THE GAIA MISSION
CURRENT STATUS AND DATA RELEASES

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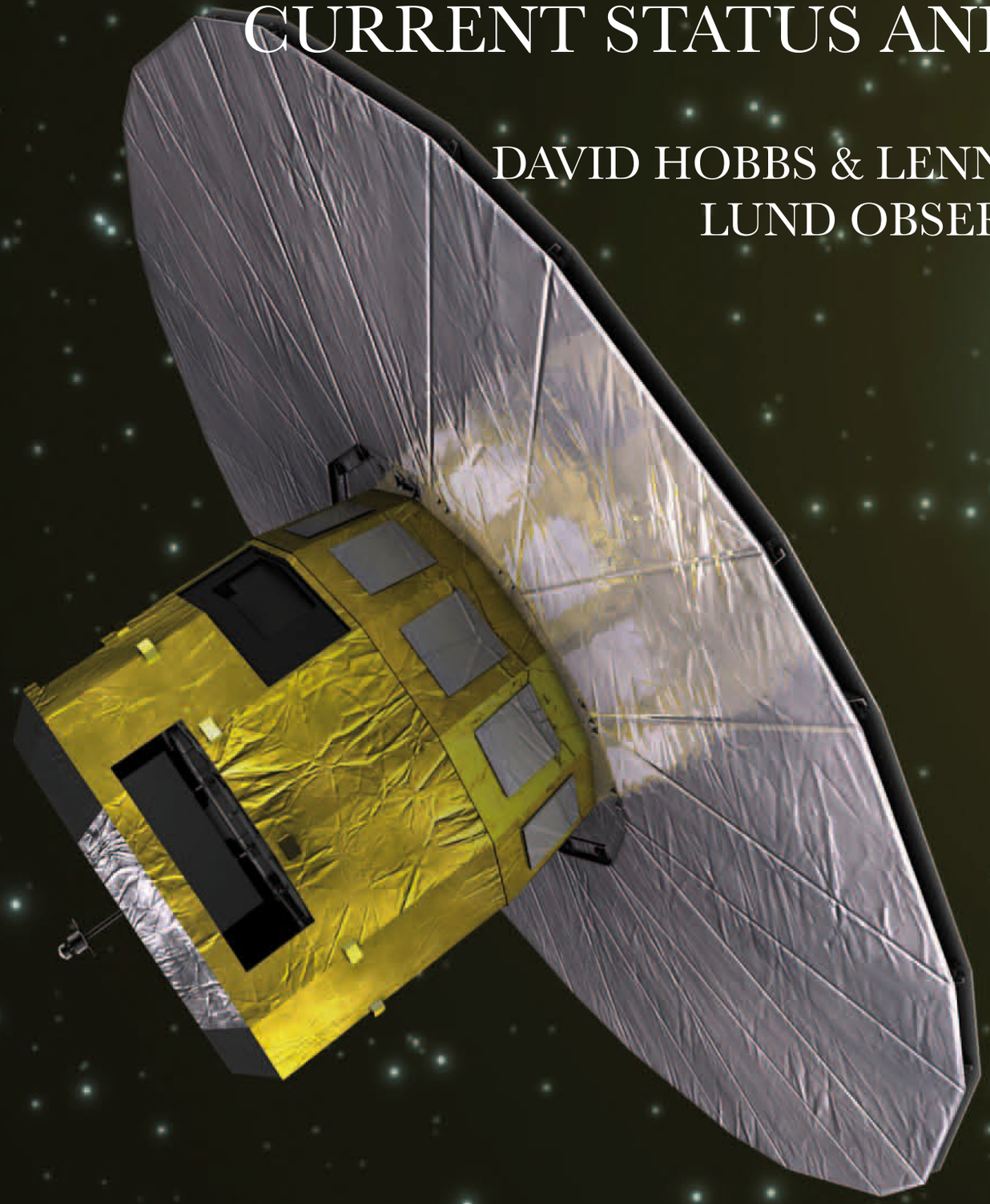
LUND OBSERVATORY



Launch

Commissioning

Lund's Activities

Data Releases

Launch Overview

Launch on December 19th at 10:12:19am Swedish time

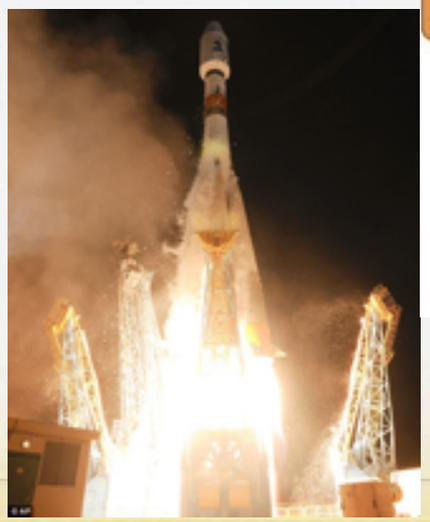
Soyuz-STB/Fregat (Vol Soyuz 6)

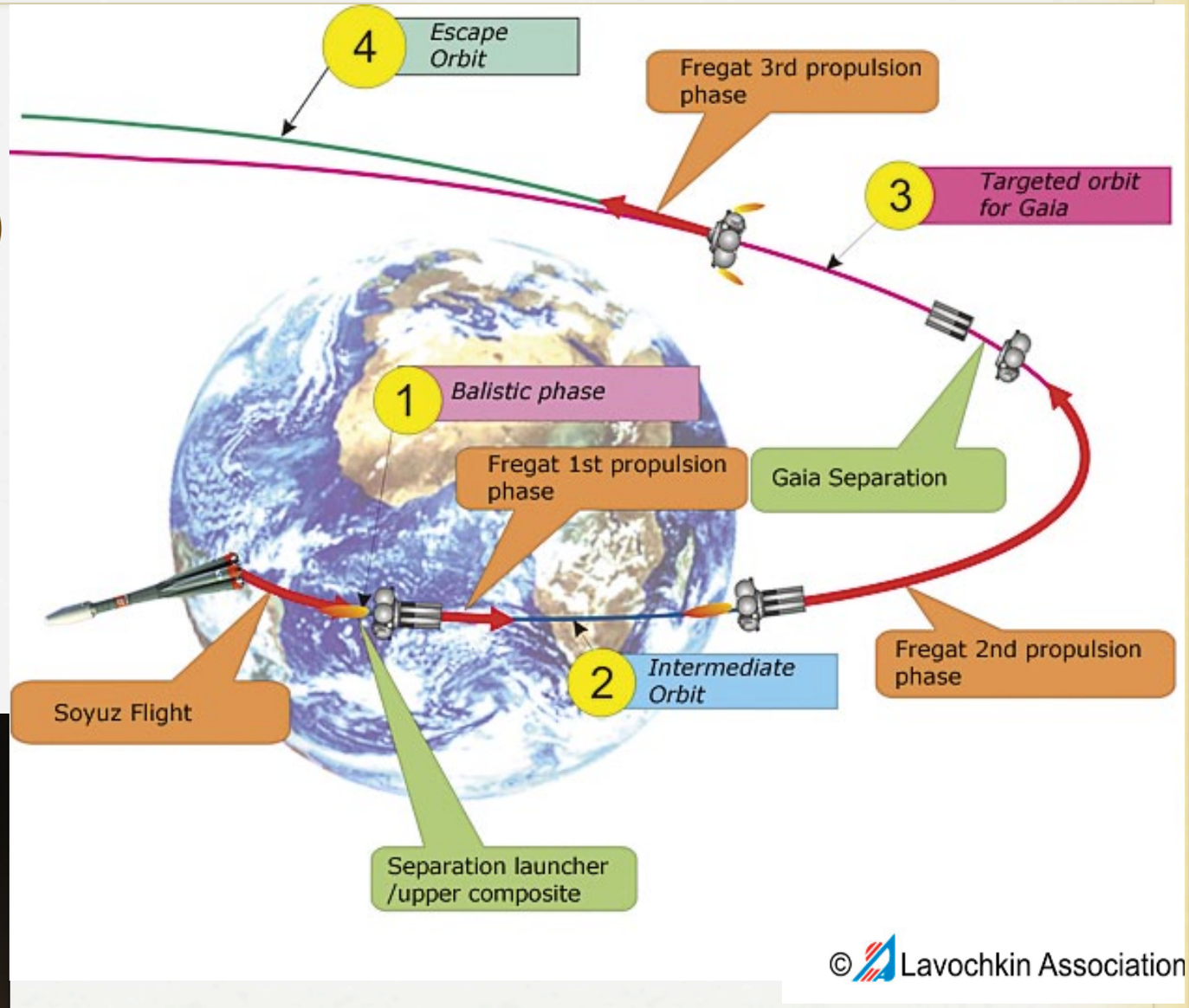
Burning the lower three Soyuz stages lasts ~9 minutes

Two burns of the upper stage followed by separation of Gaia

Deployment of the sun shield

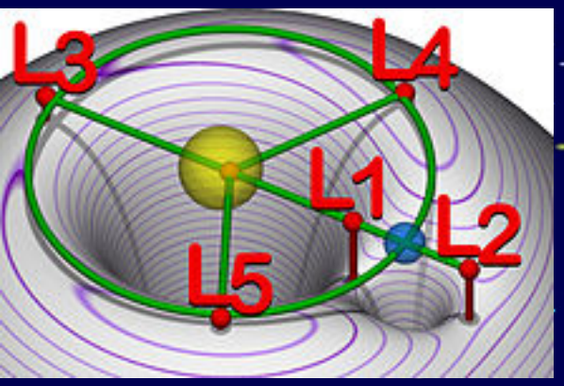
All went perfect!





Gaia launch and orbit

(Credit: EADS Astrium)



Lissajous orbit around L_2
~1 orbit correction per month

5 - 6 years of (almost) continuous observation

2 months ecliptic pole scanning for photometry & chromatic aberrations

0.5 yr

~1 month
transfer orbit to L_2

L_2, a = 1.01 AU

Soyuz/Fregat launch from Kourou (French Guyana)

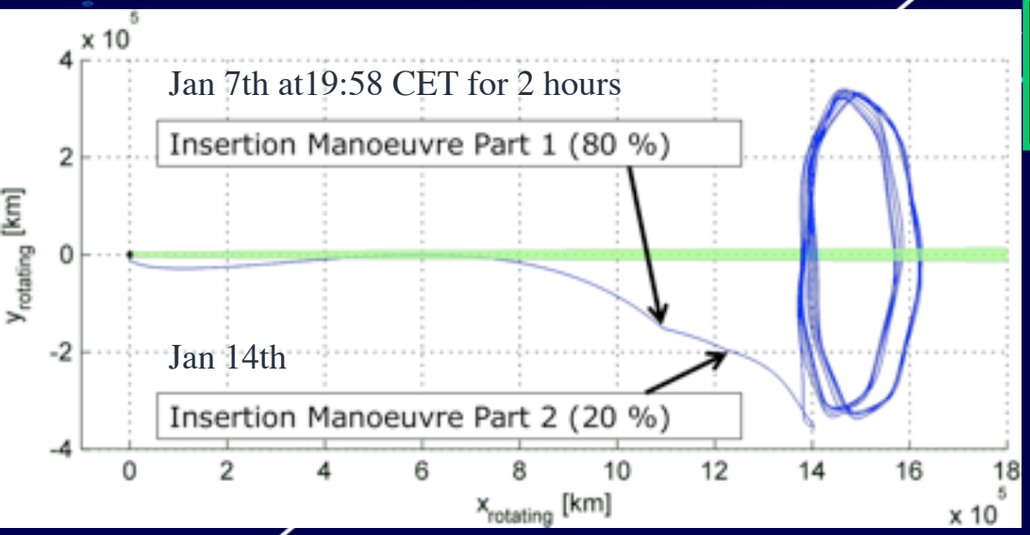


Image courtesy A. Rudolph, D. Milligan (ESOC)

Earth-Moon barycentre, a = 1 AU

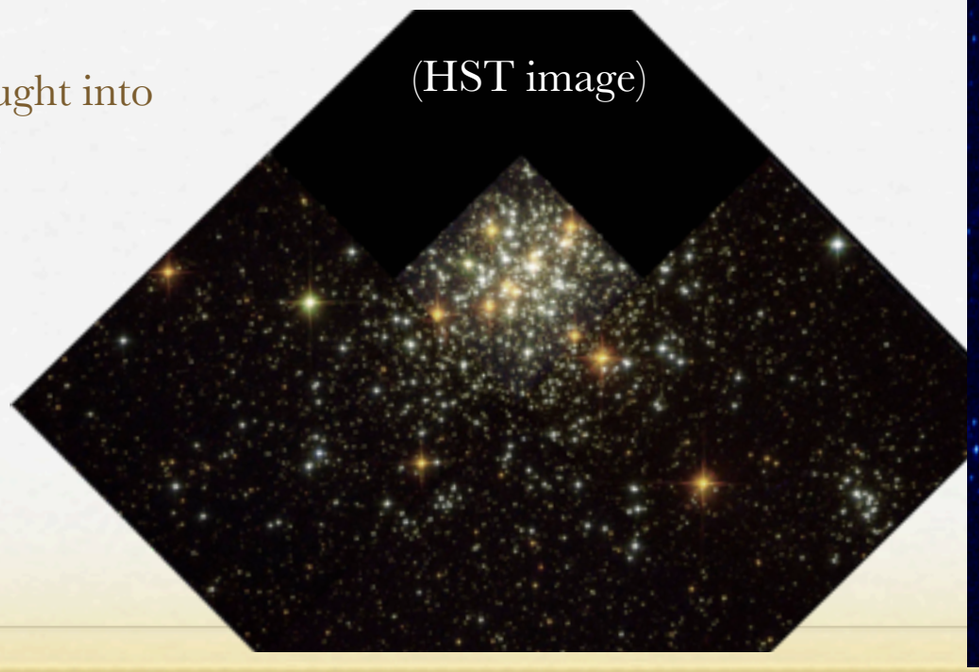
Commissioning (January-April)

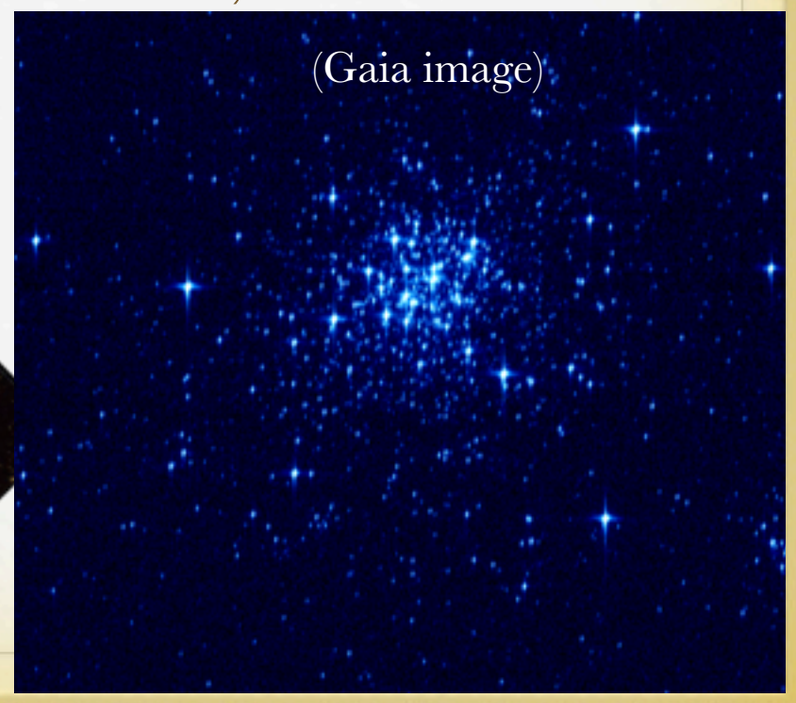
After insertion at L2 (January 14th) commissioning began

- Basic angle monitoring (BAM)
- Wavefront Sensor Monitoring
- Monitor stray light due to BAM laser
- Early calibration of CCD's (bias levels & non-uniformity, etc.)
- Alignment and focusing of the two telescopes (6-7 weeks)

First image: Gaia slowly being brought into focus shows a dense cluster of stars (NGC1818) in the LMC

Normally, we do not make images but the SM's can be read out to produce outreach images





Current Status

Half way through commissioning - nominal operations start May 9th

Gaia is working well and is responsive to commanding

DPAC people and software working well to interpret data

- Small bugs in the processing chain are being detected and fixed

No show stoppers have been identified but some problems identified:

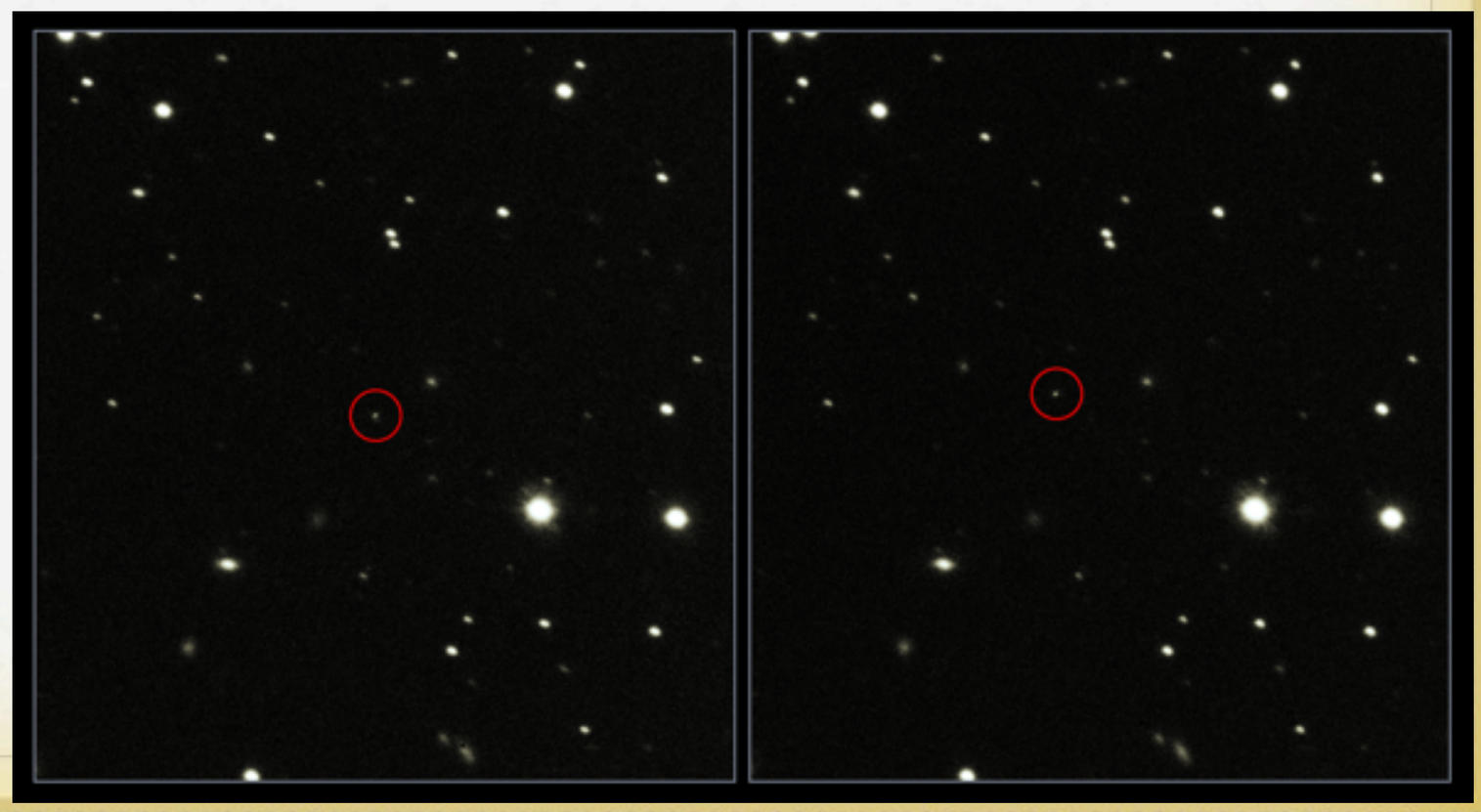
- Not unusual for any science mission at this stage
- Two more months of commissioning to go!

The 2.24m telescope at Mauna Kea Observatory in Hawaii was used to capture Gaia's tilt from 0° to 45° on 27 Feb. over half an hour to test stray light

Also main belt asteroid (2002 RS34) moving from top centre to right

Unexpected Issues

- Brightness in the sky - GBOT (Ground Based Optical Tracking) of Gaia is needed for orbit reconstruction and velocity aberration corrections. Gaia is currently at G magnitude ~20.5 (18 was hoped for)
  - ESO could give observing time on VST or other 2m class telescopes
  - VLBI observations of Gaia (mas astrometry) have been tested successfully

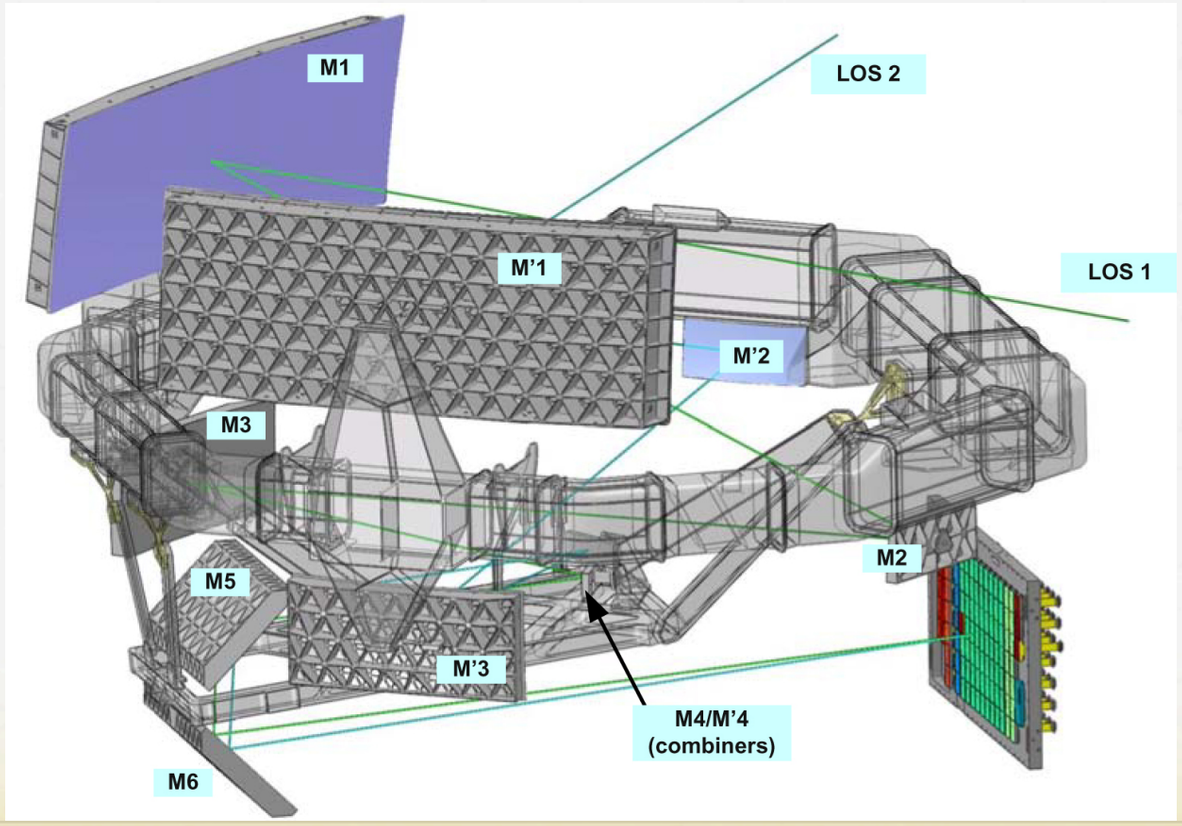


Two images of Gaia taken 6.5 minutes apart on January 23rd as seen with the Very Large Survey Telescope (2.61m) in Chile.

Position accuracy needs to be < 150m and velocity < 2.5 mm/s.

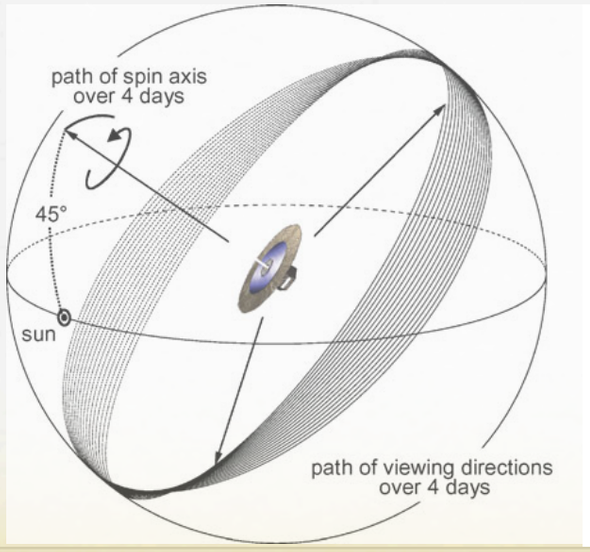
Loss Of Transmission

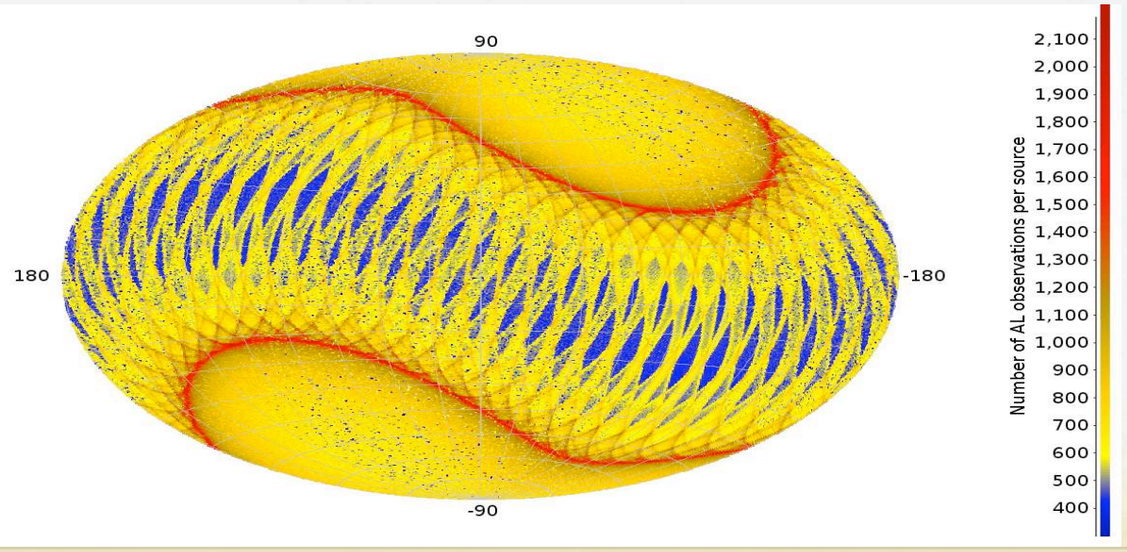
- Loss of transmission in telescope 2 (T2) - a loss of 1 G_{mag} (0.1 G_{mag} in T1). Slightly dependent on FP position and star color. Possibly from condensed water or gas from the payload module or thermal tent structures.
    - Decontamination strategy in progress which consists of heating mirrors (M/M'4 and mirror M'2) and monitoring the transmission of T2. Ongoing but proving successful.



Stray Light

- Stray light in the FP - evolves in time with a period of 6 hours. Small performance loss in astrometry. For photometry & spectroscopy a shift to brighter magnitudes and a shallower survey.
- Cause is uncertain, Astrium suspect diffraction of sun light at the edge of the 10m sun shield but part of it could also be diffuse background from GC and/or zodiacal light.
  - Tests changing SAA from 45° to 42° show some improvement (30% less at the peak level and on average 5-10% less).
  - New test changing SAA to 0° should tell more. Slew started March 6, with a slew back to 45° degrees on March 7, data taken during the slews.





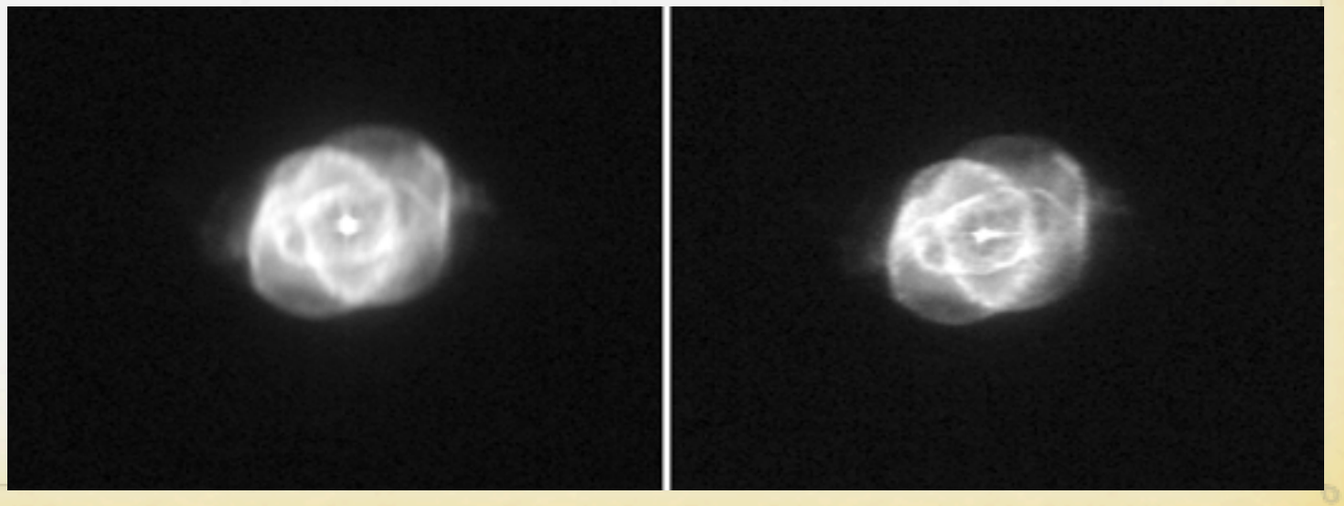
Gaia Is In A Good State

- 106 CCDs and 106 backend electronics units
- 7 on board computers managing the CCDs and electronics
- On-board SW working as expected
- Payload and data handling unit for storing and downlinking data
- The chemical propulsion system for large manoeuvres
- Rubidium atomic clock
- Phased array antenna giving plenty of margin in downlink capacity
- μ-propulsion system to control Gaia's spin rate and torque due to solar radiation pressure

Images of the Cat's Eye Nebula, from 23 - 25 January show the effect of the spin rate

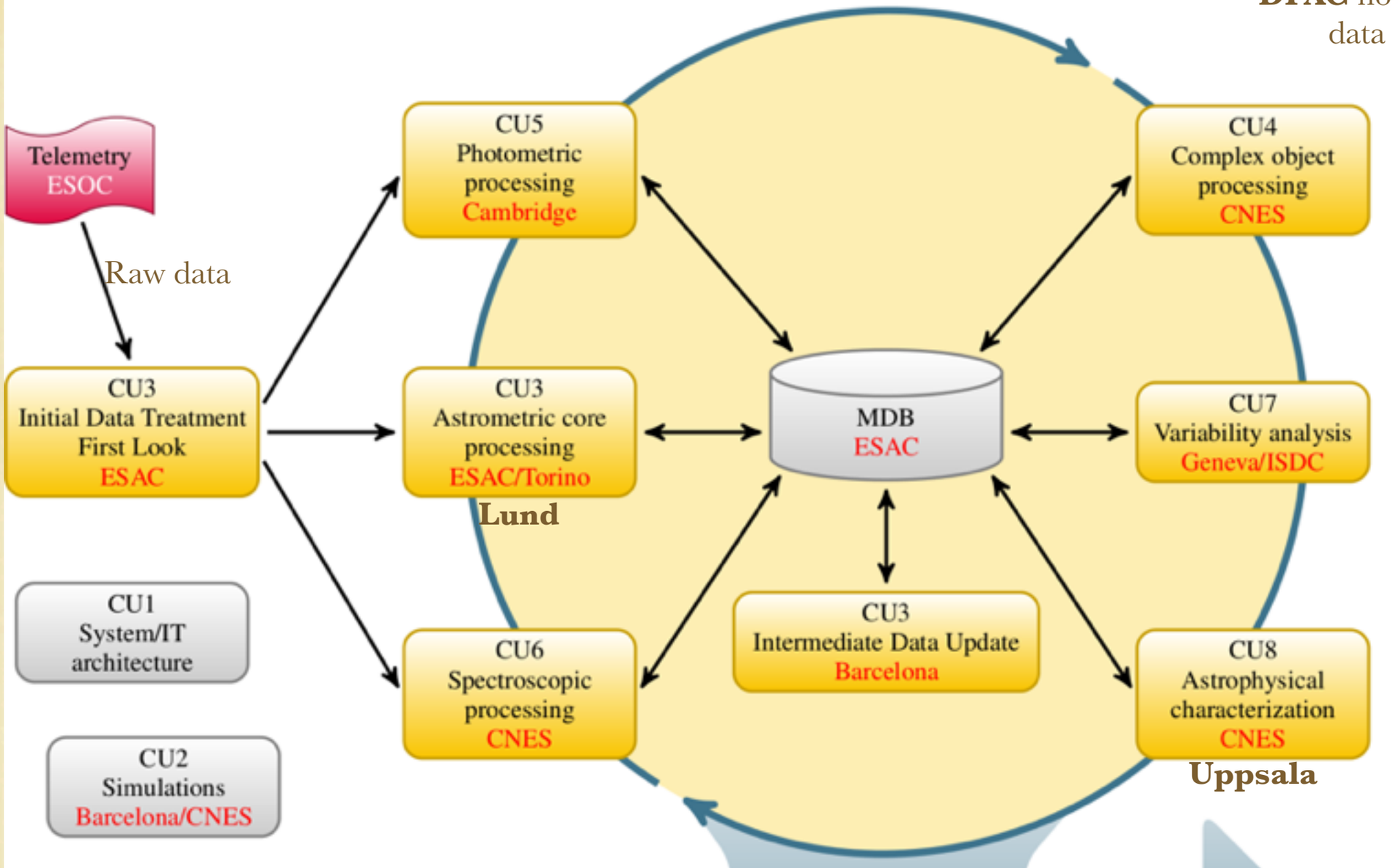
Left: non-optimized spin rate

Right: much sharper image as spin rate is closer to TDI read-out rate of the CCDs (AL vertical)

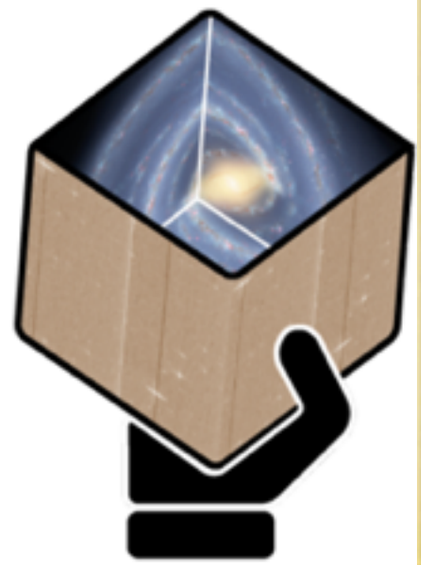


Upstream → Downstream

DPAC now has 450 people and 6 data processing centers



How Lund Contributes



Images ESA

Early Data Releases

- Science Alerts (e.g. Supernova or micro-lensing): within hours or days
- L + 22 months (Sept. 2015):
  - Positions, G-magnitudes for well behaved single stars & 90% sky coverage
  - Proper motions for Hipparcos stars - order of magnitude improvement
  - Ecliptic pole data from calibration of photometry in 1° fields around the poles
- L + 28 months (March 2016):
  - First 5 parameter astrometry for single stars & >90% sky coverage
  - Radial velocities for 90% of bright well behaved stars
  - Integrated photometry BP/RP with basic verified astrophysical parameters

Later Data Releases

- L + 40 months (March 2017):
  - BP/RP spectrophotometry plus RV spectra for well behaved objects
  - Object classification and astrophysical parameters
  - Orbital solutions for short period (2 to ~30 months) binaries
- L + 65 months (May 2019):
  - Variable-star classifications with the photometry observations
  - Solar system results with preliminary orbital solutions
  - Non-single star catalogues

Final Catalogue Release

- L + 101 months (May 2022): 5 yr mission + 3 yr processing
- L + 113 months (May 2023): 6 yr mission + 3 yr processing
- Consumables in Gaia could last up to 10 years and the mission could be extended depending on funding, radiation damage, etc.
- L + 161 months (May 2027): 10 yr mission + 3 yr processing
    - Full astrometric, photometric, and radial-velocity catalogues
    - All available variable-star and non-single-star solutions
    - Source classifications plus astrophysical parameters
    - Exo-planet data
    - All epoch and transit data for all sources
    - All ground-based observations made for data-processing purposes

Lund Group

Lennart Lindegren:
Space Astrometry

David Hobbs:
Space Astrometry

Giorgi Kokaia:
Weak gravitational lensing effects in Gaia Data

Rajesh Kumar Bachchan:
Fundamental physics with Gaia

Ylva Götberg
Probing the Galactic potential and dark matter

Daniel Michalik:
Merging of astrometric catalogues (HTPM)