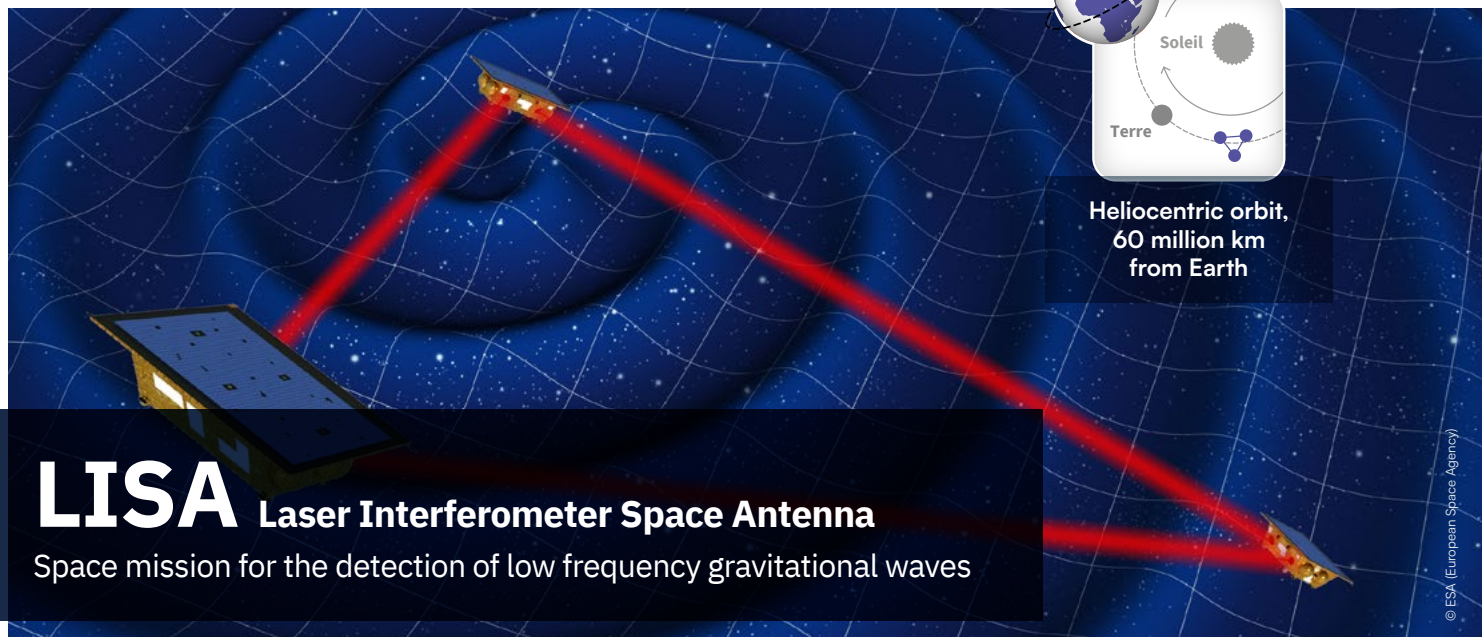


Gravitational waves



Heliocentric orbit, 60 million km from Earth

LISA

Laser Interferometer Space Antenna

Space mission for the detection of low frequency gravitational waves

Scientific leader: Hubert Halloin (APC) *

Laboratories involved: APC (Paris), CPPM (Marseille), JCLab (Orsay), L2IT (Toulouse), IP2I-LMA (Lyon), LPCC (Caen)

Nature: space projet

Status: project of the European Space Agency (ESA) in partnership with the US Space Agency (NASA). Mission officially approved by The European Space Agency in January 2024.

Website: <https://lisamission.org/>

Scientific objectives

LISA (Laser Interferometer Space Antenna) is a space project led by ESA. Its objective is to detect low-frequency gravitational waves (between 0.1 and 100mHz), emitted by the most violent phenomena in the Universe such as the coalescence of supermassive black holes. Its observations will help answer questions in fundamental physics (strong field gravitation, physics of the primordial Universe, etc.), astrophysics (origin of black holes, formation and evolution of compact binary objects in our Galaxy, etc.) and cosmology (expansion of the Universe, nature of dark energy, etc.).

Resources deployed

To detect the minute deformations of space-time caused by the passage of a gravitational wave, LISA consists of three satellites 2.5 million kilometres apart. These exchange laser links and form a giant space interferometer. In order to follow a purely gravitational orbit, each satellite contains two free-falling cubic masses of 2 kilogrammes and protects these from external disturbances. High-precision interferometry allows the distance fluctuations between these inertial masses to be reconstructed with an accuracy of about ten picometers over 1 000 seconds.

3 satellites 2.5 million km apart	6 to 10 years of measurements
1 500 members in the LISA consortium	2035-2037 planned launch years

IN2P3 CONTRIBUTIONS

- Important contribution to the proof of concept with LISA pathfinder
- Modelling of the scientific performance of the mission
- Realization of interferometric metrology benches for the validation of the instruments before the launch
- Establishment of a distributed data processing centre

Other french laboratories involved
 CNES, Irfu (CEA Saclay), OCA (ARTEMIS), OBSPM (SYRTE), IAP, ONERA, Fresnel Institut, LAM, LPC2E

- 1978** First proposals for a space-based gravitational wave detector
- 2013** Selection of "The Gravitational Universe" as the theme for ESA's L3 mission
- 2015-2017** Launch and operation of the LISA Pathfinder technology demonstration satellite
- 2017** LISA selected as ESA's L3 space mission
- 2021** LISA feasibility study (Phase A) completed
- 2024** LISA mission officially approved by ESA
- 2035-2037** Planned launch of LISA mission on Ariane 6.4

* Since 2017