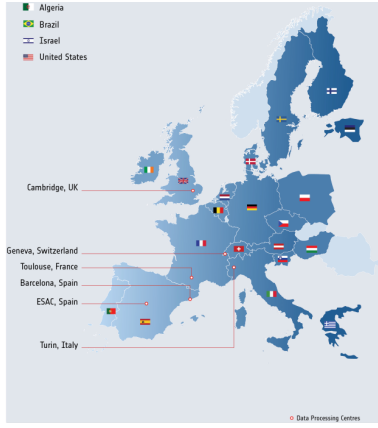
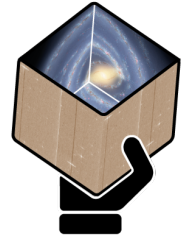
The Gaia Sky Version 1.0

Anthony Brown
Leiden Observatory, Leiden University
brown@strw.leidenuniv.nl

Teamwork to deliver the promise of Gaia

- 10+ years of effort
- 450 scientists and engineers
- 160 institutes
- 24 countries and ESA
- Six data processing centres





gaia

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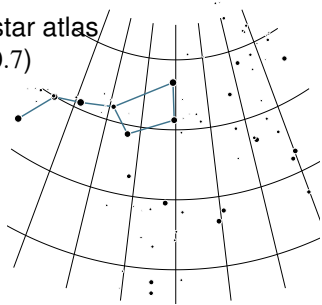
Gaia DPAC Data Processing & Analysis Consortium

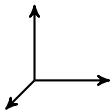
$\alpha\ \delta\ \varpi\ \mu_{\alpha*}\ \mu_\delta\ G\ \ldots$

What's in the Gaia DR1 delivery

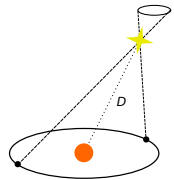
Billion star atlas
($G \lesssim 20.7$)

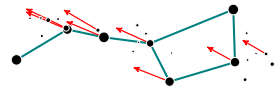


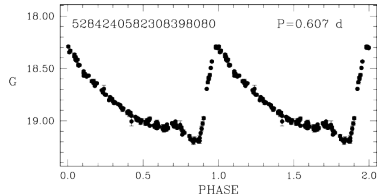
Positions and magnitudes
for ~ 2000 ICRF quasars



Tycho-Gaia
Astrometric Solution
(~ 2 million, $G \lesssim 12$)

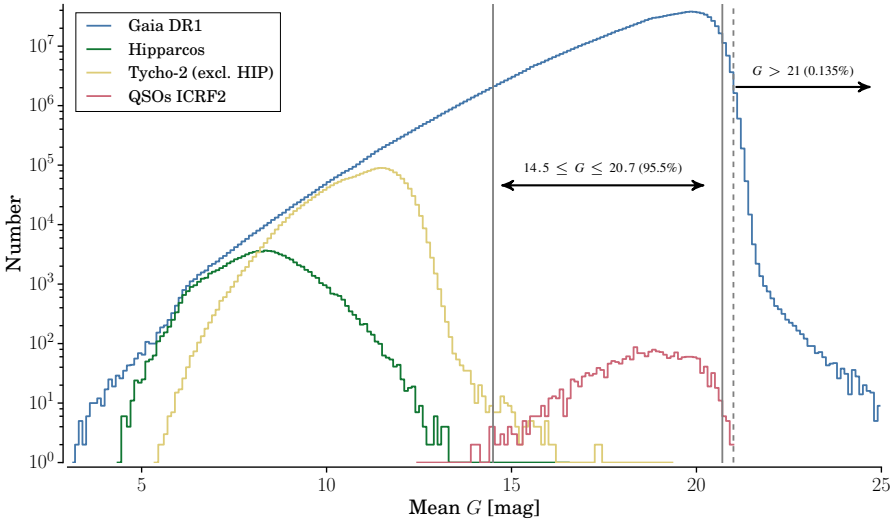






Variable stars near
south ecliptic pole
(~ 600 Cepheids,
~ 2600 RR Lyrae)

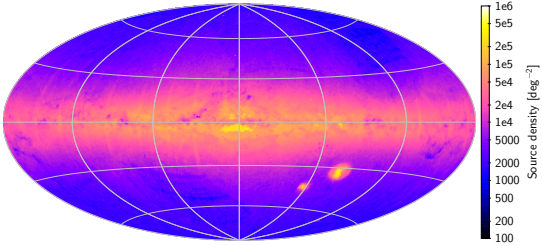
Gaia DR1 magnitude distribution



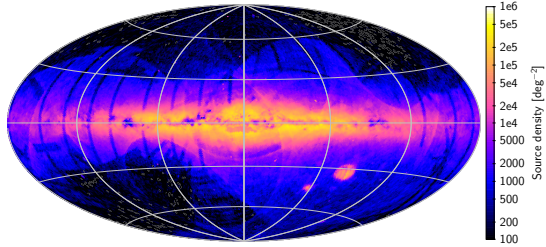
Gaia Collaboration, 2016, A&A

Highly precise positions, new sources

685 million sources matched to IGSL



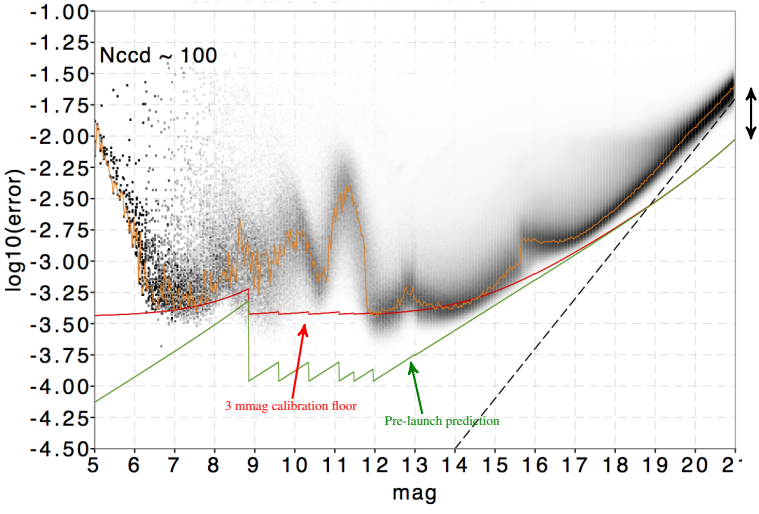
456 million new sources in Gaia DR1



DPAC/CU3/Lindegren et al., 2016, A&A

- (α, δ) for $\sim$ 1.1 billion sources to $G = 20.7$
- Epoch J2015.0, alignment to ICRF < 0.1 mas, rotation < 0.03 mas yr^{-1}
- Typical position uncertainty $\sim$ 10 mas
- Positions of 2191 ICRF sources from special astrometric solution (Mignard et al., 2016, A&A)
  - 90% with $\sigma_{\rm pos} < 3.35$ mas
  - no systematic differences with radio positions of more than few tenths of mas

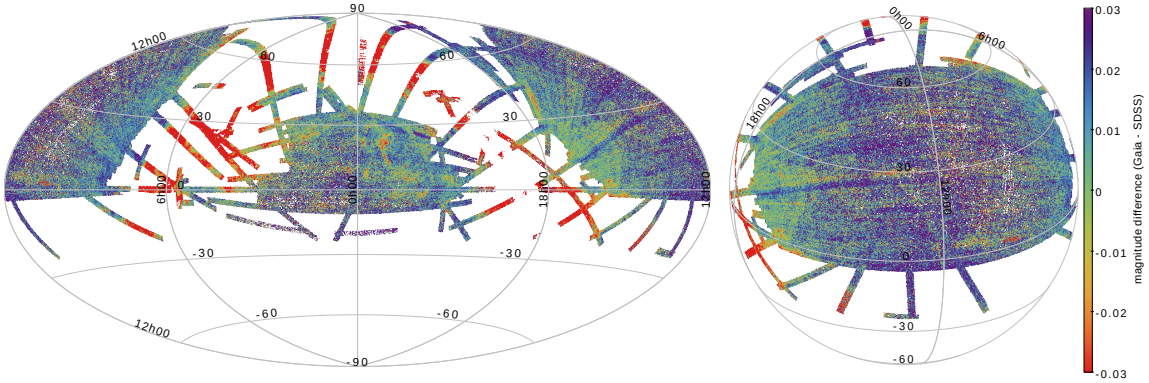
Gaia DR1 Photometry



Stray light effect

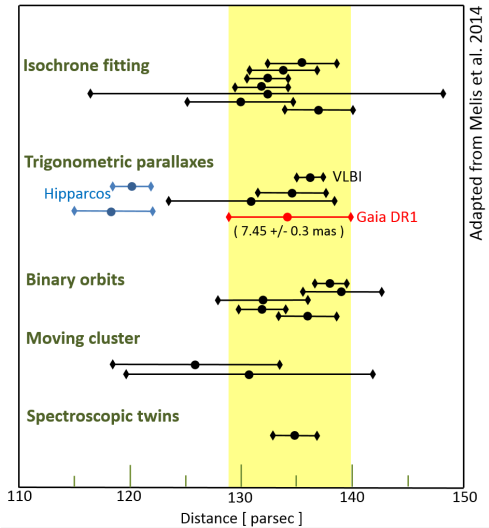
Error on the weighted mean G value for sources with $\sim$ 100 CCD transits (Evans et al., 2017, A&A)

Gaia DR1 Photometry



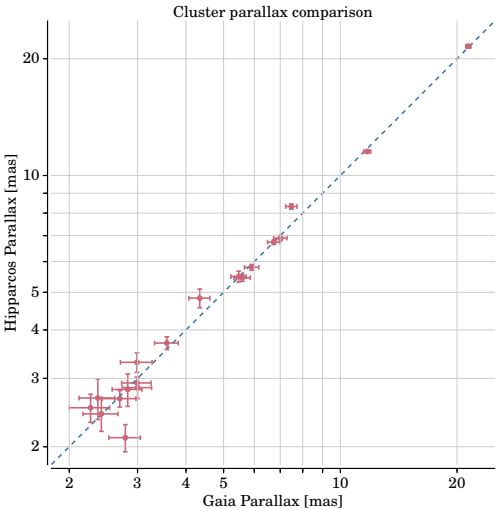
Gaia-SDSS comparison for sources at $G > 15$ and $0.8 < g - r < 1.1$ (Evans et al., 2017, A&A)

Comment on the Pleiades cluster distance



- Preliminary distance estimate 134 ± 6 pc
- Limited in accuracy by:
  - simplistic analysis
  - systematic and correlated errors in parallaxes
  - incomplete survey of the cluster
- Definitive conclusion on Pleiades distance not yet possible

Comment on the Pleiades cluster distance

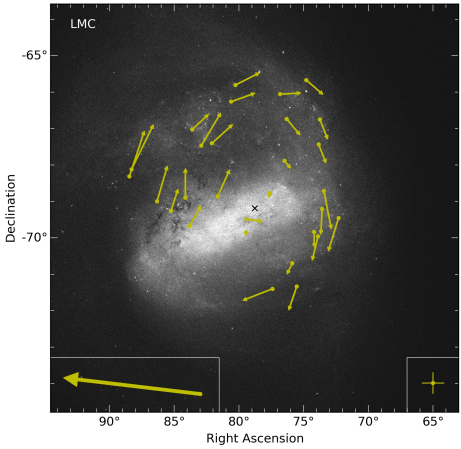


- Full analysis of nearby clusters in Gaia Collaboration, van Leeuwen, et al, 2017 A&A
- Excellent agreement between Hipparcos and Gaia for other clusters

About 100 papers using Gaia DR1 since 2016-09-14

- Parallax validation
  - No global offsets from Cepheids and RR Lyrae (PL relations)
  - Offsets claimed in samples of eclipsing binaries and in comparison to asteroseismic distances (Methodology? Assumptions about the stellar types involved?)
- Verification of quoted TGAS errors
  - Various indications of 10–20% overestimate of the errors: depends on sample of stars used
- Gaia DR1 positions and photometry already a reference for other surveys
  - new proper motion catalogues

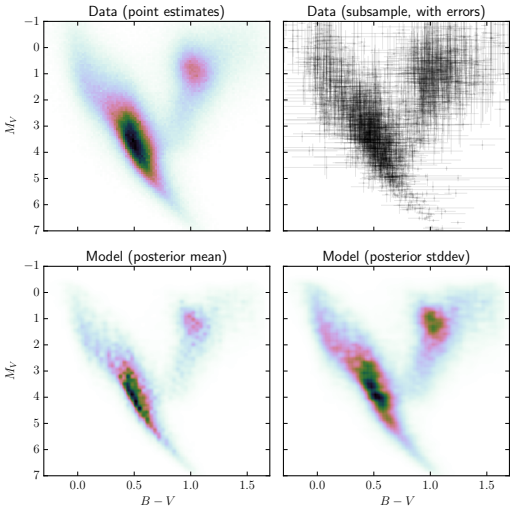
Magellanic cloud kinematics



- Measured proper motions of LMC and SMC consistent with HST result
- Residual kinematics in LMC show clear rotation pattern
  - also seen in HST studies
  - rotation curve from proper motions consistent with result from line-of-sight motions
  - Kinematic distance modulus of 18.54 ± 0.39

van der Marel & Sahlmann, arXiv:1609.04395

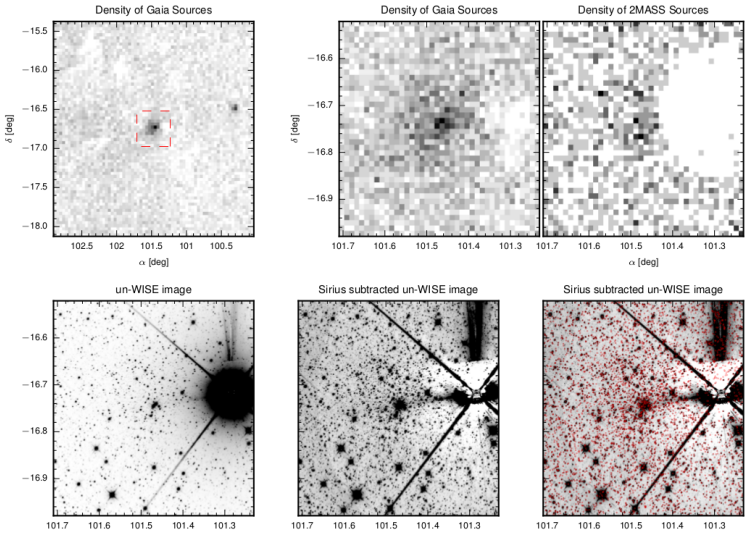
Data driven model of the CMD



- Infer distance from parallax, apparent magnitude, colour
  - infer distribution of stars in CMD from the same data
- Result is ‘de-noised’ CMD
  - use of all information, including low SNR parallaxes
- First step to accurate empirical description of CMD

Leistedt & Hogg, 2017, arXiv:1703.0811

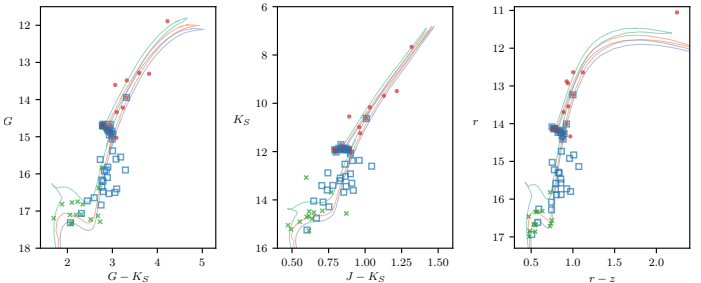
Gaia 1

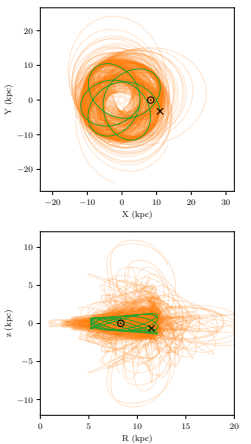


- Cluster hiding behind Sirius
- Power of all-sky, deep, high resolution, star-map

Koposov et al., 2017, arXiv:1702.01122

Gaia 1, Siriusly

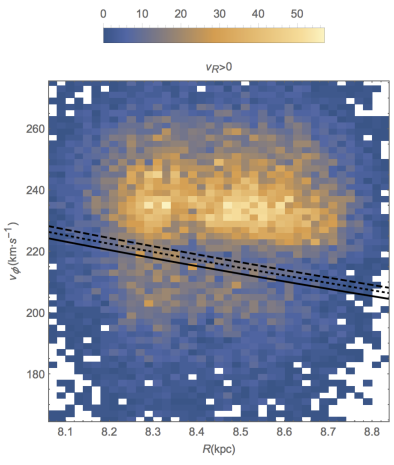




- ~ 3 Gyr old stellar cluster, $[\mathrm{Fe/H}] = -0.13 \pm 0.13$, $v_{\mathrm{rad}} = 58.30 \pm 0.22$ km s^{-1}
- Orbit: $e = 0.3 \pm 0.2$, $z_{\mathrm{max}} = 1.7^{+2.1}_{-0.9}$ kpc

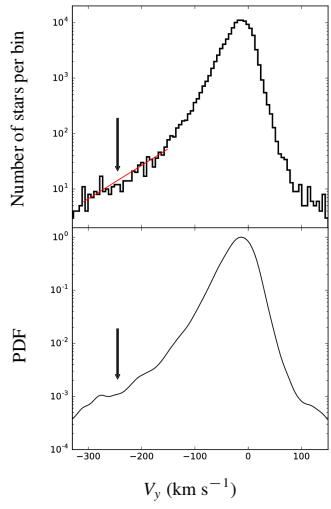
Simpson et al., 2017, arXiv:1703.03823

Fast short bar and ‘Carlberg gap’

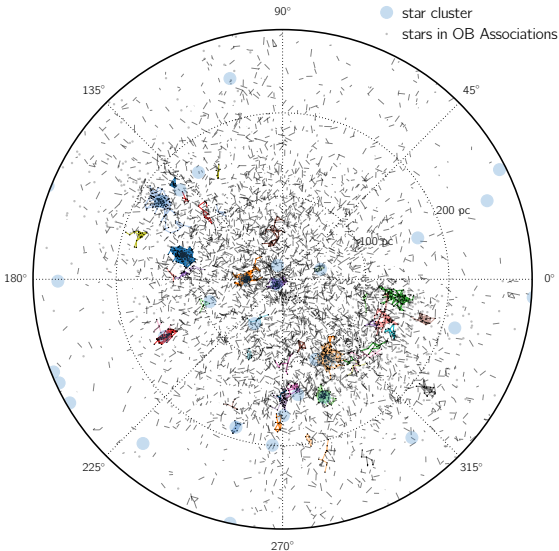


Left: Monari et al., arXiv:1610.05342, TGAS+LAMOST data, Gap in v_ϕ for stars at $v_R > 0$ consistent with short and fast bar (54km s^{-1} kpc^{-1})

Right: Hunt et al., arXiv:1610.02030, TGAS+RAVE, Dip in v_y distribution hints at low angular momentum stars scattered onto chaotic halo orbits, infer $V_\odot = 239 \pm 9$ km s^{-1} and $R_0 = 7.9 \pm 0.3$ kpc



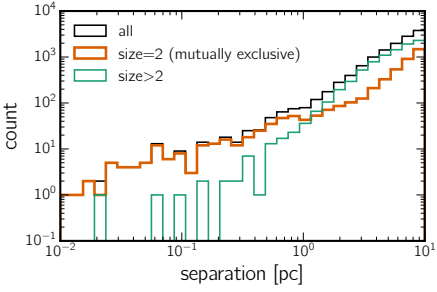
Co-moving pairs

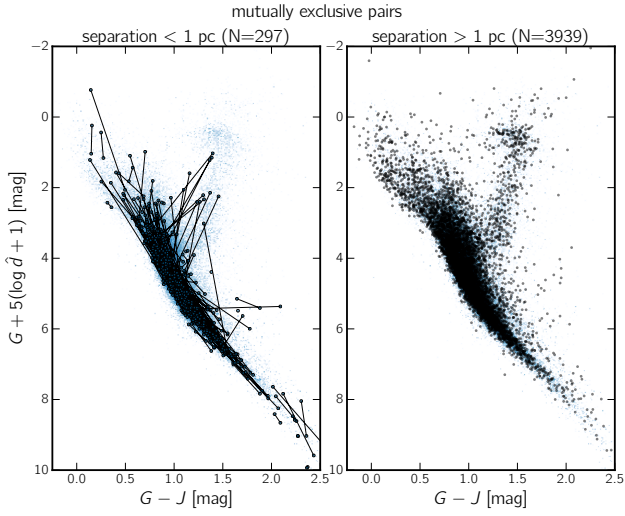


- 13 085 co-moving pairs identified in TGAS
  - based on proper motions, parallaxes, and marginalized model for 3D velocities
- Find pairs as well as networks of co-moving stars (clusters, associations, moving groups)
- Excess of pairs with > 1 pc separation, wide binaries drifting apart?

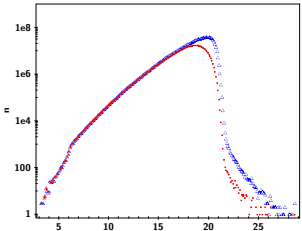
Oh et al., arXiv:1612.02440

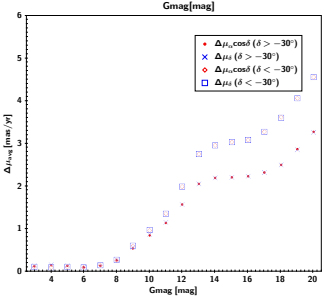
Co-moving pairs

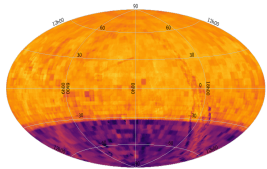




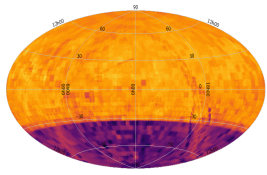
Hot Stuff for One Year



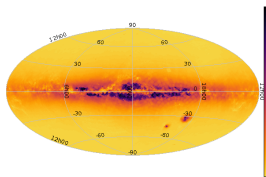




$\sigma_{\mu_{\alpha*}}$ [mas yr^{-1}]



σ_{μ_δ} [mas yr^{-1}]

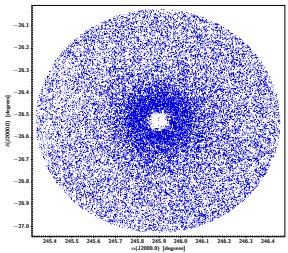


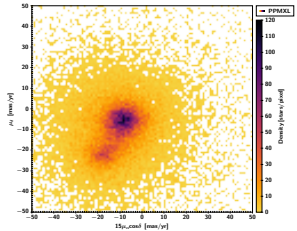
- 583 million proper motions
- Gaia DR1 – PPMXL combination
- Altmann et al., 2017, A&A 600, L4 (arXiv:1701.02629)

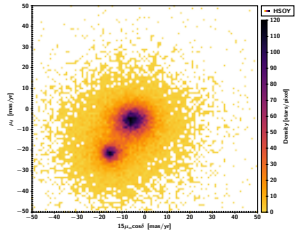
Hot Stuff for One Year

PPMXL

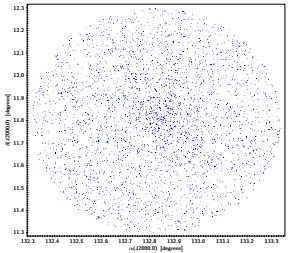
HSOY

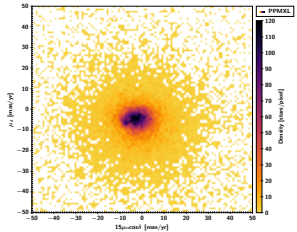


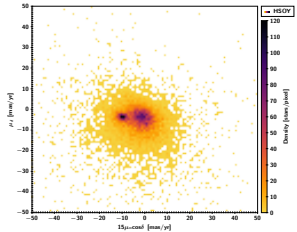




M4







M67

Gaia DR2: April 2018

- Five-parameter astrometric solutions for all sources with acceptable formal standard errors ($> 10^9$ anticipated), and positions (α, δ) for sources for which parallaxes and proper motions cannot be derived
- G and integrated $G_{\rm BP}$ and $G_{\rm RP}$ photometric fluxes and magnitudes for all sources
- Median radial velocities for sources brighter than $G_{\rm RVS} = 12$
- For stars brighter than $G = 17$, estimates of $T_{\rm eff}$ and, where possible, A_V, based on integrated photometry
- Photometric data for a sample of variable stars
- Epoch astrometry for a pre-selected list of $> 10\,000$ asteroids

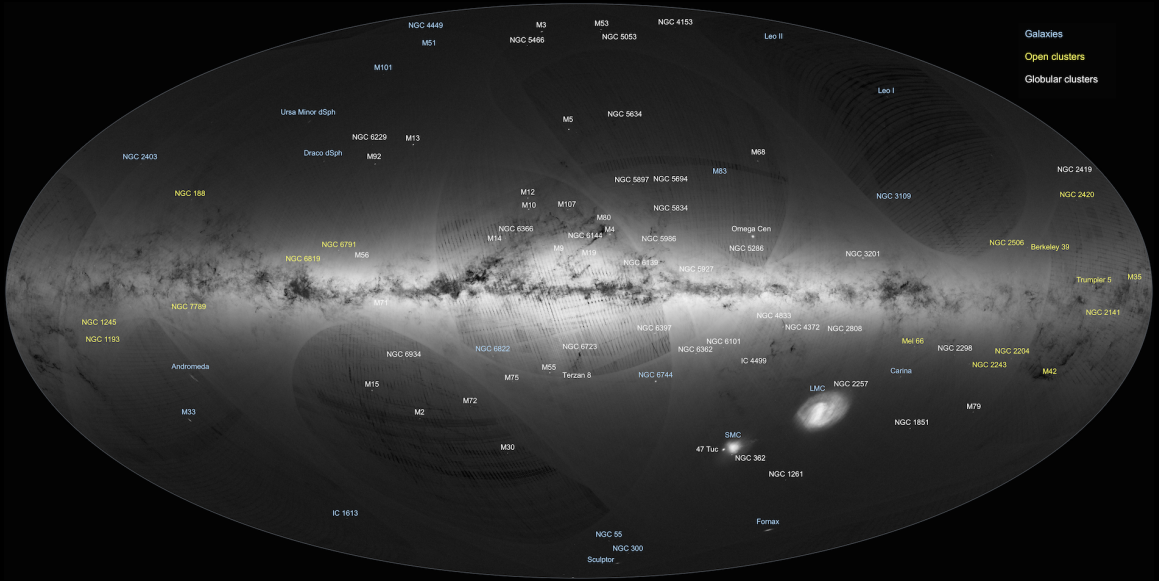
At the back of your paper...

Gaia DPAC gaia

Gaia 

- Please acknowledge the work by DPAC and ESA in your papers!
  - helps us argue the case for continued funding of the data processing
  - strengthens the mission extension case

`https://gaia.esac.esa.int/documentation/GDR1/Miscellaneous/sec_credit_and_citation_instructions.html`



ESA/Gaia/DPAC