source in Milliquas (Flesch 2019) v6.5 (2020) update.

**C75** : The flag describing if the Gaia-CRF3 source was found in the catalogue C75 (boolean)

The flag describing if the Gaia-CRF3 source was found in the catalogue C75 (Assef et al. 2018).

**C75_NAME** : The name for this source in C75 (string)

The name for this source in C75 (Assef et al. 2018).

**DR14Q** : The flag describing if the Gaia-CRF3 source was found in the catalogue SDSS DR14Q (boolean)

The flag describing if the Gaia-CRF3 source was found in SDSS DR14Q (Pâris et al. 2018).

**DR14Q_NAME** : The name for this source in SDSS DR14Q (string)

The name for this source in SDSS DR14Q (Pâris et al. 2018).

**LQAC5** : The flag describing if the Gaia-CRF3 source was found in LQAC-5 (boolean)

The flag describing if the Gaia-CRF3 source was found in LQAC-5 (Souchay et al. 2019).

**LQAC5_NAME** : The name for this source in LQAC-5 (string)

The name for this source in LQAC-5 (Souchay et al. 2019).

**LAMOST5** : The flag describing if the Gaia-CRF3 source was found in the LAMOST QSO catalogue (boolean)

The flag describing if the Gaia-CRF3 source was found in the LAMOST QSO catalogue (Yao et al. 2019); `https://nadc.china-vo.org/data/article/20190107155838`

**LAMOST5_NAME** : The name for this source in the LAMOST QSO catalogue (string)

The name for this source in the LAMOST QSO catalogue (Yao et al. 2019); `https://nadc.china-vo.org/data/article/20190107155838`

**LQRF** : The flag describing if the Gaia-CRF3 source was found in LQRF (boolean)

The flag describing if the Gaia-CRF3 source was found in LQRF (Andrei et al. 2009).

**LQRF_NAME** : The name for this source in LQRF (string)

The name for this source in LQRF (Andrei et al. 2009).

**CAT2QZ** : The flag describing if the Gaia-CRF3 source was found in 2QZ (boolean)

The flag describing if the Gaia-CRF3 source was found in 2QZ (Croom et al. 2004).

**CAT2QZ_NAME** : The name for this source in 2QZ (string)

The name for this source in 2QZ (Croom et al. 2004).

**BZCAT5** : The flag describing if the Gaia-CRF3 source was found in Roma-BZCAT, v5 (boolean)

The flag describing if the Gaia-CRF3 source was found in Roma-BZCAT, v5 (Massaro et al. 2015).

**BZCAT5_NAME** : The name for this source in Roma-BZCAT, v5 (string)

The name for this source in Roma-BZCAT, v5 (Massaro et al. 2015).

**CAT2WHSPJ** : The flag describing if the Gaia-CRF3 source was found in 2WHSPJ (boolean)

The flag describing if the Gaia-CRF3 source was found in 2WHSPJ (Chang et al. 2017).

**CAT2WHSPJ_NAME** : The name for this source in 2WHSPJ (string)

The name for this source in 2WHSPJ (Chang et al. 2017).

**ALMA19** : The flag describing if the Gaia-CRF3 source was found in the ALMA calibrator catalogue (boolean)

The flag describing if the Gaia-CRF3 source was found in the ALMA calibrator catalogue (Bonato et al. 2019).

**ALMA19_NAME** : The name for this source in the ALMA calibrator catalogue (string)

The name for this source in the ALMA calibrator catalogue (Bonato et al. 2019).

**GUW** : The flag describing if the Gaia-CRF3 source was found in Gaia-unWISE (boolean)

The flag describing if the Gaia-CRF3 source was found in Gaia-unWISE (Shu et al. 2019).

**GUW_NAME** : The name for this source in Gaia-unWISE (string)

The name for this source in Gaia-unWISE (Shu et al. 2019).

**B19** : The flag describing if the Gaia-CRF3 source was found in the Gaia DR2 quasar and galaxy classification catalogue (boolean)

The flag describing if the Gaia-CRF3 source was found in the Gaia DR2 quasar and galaxy classification catalogue (Bailer-Jones et al. 2019).

**B19_NAME** : The name for this source in the Gaia DR2 quasar and galaxy classification catalogue (string)

The name for this source in the Gaia DR2 quasar and galaxy classification catalogue (Bailer-Jones et al. 2019).

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