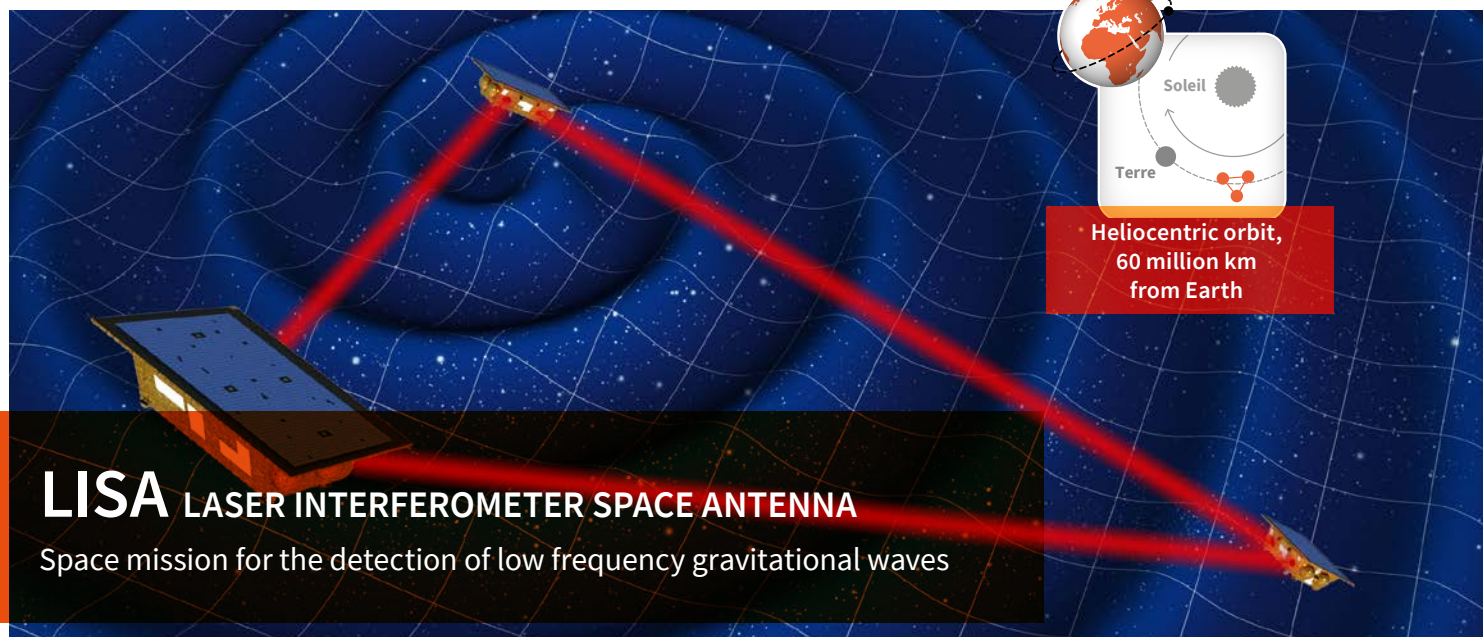


Gravitational waves



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- **Scientific leader:** Hubert Halloin (APC) *
- **Laboratories involved:** APC (Paris), CPPM (Marseille), IJCLab (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). The feasibility study phase (Phase A) was completed in December 2021, the preliminary definition phase (Phase B) started in spring 2022.
- **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 100 mHz), 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 km 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 kg 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.

1 500 members in the LISA consortium

2034 is the planned launch year

6 to 10 years of measurements

3 satellites 2.5 million km apart

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

2034 – 2035

Planned launch of LISA mission on Ariane 6.4