

## PDF hosted at the Radboud Repository of the Radboud University Nijmegen

The following full text is a publisher's version.

For additional information about this publication click this link.

<https://repository.ubn.ru.nl/handle/2066/234260>

Please be advised that this information was generated on 2021-09-26 and may be subject to change.

## ***Gaia* Early Data Release 3**

### **Summary of the contents and survey properties**

#### ***(Corrigendum)***

Gaia Collaboration: A. G. A. Brown<sup>1,\*</sup>, A. Vallenari<sup>2</sup>, T. Prusti<sup>3</sup>, J. H. J. de Bruijne<sup>3</sup>, C. Babusiaux<sup>4,5</sup>, M. Biermann<sup>6</sup>, O. L. Creevey<sup>7</sup>, D. W. Evans<sup>8</sup>, L. Eyer<sup>9</sup>, A. Hutton<sup>10</sup>, F. Jansen<sup>3</sup>, C. Jordi<sup>11</sup>, S. A. Klioner<sup>12</sup>, U. Lammers<sup>13</sup>, L. Lindegren<sup>14</sup>, X. Luri<sup>11</sup>, F. Mignard<sup>7</sup>, C. Panem<sup>15</sup>, D. Pourbaix<sup>16,17</sup>, S. Randich<sup>18</sup>, P. Sartoretti<sup>5</sup>, C. Soubiran<sup>19</sup>, N. A. Walton<sup>8</sup>, F. Arenou<sup>5</sup>, C. A. L. Bailer-Jones<sup>20</sup>, U. Bastian<sup>6</sup>, M. Cropper<sup>21</sup>, R. Drimmel<sup>22</sup>, D. Katz<sup>5</sup>, M. G. Lattanzi<sup>22,23</sup>, F. van Leeuwen<sup>8</sup>, J. Bakker<sup>13</sup>, C. Cacciari<sup>24</sup>, J. Castañeda<sup>25</sup>, F. De Angeli<sup>8</sup>, C. Ducourant<sup>19</sup>, C. Fabricius<sup>11</sup>, M. Fouesneau<sup>20</sup>, Y. Frémat<sup>26</sup>, R. Guerra<sup>13</sup>, A. Guerrier<sup>15</sup>, J. Guiraud<sup>15</sup>, A. Jean-Antoine Piccolo<sup>15</sup>, E. Masana<sup>11</sup>, R. Messineo<sup>27</sup>, N. Mowlavi<sup>9</sup>, C. Nicolas<sup>15</sup>, K. Nienartowicz<sup>28,29</sup>, F. Pailler<sup>15</sup>, P. Panuzzo<sup>5</sup>, F. Riclet<sup>15</sup>, W. Roux<sup>15</sup>, G. M. Seabroke<sup>21</sup>, R. Sordo<sup>2</sup>, P. Tanga<sup>7</sup>, F. Thévenin<sup>7</sup>, G. Gracia-Abril<sup>30,6</sup>, J. Portell<sup>11</sup>, D. Teyssier<sup>31</sup>, M. Altmann<sup>6,32</sup>, R. Andrae<sup>20</sup>, I. Bellas-Velidis<sup>33</sup>, K. Benson<sup>21</sup>, J. Berthier<sup>34</sup>, R. Blomme<sup>26</sup>, E. Brugaletta<sup>35</sup>, P. W. Burgess<sup>8</sup>, G. Busso<sup>8</sup>, B. Carry<sup>7</sup>, A. Cellino<sup>22</sup>, N. Cheek<sup>36</sup>, G. Clementini<sup>24</sup>, Y. Damerdjji<sup>37,38</sup>, M. Davidson<sup>39</sup>, L. Delchambre<sup>37</sup>, A. Dell'Oro<sup>18</sup>, J. Fernández-Hernández<sup>40</sup>, L. Galluccio<sup>7</sup>, P. García-Lario<sup>13</sup>, M. Garcia-Reinaldos<sup>13</sup>, J. González-Núñez<sup>36,41</sup>, E. Gosset<sup>37,17</sup>, R. Haigron<sup>5</sup>, J.-L. Halbwachs<sup>42</sup>, N. C. Hambly<sup>39</sup>, D. L. Harrison<sup>8,43</sup>, D. Hatzidimitriou<sup>44</sup>, U. Heiter<sup>45</sup>, J. Hernández<sup>13</sup>, D. Hestroffer<sup>34</sup>, S. T. Hodgkin<sup>8</sup>, B. Holl<sup>9,28</sup>, K. Janßen<sup>46</sup>, G. Jevardat de Fombelle<sup>9</sup>, S. Jordan<sup>6</sup>, A. Krone-Martins<sup>47,48</sup>, A. C. Lanzafame<sup>35,49</sup>, W. Löffler<sup>6</sup>, A. Lorca<sup>10</sup>, M. Manteiga<sup>50</sup>, O. Marchal<sup>42</sup>, P. M. Marrese<sup>51,52</sup>, A. Moitinho<sup>47</sup>, A. Mora<sup>10</sup>, K. Muinonen<sup>53,54</sup>, P. Osborne<sup>8</sup>, E. Pancino<sup>18,52</sup>, T. Pauwels<sup>26</sup>, J.-M. Petit<sup>55</sup>, A. Recio-Blanco<sup>7</sup>, P. J. Richards<sup>56</sup>, M. Rielo<sup>8</sup>, L. Rimoldini<sup>28</sup>, A. C. Robin<sup>55</sup>, T. Roegiers<sup>57</sup>, J. Rybizki<sup>20</sup>, L. M. Sarro<sup>58</sup>, C. Siopis<sup>16</sup>, M. Smith<sup>21</sup>, A. Sozzetti<sup>22</sup>, A. Ulla<sup>59</sup>, E. Utrilla<sup>10</sup>, M. van Leeuwen<sup>8</sup>, W. van Reeve<sup>10</sup>, U. Abbas<sup>22</sup>, A. Abreu Aramburu<sup>40</sup>, S. Accart<sup>60</sup>, C. Aerts<sup>61,62,20</sup>, J. J. Aguado<sup>58</sup>, M. Ajaj<sup>5</sup>, G. Altavilla<sup>51,52</sup>, M. A. Álvarez<sup>63</sup>, J. Álvarez Cid-Fuentes<sup>64</sup>, J. Alves<sup>65</sup>, R. I. Anderson<sup>66</sup>, E. Anglada Varela<sup>40</sup>, T. Antoja<sup>11</sup>, M. Audard<sup>28</sup>, D. Baines<sup>31</sup>, S. G. Baker<sup>21</sup>, L. Balaguer-Núñez<sup>11</sup>, E. Balbinot<sup>67</sup>, Z. Balog<sup>6,20</sup>, C. Barache<sup>32</sup>, D. Barbato<sup>9,22</sup>, M. Barros<sup>47</sup>, M. A. Barstow<sup>68</sup>, S. Bartolomé<sup>11</sup>, J.-L. Bassilana<sup>60</sup>, N. Bauchet<sup>34</sup>, A. Baudesson-Stella<sup>60</sup>, U. Becciani<sup>35</sup>, M. Bellazzini<sup>24</sup>, M. Bernet<sup>11</sup>, S. Bertone<sup>69,70,22</sup>, L. Bianchi<sup>71</sup>, S. Blanco-Cuaresma<sup>72</sup>, T. Boch<sup>42</sup>, A. Bombrun<sup>73</sup>, D. Bossini<sup>74</sup>, S. Bouquillon<sup>32</sup>, A. Bragaglia<sup>24</sup>, L. Bramante<sup>27</sup>, E. Breedt<sup>8</sup>, A. Bressan<sup>75</sup>, N. Brouillet<sup>19</sup>, B. Bucciarelli<sup>22</sup>, A. Burlacu<sup>76</sup>, D. Busonero<sup>22</sup>, A. G. Butkevich<sup>22</sup>, R. Buzzzi<sup>22</sup>, E. Caffau<sup>5</sup>, R. Cancelliere<sup>77</sup>, H. Cánovas<sup>10</sup>, T. Cantat-Gaudin<sup>11</sup>, R. Carballo<sup>78</sup>, T. Carlucci<sup>32</sup>, M. I. Carnerero<sup>22</sup>, J. M. Carrasco<sup>11</sup>, L. Casamiquela<sup>19</sup>, M. Castellani<sup>51</sup>, A. Castro-Ginard<sup>11</sup>, P. Castro Sampol<sup>11</sup>, L. Chaoul<sup>15</sup>, P. Charlot<sup>19</sup>, L. Chemin<sup>79</sup>, A. Chiavassa<sup>7</sup>, M.-R. L. Cioni<sup>46</sup>, G. Comoretto<sup>80</sup>, W. J. Cooper<sup>81,22</sup>, T. Cornez<sup>60</sup>, S. Cowell<sup>8</sup>, F. Crifo<sup>5</sup>, M. Crosta<sup>22</sup>, C. Crowley<sup>73</sup>, C. Dafonte<sup>63</sup>, A. Dapergolas<sup>33</sup>, M. David<sup>82</sup>, P. David<sup>34</sup>, P. de Laverny<sup>7</sup>, F. De Luise<sup>83</sup>, R. De March<sup>27</sup>, J. De Ridder<sup>61</sup>, R. de Souza<sup>84</sup>, P. de Teodoro<sup>13</sup>, A. de Torres<sup>73</sup>, E. F. del Peloso<sup>6</sup>, E. del Pozo<sup>10</sup>, M. Delbo<sup>7</sup>, A. Delgado<sup>8</sup>, H. E. Delgado<sup>58</sup>, J.-B. Delisle<sup>9</sup>, P. Di Matteo<sup>5</sup>, S. Diakite<sup>85</sup>, C. Diener<sup>8</sup>, E. Distefano<sup>35</sup>, C. Dolding<sup>21</sup>, D. Eappachen<sup>86,62</sup>, B. Edvardsson<sup>87</sup>, H. Enke<sup>46</sup>, P. Esquej<sup>88</sup>, C. Fabre<sup>89</sup>, M. Fabrizio<sup>51,52</sup>, S. Faigler<sup>90</sup>, G. Fedorets<sup>53,91</sup>, P. Fernique<sup>42,92</sup>, A. Fienga<sup>93,34</sup>, F. Figueras<sup>11</sup>, C. Fournon<sup>76</sup>, F. Fragkoudi<sup>94</sup>, E. Fraile<sup>88</sup>, F. Franke<sup>95</sup>, M. Gai<sup>22</sup>, D. Garabato<sup>63</sup>, A. Garcia-Gutierrez<sup>11</sup>, M. García-Torres<sup>96</sup>, A. Garofalo<sup>24</sup>, P. Gavras<sup>88</sup>, E. Gerlach<sup>12</sup>, R. Geyer<sup>12</sup>, P. Giacobbe<sup>22</sup>, G. Gilmore<sup>8</sup>, S. Girona<sup>64</sup>, G. Giuffrida<sup>51</sup>, R. Gomel<sup>90</sup>, A. Gomez<sup>63</sup>, I. Gonzalez-Santamaria<sup>63</sup>, J. J. González-Vidal<sup>11</sup>, M. Granvik<sup>53,97</sup>, R. Gutiérrez-Sánchez<sup>31</sup>, L. P. Guy<sup>28,80</sup>, M. Hauser<sup>20,98</sup>, M. Haywood<sup>5</sup>, A. Helmi<sup>67</sup>, S. L. Hidalgo<sup>99,100</sup>, T. Hilger<sup>12</sup>, N. Hładczuk<sup>13</sup>, D. Hobbs<sup>14</sup>, G. Holland<sup>8</sup>, H. E. Huckle<sup>21</sup>, G. Jasiewicz<sup>101</sup>, P. G. Jonker<sup>62,86</sup>, J. Juaristi Campillo<sup>6</sup>, F. Julbe<sup>11</sup>, L. Karbevská<sup>9</sup>, P. Kervella<sup>102</sup>

\* Corresponding author: e-mail: brown@strw.leidenuniv.nl

S. Khanna<sup>67</sup>, A. Kochoska<sup>103</sup>, M. Kontizas<sup>44</sup>, G. Kordopatis<sup>7</sup>, A. J. Korn<sup>45</sup>, Z. Kostrzewa-Rutkowska<sup>1,86</sup>, K. Kruszyńska<sup>104</sup>, S. Lambert<sup>32</sup>, A. F. Lanza<sup>35</sup>, Y. Lasne<sup>60</sup>, J.-F. Le Campion<sup>105</sup>, Y. Le Fustec<sup>76</sup>, Y. Lebreton<sup>102,106</sup>, T. Lebzelter<sup>65</sup>, S. Leccia<sup>107</sup>, N. Leclerc<sup>5</sup>, I. Lecoeur-Taibi<sup>28</sup>, S. Liao<sup>22</sup>, E. Licata<sup>22</sup>, H. E. P. Lindstrøm<sup>22,108</sup>, T. A. Lister<sup>109</sup>, E. Livanou<sup>44</sup>, A. Lobel<sup>26</sup>, P. Madrero Pardo<sup>11</sup>, S. Managau<sup>60</sup>, R. G. Mann<sup>39</sup>, J. M. Marchant<sup>110</sup>, M. Marconi<sup>107</sup>, M. M. S. Marcos Santos<sup>36</sup>, S. Marinoni<sup>51,52</sup>, F. Marocco<sup>111,112</sup>, D. J. Marshall<sup>113</sup>, L. Martin Polo<sup>36</sup>, J. M. Martín-Fleitas<sup>10</sup>, A. Masip<sup>11</sup>, D. Massari<sup>24</sup>, A. Mastrobuono-Battisti<sup>14</sup>, T. Mazeh<sup>90</sup>, P. J. McMillan<sup>14</sup>, S. Messina<sup>35</sup>, D. Michalik<sup>3</sup>, N. R. Millar<sup>8</sup>, A. Mints<sup>46</sup>, D. Molina<sup>11</sup>, R. Molinaro<sup>107</sup>, L. Molnár<sup>114,115,116</sup>, P. Montegriffo<sup>24</sup>, R. Mor<sup>11</sup>, R. Morbidelli<sup>22</sup>, T. Morel<sup>37</sup>, D. Morris<sup>39</sup>, A. F. Mulone<sup>27</sup>, D. Munoz<sup>60</sup>, T. Muraveva<sup>24</sup>, C. P. Murphy<sup>13</sup>, I. Musella<sup>107</sup>, L. Noval<sup>60</sup>, C. Ordénovic<sup>7</sup>, G. Orrù<sup>27</sup>, J. Osinde<sup>88</sup>, C. Pagani<sup>68</sup>, I. Pagano<sup>35</sup>, L. Palaversa<sup>117,8</sup>, P. A. Palicio<sup>7</sup>, A. Panahi<sup>90</sup>, M. Pawlak<sup>118,104</sup>, X. Peñalosa Esteller<sup>11</sup>, A. Penttilä<sup>53</sup>, A. M. Piersimoni<sup>83</sup>, F.-X. Pineau<sup>42</sup>, E. Plachy<sup>114,115,116</sup>, G. Plum<sup>5</sup>, E. Poggio<sup>22</sup>, E. Poretti<sup>119</sup>, E. Poujoulet<sup>120</sup>, A. Prša<sup>103</sup>, L. Pulone<sup>51</sup>, E. Racero<sup>36,121</sup>, S. Ragaini<sup>24</sup>, M. Rainer<sup>18</sup>, C. M. Raiteri<sup>22</sup>, N. Rambaux<sup>34</sup>, P. Ramos<sup>11</sup>, M. Ramos-Lerate<sup>122</sup>, P. Re Fiorentin<sup>22</sup>, S. Regibo<sup>61</sup>, C. Reylé<sup>55</sup>, V. Ripepi<sup>107</sup>, A. Riva<sup>22</sup>, G. Rixon<sup>8</sup>, N. Robichon<sup>5</sup>, C. Robin<sup>60</sup>, M. Roelens<sup>9</sup>, L. Rohrbasser<sup>28</sup>, M. Romero-Gómez<sup>11</sup>, N. Rowell<sup>39</sup>, F. Royer<sup>5</sup>, K. A. Rybicki<sup>104</sup>, G. Sadowski<sup>16</sup>, A. Sagristà Sellés<sup>6</sup>, J. Sahlmann<sup>88</sup>, J. Salgado<sup>31</sup>, E. Salguero<sup>40</sup>, N. Samaras<sup>26</sup>, V. Sanchez Gimenez<sup>11</sup>, N. Sanna<sup>18</sup>, R. Santoveña<sup>63</sup>, M. Sarasso<sup>22</sup>, M. Schultheis<sup>7</sup>, E. Sciacca<sup>35</sup>, M. Segol<sup>95</sup>, J. C. Segovia<sup>36</sup>, D. Ségransan<sup>9</sup>, D. Semeux<sup>89</sup>, S. Shahaf<sup>90</sup>, H. I. Siddiqui<sup>123</sup>, A. Siebert<sup>42,92</sup>, L. Siltala<sup>53</sup>, E. Slezak<sup>7</sup>, R. L. Smart<sup>22</sup>, E. Solano<sup>124</sup>, F. Solitro<sup>27</sup>, D. Souami<sup>102,125</sup>, J. Souchay<sup>32</sup>, A. Spagna<sup>22</sup>, F. Spoto<sup>72</sup>, I. A. Steele<sup>110</sup>, H. Steidelmüller<sup>12</sup>, C. A. Stephenson<sup>31</sup>, M. Süveges<sup>28,126,20</sup>, L. Szabados<sup>114</sup>, E. Szegedi-Elek<sup>114</sup>, F. Taris<sup>32</sup>, G. Tauran<sup>60</sup>, M. B. Taylor<sup>127</sup>, R. Teixeira<sup>84</sup>, W. Thuillot<sup>34</sup>, N. Tonello<sup>64</sup>, F. Torra<sup>25</sup>, J. Torra<sup>†11</sup>, C. Turon<sup>5</sup>, N. Unger<sup>9</sup>, M. Vaillant<sup>60</sup>, E. van Dillen<sup>95</sup>, O. Vanel<sup>5</sup>, A. Vecchiato<sup>22</sup>, Y. Viala<sup>5</sup>, D. Vicente<sup>64</sup>, S. Voutsinas<sup>39</sup>, M. Weiler<sup>11</sup>, T. Wevers<sup>8</sup>, Ł. Wyrzykowski<sup>104</sup>, A. Yoldas<sup>8</sup>, P. Yvard<sup>95</sup>, H. Zhao<sup>7</sup>, J. Zorec<sup>128</sup>, S. Zucker<sup>129</sup>, C. Zurbach<sup>130</sup>, and T. Zwitter<sup>131</sup>

(Affiliations can be found after the references)

A&A, 649, A1 (2021), <https://doi.org/10.1051/0004-6361/202039657>

**Key words.** catalogs – astrometry – parallaxes – proper motions – techniques: photometric – errata, addenda

This is a corrigendum for [Gaia Collaboration \(2021\)](#). It corrects errors in Sects. 6.3.2 and 7.2 and Appendix A, which erroneously state that the correction to the *G*-band fluxes and magnitudes presented in [Riello et al. \(2021\)](#) (their Table 5) should be applied to sources in *Gaia* EDR3 with six-parameter astrometric solutions. In fact, the corrections should be applied to sources with two-parameter or six-parameter astrometric solutions. The corrected Astronomical Data Query Language (ADQL) query and Python source code from Appendix A are presented in the new version of Appendix A below.

Following the discovery of the above error, a more detailed investigation was done for the sources with two-parameter (2-p) astrometric solutions. Out of the 344 million 2-p sources present in *Gaia* EDR3, about 20 million have an astrometric solution in which the actual source colour was used instead of a default colour. This means that for these 20 million 2-p sources the *G*-band correction should actually not be applied. These sources are mostly faint, with 96% at magnitudes  $G > 20$ , and for 75% of these 20 million sources the correction that is (wrongly) applied amounts to less than 4 milli-magnitudes. It was thus decided

not to make a special effort to exclude these sources from the correction. Should a user of the *Gaia* EDR3 data wish to undo the wrong correction for one or more of these 20 million sources, the list of source IDs and applied corrections can be provided on request.

## Appendix A: *G*-band corrections for sources with two-parameter or six-parameter astrometric solutions

Figure [A.1](#) shows how to formulate an ADQL query, to be executed in the *Gaia* EDR3 archive, that contains an on-the-fly calculation of the corrected *G*-band fluxes or magnitudes. These queries are somewhat complex and create a performance overhead. Hence downloading the requisite *Gaia* EDR3 fields and calculating the corrections a posteriori may be more efficient. Example Python code to do this is included in Fig. [A.2](#). The Python code is also available as a Jupyter notebook<sup>1</sup>.

<sup>1</sup> <https://github.com/agabrown/gaiaedr3-6p-gband-correction>

Query that includes a calculation of the *G*-band flux correction. The condition ‘bp\_rp > -20’ ensures that no correction is attempted in case the ( $G_{BP} - G_{RP}$ ) colour is not available (‘bp\_rp is not null’ does not work). The condition on random\_index is included to retrieve example data for a random sample of sources.

```
select source_id, astrometric_params_solved, bp_rp, phot_g_mean_mag, phot_g_mean_flux,
if_then_else(
  bp_rp > -20,
  case_condition(
    phot_g_mean_flux * (1.00525 -0.02323*greatest(0.25, least(bp_rp, 3))
      +0.01740*power(greatest(0.25, least(bp_rp, 3)),2)
      -0.00253*power(greatest(0.25, least(bp_rp, 3)),3)),
    astrometric_params_solved = 31,
    phot_g_mean_flux,
    phot_g_mean_mag < 13,
    phot_g_mean_flux,
    phot_g_mean_mag < 16,
    phot_g_mean_flux * (1.00876 -0.02540*greatest(0.25, least(bp_rp, 3))
      +0.01747*power(greatest(0.25, least(bp_rp, 3)),2)
      -0.00277*power(greatest(0.25, least(bp_rp, 3)),3))
  ),
  phot_g_mean_flux
) as phot_g_mean_flux_corr
from gaiaedr3.gaia_source
where random_index between 1000000 and 1999999
```

Query that includes a calculation of the *G*-band magnitude correction. We note the type-cast ‘to\_real()’ of the return value of the conditional part of the query.

```
select source_id, astrometric_params_solved, bp_rp, phot_g_mean_mag, phot_g_mean_flux,
if_then_else(
  bp_rp > -20,
  to_real(case_condition(
    phot_g_mean_mag - 2.5*log10( (1.00525 -0.02323*greatest(0.25, least(bp_rp, 3))
      +0.01740*power(greatest(0.25, least(bp_rp, 3)),2)
      -0.00253*power(greatest(0.25, least(bp_rp, 3)),3)) ),
    astrometric_params_solved = 31,
    phot_g_mean_mag,
    phot_g_mean_mag < 13,
    phot_g_mean_mag,
    phot_g_mean_mag < 16,
    phot_g_mean_mag - 2.5*log10( (1.00876 -0.02540*greatest(0.25, least(bp_rp, 3))
      +0.01747*power(greatest(0.25, least(bp_rp, 3)),2)
      -0.00277*power(greatest(0.25, least(bp_rp, 3)),3)) )
  )),
  phot_g_mean_mag
) as phot_g_mean_mag_corr
from gaiaedr3.gaia_source
where random_index between 5000000 and 5999999
```

**Fig. A.1.** Example queries that can be submitted to the *Gaia* archive in ADQL to retrieve corrected *G*-band photometry.

```

import numpy as np

def correct_gband(bp_rp, astrometric_params_solved, phot_g_mean_mag, phot_g_mean_flux):
    """
    Correct the G-band fluxes and magnitudes for the input list of Gaia EDR3 data.

    Parameters
    -----
    bp_rp: float, array_like
        The (BP-RP) colour listed in the Gaia EDR3 archive.
    astrometric_params_solved: int, array_like
        The astrometric solution type listed in the Gaia EDR3 archive.
    phot_g_mean_mag: float, array_like
        The G-band magnitude as listed in the Gaia EDR3 archive.
    phot_g_mean_flux: float, array_like
        The G-band flux as listed in the Gaia EDR3 archive.

    Returns
    -----
    The corrected G-band magnitudes and fluxes. The corrections are only applied to
    sources with a 2-parameter or 6-parameter astrometric solution fainter than G=13,
    for which a (BP-RP) colour is available.

    Example

    gmag_corr, gflux_corr = correct_gband(bp_rp, astrometric_params_solved,
                                          phot_g_mean_mag, phot_g_mean_flux)
    """
    if np.isscalar(bp_rp) or np.isscalar(astrometric_params_solved) or \
        np.isscalar(phot_g_mean_mag) or np.isscalar(phot_g_mean_flux):
        bp_rp = np.float64(bp_rp)
        astrometric_params_solved = np.int64(astrometric_params_solved)
        phot_g_mean_mag = np.float64(phot_g_mean_mag)
        phot_g_mean_flux = np.float64(phot_g_mean_flux)

    if not (bp_rp.shape == astrometric_params_solved.shape \
            == phot_g_mean_mag.shape == phot_g_mean_flux.shape):
        raise ValueError('Function parameters must be of the same shape!')

    do_not_correct = np.isnan(bp_rp) | (phot_g_mean_mag < 13) | \
        (astrometric_params_solved == 31)
    bright_correct = np.logical_not(do_not_correct) & (phot_g_mean_mag >= 13) & \
        (phot_g_mean_mag <= 16)
    faint_correct = np.logical_not(do_not_correct) & (phot_g_mean_mag > 16)
    bp_rp_c = np.clip(bp_rp, 0.25, 3.0)

    correction_factor = np.ones_like(phot_g_mean_mag)
    correction_factor[faint_correct] = 1.00525 - 0.02323*bp_rp_c[faint_correct] + \
        0.01740*np.power(bp_rp_c[faint_correct], 2) - \
        0.00253*np.power(bp_rp_c[faint_correct], 3)
    correction_factor[bright_correct] = 1.00876 - 0.02540*bp_rp_c[bright_correct] + \
        0.01747*np.power(bp_rp_c[bright_correct], 2) - \
        0.00277*np.power(bp_rp_c[bright_correct], 3)

    gmag_corrected = phot_g_mean_mag - 2.5*np.log10(correction_factor)
    gflux_corrected = phot_g_mean_flux * correction_factor

    return gmag_corrected, gflux_corrected

```

**Fig. A.2.** Python code for calculating the corrections to the G-band photometry for sources with two-parameter or six-parameter astrometric solutions.

## References

- Gaia Collaboration (Brown, A. G. A., et al.) 2021, *A&A*, 649, A1  
 Riello, M., De Angeli, F., Evans, D. W., et al. 2021, *A&A*, 649, A3
- 
- <sup>1</sup> Leiden Observatory, Leiden University, Niels Bohrweg 2, 2333 CA Leiden, The Netherlands
  - <sup>2</sup> INAF – Osservatorio astronomico di Padova, Vicolo Osservatorio 5, 35122 Padova, Italy
  - <sup>3</sup> European Space Agency (ESA), European Space Research and Technology Centre (ESTEC), Keplerlaan 1, 2201AZ Noordwijk, The Netherlands
  - <sup>4</sup> Univ. Grenoble Alpes, CNRS, IPAG, 38000 Grenoble, France
  - <sup>5</sup> GEPI, Observatoire de Paris, Université PSL, CNRS, 5 Place Jules Janssen, 92190 Meudon, France
  - <sup>6</sup> Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg, Mönchhofstr. 12-14, 69120 Heidelberg, Germany
  - <sup>7</sup> Université Côte d’Azur, Observatoire de la Côte d’Azur, CNRS, Laboratoire Lagrange, Bd de l’Observatoire, CS 34229, 06304 Nice Cedex 4, France
  - <sup>8</sup> Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, UK
  - <sup>9</sup> Department of Astronomy, University of Geneva, Chemin des Maillettes 51, 1290 Versoix, Switzerland
  - <sup>10</sup> Aurora Technology for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>11</sup> Institut de Ciències del Cosmos (ICCUB), Universitat de Barcelona (IEEC-UB), Martí i Franquès 1, 08028 Barcelona, Spain
  - <sup>12</sup> Lohrmann Observatory, Technische Universität Dresden, Mommsenstraße 13, 01062 Dresden, Germany
  - <sup>13</sup> European Space Agency (ESA), European Space Astronomy Centre (ESAC), Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>14</sup> Lund Observatory, Department of Astronomy and Theoretical Physics, Lund University, Box 43, 22100 Lund, Sweden
  - <sup>15</sup> CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
  - <sup>16</sup> Institut d’Astronomie et d’Astrophysique, Université Libre de Bruxelles CP 226, Boulevard du Triomphe, 1050 Brussels, Belgium
  - <sup>17</sup> F.R.S.-FNRS, Rue d’Egmont 5, 1000 Brussels, Belgium
  - <sup>18</sup> INAF – Osservatorio Astrofisico di Arcetri, Largo Enrico Fermi 5, 50125 Firenze, Italy
  - <sup>19</sup> Laboratoire d’astrophysique de Bordeaux, Univ. Bordeaux, CNRS, B18N, allée Geoffroy Saint-Hilaire, 33615 Pessac, France
  - <sup>20</sup> Max Planck Institute for Astronomy, Königstuhl 17, 69117 Heidelberg, Germany
  - <sup>21</sup> Mullard Space Science Laboratory, University College London, Holmbury St Mary, Dorking, Surrey RH5 6NT, UK
  - <sup>22</sup> INAF – Osservatorio Astrofisico di Torino, via Osservatorio 20, 10025 Pino Torinese (TO), Italy
  - <sup>23</sup> University of Turin, Department of Physics, Via Pietro Giuria 1, 10125 Torino, Italy
  - <sup>24</sup> INAF – Osservatorio di Astrofisica e Scienza dello Spazio di Bologna, via Piero Gobetti 93/3, 40129 Bologna, Italy
  - <sup>25</sup> DAPCOM for Institut de Ciències del Cosmos (ICCUB), Universitat de Barcelona (IEEC-UB), Martí i Franquès 1, 08028 Barcelona, Spain
  - <sup>26</sup> Royal Observatory of Belgium, Ringlaan 3, 1180 Brussels, Belgium
  - <sup>27</sup> ALTEC S.p.a, Corso Marche, 79, 10146 Torino, Italy
  - <sup>28</sup> Department of Astronomy, University of Geneva, Chemin d’Ecogia 16, 1290 Versoix, Switzerland
  - <sup>29</sup> Sednai Sàrl, Geneva, Switzerland
  - <sup>30</sup> Gaia DPAC Project Office, ESAC, Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>31</sup> Telespazio Vega UK Ltd for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>32</sup> SYRTE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, LNE, 61 avenue de l’Observatoire 75014 Paris, France
  - <sup>33</sup> National Observatory of Athens, I. Metaxa and Vas. Pavlou, Palaia Penteli, 15236 Athens, Greece
  - <sup>34</sup> IMCCE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Univ. Lille, 77 av. Denfert-Rochereau, 75014 Paris, France
  - <sup>35</sup> INAF – Osservatorio Astrofisico di Catania, via S. Sofia 78, 95123 Catania, Italy
  - <sup>36</sup> Serco Gestión de Negocios for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>37</sup> Institut d’Astrophysique et de Géophysique, Université de Liège, 19c, Allée du 6 Août, 4000 Liège, Belgium
  - <sup>38</sup> CRAAG – Centre de Recherche en Astronomie, Astrophysique et Géophysique, Route de l’Observatoire Bp 63 Bouzareah 16340 Algiers, Algeria
  - <sup>39</sup> Institute for Astronomy, University of Edinburgh, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, UK
  - <sup>40</sup> ATG Europe for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanizacion Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
  - <sup>41</sup> ETSE Telecomunicación, Universidade de Vigo, Campus Lagoas-Marcosende, 36310 Vigo, Galicia, Spain
  - <sup>42</sup> Université de Strasbourg, CNRS, Observatoire astronomique de Strasbourg, UMR 7550, 11 rue de l’Université, 67000 Strasbourg, France
  - <sup>43</sup> Kavli Institute for Cosmology Cambridge, Institute of Astronomy, Madingley Road, Cambridge, CB3 0HA
  - <sup>44</sup> Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University of Athens, Panepistimiopolis, Zografos, 15783 Athens, Greece
  - <sup>45</sup> Observational Astrophysics, Division of Astronomy and Space Physics, Department of Physics and Astronomy, Uppsala University, Box 516, 751 20 Uppsala, Sweden
  - <sup>46</sup> Leibniz Institute for Astrophysics Potsdam (AIP), An der Sternwarte 16, 14482 Potsdam, Germany
  - <sup>47</sup> CENTRA, Faculdade de Ciências, Universidade de Lisboa, Edif. C8, Campo Grande, 1749-016 Lisboa, Portugal
  - <sup>48</sup> Department of Informatics, Donald Bren School of Information and Computer Sciences, University of California, 5019 Donald Bren Hall, 92697-3440 CA Irvine, USA
  - <sup>49</sup> Dipartimento di Fisica e Astronomia “Ettore Majorana”, Università di Catania, Via S. Sofia 64, 95123 Catania, Italy
  - <sup>50</sup> CITIC, Department of Nautical Sciences and Marine Engineering, University of A Coruña, Campus de Elviña s/n, 15071, A Coruña, Spain
  - <sup>51</sup> INAF – Osservatorio Astronomico di Roma, Via Frascati 33, 00078 Monte Porzio Catone (Roma), Italy
  - <sup>52</sup> Space Science Data Center - ASI, Via del Politecnico SNC, 00133 Roma, Italy
  - <sup>53</sup> Department of Physics, University of Helsinki, PO Box 64, 00014 Helsinki, Finland
  - <sup>54</sup> Finnish Geospatial Research Institute FGI, Geodeetinrinne 2, 02430 Masala, Finland
  - <sup>55</sup> Institut UTINAM CNRS UMR6213, Université Bourgogne Franche-Comté, OSU THETA Franche-Comté Bourgogne, Observatoire de Besançon, BP1615, 25010 Besançon Cedex, France
  - <sup>56</sup> STFC, Rutherford Appleton Laboratory, Harwell, Didcot, OX11 0QX, UK
  - <sup>57</sup> HE Space Operations BV for European Space Agency (ESA), Keplerlaan 1, 2201AZ Noordwijk, The Netherlands
  - <sup>58</sup> Dpto. de Inteligencia Artificial, UNED, c/ Juan del Rosal 16, 28040 Madrid, Spain
  - <sup>59</sup> Applied Physics Department, Universidade de Vigo, 36310 Vigo, Spain

- <sup>60</sup> Thales Services for CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
- <sup>61</sup> Instituut voor Sterrenkunde, KU Leuven, Celestijnenlaan 200D, 3001 Leuven, Belgium
- <sup>62</sup> Department of Astrophysics/IMAPP, Radboud University, PO Box 9010, 6500 GL Nijmegen, The Netherlands
- <sup>63</sup> CITIC – Department of Computer Science and Information Technologies, University of A Coruña, Campus de Elviña s/n, 15071, A Coruña, Spain
- <sup>64</sup> Barcelona Supercomputing Center (BSC) - Centro Nacional de Supercomputación, c/ Jordi Girona 29, Ed. Nexus II, 08034 Barcelona, Spain
- <sup>65</sup> University of Vienna, Department of Astrophysics, Türkenschanzstraße 17, A1180 Vienna, Austria
- <sup>66</sup> European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany
- <sup>67</sup> Kapteyn Astronomical Institute, University of Groningen, Landleven 12, 9747 AD Groningen, The Netherlands
- <sup>68</sup> School of Physics and Astronomy, University of Leicester, University Road, Leicester LE1 7RH, UK
- <sup>69</sup> Center for Research and Exploration in Space Science and Technology, University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore MD, USA
- <sup>70</sup> GSFC – Goddard Space Flight Center, Code 698, 8800 Greenbelt Rd, 20771 MD Greenbelt, USA
- <sup>71</sup> EURIX S.r.l., Corso Vittorio Emanuele II 61, 10128 Torino, Italy
- <sup>72</sup> Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS 15, Cambridge, MA 02138, USA
- <sup>73</sup> HE Space Operations BV for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanización Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
- <sup>74</sup> CAUP - Centro de Astrofísica da Universidade do Porto, Rua das Estrelas, Porto, Portugal
- <sup>75</sup> SISSA – Scuola Internazionale Superiore di Studi Avanzati, via Bonomea 265, 34136 Trieste, Italy
- <sup>76</sup> Telespazio for CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
- <sup>77</sup> University of Turin, Department of Computer Sciences, Corso Svizzera 185, 10149 Torino, Italy
- <sup>78</sup> Dpto. de Matemática Aplicada y Ciencias de la Computación, Univ. de Cantabria, ETS Ingenieros de Caminos, Canales y Puertos, Avda. de los Castros s/n, 39005 Santander, Spain
- <sup>79</sup> Centro de Astronomía – CITEVA, Universidad de Antofagasta, Avenida Angamos 601, Antofagasta 1270300, Chile
- <sup>80</sup> Vera C Rubin Observatory, 950 N. Cherry Avenue, Tucson, AZ 85719, USA
- <sup>81</sup> Centre for Astrophysics Research, University of Hertfordshire, College Lane, AL10 9AB, Hatfield, UK
- <sup>82</sup> University of Antwerp, Onderzoeksgroep Toegepaste Wiskunde, Middelheimlaan 1, 2020 Antwerp, Belgium
- <sup>83</sup> INAF – Osservatorio Astronomico d’Abruzzo, Via Mentore Maggini, 64100 Teramo, Italy
- <sup>84</sup> Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, Rua do Matão, 1226, Cidade Universitária, 05508-900 São Paulo, SP, Brazil
- <sup>85</sup> Mésocentre de calcul de Franche-Comté, Université de Franche-Comté, 16 route de Gray, 25030 Besançon Cedex, France
- <sup>86</sup> SRON, Netherlands Institute for Space Research, Sorbonnelaan 2, 3584CA Utrecht, The Netherlands
- <sup>87</sup> Theoretical Astrophysics, Division of Astronomy and Space Physics, Department of Physics and Astronomy, Uppsala University, Box 516, 751 20 Uppsala, Sweden
- <sup>88</sup> RHEA for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanización Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
- <sup>89</sup> ATOS for CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
- <sup>90</sup> School of Physics and Astronomy, Tel Aviv University, Tel Aviv 6997801, Israel
- <sup>91</sup> Astrophysics Research Centre, School of Mathematics and Physics, Queen’s University Belfast, Belfast BT7 1NN, UK
- <sup>92</sup> Centre de Données Astronomique de Strasbourg, Strasbourg, France
- <sup>93</sup> Université Côte d’Azur, Observatoire de la Côte d’Azur, CNRS, Laboratoire Géoazur, Bd de l’Observatoire, CS 34229, 06304 Nice Cedex 4, France
- <sup>94</sup> Max-Planck-Institut für Astrophysik, Karl-Schwarzschild-Straße 1, 85748 Garching, Germany
- <sup>95</sup> APAVE SUDEUROPE SAS for CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
- <sup>96</sup> Área de Lenguajes y Sistemas Informáticos, Universidad Pablo de Olavide, Ctra. de Utrera, km 1. 41013 Sevilla, Spain
- <sup>97</sup> Onboard Space Systems, Luleå University of Technology, Box 848, 981 28 Kiruna, Sweden
- <sup>98</sup> TRUMPF Photonic Components GmbH, Lise-Meitner-Straße 13, 89081 Ulm, Germany
- <sup>99</sup> IAC – Instituto de Astrofísica de Canarias, Via Láctea s/n, 38200 La Laguna S.C., Tenerife, Spain
- <sup>100</sup> Department of Astrophysics, University of La Laguna, Via Láctea s/n, 38200 La Laguna S.C., Tenerife, Spain
- <sup>101</sup> Laboratoire Univers et Particules de Montpellier, CNRS Université Montpellier, Place Eugène Bataillon, CC72, 34095 Montpellier Cedex 05, France
- <sup>102</sup> LESIA, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Université de Paris, 5 Place Jules Janssen, 92190 Meudon, France
- <sup>103</sup> Villanova University, Department of Astrophysics and Planetary Science, 800 E Lancaster Avenue, Villanova PA 19085, USA
- <sup>104</sup> Astronomical Observatory, University of Warsaw, Al. Ujazdowski 4, 00-478 Warszawa, Poland
- <sup>105</sup> Laboratoire d’astrophysique de Bordeaux, Univ. Bordeaux, CNRS, B18N, allée Geoffroy Saint-Hilaire, 33615 Pessac, France
- <sup>106</sup> Université Rennes, CNRS, IPR (Institut de Physique de Rennes) - UMR 6251, 35000 Rennes, France
- <sup>107</sup> INAF – Osservatorio Astronomico di Capodimonte, Via Moiriello 16, 80131 Napoli, Italy
- <sup>108</sup> Niels Bohr Institute, University of Copenhagen, Juliane Maries Vej 30, 2100 Copenhagen Ø, Denmark
- <sup>109</sup> Las Cumbres Observatory, 6740 Cortona Drive Suite 102, Goleta, CA 93117, USA
- <sup>110</sup> Astrophysics Research Institute, Liverpool John Moores University, 146 Brownlow Hill, Liverpool L3 5RF, UK
- <sup>111</sup> IPAC, Mail Code 100-22, California Institute of Technology, 1200 E. California Blvd., Pasadena, CA 91125, USA
- <sup>112</sup> Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, M/S 169-327, Pasadena, CA 91109, USA
- <sup>113</sup> IRAP, Université de Toulouse, CNRS, UPS, CNES, 9 Av. colonel Roche, BP 44346, 31028 Toulouse Cedex 4, France
- <sup>114</sup> Konkoly Observatory, Research Centre for Astronomy and Earth Sciences, MTA Centre of Excellence, Konkoly Thege Miklós út 15-17, 1121 Budapest, Hungary
- <sup>115</sup> MTA CSFK Lendület Near-Field Cosmology Research Group, Konkoly Thege Miklós út 15-17, 1121 Budapest, Hungary
- <sup>116</sup> ELTE Eötvös Loránd University, Institute of Physics, 1117, Pázmány Péter sétány 1A, Budapest, Hungary
- <sup>117</sup> Ruđer Bošković Institute, Bijenička cesta 54, 10000 Zagreb, Croatia
- <sup>118</sup> Institute of Theoretical Physics, Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic
- <sup>119</sup> INAF – Osservatorio Astronomico di Brera, via E. Bianchi 46, 23807 Merate (LC), Italy
- <sup>120</sup> AKKA for CNES Centre Spatial de Toulouse, 18 avenue Edouard Belin, 31401 Toulouse Cedex 9, France
- <sup>121</sup> Departamento de Física de la Tierra y Astrofísica, Universidad Complutense de Madrid, 28040 Madrid, Spain
- <sup>122</sup> Vitrociset Belgium for European Space Agency (ESA), Camino bajo del Castillo, s/n, Urbanización Villafranca del Castillo, Villanueva de la Cañada, 28692 Madrid, Spain
- <sup>123</sup> Department of Astrophysical Sciences, 4 Ivy Lane, Princeton University, Princeton NJ 08544, USA

- <sup>124</sup> Departamento de Astrofísica, Centro de Astrobiología (CSIC-INTA), ESA-ESAC. Camino Bajo del Castillo s/n 28692 Villanueva de la Cañada, Madrid, Spain
- <sup>125</sup> naXys, University of Namur, Rempart de la Vierge, 5000 Namur, Belgium
- <sup>126</sup> EPFL – Ecole Polytechnique fédérale de Lausanne, Institute of Mathematics, Station 8 EPFL SB MATH SDS, Lausanne, Switzerland
- <sup>127</sup> H H Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK
- <sup>128</sup> Sorbonne Université, CNRS, UMR7095, Institut d’Astrophysique de Paris, 98bis bd. Arago, 75014 Paris, France
- <sup>129</sup> Porter School of the Environment and Earth Sciences, Tel Aviv University, Tel Aviv 6997801, Israel
- <sup>130</sup> Laboratoire Univers et Particules de Montpellier, Université Montpellier, Place Eugène Bataillon, CC72, 34095 Montpellier Cedex 05, France
- <sup>131</sup> Faculty of Mathematics and Physics, University of Ljubljana, Jadranska ulica 19, 1000 Ljubljana, Slovenia