Gaia Status & Promises

F. Mignard

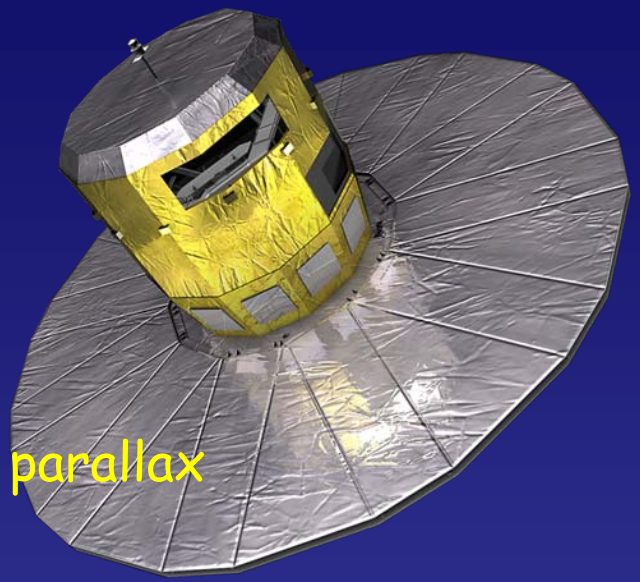
Observatory of the Côte d'Azur, Nice, (France)

Outline

- Mission summary
- Main features of Gaia observations
- Accuracy
- Early operations schedule
- Planned releases

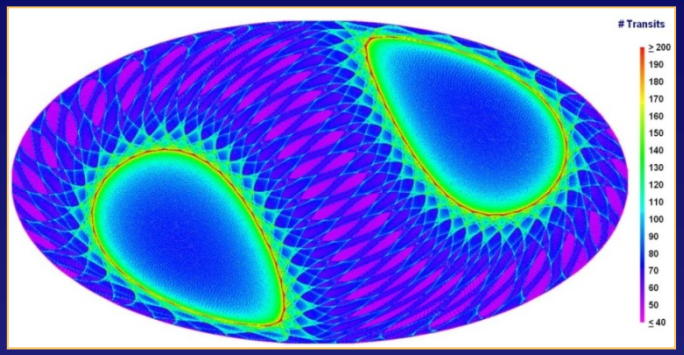
Gaia quick fact sheet

- Main goal : astrometry and photometric survey to V = 20
  - ~ 10^9 sources
    - stars, QSOs, Solar system, galaxies



- Accuracy in astrometry : 25 μas @ V = 15 for parallax
  - 10 μas V < 13 - 300 μas V = 20
- Regular scan of sky over 5 yrs
  - each source observed about ~80 times
  - internal autonomous detection system
- Launch fall 2013 from Kourou
- Current integration of P/L and S/M advancing smoothly

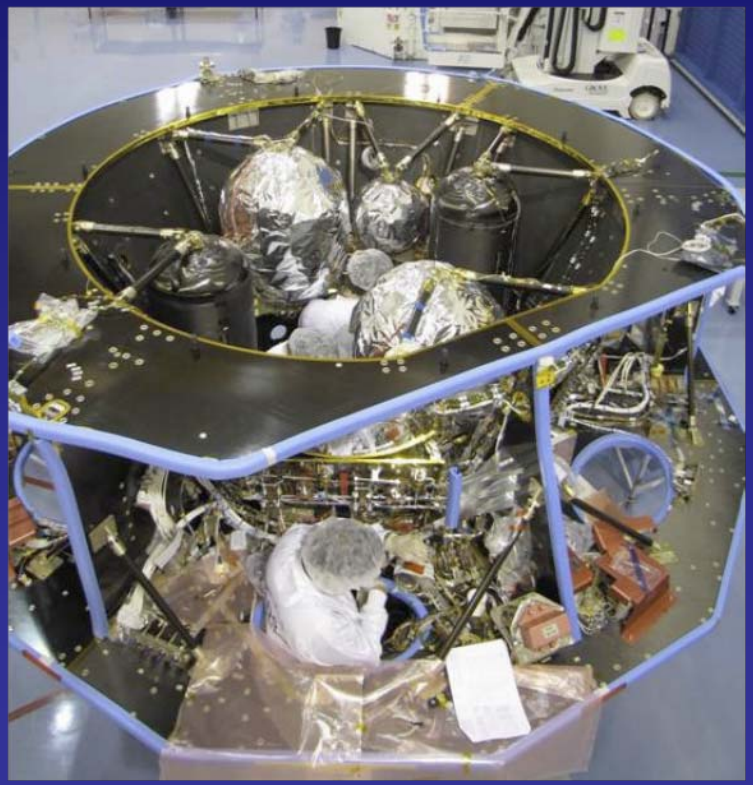
Observation principles



- Gaia is a scanning mission
  - no pointing, no change in the schedule
- Gaia gathers astrometric, photometric and spectroscopic data
  - each source is observed ~ 75 times in astrometry & photom. , 50 in spectroscopy
- Gaia has an internal system of detection
  - sensitivity limited detection at G ~ R = 20
- Objects are reasonably regularly measured during the mission
  - orbit reconstruction
  - light curves

Main Activities on the S/C

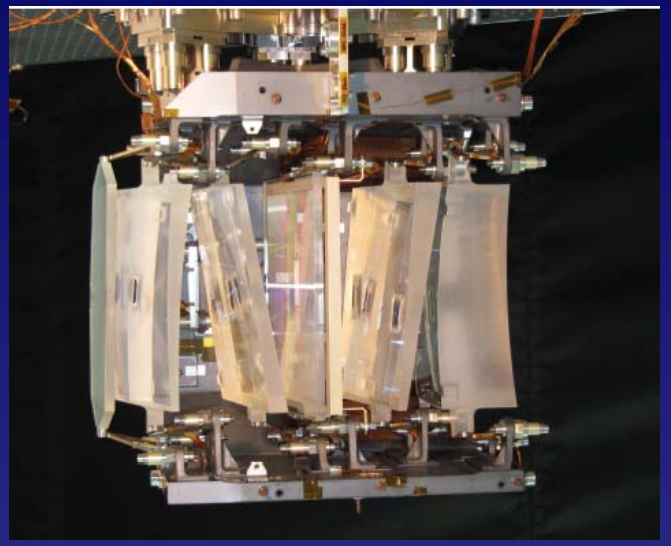
- Service Module finalised
- Thermal/vacuum tests during summer



- Deployable Sunshield qualified
- Put into storage

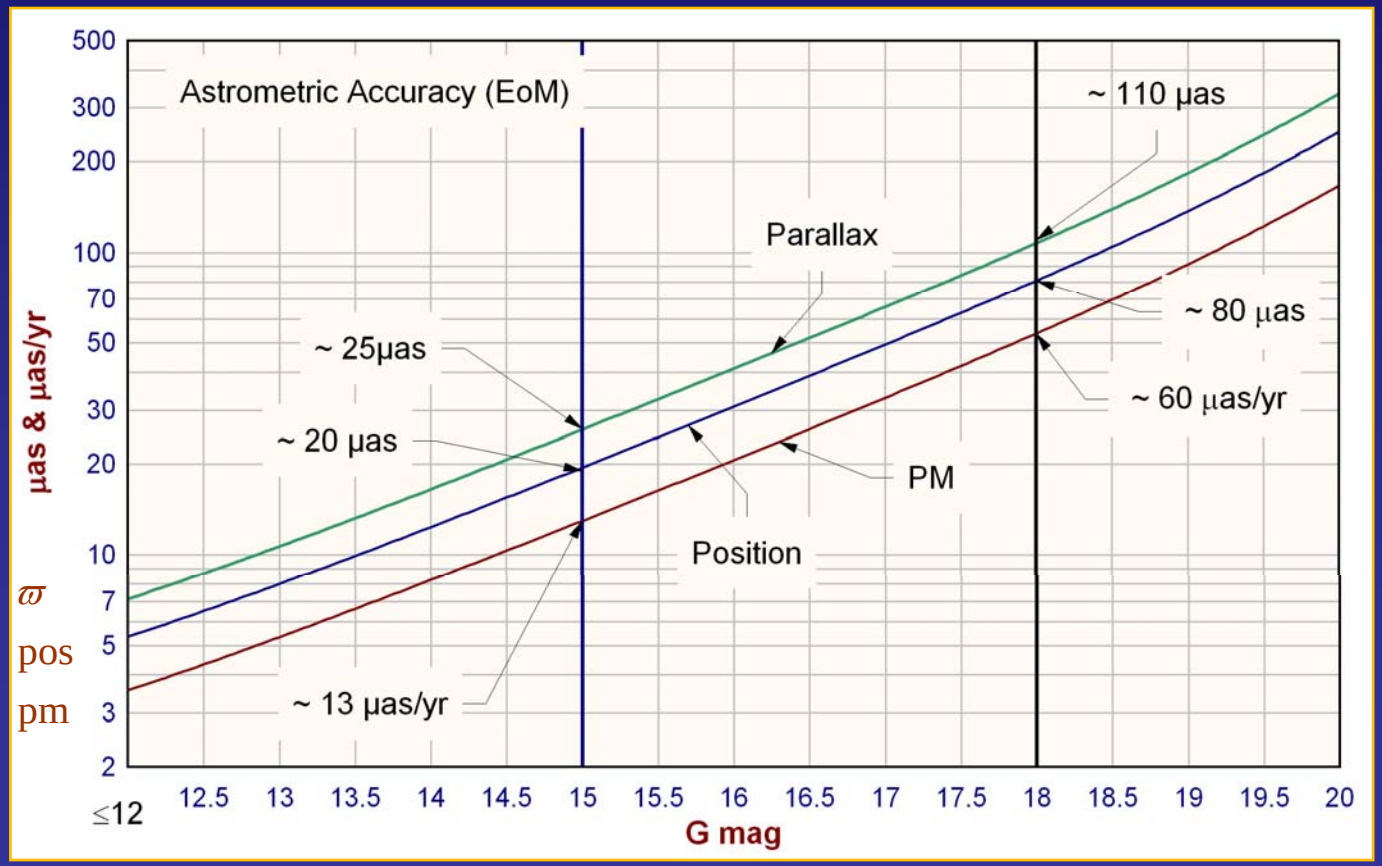
Main Activities on the P/L

- Assembly, Integration and Testing of the payload
- Telescope alignment completed with final checks underway
- Focal Plane Assembly completed
- On-going final thermo-mechanical tests



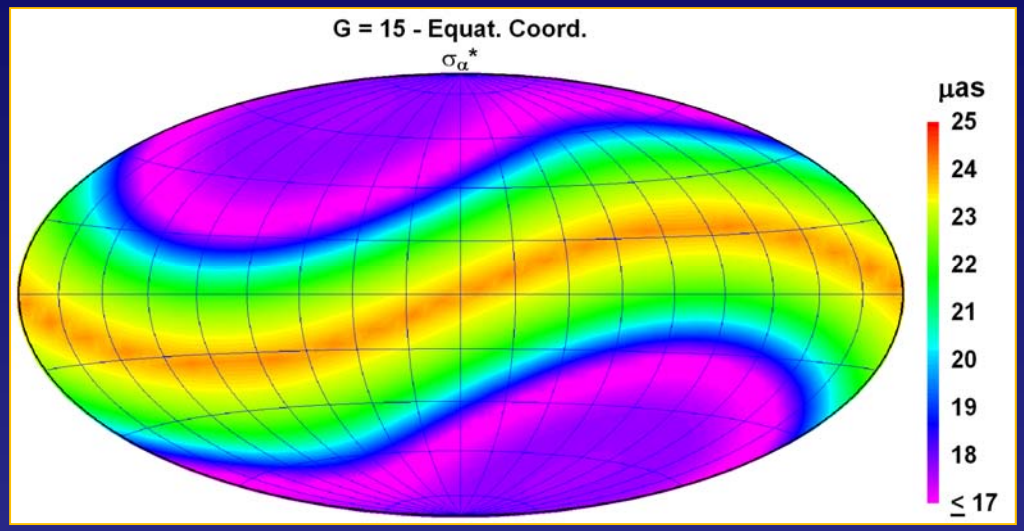
Gaia Accuracy at mean epoch

- Five year mission, sky –averaged
  - reference value: σ_ω = 25 μas @ G = 15
  - based on data from J. De Bruijne (ESA)



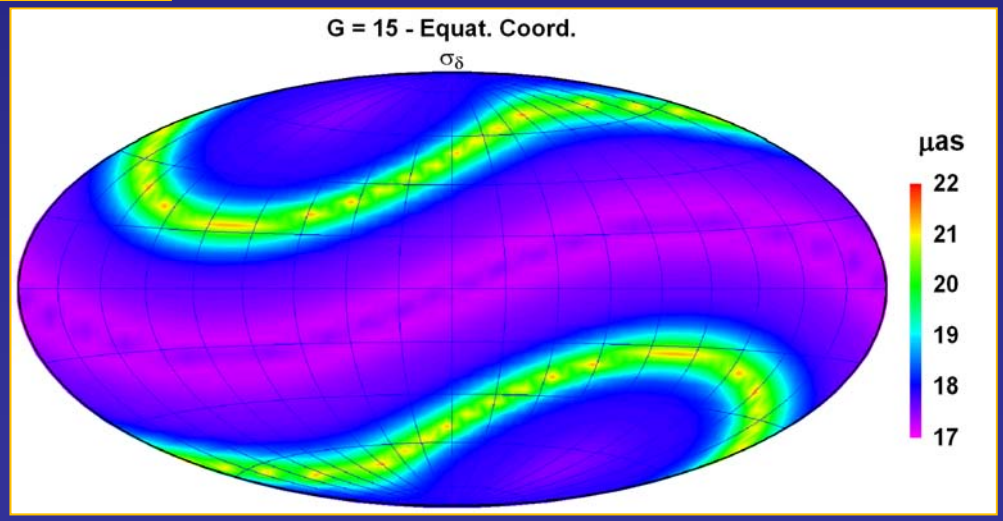
Sky distribution – Positions (~ 2016.5)

- Plots for *G* =15, but scalable to other magnitudes



σ_α^* – μas

$$<\sigma_\alpha^*> = 21\mu\text{as}$$

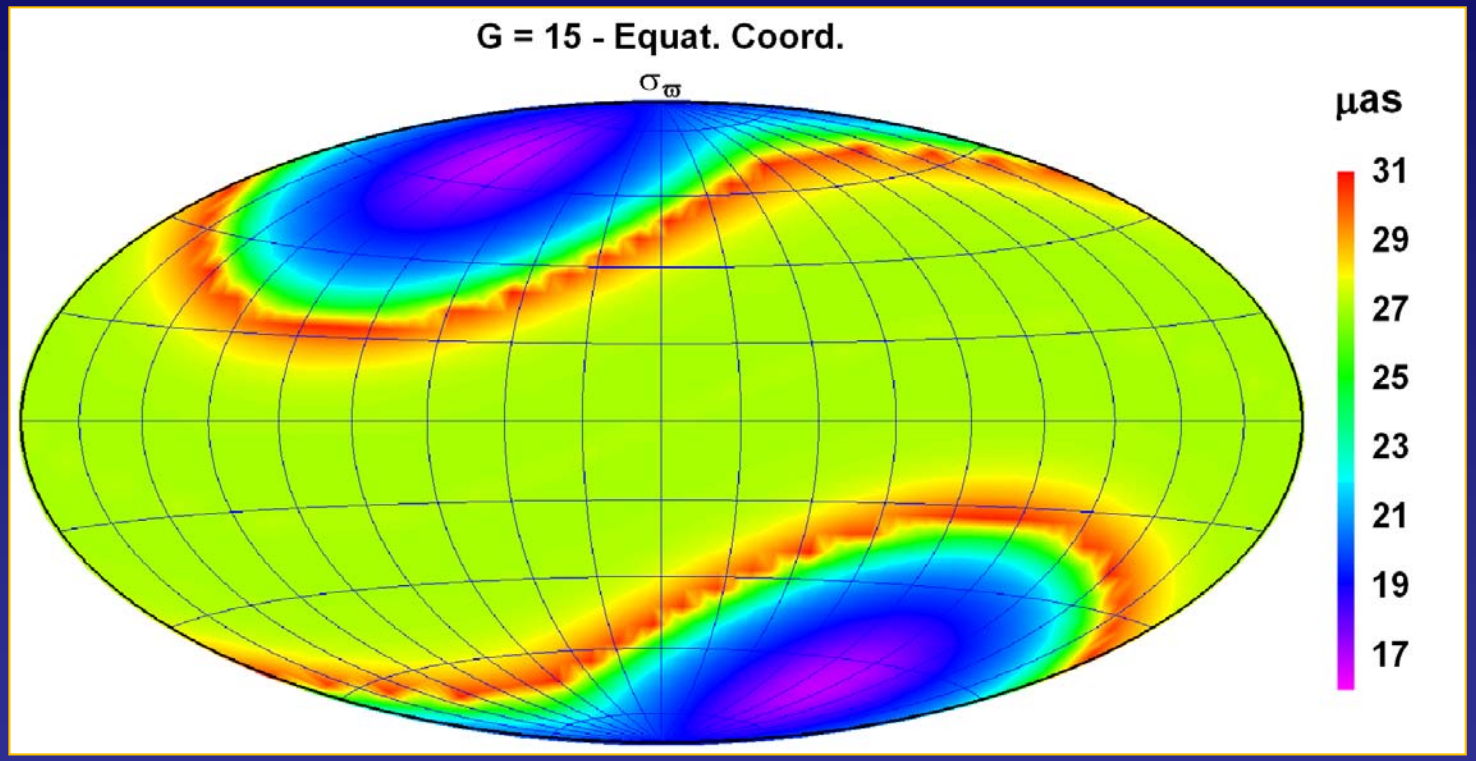


σ_δ – μas

$$<\sigma_\delta> = 18\mu\text{as}$$

Sky distribution – Parallaxes

- Plot for *G* =15, but scalable to other magnitudes

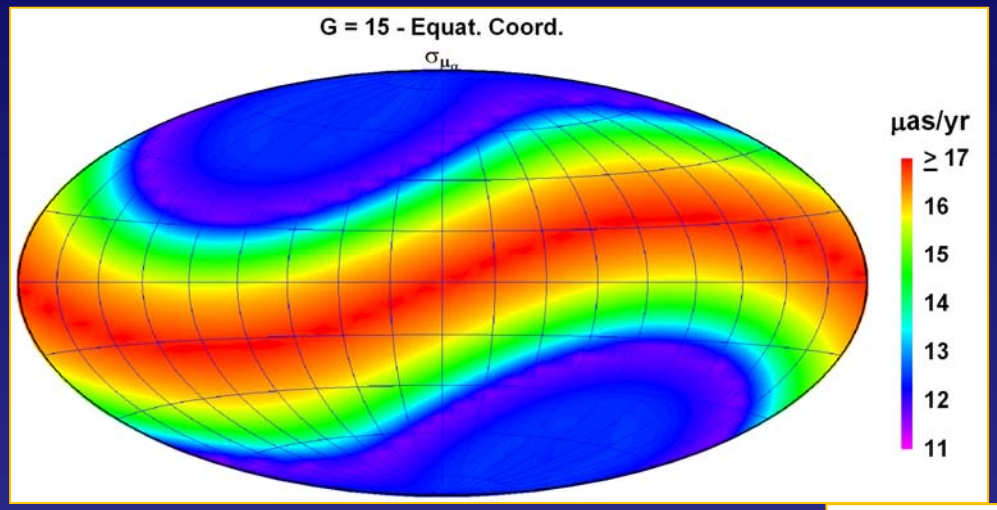


$\sigma_\varpi - \mu\text{as}$

$$< \sigma_\varpi > = 25\ \mu\text{as}$$

Sky distribution – Proper motions

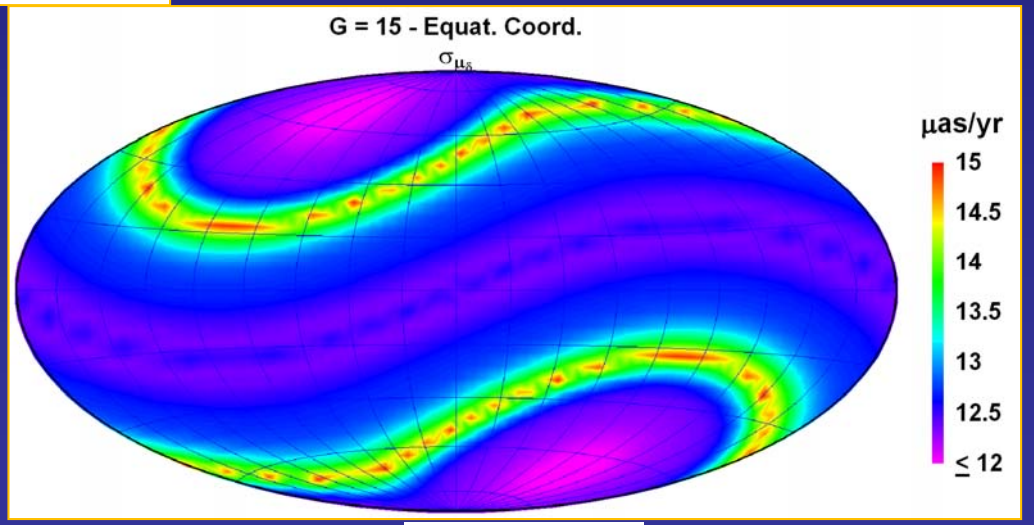
- Plots for G =15, but scalable to other magnitudes



$$\sigma^*_{\mu_\alpha} - \mu\text{as yr}^{-1}$$

$$< \sigma^*_{\mu_\alpha} > = 15\,\mu\text{as yr}^{-1}$$

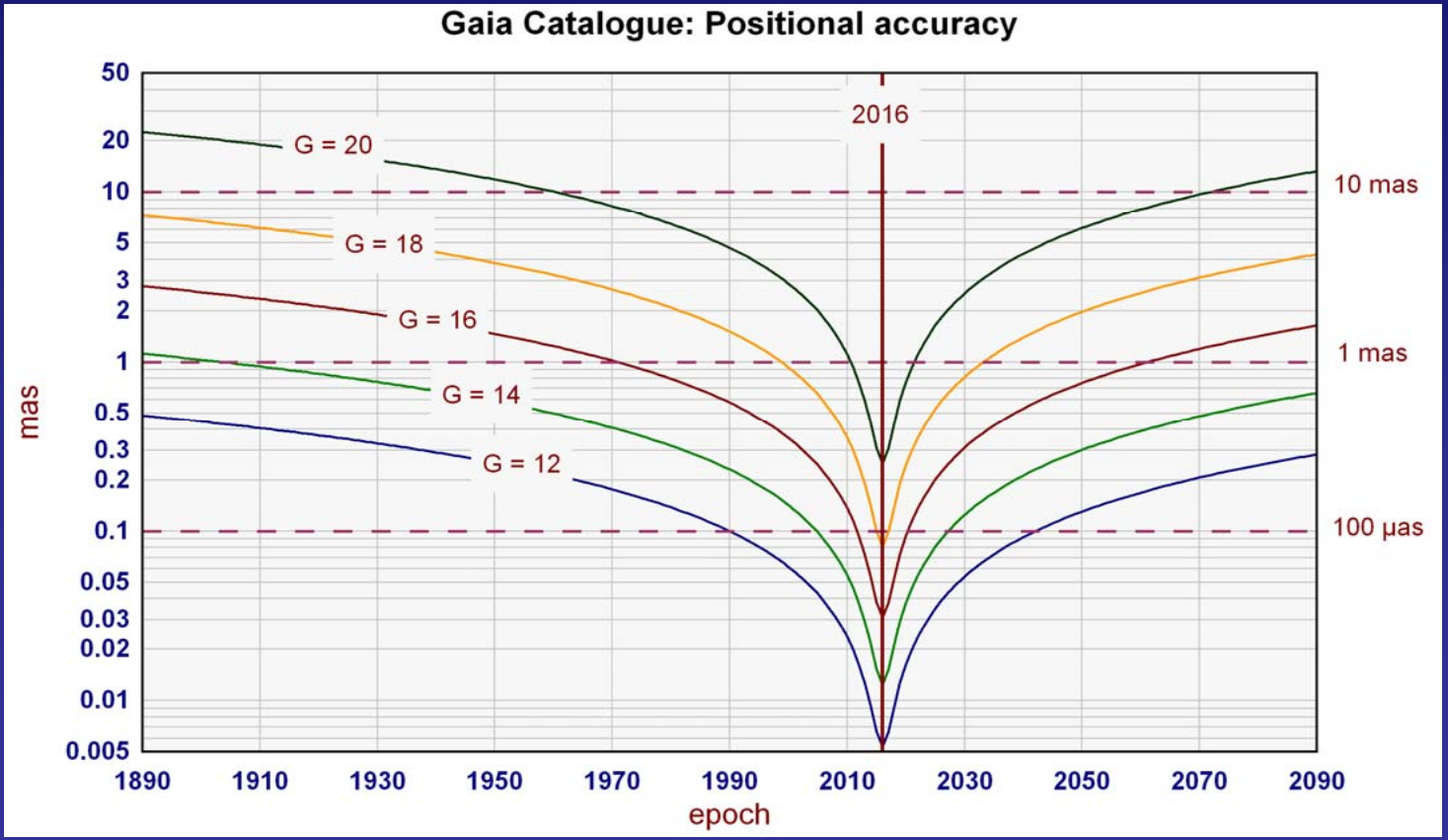
$$< \sigma_{\mu_\delta} > = 13\,\mu\text{as yr}^{-1}$$



$$\sigma_{\mu_\delta} - \mu\text{as yr}^{-1}$$

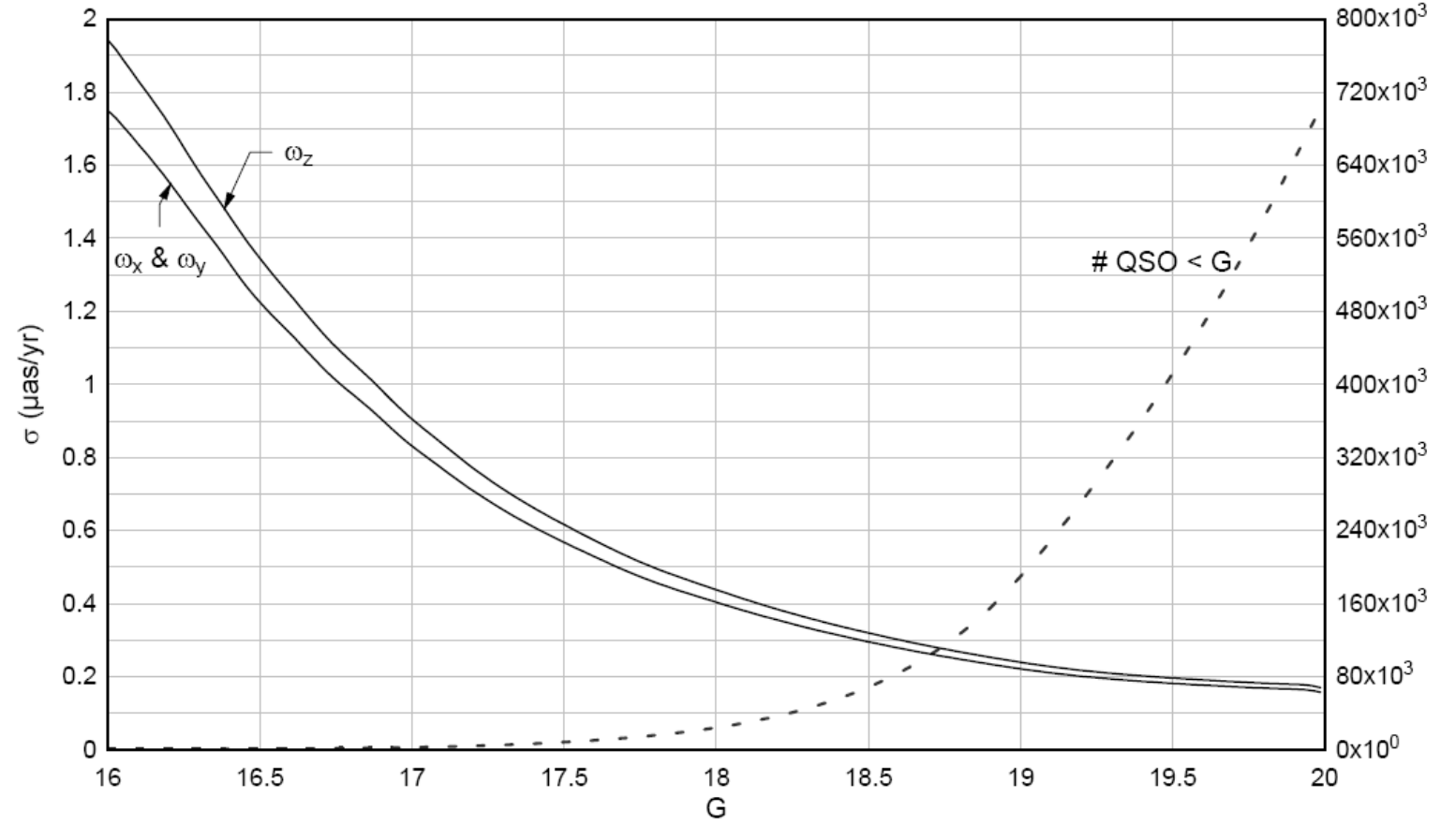
Gaia Accuracy in the past and future

- Covariance matrix fully propagated at t = 1890..2090 step 1 yr
  - sky averaged accuracy
  - mean accuracy between α and δ



Main feature of the Gaia Frame

- ICRF directly in the visible
- Between 20,000 et 50,000 primary sources
- Inertiality < 0.3 muas/yr



Early Operations Schedule I

- L = Launch in fall 2013
  - Cruise and insertion to L2 takes about one month
  - Followed by outgassing and return to thermal equilibrium
- First TM (Telemetry) data ➔ L + 2.5 months
- Instrument Commissioning Phase ➔ + 4 to 6 weeks
  - In-orbit spacecraft verification and early calibration
  - Evaluation of the scientific performance
  - Test of the different operation modes, adjusting AOCS, spin rate ...

Early Operations Schedule II

- Processing initialisation phase → + ~ 2 months
  - use a specific scanning mode with repeated observations
  - Initialise DPAC processing subsystems
  - More in-depth instrument calibration

Start of Routine Operations : Launch + 6 months

Data Releases: some issues I

- Gaia principles involve global astrometry
  - no immediate scientific data from single observations
  - At least one full sky coverage needed for an astrometric solution
    - this takes at least 6 months with the Gaia scanning law
  - no valuable parallaxes without at least 12 months of data
    - but sampling might be not sufficient in many cases
- Gaia is self-calibrating
  - instrument parameters, attitude and stellar parameters are determined in an iterative loop
  - colors must be known to achieve good accuracy

Data Releases: some issues II

- The Data Consortium Analysis (DPAC) needs time to initialise and certify its processing system
  - The processing itself is organised into:
    - daily operations for initial data management
    - cycles of about 6 months for global processing
  - There is a time dependency between systems
    - eg: attitude must be known to process solar system objects
- Any data release must be carefully checked and documented
  - This must be agreed between ESA and the DPAC

Intermediate Releases Plans

- Intermediate Data Release Scenario agreed between ESA and DPAC
- Science Alerts as soon as possible
  - some should be within a day after observations after the system is validated
- L+22m: positions, G-magnitudes, proper motions to Hipparcos stars, ecliptic pole data
- L+28m: + first 5 parameter astrometric results, bright star radial velocities, integrated BP/RP photometry
- L+40m: + BP/RP data, some RVS spectra, astrophysical parameters, orbital solutions for short period binaries
- L+65m: + variability, solar system objects

First Soyuz launch from Kourou, 20 October 2011

Gaia launcher manufactuting has started

- Soyuz rocket Sz-013