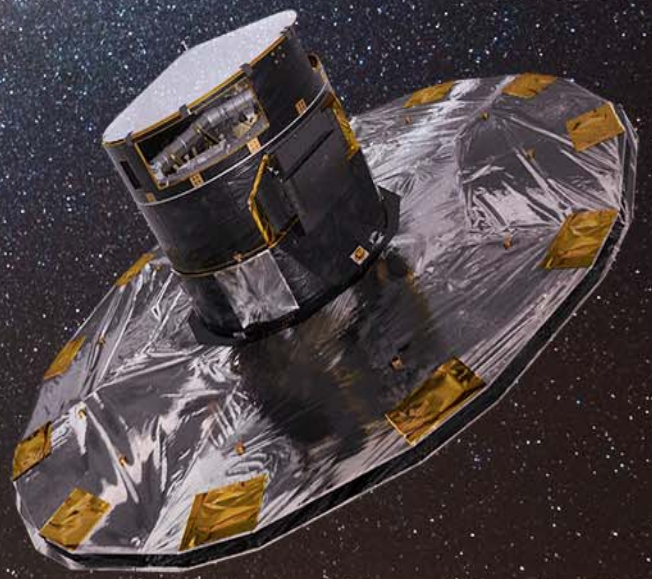
Gaia Status & Early Releases Plan

F. Mignard
Univ. Nice Sophia-Antipolis
&
Observatory of the Côte de Azur



Université Nice Sophia Antipolis

Observatoire de la CÔTE d'AZUR

LAGRANGE

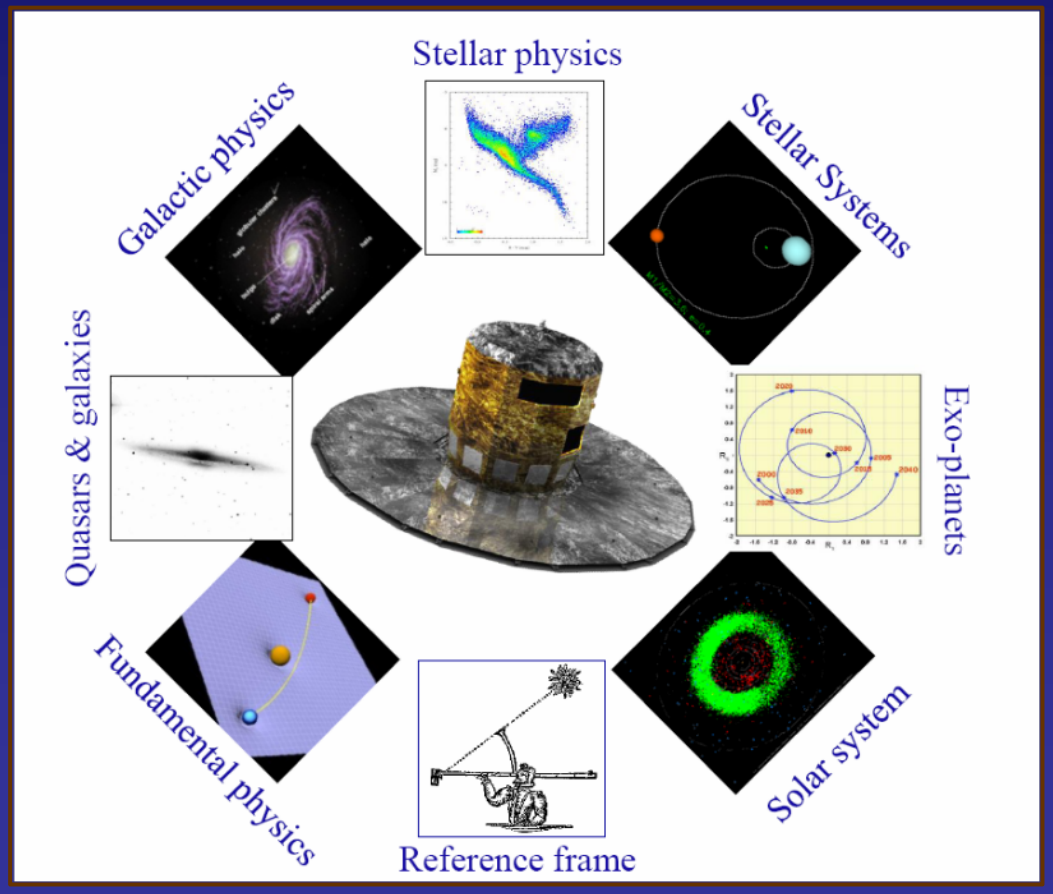
Gaia launch: 20 November 2013

@ 08:57:30 UTC

Gaia: a many-sided mission

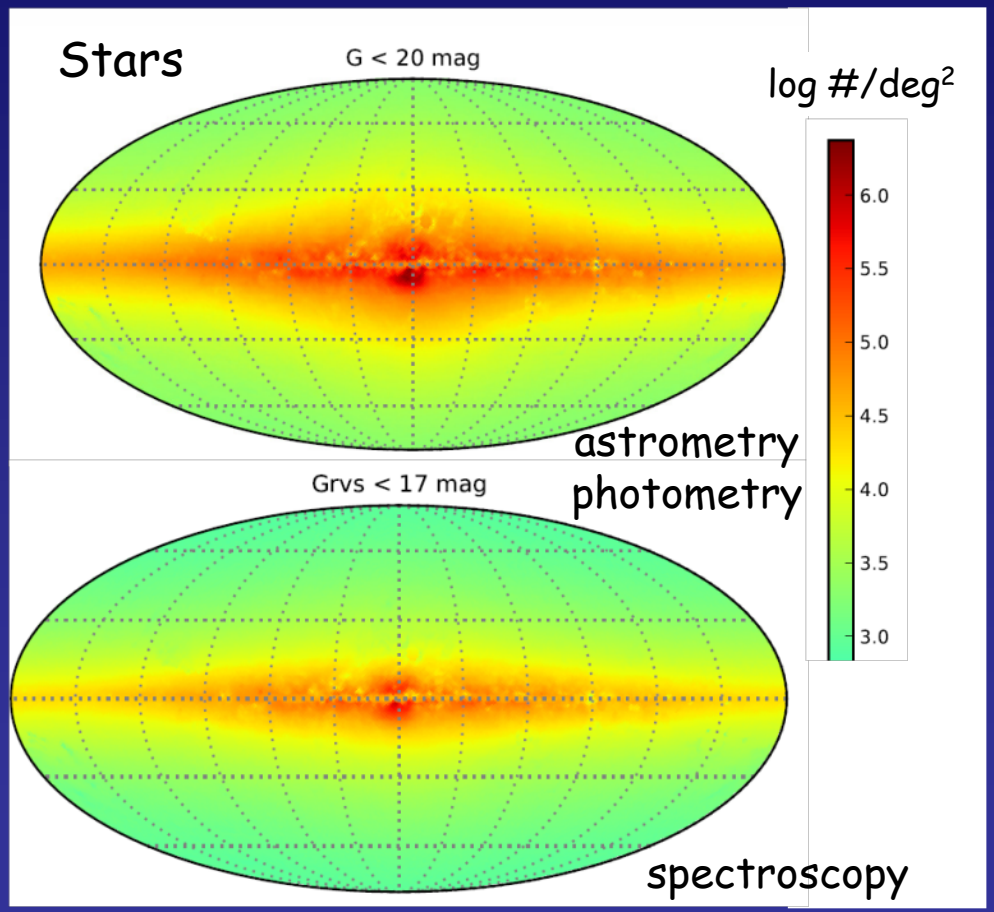
Driven by Astrometry,

designed for astrophysics



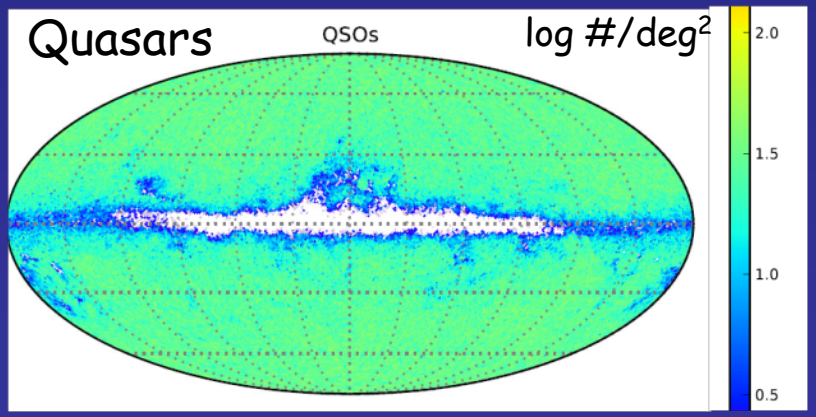
The Gaia Sky

- All-sky survey to 20 mag
- 70 observations per source, 5 years

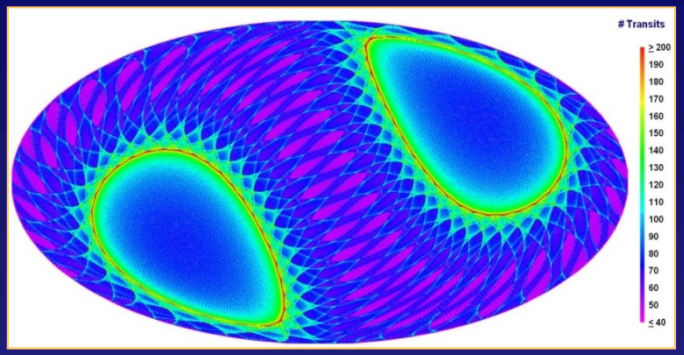


from Robin et al., 2012

- 1 billion stars
- 600,000 quasars
- 350,000 asteroids
- 1-10 million galaxies
- >10,000 exoplanets



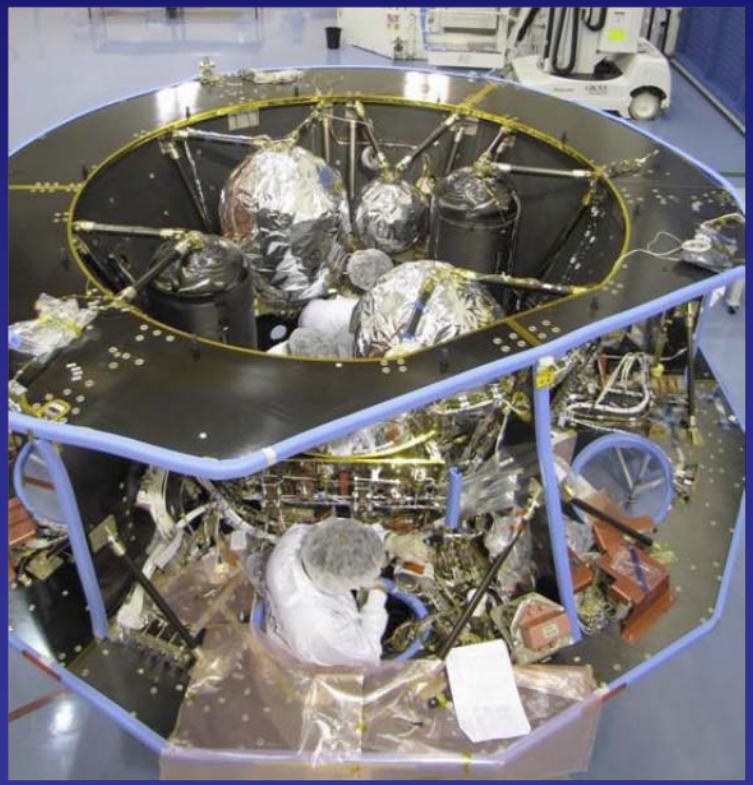
Observation principles



- 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

Final Activities on the S/C in 2012-13

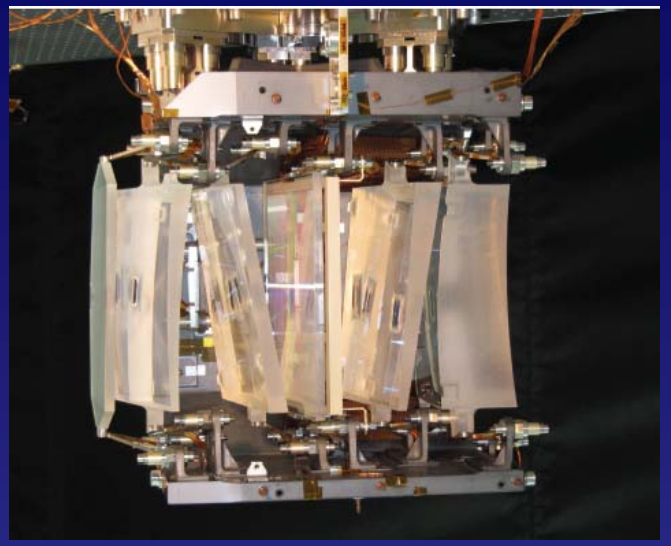
- Service Module finalised
- Thermal/vacuum tests during summer 2012



- Deployable Sunshield qualified
- Put into storage

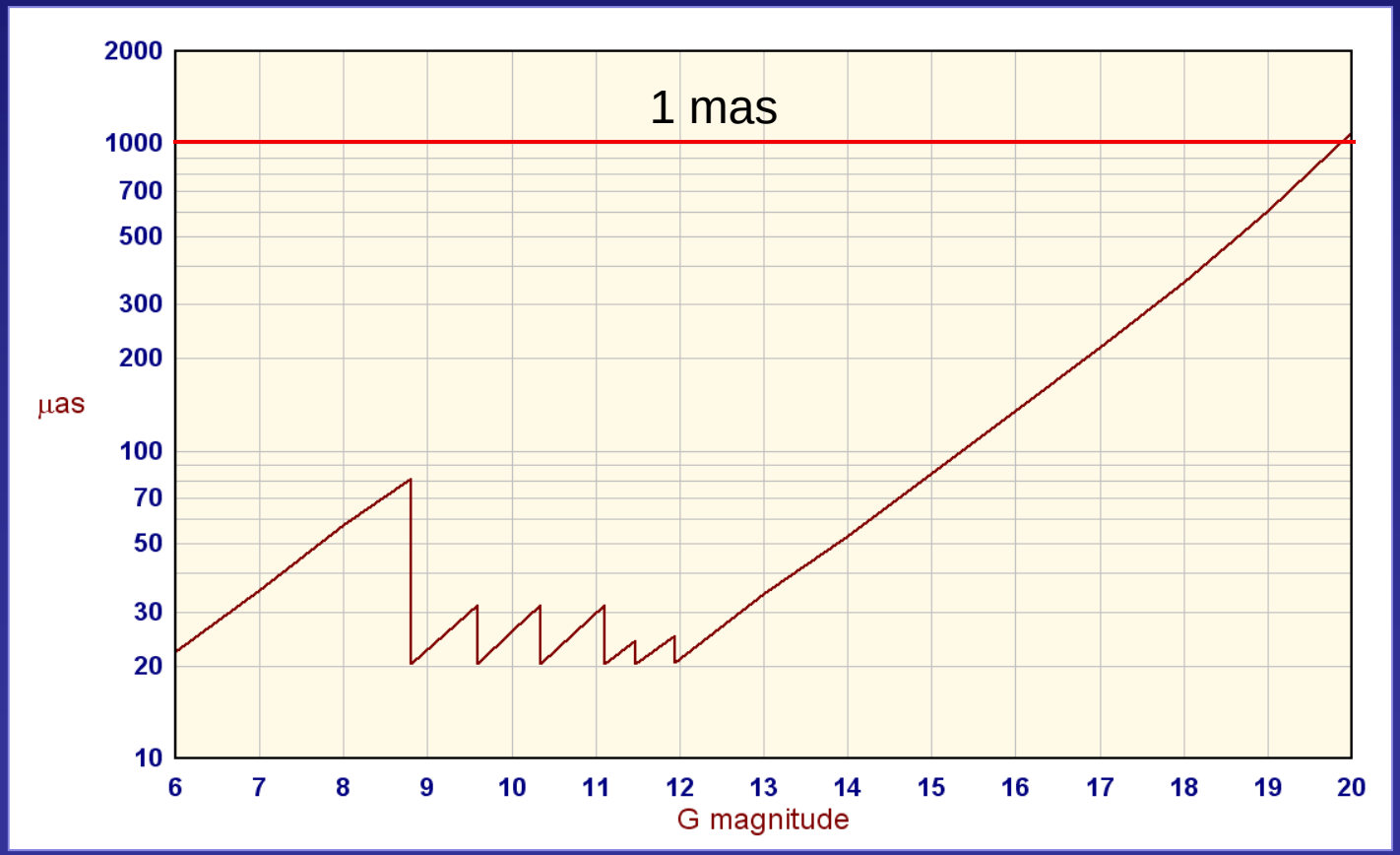
Main Activities on the P/L

- Assembly, Integration and Testing of the payload
- Telescope alignment completed with final checks
- Focal Plane Assembly completed
- Payload and Service modules mated



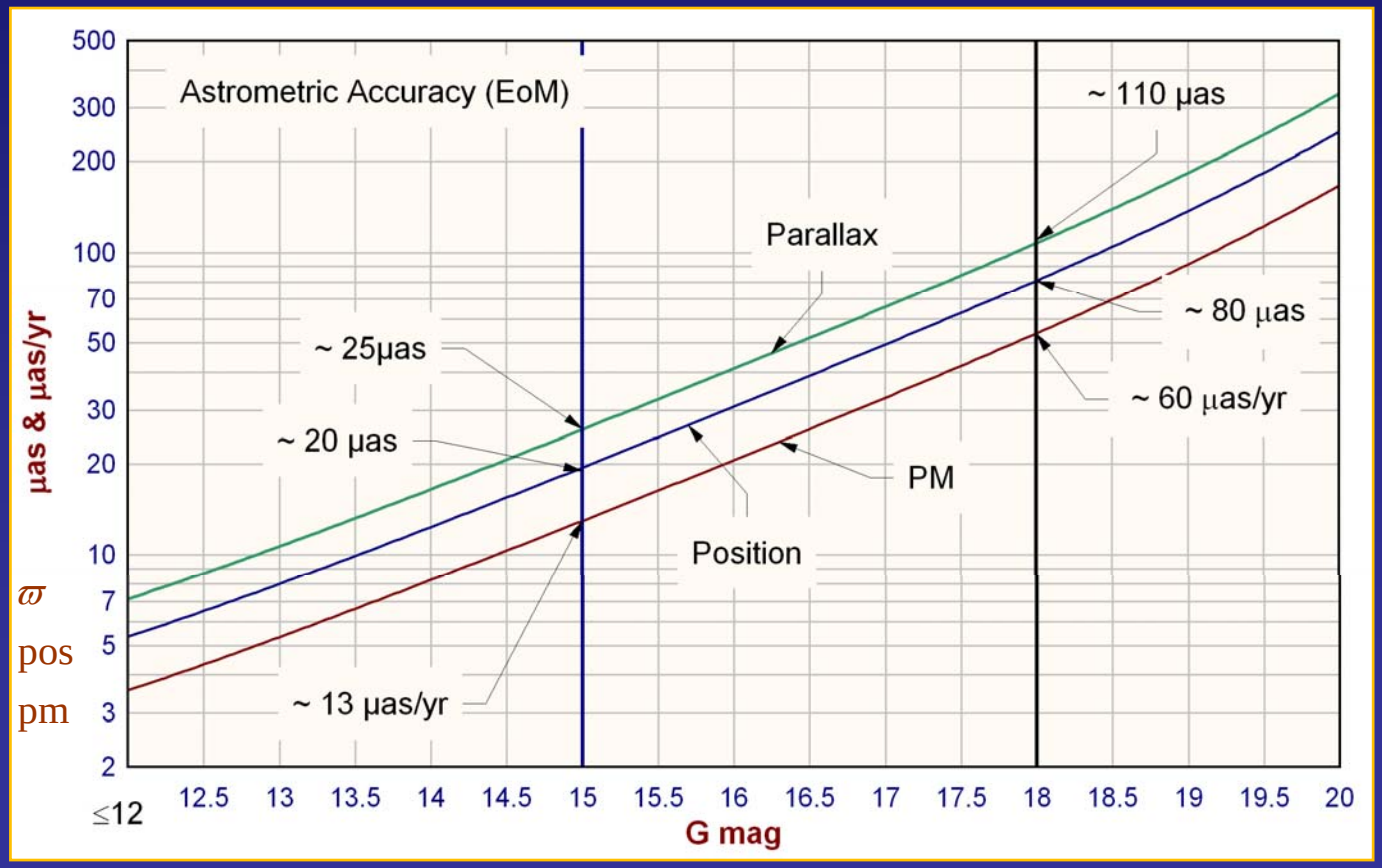
Astrometric accuracy: single observation

- Small field accuracy with final attitude
- Single observation accuracy ➔ orbit, solar system
  - one field transit, final attitude
  - point source



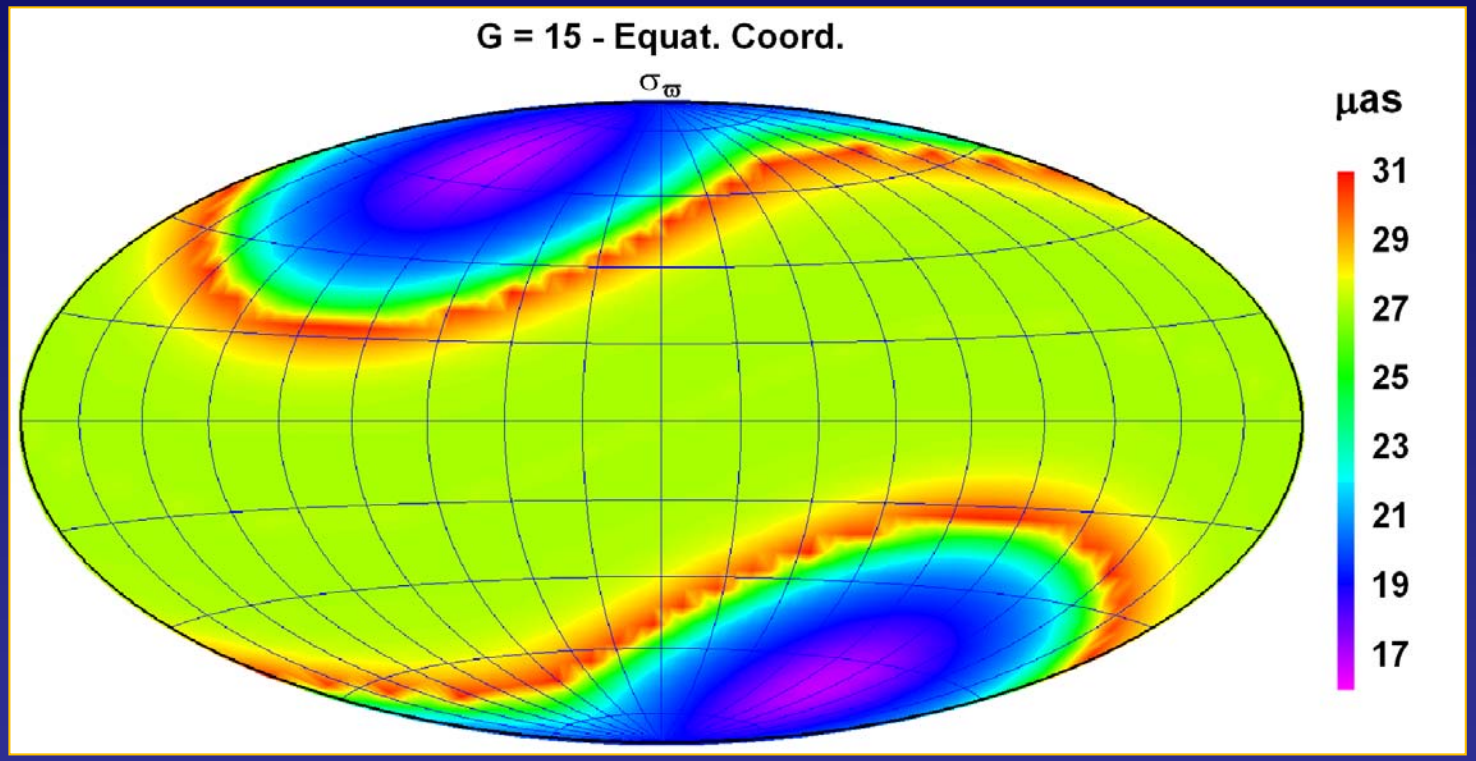
Gaia Accuracy at mean epoch

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



Sky distribution – Parallaxes

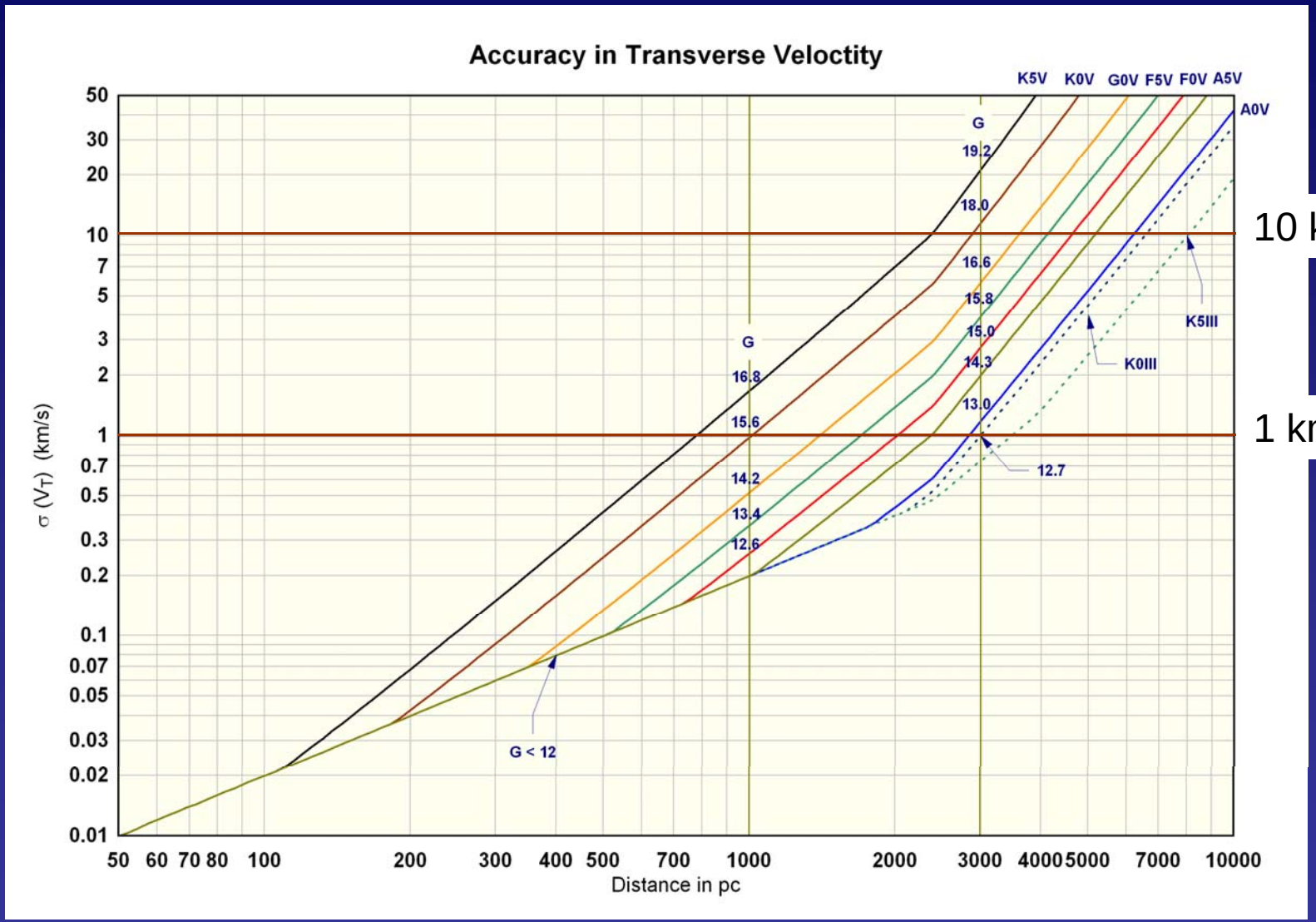
- Plot for *G* =15, but scalable to other magnitudes



σ_{ϖ} – μas

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

Transverse velocity estimate with Gaia

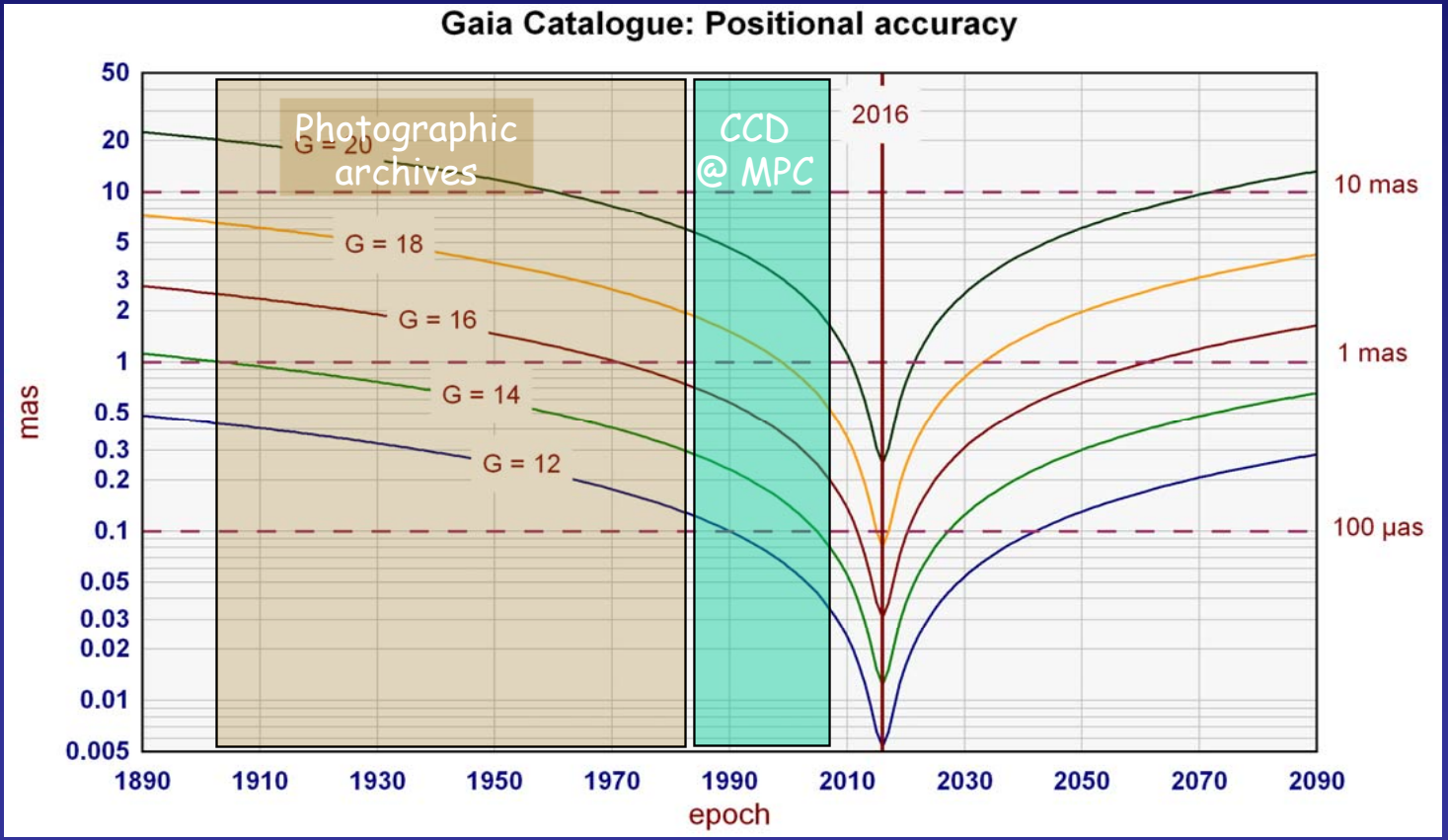


10 km/s

1 km/s

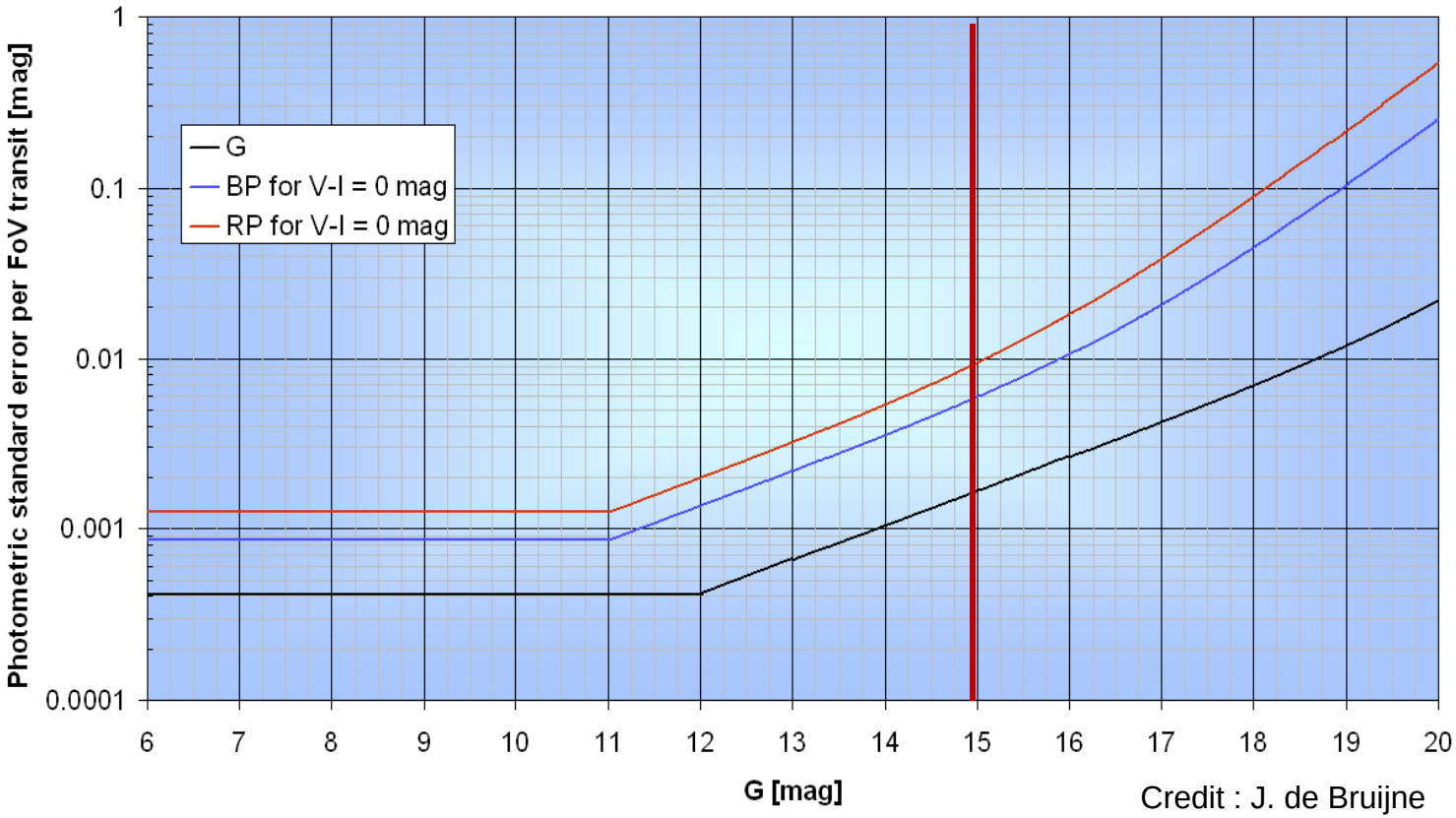
Gaia Accuracy in the past and future

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



Photometric accuracy

- Epoch photometry : 1 transit over Astro CCDs or BP/RP
  - performances for photometric stability

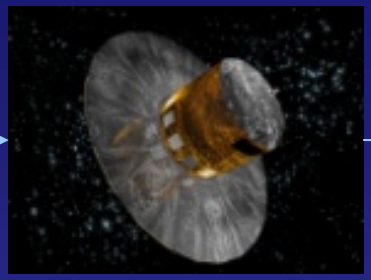


The Mission

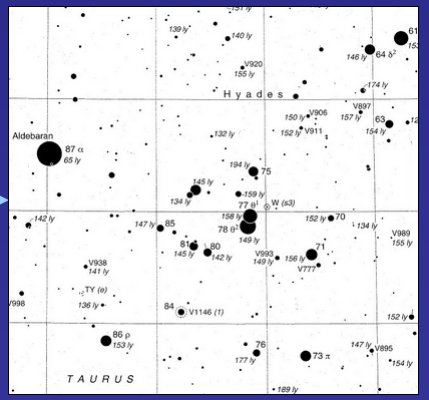
Gaia: Mission Components

Industry/ESA CSG/ESOC/ESAC

(2013)



One consortium for the Processing: the DPAC



Operations Schedule I

- Sun Shield Deployment test 10-11 October
- S/C fuelling 2-5 November
- L = Launch 20 November 2013
  - Cruise and insertion to L2 takes about one month
  - Followed by outgassing and return to thermal equilibrium
- First Telemetry data ➔ L + 2.0 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 ...

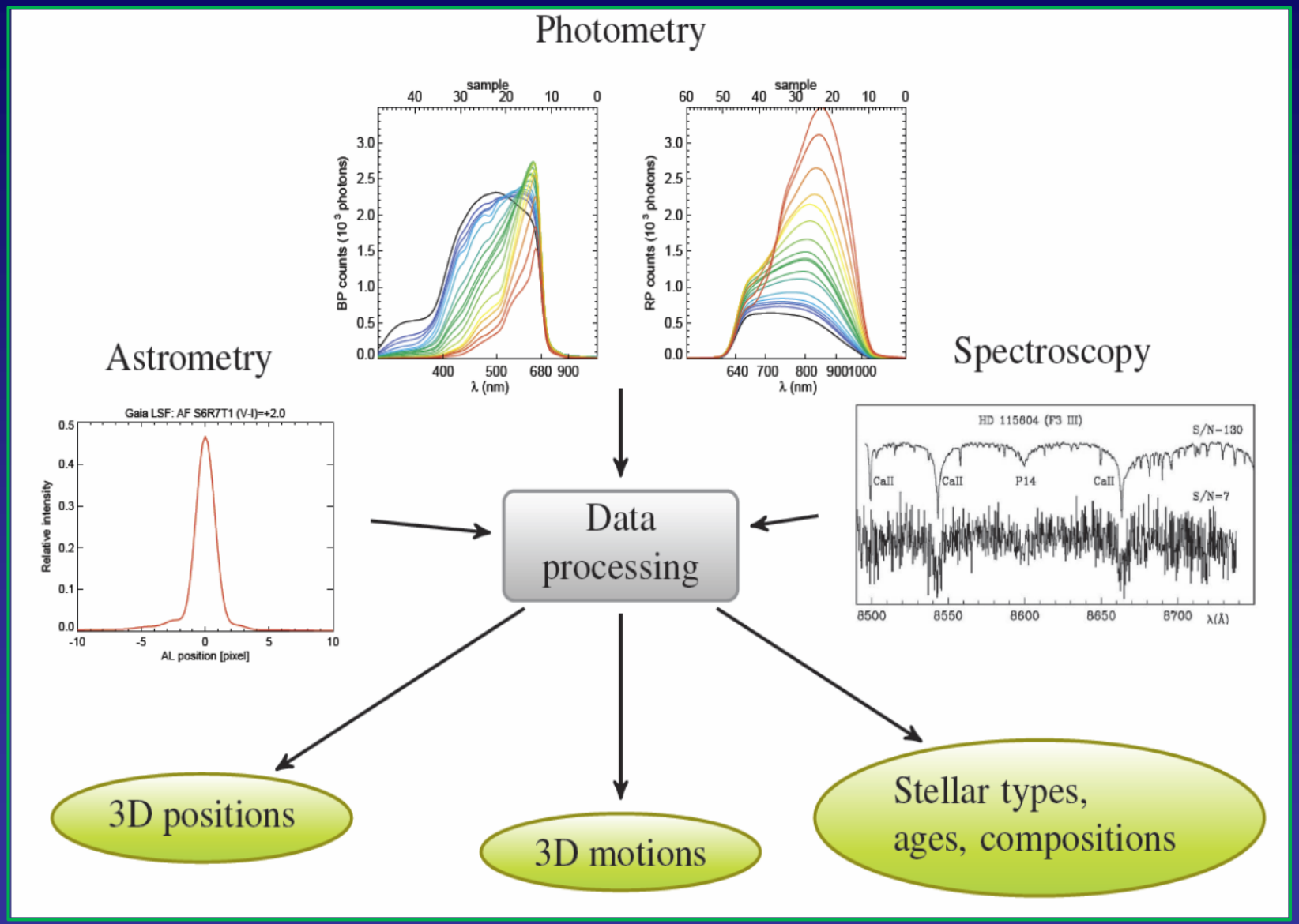
Early Operations Schedule II

- 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 + 5-6 months

  - first full sky coverage → L + 12 months
  - 1st non-degenerate solution for parallaxes & PM → L +24 m

What Gaia will deliver



cartoon: A. Brown

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

- Mission with no instrument PI
- No observation calls
- Mission with no data right for participants
- No proprietary period for DPAC members
  - specific and coordinated publications during the processing
- Global astrometry is the core of the mission
  - full processing needed to get the best results
  - every stars, every observations are considered equally
  - no mean to isolate subsets in this processing
  - binary or planetary orbits must wait until the mission end

Data Releases: some issues III

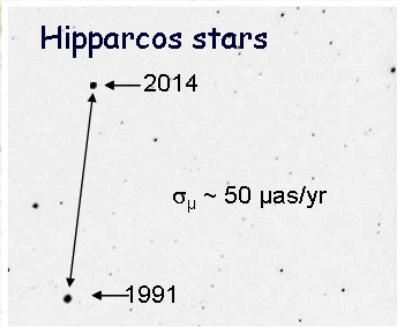
- The Data Consortium Analysis (DPAC) needs time to initialise and certify its processing system
  - The processing itself is organised into:
    - daily operations for initial data management
    - cycles of about 6 months for global processing
  - There is a time dependency between systems
    - eg: 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

Gaia Releases

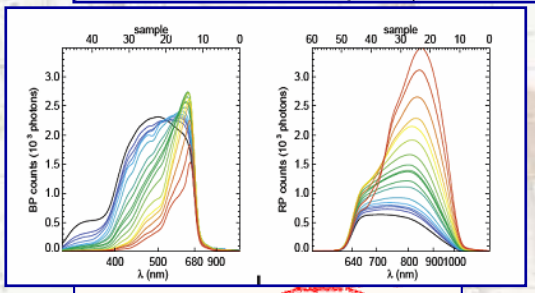
Release
L + 22m
L + 28m
L + 40m
L + 65m

α deg 8	δ deg 9
4.18700521	41.06905721
57.84982093	−25.93298679
87.24506095	63.69702032
97.98452970	−27.72950422

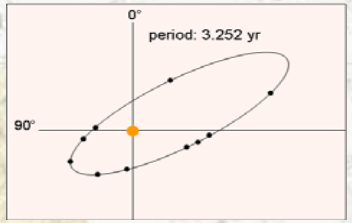
α deg 8	δ deg 9	mas 11	mas/yr 12	13
4.18700521	41.06905721	18.92	190.14	27.75
57.84982093	−25.93298679	21.42	273.72	167.93
87.24506095	63.69702032	4.12	5.07	−98.19
97.98452970	−27.72950422	17.95	21.31	217.87
106.43757563	26.14031575	21.74	18.58	−10.54
109.41026120	−29.01434479	7.92	−4.53	−7.01

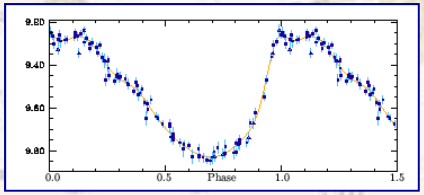


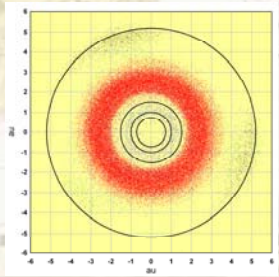
G G_{BP} G_{RP}



⟨Vr⟩





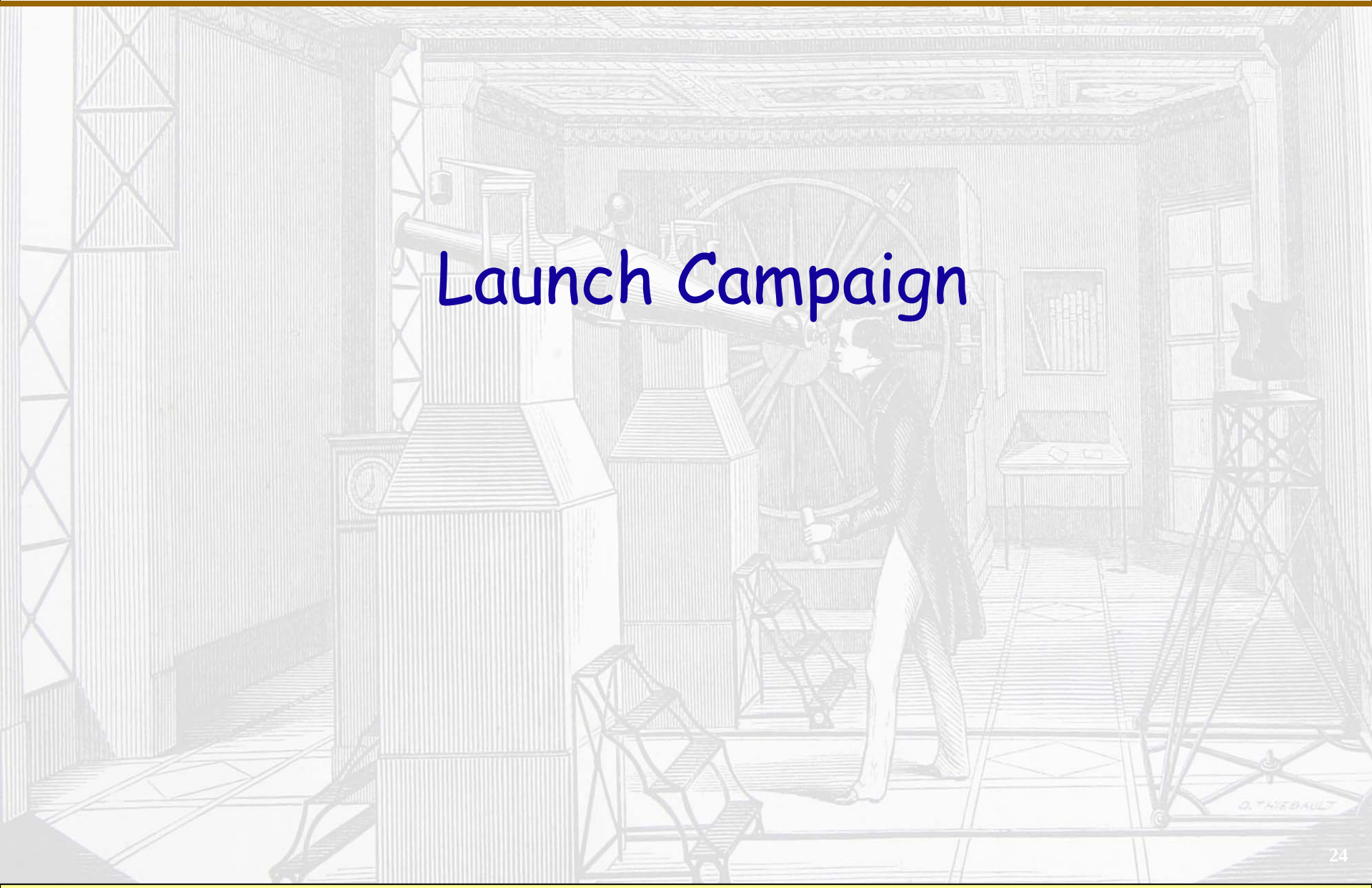


Gaia Data Access

- Effective and efficient access to the Billion source catalogue and related data
  - no boundaries: seamless interfaces to related missions and survey data
- Science enabling and visualisation applications
- Long term access – data preservation and data re-use
- Gaia data access relevant and arranged for access to all users
  - from research scientists to the wider public

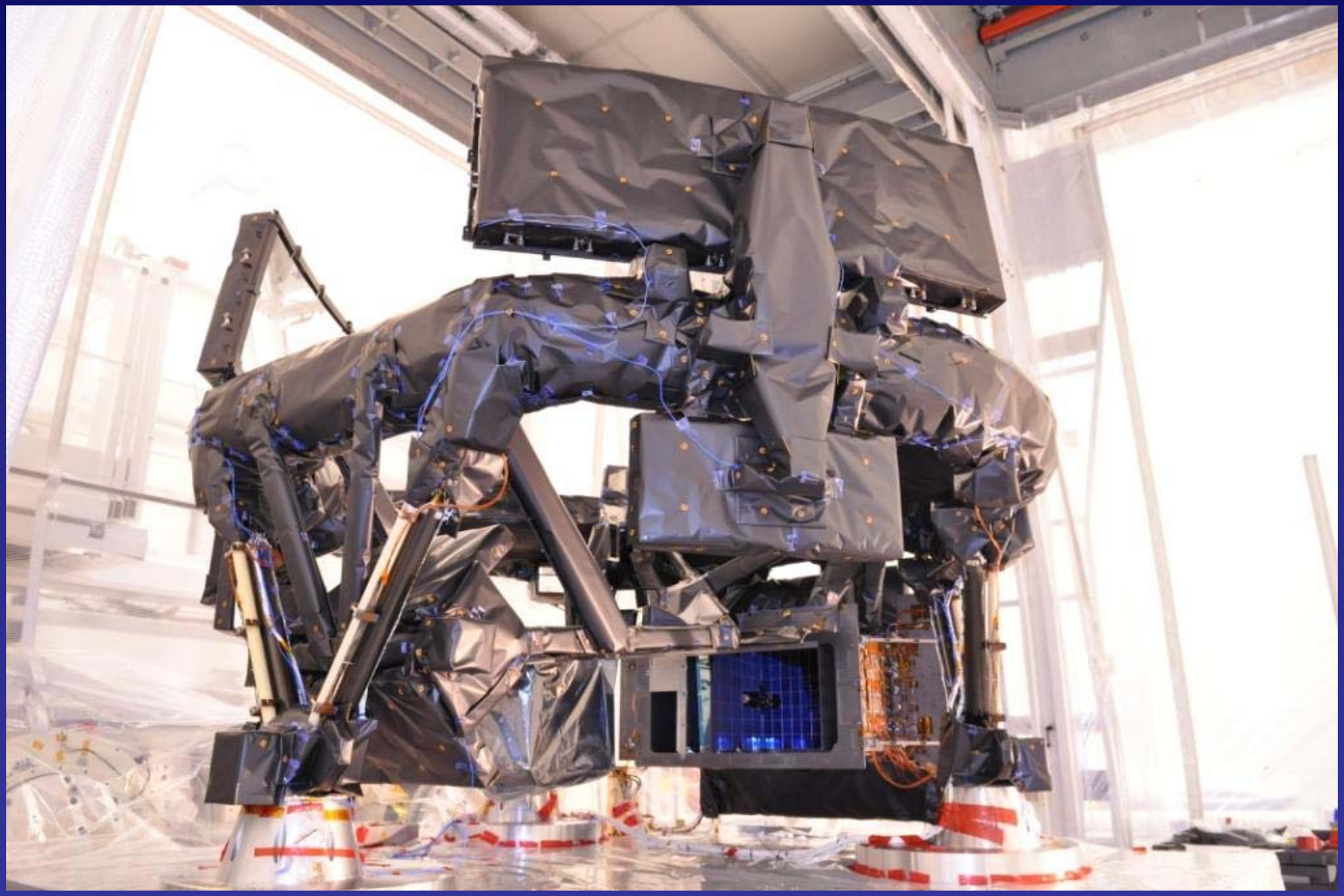
Building the archive and access system is now underway with requirements from the community driving its shape and scope

New DPAC CU selected by ESA SPC in 2013



Launch Campaign

Gaia P/L wrapped before shipment



PLM and SVM Mating

PFM#2 configuration →

Final configuration

Gaia: last days in Toulouse

Gaia packed in Toulouse

on a truck to reach the airport


Take- off from Toulouse to Kourou

pictures : Astrium/ESA

Gaia first day in Kourou

Gaia arrival in Kourou

Container in the clean room, Kourou


unloaded in Kourou

pictures : CNES


Crate open, Gaia is in !