What to expect from Gaia (E)DR3: Photometry and low-resolution spectra

EDR3: G, G<sub>BP</sub>, G<sub>Rp</sub> Photometry

### Mean photometry

<table>
<thead>
<tr>
<th>Sources</th>
<th>Uncertainties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G-band</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;1.8 billion</td>
<td>0.25 mmag at G&lt;13</td>
</tr>
<tr>
<td></td>
<td>1 mmag at G=17</td>
</tr>
<tr>
<td></td>
<td>5 mmag at G=20</td>
</tr>
<tr>
<td><strong>G&lt;sub&gt;BP&lt;/sub&gt; and G&lt;sub&gt;Rp&lt;/sub&gt;</strong></td>
<td></td>
</tr>
<tr>
<td>~85%</td>
<td>1 mmag at G&lt;13</td>
</tr>
<tr>
<td></td>
<td>10 / 5 mmag at G=17</td>
</tr>
<tr>
<td></td>
<td>100 / 50 mmag at G=20</td>
</tr>
</tbody>
</table>

Based on the scatter of epoch measurements per source

**Photometric system definition**

- G, G<sub>BP</sub> and G<sub>Rp</sub> photometric passbands
Precision of the mean photometry

- **2 mmag calibration floor on individual CCD measurements**
- **Saturation effects & problematic calibrations due to fewer calibrators**
- **Change in windowing scheme, photometric system inhomogeneities**

*Gaia DR1, Gaia DR2, Gaia DR3*
Precision of the mean photometry

$G_{BP}$

$N_{CCD} \sim 20$

$G_{RP}$

$N_{CCD} \sim 20$
Quality metrics

- Flux excess factor defined as the ratio between the sum of $G_{BP}$ and $G_{RP}$ fluxes and the $G$ flux.

- The smoother sky distribution is a clear sign of the improvements in the BP and RP calibrations in contaminated and crowded regions.

- Refer to the Gaia EDR3 papers for more details on this and other quality metrics.
EDR3: Passbands

Essential to estimate the magnitude measured by a given instrument given the absolute spectrum of a source.

- Photometric passbands and zero-points in the Vega and AB systems will be released in advance of EDR3.

- The Gaia EDR3 papers and on-line documentation will provide newly determined transformations between the Gaia photometry and other photometric systems.

The internal photometric system is NOT the same as for Gaia DR2.

No evidence for magnitude terms as reported for DR2 in Casagrande & VandenBerg 2018 and Weiler 2018.
DR3: New products

Epoch photometry

- Variable light-curves (more variability types, up to ~7 million photometric light-curves and classifications)
- Gaia Andromeda Photometric Survey (GAPS) ($G$, $G_{BP}$, $G_{RP}$ light-curves for ~1M sources)

BP/RP low-resolution spectroscopy and related products

- Internally calibrated mean BP and RP spectra for at least 100M sources
- External calibration of the BP and RP mean instrument
- Astrophysical parameters
- Reflectances from BP/RP spectra of asteroids
DR3: Mean BP/RP spectra

BP: 330-680 nm

RP: 640-1100 nm
DR3: Mean BP/RP spectra

Epoch spectra

Mean spectra

F_{BP} [e^-/s/sample]

F_{RP} [e^-/s/sample]

Pseudo – wavelength

Pseudo – wavelength

Observation epoch [revolutions]

upcoming

IMAGE OF THE WEEK
DR3: Mean BP/RP spectra

Internally-calibrated spectra

External instrument calibration

Externally-calibrated absolute spectra

Simulating Gaia internally calibrated spectra for a given SED will also be possible based on the same external calibration model.
While we obviously encourage users to take advantage of the full information contained in the spectra, synthetic photometry in bands in the range 330-1100 nm can be generated for quick investigations or specific use cases.

A Python package is being developed to facilitate the usage of BP and RP spectra in various scenarios.
Gaia DR3 will include reflectances for several thousand asteroids computed from BP/RP epoch spectra. This will be a unique catalogue for its homogeneity and size.

The Gaia reflectances will extend the wavelength coverage in the range 350-500nm which is important to understand the chemical composition of these objects and is not covered by ground-based data.