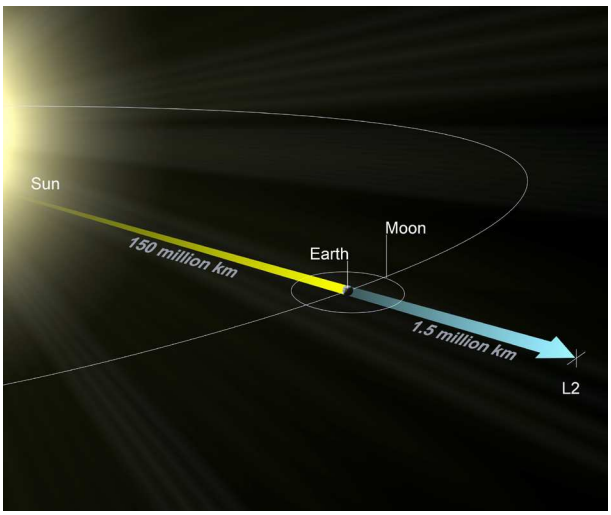

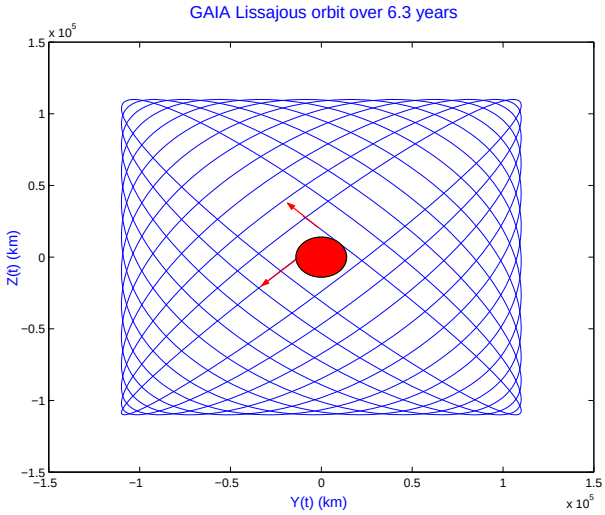

Left: The second Lagrange point lies on the Sun-Earth line, in the direction opposite to the Sun, at a distance of 1.5 million km from the Earth. L2 is a semi-stable region of gravity where spacecraft can be maintained for several years with cheap orbit manoeuvres. Right: Example of a Lissajous orbit projected on the plane perpendicular to the Earth-L2 line, as seen from the Earth. The initial conditions are chosen such that the orbit wanders outside the Earth shadow (red circle at the centre) until the occurrence of the next eclipse more than six years later.

Gaia will operate in the vicinity of the second Lagrange point (L2), approximately 1.5 million km from the Earth, along the Sun-Earth line in the direction opposite to the Sun. The region around L2 is a gravitational saddle point, where spacecraft can be maintained at roughly constant distance from the Earth for several years by small and cheap manoeuvres.

Around L2 there is a circular zone of radius $\sim$ 13,000 km where the Sun is always eclipsed by the Earth. Here the solar panels of a spacecraft would be unable to generate sufficient power since they would not receive enough sunlight. In addition, even entering this region for a few minutes would generate a detrimental thermal shock in the spacecraft. Therefore, Gaia will be placed in a large Lissajous orbit ($\sim$ 300,000 km) around L2 to ensure that it stays away from the eclipse zone for at least six years. The constant pull exerted by the Sun and the Earth will cause Gaia to swing around L2 on a nearly periodic circuit and six months will be needed to complete a full cycle (see figure above.)

The selection of the orbit arises from a trade-off between communication, operations, cost, thermal and radiation environment, and accessibility with current rockets. Around L2 one benefits from a virtually unchanging environment with very stable thermal conditions, an essential asset for the success of the mission. The optics are so sensitive to minute changes of temperature that a variation of less than one thousandth of a degree over a few hours would disturb the alignment of the mirrors and degrade the quality of the images.

Gaia will first be launched into low-Earth orbit and then injected into a smooth transfer orbit for a quiet trip of $\sim$ 1 month to its final Lissajous orbit about L2, where the observations will commence for a mission lasting at least five years.

Gaia will not be alone around L2 since this remote location is now favoured by several missions: ESA's Herschel-Planck and the NASA/ESA James Webb Space Telescope (will) operate from L2. In 2001, NASA's WMAP mission was the first to use an L2 orbit as its permanent observing station.

Lagrange points (L1 to L5) are named after the French-Italian mathematician Joseph-Louis Lagrange (1736-1813) who discovered them in the eighteenth century as equilibrium solutions of the three-body problem.