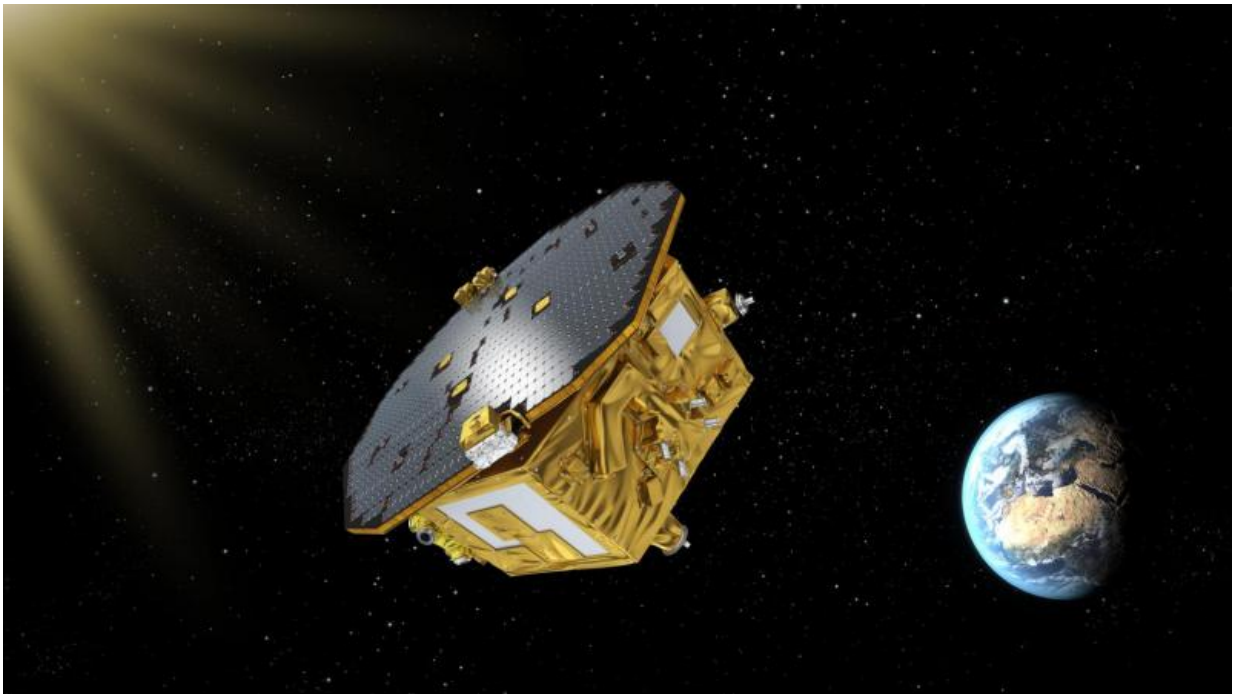


First locks released from Lisa Pathfinder's cubes

February 9 2016



Artist's impression of LISA Pathfinder, ESA's mission to test technology for future gravitational-wave observatories in space. Credit: ESA–C.Carreau

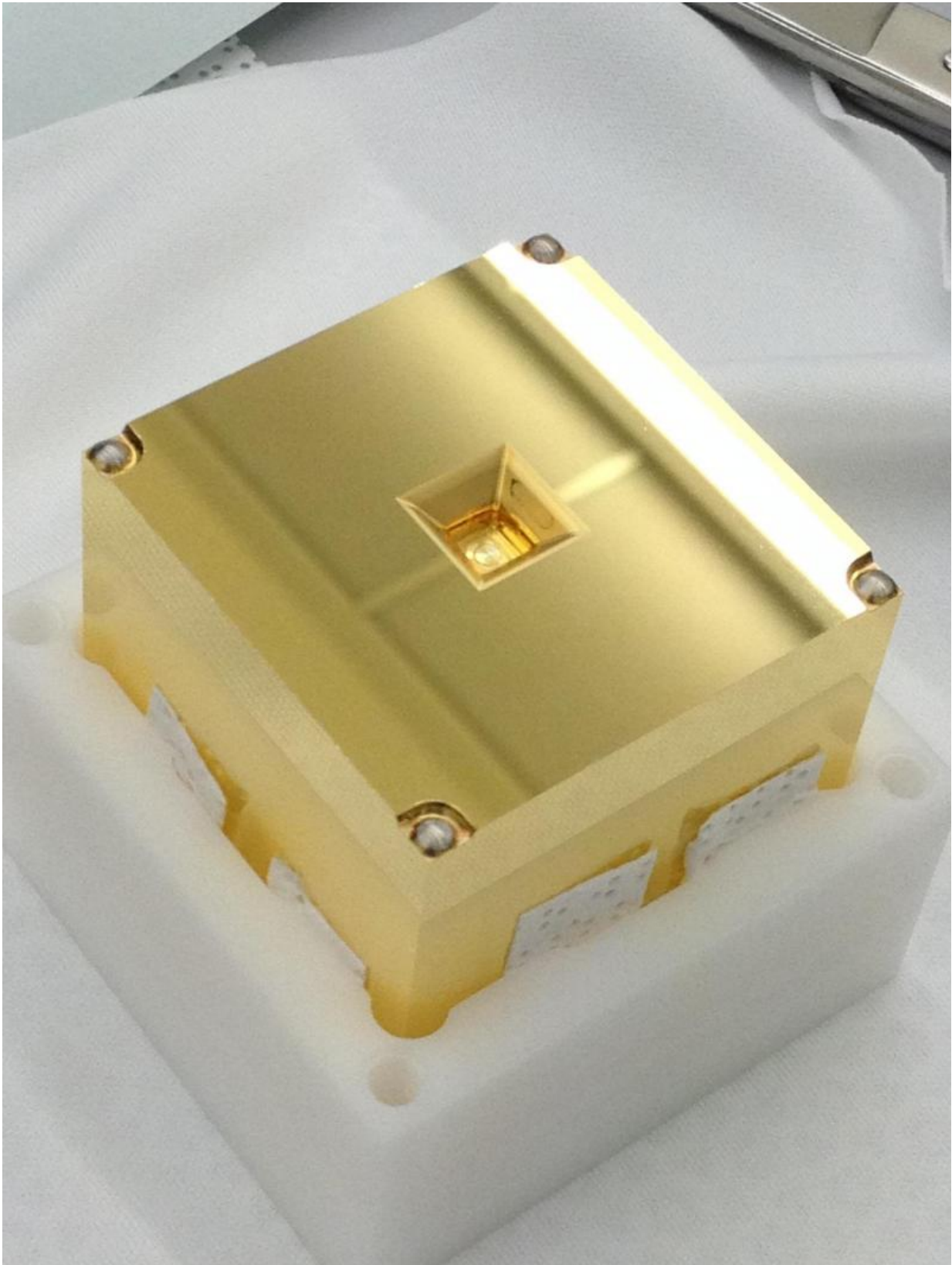
Today, the lock fingers that kept the two test masses on LISA Pathfinder secure during the launch and cruise phase were successfully unlocked. As planned, the two cubes are still attached to the spacecraft via an additional mechanism that will hold them in place until mid February, as the teams carry on with the spacecraft and payload commissioning.

Tests on LISA Pathfinder are proceeding on schedule. The spacecraft completed its six-week journey in space, reaching its operational location in orbit around the Lagrange point L1 on 22 January 2016.

With the spacecraft settling into its new home, teams from ESA, Airbus Defence and Space (the prime contractor) and the institutes that provided the payload hardware continue to perform tests on the various systems, subsystems and instruments in preparation for when science operations will begin on 1 March.

At the centre of the spacecraft is the LISA Technology Package, which houses the two test masses that will be put in the most precise free-fall motion ever obtained in space. The position and attitude of these two identical gold-platinum cubes is monitored by a laser interferometer to estimate how much their motion is affected by other forces beyond gravity.

On 13 January, the laser was the first element of the science payload to be switched on, and preliminary measurements indicate that its performance is exceptionally good.



This photo shows one of LISA Pathfinder's two test masses. Each test mass is a cube of solid gold–platinum alloy, measuring 4.6 cm on a side and weighing almost 1.96 kg. Credit: CGS SpA

But it will be another few weeks before everything is ready to begin the science phase of this mission.

"During operations on ground, launch and cruise, each cube was held in position by eight launch lock fingers pressing the cube's eight corners," explains César García Marirrodriga, ESA's LISA Pathfinder project manager.

"Today, we successfully pulled back the lock fingers, handing the cubes over to the Grabbing, Positioning and Release Mechanism (GPRM) – these are additional mechanical elements that are softly holding the two opposite faces of each cube," he adds.



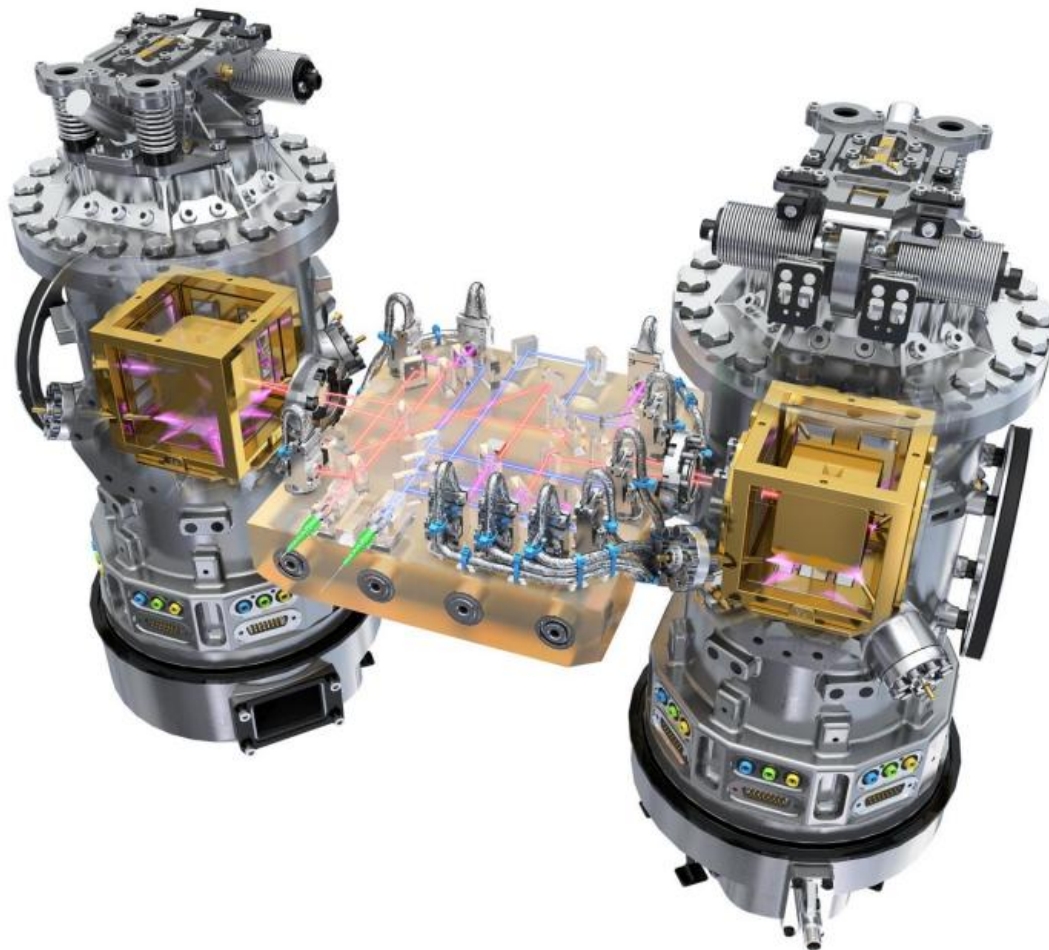
Assembly of one of the Inertial Sensor Heads for the LISA Technology Package (LTP). Credit: CGS SpA

The release of the test masses is a crucial procedure for operating the mission, so it was designed in two steps.

First, the launch lock fingers are retracted, simultaneously opening a gate valve to vent the interior of the inertial sensors and pump residual gas molecules out to space. Recreating a high vacuum environment around the test masses will take a couple of weeks. Second, the GPRM will be retracted from one of the cubes on 15 February, and on the following day from the other one. When the GPRM is retracted, the test masses

will no longer be in mechanical contact with the spacecraft, freely floating inside their housing.

The cubes measure 46 mm across and are about 4 mm away from the walls of their respective housing. In order to place them correctly, the mechanism must release each cube with a positional accuracy of approximately 200 μm with respect to the geometrical centre in all three directions. To avoid reaching any of the walls, the masses must be released with a velocity of less than 5 $\mu\text{m/s}$, or 18 mm/h, meaning that it would take them about a quarter of an hour to cover the space separating them from the surrounding walls.



This artist's impression illustrates the LISA Technology Package core assembly. The two gold cubes, enclosed in vacuum containers (shown here with the launch lock mechanism), are key to the LISA Pathfinder mission. Each of these electrode containers houses a gold-platinum test mass. LISA Pathfinder will monitor the two cubes as they enter free-fall motion using a high-precision laser interferometer. The optical bench interferometer is shown between the two masses. This instrument is made from a 20 cm by 20 cm block of Zerodur ceramic glass, and has a set of 22 mirrors and beam-splitters bonded to its surface that direct laser beams. These beams will allow scientists to precisely

measure the cubes' motion, position, and orientation without touching them. In this way, LISA Pathfinder will perform the first high-precision laser interferometric tracking of orbiting bodies in space. Credit: ESA/ATG medialab

"We are excited about the final test mass release, because the minute forces and velocities involved could not be fully tested on ground: it was not physically possible in the presence of Earth's gravity," says Hans Rozemeijer, LISA Pathfinder payload engineer.

"In space missions we normally test what we will fly, and then we fly what we tested, but sometimes the ground conditions simply do not let us fulfil this paradigm," he adds.

Immediately after the GPRM is released, the teams will apply electrostatic forces to the cubes using the electrodes in their housings to move them and make them follow the spacecraft. Over the following days, they will gradually reduce the intensity of the electrostatic force until eventually no force is applied to the masses, and the [spacecraft](#) will start moving around one of the free-falling cubes. This is the nominal operating mode for the science phase of LISA Pathfinder, and it will be first activated on 23 February.

Provided by European Space Agency

Citation: First locks released from Lisa Pathfinder's cubes (2016, February 9) retrieved 27 April 2024 from <https://phys.org/news/2016-02-lisa-pathfinder-cubes.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.