Gaia Data Release 3

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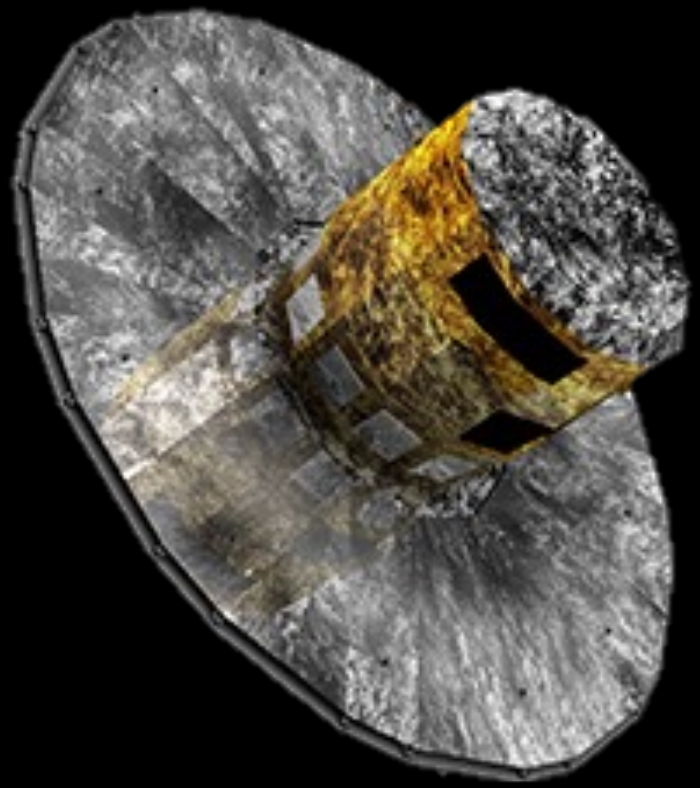
Caltech ARC Seminar

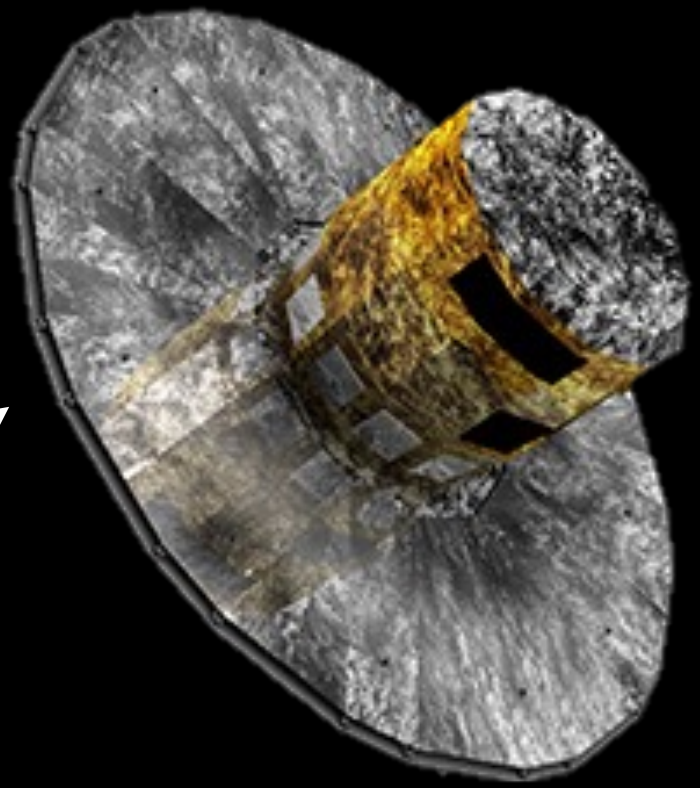
in the beginning, there was nothing.

and then, there was Gaia



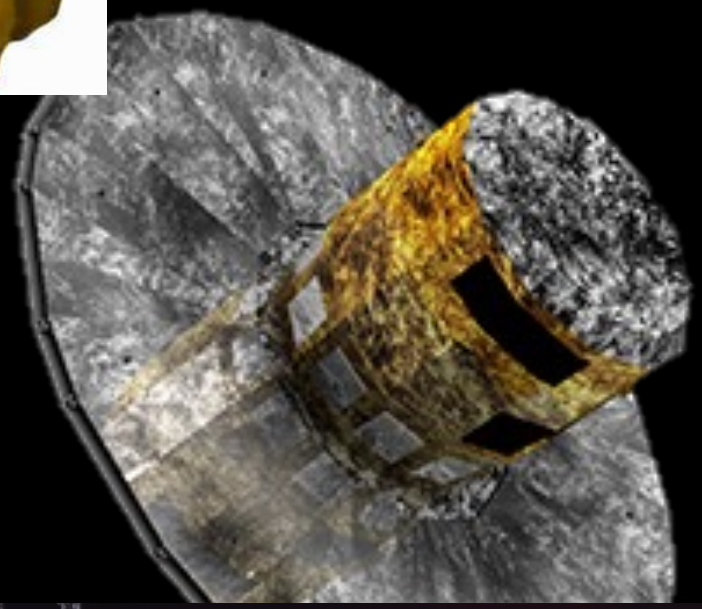
and then, there was Gaia

weird soup
can thing idk



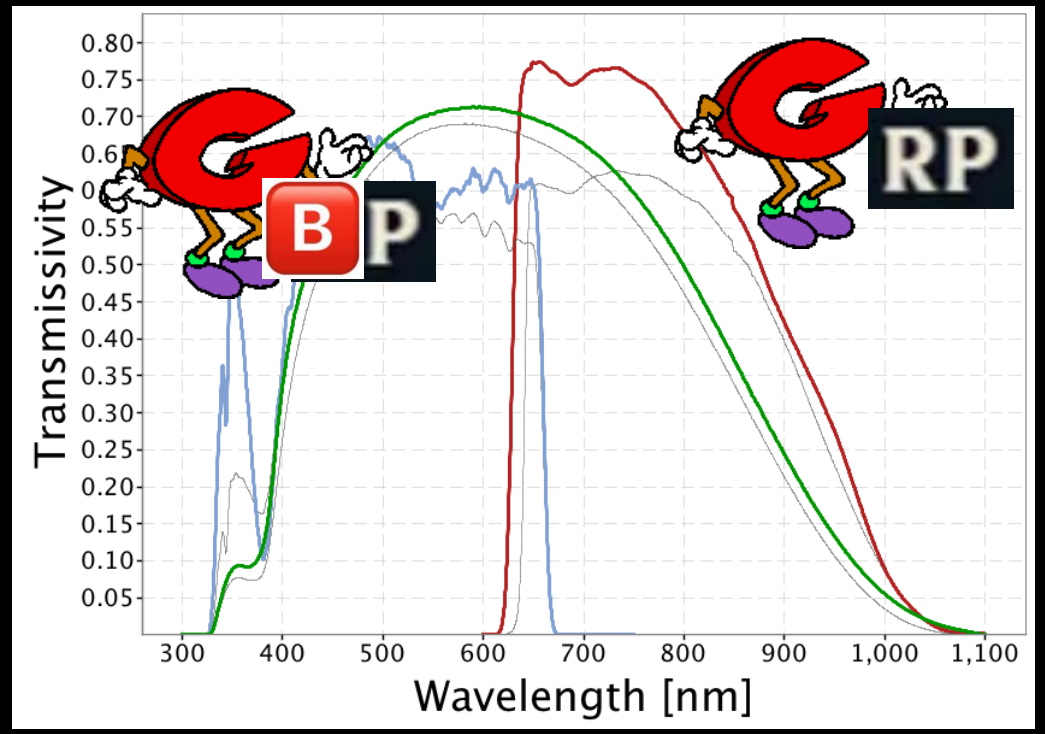
Data Release 1 (2016)

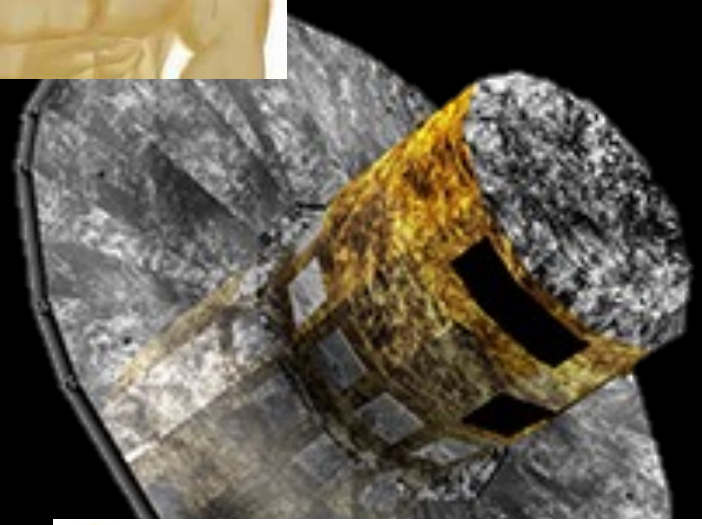
- positions + magnitudes for 1.1 bil. stars
- astrometric solutions (incl. parallaxes + proper motions) for 2 mil. (TGAS)
- only one band :(



Data Release 2 (2018)

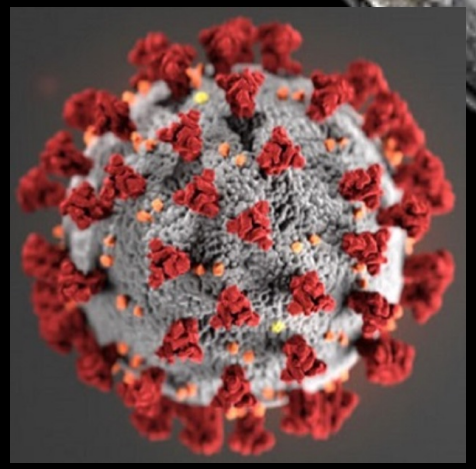
- astrometric solutions for 1.3 bil. stars
- RVs for 7 mil. stars
- two new bands





Early Data Release 3 (2020)

- more astrometry, more photometry idk



Data Release 3 (2022)

- Classifications & params for ~1.6 bil. sources (e.g., Teff, logg, [M/H], AG, distance)
- Metal abundances from RVS spectra for 5.5 mil objects
- Classification (with epoch data) of variable sources for 10.5 mil. sources
- Mean RVs for ~33 mil. stars
- Literally all this stuff

In Gaia Data Release 3 (Gaia DR3), the above set of data is complemented with new products released on 13 June 2022:

- Object classifications for 1.59 billion sources and astrophysical parameters (T_{eff}, logg, [M/H], A_G, distance, etc.) from BP/RP spectra for 470 million objects, including MCMC samples for most sources with astrophysical parameters. Other astrophysical parameters from the BP/RP spectra include:
  - Spectral types (217 million stars) and emission-line star classifications (57,000 stars);
  - Spectroscopic parameters for 2.3 million hot stars, 94,000 ultra-cool stars, activity index for 1.3 million cool stars, and H-alpha emission for 235 million stars;
  - Evolutionary parameters (mass and age) for 128 million stars;
  - Astrophysical parameters for 348 million objects based on the assumption of an unresolved binary in the BP/RP spectra;
  - Self-organised map (outlier) analysis based on 56 million sources with the weakest object classifications.
- Astrophysical parameters (T_{eff}, logg, [M/H], [X/M] for 12 elements, etc.) from RVS spectra for 5.5 million objects, including diffuse interstellar bands for 472,000 objects.
- All-sky total galactic extinction maps at 4 different spatial resolutions (HEALPix levels 6, 7, 8, and 9).
- Mean BP/RP spectra for 219 million sources, most of them with G < 17.6 mag.
- Mean RVS spectra for 1 million well-behaved objects.
- Mean radial velocities for 33 million stars and mean G_{RVS} magnitudes for 32 million objects with G_{RVS} <~ 14 mag with effective temperatures (T_{eff}) in the range of ~3100 to 14,500 K.
- Rotational velocities for 3.5 million sources with G_{RVS} <~ 12 mag.
- Variability analysis, together with the underlying epoch photometry, for 10.5 million sources. Apart from classification into 24 variability classes, detailed variability results are provided in separate tables for the following candidates:
  - Cepheids (15,021 objects);
  - Compact companions (6306 objects);
  - Eclipsing binaries (2,184,477 objects);
  - Long-period variables (1,720,588 objects);
  - Microlensing events (363 objects);
  - Planetary transits (214 objects);
  - RR Lyrae stars (271,779 objects);
  - Short-timescale variables (471,679 objects);
  - Solar-like rotational modulation variables (474,026 objects);
  - Upper-main-sequence oscillators (54,476 objects);
  - Active galactic nuclei (872,228 objects).
- Solar-system results for 158,000 sources (including 31 planetary satellites), with orbital solutions and individual epoch observations for 154,000 objects and with mean BP/RP reflectance spectra for more than 60,000 objects.
- Some 813,000 non-single stars, including amongst others non-single-star models for sources compatible with an astrometric acceleration solution, non-single-star orbital models for spectroscopic binaries compatible with a trend, and non-single-star orbital models for sources compatible with a two-body solution.
- Some 6.6 million quasar candidates with redshift estimates for most of them.
- Some 1.1 million quasars analysed with 60,000 host galaxies detected and 15,000 surface brightness profiles of the host galaxy.
- Some 4.8 million galaxy candidates with redshift estimates for more than 1 million objects.
- Some 900,000 galaxies analysed with two surface brightness profiles.
- The Gaia Andromeda Photometric Survey (GAPS), consisting of the photometric time series for all 1.2 million sources located in a 5.5-degree radius field centred on the Andromeda galaxy.
- Selected tables from Gaia Collaboration performance verification papers published with Gaia DR3.
- All 2612 science alerts triggered in the period underlying Gaia DR3.

Using Gaia DR3

- accessing gaia involves adql, which is a dialect of sql
- not turing-complete, which is a good idea for some reason

- there are literally 46 papers for gaia dr3 alone (not including dr1, dr2, or even edr3)

me

- so you're gonna have to trust me on this one