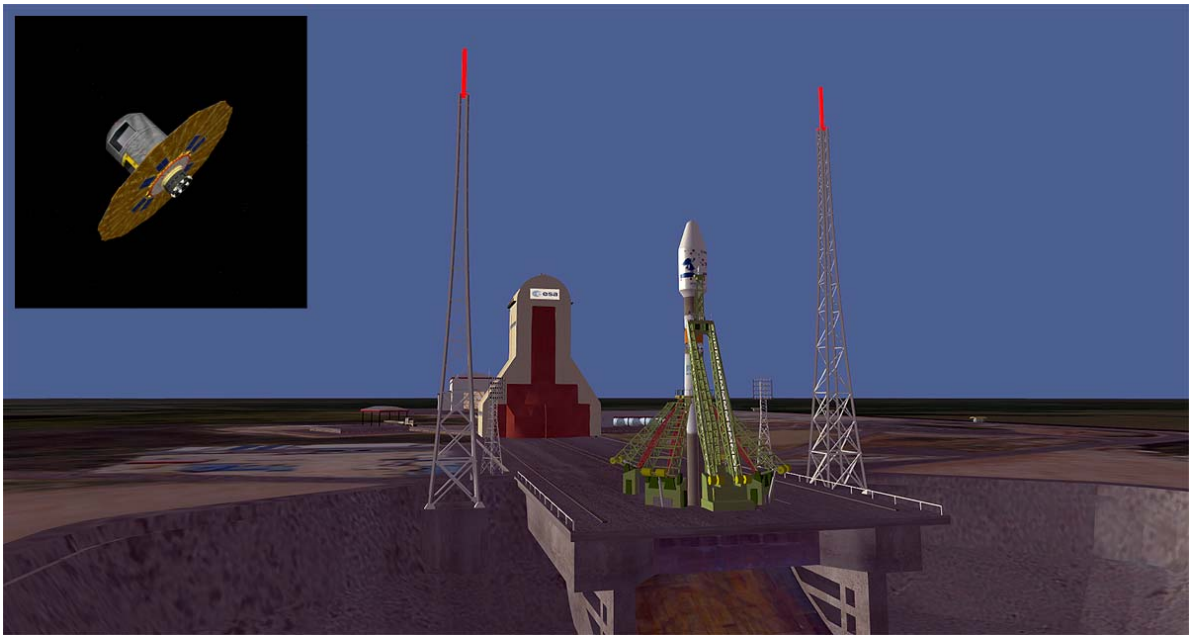
GAÏA MISSION

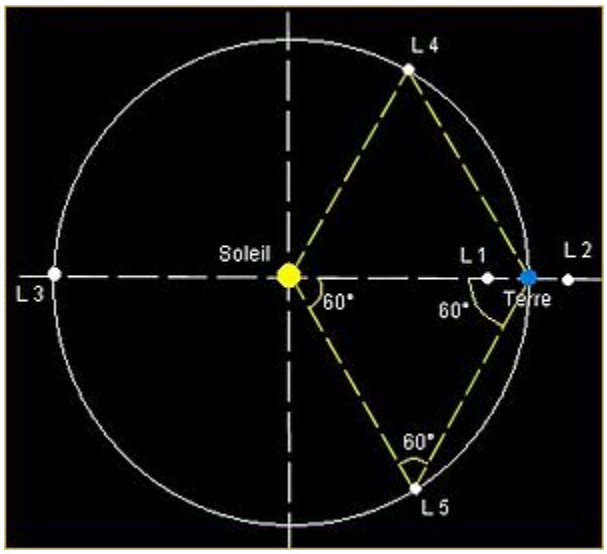


1 - Mission objective

In this mission you are expected to launch the Gaia satellite and place it to the L2 Lagrange point of the Sun-Earth couple. Once there, Gaia should remain on the Sun-Earth axis and would then be able to carry out the planned observation of the universe..

Lagrange points of the Sun-Earth system are noted and defined as follows :

- **L_1** : on the line defined by the two masses and between them, the exact position depending on mass ratio between the two bodies. In the case where one of the two bodies has a much smaller mass than the other, the L1 point is located significantly closer to the low-mass body than to the more massive body.
- **L_2** : on the line defined by the two masses, beyond the smaller. In the case where one of the two bodies has a much smaller mass, the distance from L2 to that body is comparable to the distance between L1 and that body.
- **L_3** : on the line defined by the two masses, beyond the greater. In the case where one of the two bodies is substantially less massive than the other, the distance between L3 and the massive body is comparable to that between the two bodies.



On one of the Lagrange points, a third body of insignificant mass remains immobile relative to the two others, in that it revolves around their common center of gravity at the same angular velocity, while maintaining its position relative to them.

We can calculate that L2 point is roughly 1.5 million km from the center of the Earth.

(not to scale on the picture)

The **Gaia satellite** is dedicated to measuring the position, distance, and movement of the stars.

2 - Satellite Gaïa

Gaïa is a satellite 2 030 kg in weight, of which 920 kg for the platform, 710 kg for the payload, 335 kg of propellant used by 12 rocket engines in charge of the maneuvers until the beginning of the scientific phase of the mission, and 60 kg of gas used by the cold gas thrusters used by 12 RCS during the rest of the mission. The main structure has the shape of a hexagonal prism 3.5 m high and 3 m in diameter, excluding the sunshade which would bring the total diameter to 10m

***Gaia consists of three subsets* :**

- the payload, which should complete the objectives, is composed of two telescopes and some instruments set on the focal plane.
- the platform holding the equipment in charge of making the satellite work (attitude control, propulsion, telecommunications, energy, onboard computer).
- a large diameter sunshade (10 m), designed to keep the temperature steady in order to avoid any mechanical strain which could reduce the measurement accuracy.

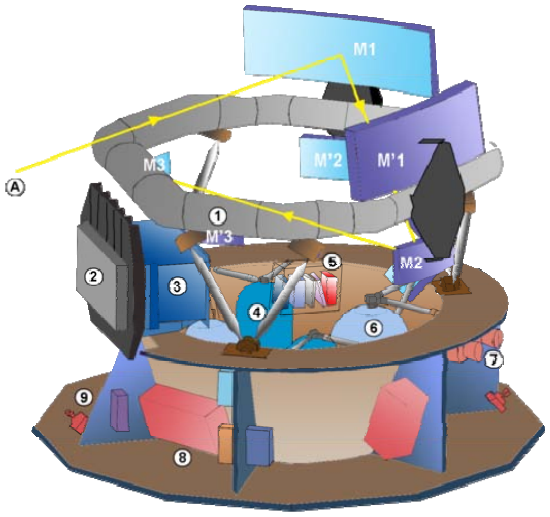
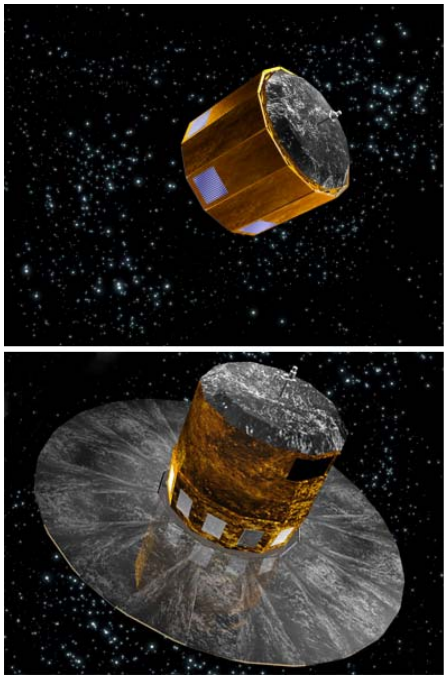


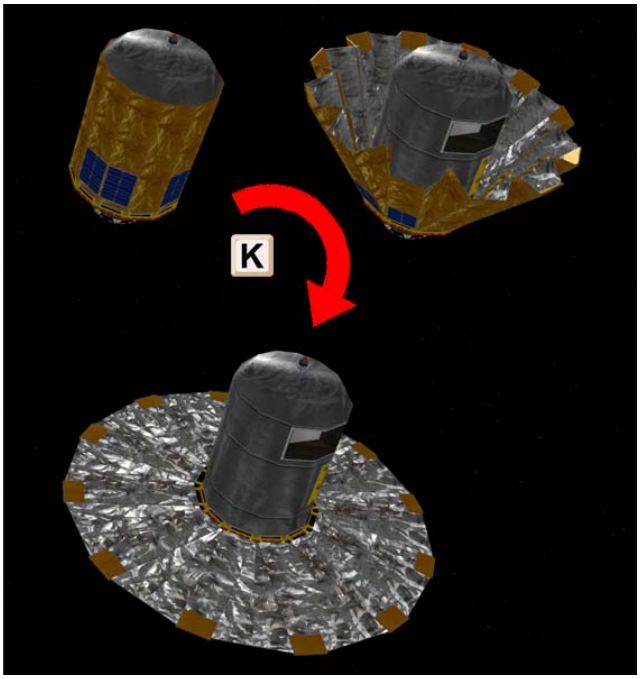
Diagram of *Gaïa* without its sunshade and its external thermal protection:

M1, M2 et M3 : Mirrors of telescope #1
M'1, M'2 et M'3 : Mirrors of telescope #2
M4, M'4, M5 et M6 : Mirrors not shown
A : Light path of telescope #1 between mirrors M1-M2-M3
1 : Optical bench (silicon carbide torus)
2 : Focal plane cooling radiator
3 : Focal plane electronics
4 : Nitrogen tanks
5 : Diffraction grating spectroscope
6 : Liquid propellant tanks
7 : Star trackers
8 : Telecommunication panel and batteries
9 : Main propulsion subsystem

Gaia's command keys in Orbiter :

- **K** : deploy the sunshade
- **G** : initiates the self destruction of the satellite (I don't recommend to use this key...)
- If you have enabled *"Play cabin air conditioning"* in OrbiterSound options, you will hear (in internal view) a relaxing music...





3 - Required add-ons

Kourou CSG-ELS (you can also use Kourou CSG global)
http://francophone.dansteph.com/?page=addon&id=60

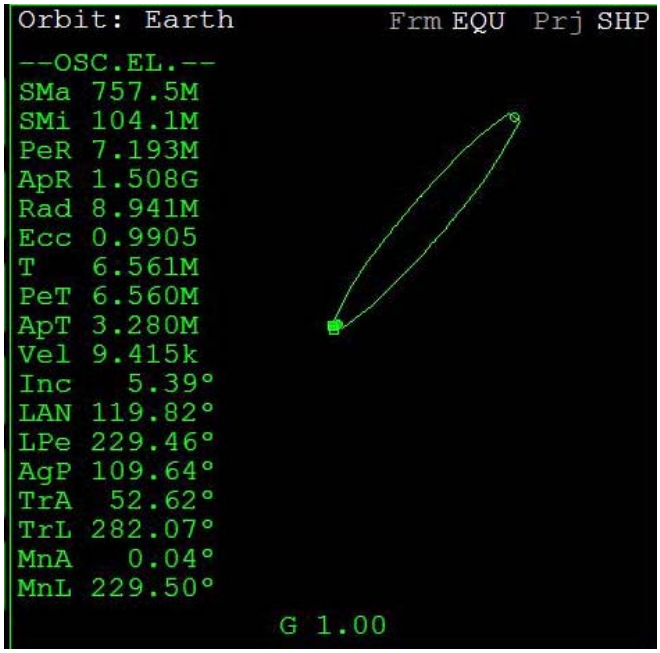
Lagrangian points MFD v.02 (Enable *Lagrange module* in the LaunchPad)
http://www.orbithangar.com/search_quick.php?text=Lagrangian&submit.x=0&submit.y=0

IMFD 5.5 from Jarmo Nikkanen
http://koti.mbnet.fi/jarmonik/Orbiter.html

4 - Mission run

The launch will occur on December 19, 2013 at 10:12:00 UTC, on the "**Kourou ELS**" site, with the help of a **Soyuz rocket** equipped with a **Fregat** stage.

Scenario **1 – Lancement Gaïa** starts at 10:11:00.
At 10:11:30 press **P** to trigger the automatic launching of the rocket.

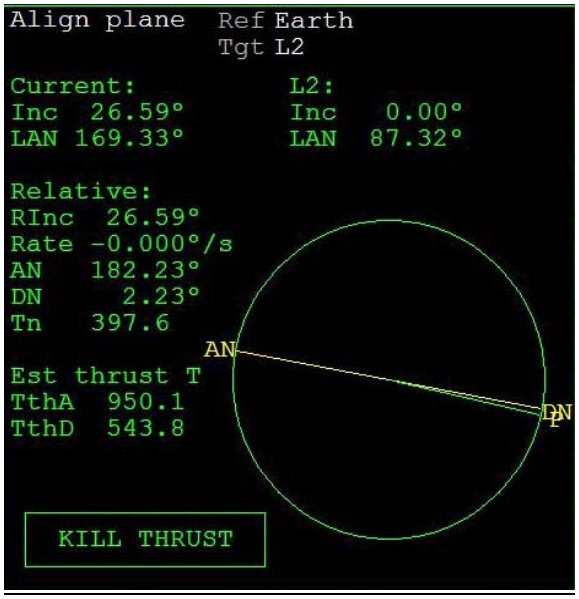


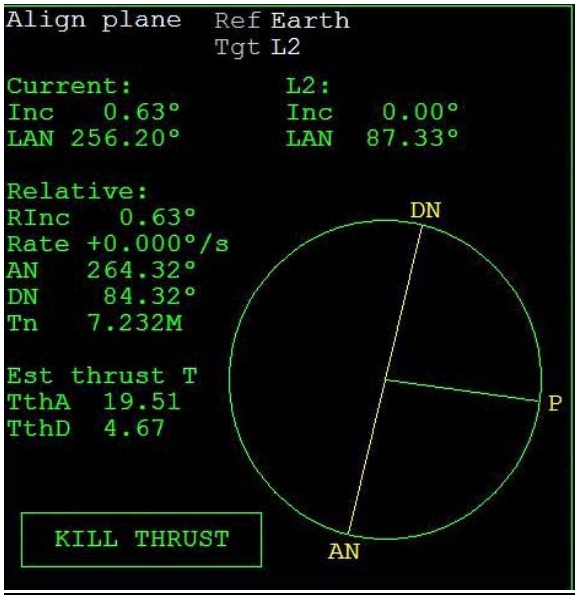
From there on, you'll have to wait patiently for the launch to complete, and for the orbit around the Earth to reach an apoapsis (ApR) of about 1.5G (1,500,000,000 m).

The whole sequence takes approximately 1400s, and you should avoid using time acceleration.
Please be patient !

(Once burn time is over, complete if needed by using some slight thrust in *prograde mode* to bring ApR to about 1.5G).

To prepare alignment to L2 plane, open **Align Planes MFD** with TGT = L2.
(I have added this fictional point in the scenario as an "invisible mesh", but unfortunately it tends to move around a little).





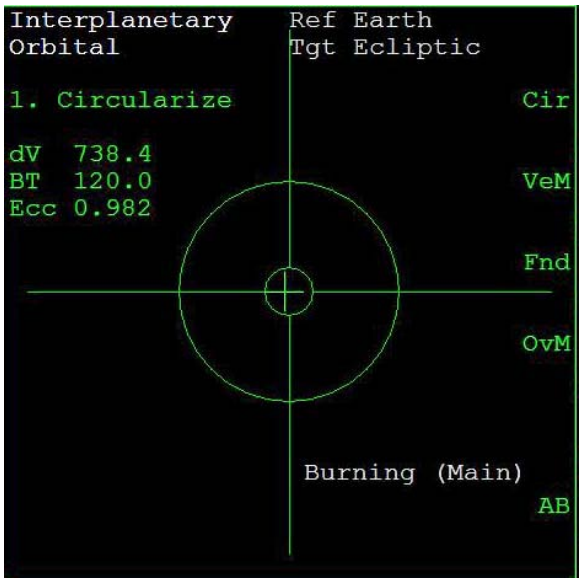
Around Tn = 400s, ignite the engines on NML+ position since we have reached the **D**escending **N**ode.

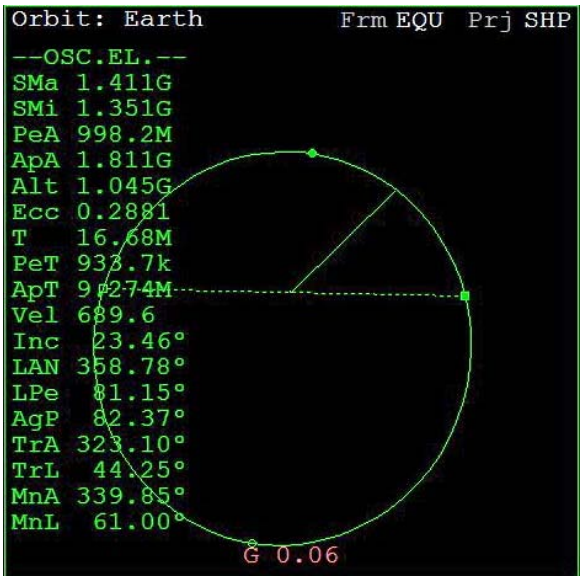
Bring down RInc as close as possible to 0.

Scenario **2 - Apres alignement plans** is at the end of this stage.
Now this method of approaching L2 is rather empirical :
(but I couldn't work out anything better)...

When you are approximately 1G from the Earth, circularize your orbit around the Earth by using the **IMFD Orbital module**. (Be careful to set the reference to 'Earth').
Burn time is about 120s.

When this is done, proceed to *Prograde*, and apply some thrust to bring ApR (which has now shifted) to at least 1.7G (again be careful to have the reference set to 'Earth').

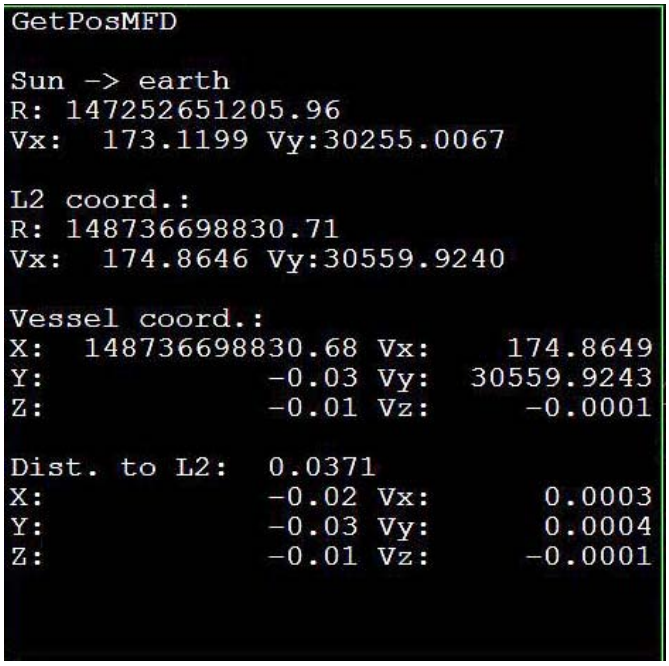




The **Fregat module** will be practically empty, and it can be jettisoned by using the 'J' key.
Press 'K' to deploy Gaia's sunshield.

Today's December 31, late afternoon.

All we have to do is continue our journey until January 23, 2014 to be roughly aligned with the Earth and the Sun.
But we are not quite at the L2 point which is difficult to reach with precision.



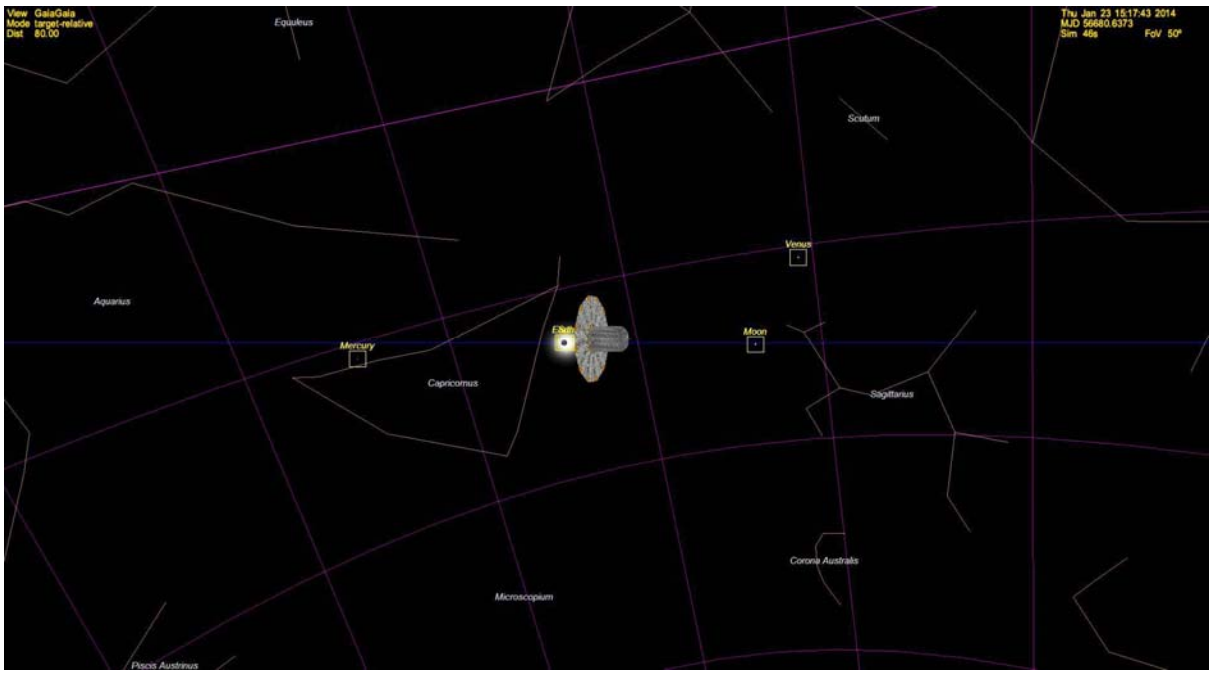
Let's cheat by opening ***Lagrange-MFD*** with this input :

- Set = Earth
- Select L2 with Nxt
- Then select and press GO.

Gaia is now well positioned on L2.

The distance to L2 is very small but unfortunately it is changing through time due to interference influence such as with the Moon.

On the picture below, the black disk on the Sun is the Earth.
I shifted the angle of view to make it visible, but Gaia is properly aligned.



Now you can enjoy yourself moving Gaia in translation and rotation, and admire the constellations.

THANKS TO *ELPHIFOU* FOR HIS HELP FOR ENGLISH TRANSLATION OF THIS MANUAL

Papyref - Mars 2014