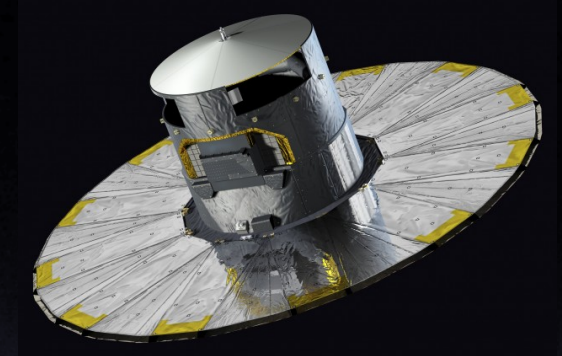


Gaia: the 1st data release



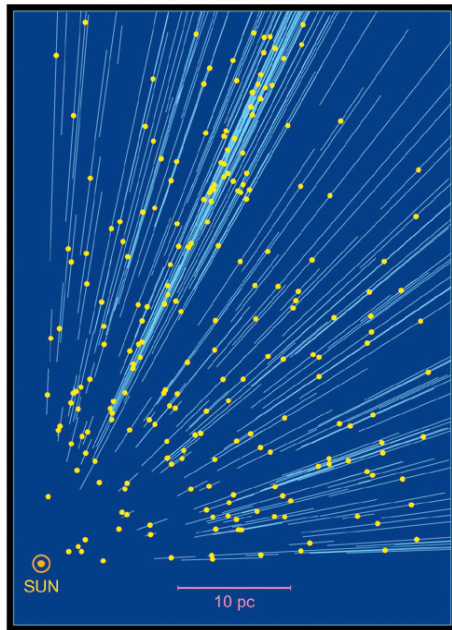
by Elena Pancino



Gaia astrometry

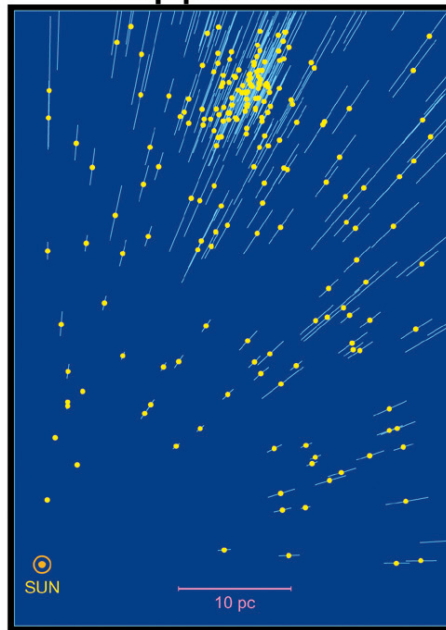
Pleiades

Ground



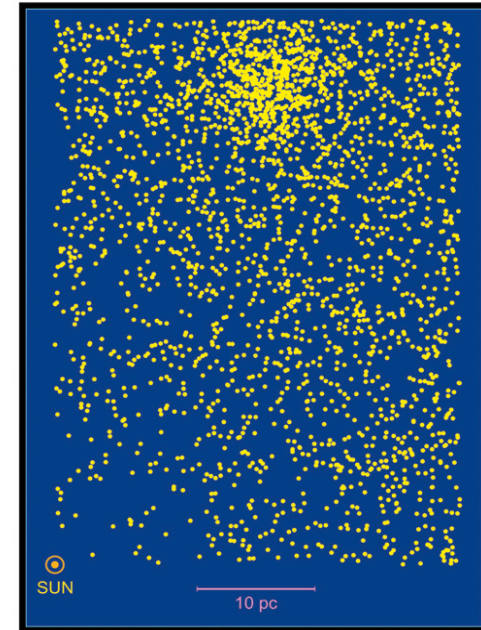
errors ~ a few mas

Hipparcos



errors ~ 0.6-1 mas
 $V < 12$ mag

Gaia



errors ~ 20 μ as – 0.6 mas
 $V < 20$ mag

Astrometry Principle

Sky scans (highest accuracy along scan)

Scan width: 0.7°

Global Iterative Solution:

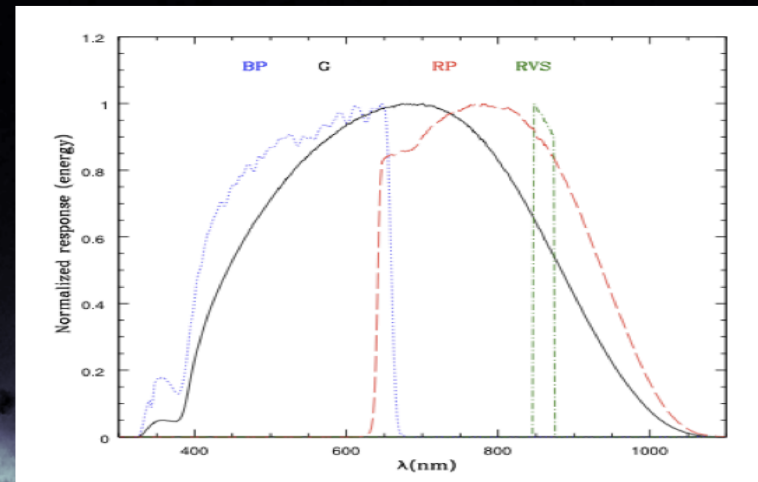
- Match objects
- Re-compute attitude
- Solve for positions etc.
- Higher terms solution
- Add new scans
- Iterate

The GDR1 angle coverage is not complete!

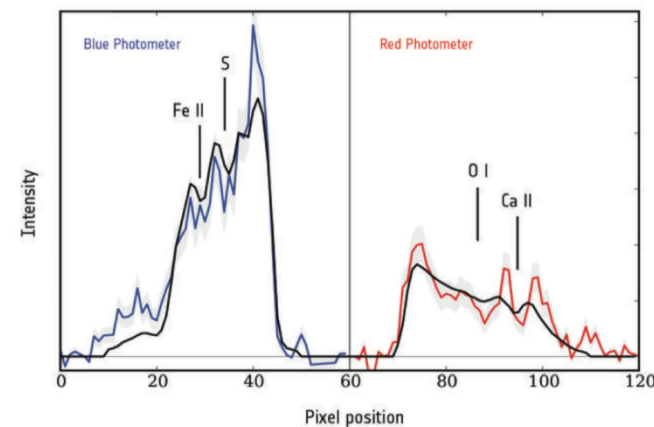
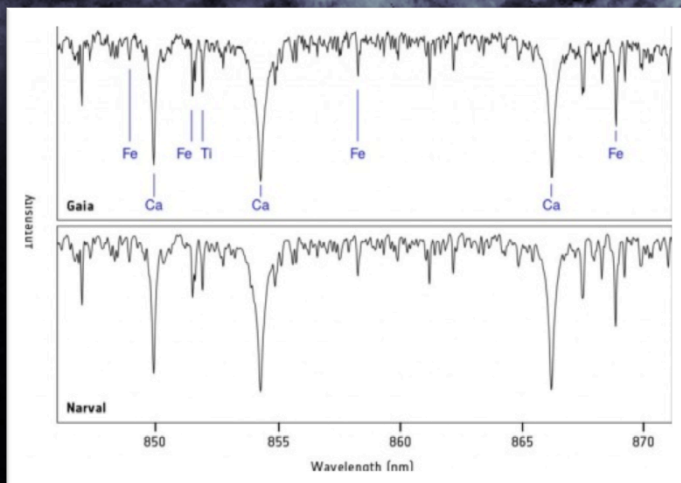


Three instruments

- ★ White light (G-band, $V < 20$ mag)
 - ★ astrometry, mmag photometry
- ★ Blue and red dispersed images
 - ★ parameters, (BP-RP) color
- ★ CaT spectroscopy ($V < 16$ mag)
 - ★ RV, parameters, abundances



$V < 16$ mag
 $R \sim 10000$



$V < 20$ mag
 $R \sim 100$

Gaia data releases

First data release DR1 (14 Sep 2016)

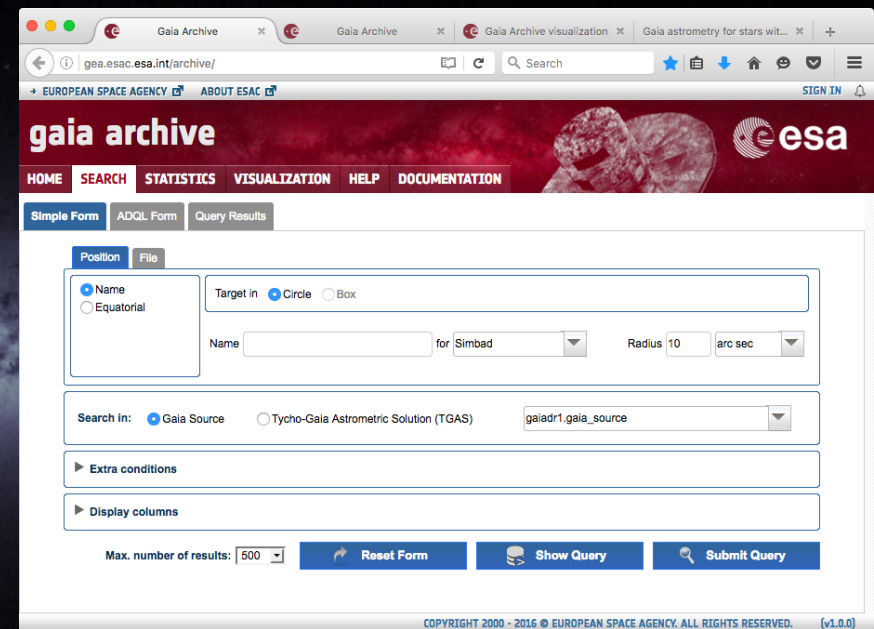
- ★ Position (α, δ) and G mag for ~90% of the stars
- ★ G light curves for variables at the Ecliptic poles
- ★ 5 p solution ($\alpha, \delta, \pi, \mu_\alpha, \mu_\delta$) for TGAS ($V < 12$ mag)

Second data release (Q4 2017)

- ★ 5 p solution ($\alpha, \delta, \pi, \mu_\alpha, \mu_\delta$) for 90% of the stars
- ★ G, G_{BP} , G_{RP} – magnitudes and colours
- ★ RV for 90% of the bright sources ($V < 16.2$ mag)

Following data releases (roughly yearly < 2023)

- ★ Increasing # and type of objects
- ★ Increasing # of data products
- ★ Increasing # of transits per object
- ★ Increasing overall quality of measurements

A screenshot of the Gaia Archive search interface. The browser window shows the URL 'gea.esac.esa.int/archive/'. The page has a red header with the 'gaia archive' logo and the ESA logo. Below the header is a navigation bar with links: HOME, SEARCH, STATISTICS, VISUALIZATION, HELP, DOCUMENTATION. The main content area has tabs for 'Simple Form', 'ADQL Form', and 'Query Results'. The 'Simple Form' tab is active. It contains a 'Position' section with 'Name' and 'Equatorial' radio buttons, a 'Target in' section with 'Circle' and 'Box' radio buttons, and a 'Name' input field. Below these is a 'Search in' section with 'Gaia Source' and 'Tycho-Gaia Astrometric Solution (TGAS)' radio buttons, and a dropdown menu showing 'gaiadr1.gaia_source'. There are also 'Extra conditions' and 'Display columns' sections. At the bottom, there is a 'Max. number of results' dropdown set to '500', and buttons for 'Reset Form', 'Show Query', and 'Submit Query'. The footer contains copyright information: 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED. [v1.0.0]'.

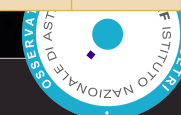
<http://gea.esac.esa.int/archive>



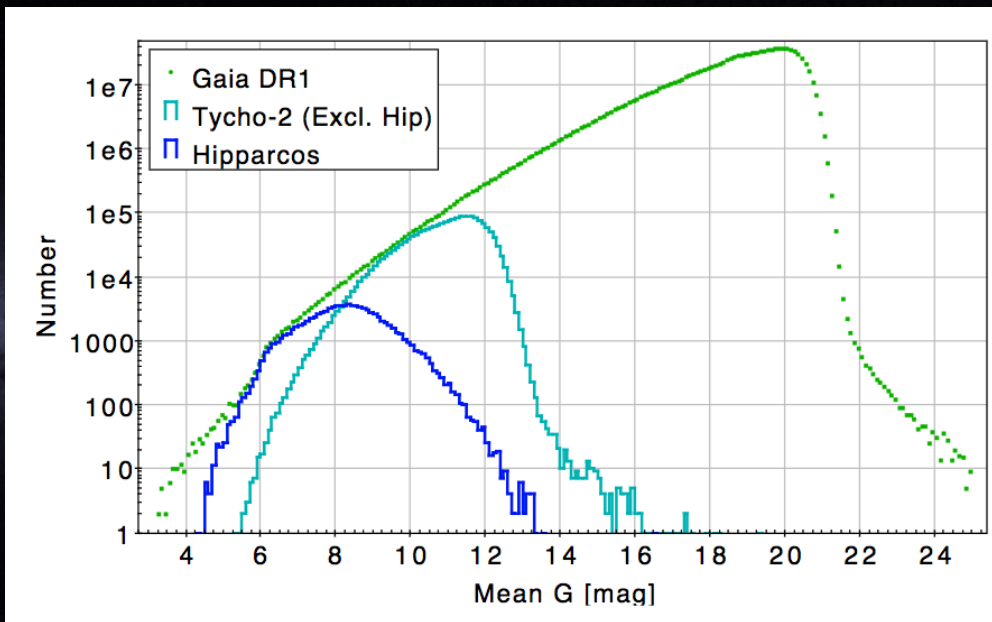
Expectations

Courtesy: Randich

	DR1	DR2	DR3	DR4	DR5
Five parameter solution for Tycho-2 Sources (2×10^6)	X				
Positions and G-band magnitudes for well behaved sources	X				
Light curves for ~3000 variable stars	X				
Five parameter solution for well-behaved sources		X			
Integrated BP/RP photometry		X			
Mean radial velocities for objects showing no radial-velocity variation		X	X		
Orbital solution, system velocity, 5par. solution for binaries with well covered periods			X		
Object classification and astrophysical parameters			X		
BP/RP spectra and RVS spectra for 'well behaved objects'			X		
Variable star classification and epoch photometry				X	
Solar system results				X	
Non-single star catalogue				X	
Full astrometric, photometric, and radial-velocity catalogues; all available variable-star and non-single-star solutions					X
Exo-planets list					X
Source classifications (probabilities) plus multiple astrophysical parameters					X
All data, including GB data acquired for calibrations					X



GDR1 – ID card

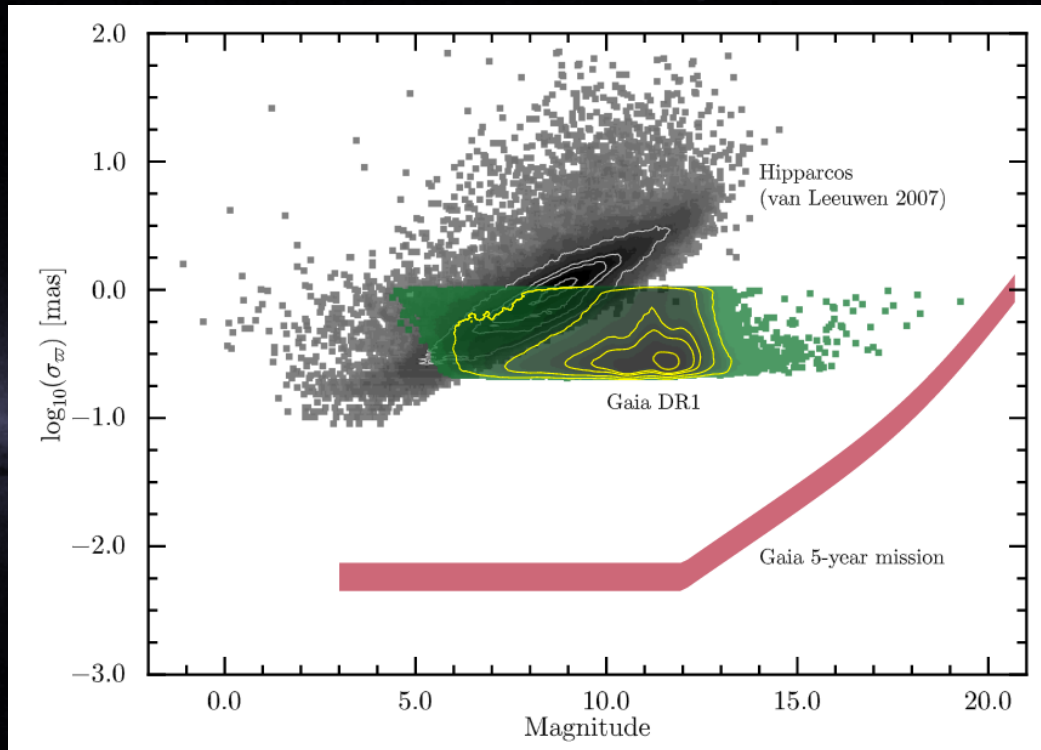


Gaia collaboration, Brown et al. (2016)

- ★ Some **statistics** of DR1
 - ★ $\sim 1.2 \cdot 10^9$ sources released
 - ★ $\sim 2 \cdot 10^6$ TGAS sources
 - ★ 93635 Hipparcos stars
 - ★ ~ 3000 variable stars
- ★ Source **filtering** on quality
 - ★ On errors, not measures
 - ★ Filtering is not perfect
- ★ Duplicates
 - ★ Flagged and removed
 - ★ Lower quality

GDR1 – Performance

Gaia collaboration, Brown et al. (2016)

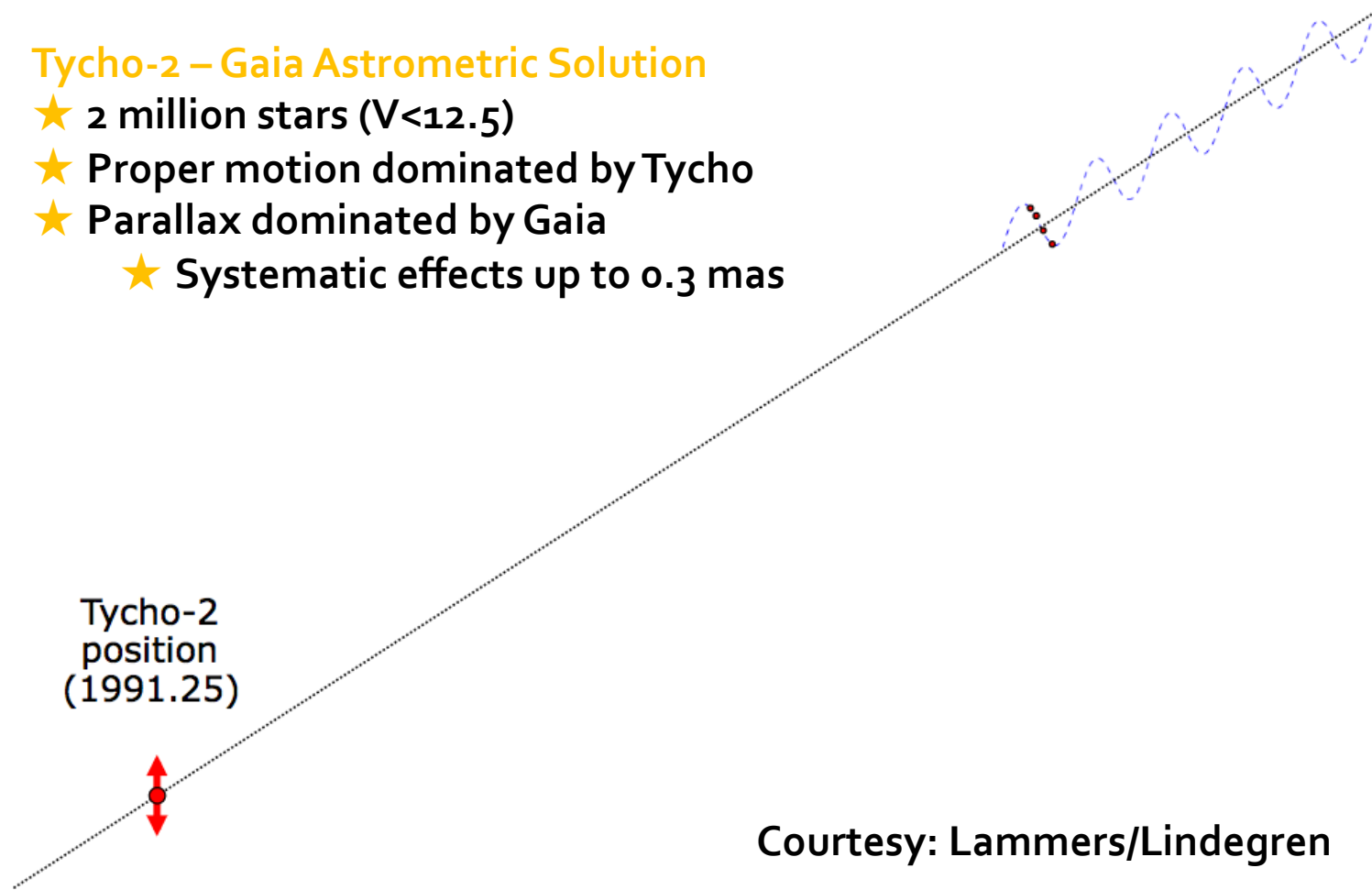


- ★ DR1 specific properties
 - ★ Parallax errors roughly **invariant** with magnitude
 - ★ Error correlations: **covariance** is essential
 - ★ Systematic error of about **± 0.3 mas**
- ★ Mitigated naturally in the next Gaia releases
- ★ *Cannot average to reduce errors – important !*

GDR1 - TGAS

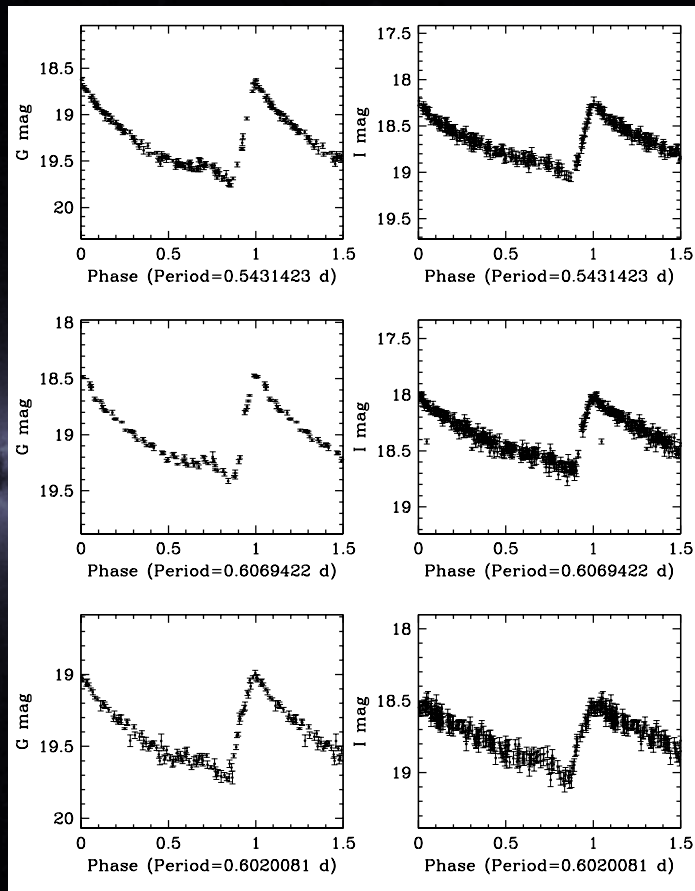
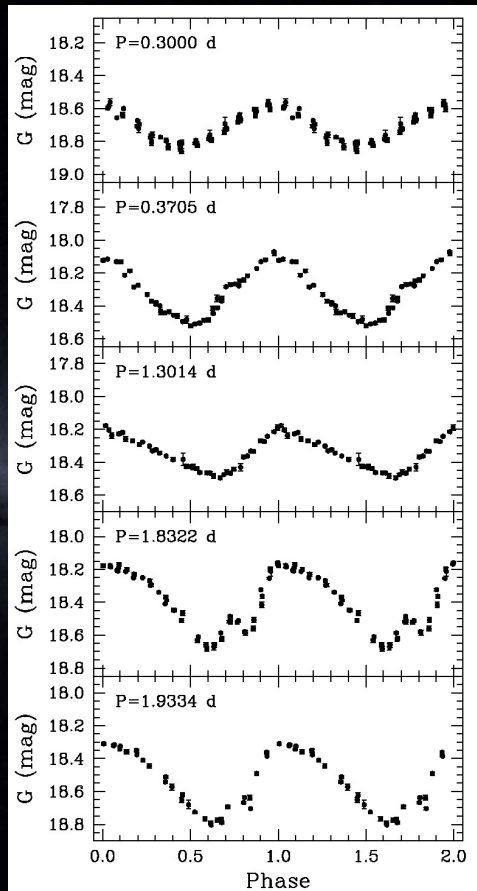
Tycho-2 – Gaia Astrometric Solution

- ★ 2 million stars ($V < 12.5$)
- ★ Proper motion dominated by Tycho
- ★ Parallax dominated by Gaia
 - ★ Systematic effects up to 0.3 mas



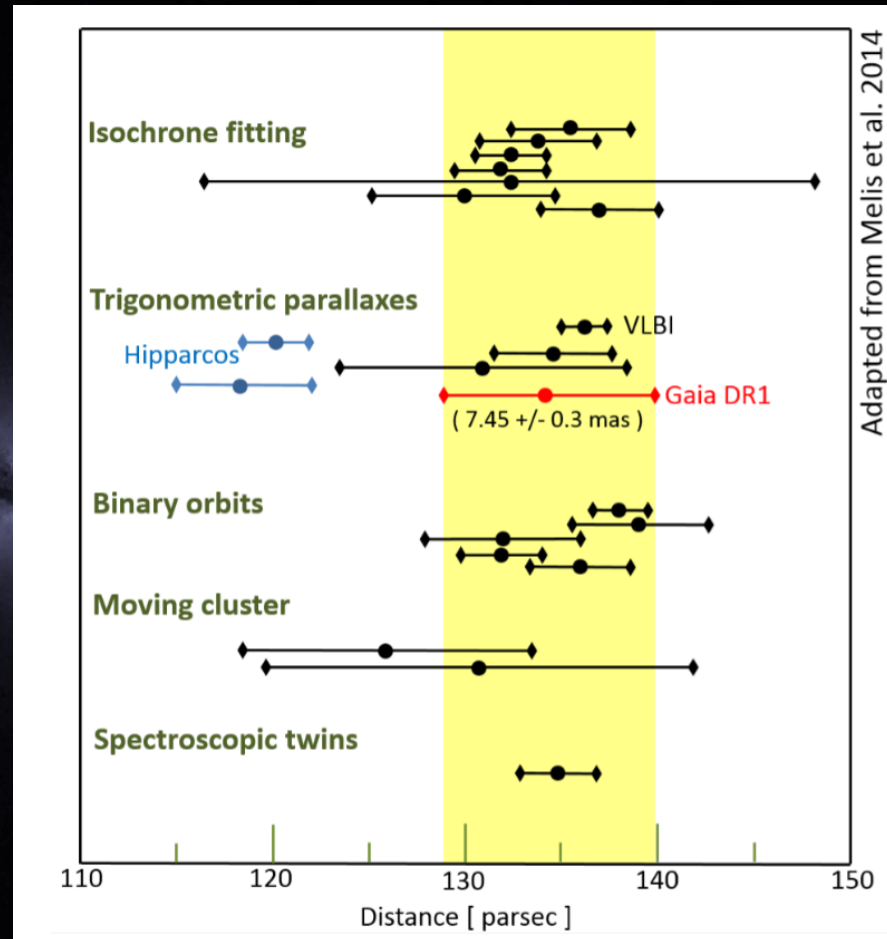
Courtesy: Lammers/Lindegren

GDR1 - EPSL



- ★ Faint Cepheids
- ★ 599
- ★ 43 new
- ★ RR Lyrae
- ★ 2595
- ★ 343 new

GDR1 - Pleiades



GDR1 – navigation

