LISA pathfinder thrusters operated successfully

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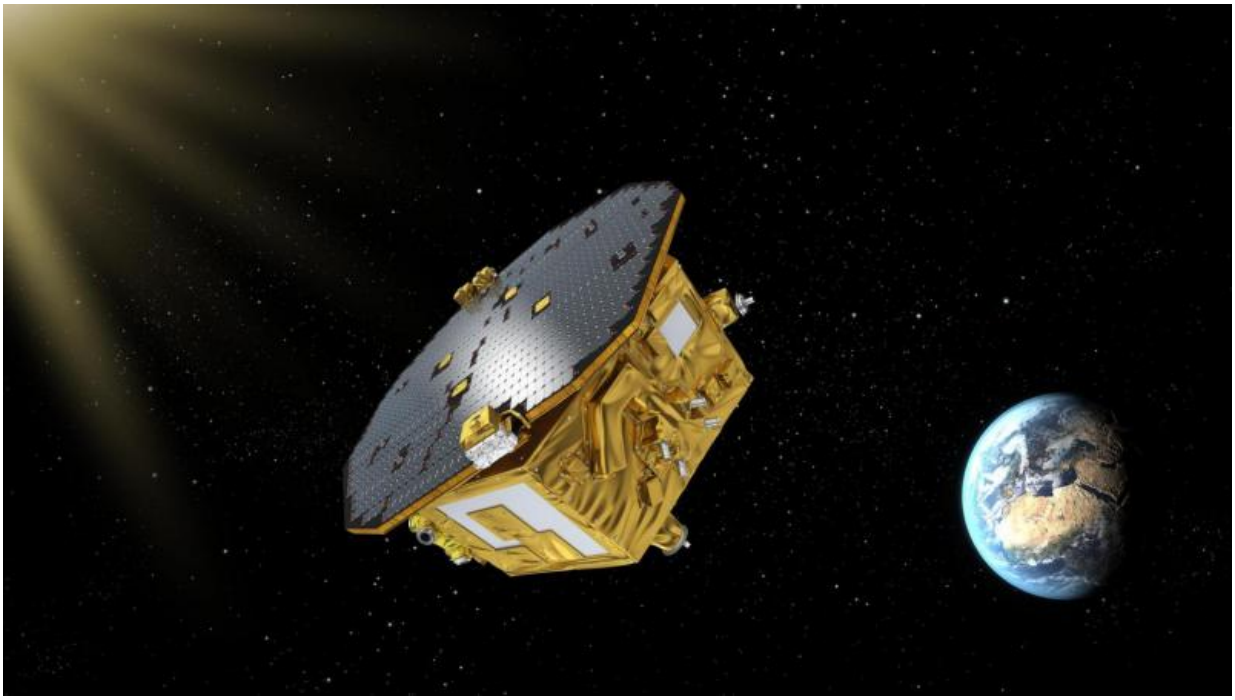

The LISA Pathfinder spacecraft will help pave the way for a mission to detect gravitational waves. NASA/JPL developed a thruster system onboard. Credit: ESA

While some technologies were created to make spacecraft move billions of miles, the Disturbance Reduction System has the opposite goal: To keep a spacecraft as still as possible.

The thruster system, managed by NASA's Jet Propulsion Laboratory, Pasadena, California, is part of the European Space Agency's LISA Pathfinder spacecraft, which launched from Kourou, French Guiana on Dec. 3, 2015 GMT (Dec. 2 PST). LISA Pathfinder will test technologies that could one day allow detection of gravitational waves, whose effects are so miniscule that a spacecraft would need to remain extremely steady to detect them. Observing gravitational waves would be a huge step forward in our understanding of the evolution of the universe.

Now, LISA Pathfinder is on its way to Lagrange Point L1, about 930,000 miles (1.5 million kilometers) from Earth in the direction of the sun. L1 is a special point that a spacecraft can orbit while maintaining a nearly constant distance to Earth. This month, scientists and engineers have been switching on LISA Pathfinder's instruments to test them in space. This has included the Disturbance Reduction System instrument computer and thrusters.

The system uses colloid micronewton thrusters, which operate by applying an electric charge to small droplets of liquid and accelerating them through an electric field, to precisely control the position of the spacecraft. Thrusters that work this way had never been successfully operated in space before LISA Pathfinder launched.

This cluster of four colloid thrusters is part of the Disturbance Reduction System, developed by NASA/JPL, which will help keep the LISA Pathfinder spacecraft extremely stable. Credit: ESA/NASA/JPL-Caltech

As of Jan. 10, all eight identical thrusters, developed by Busek Co., Natick, Massachusetts, with technical support from JPL, passed their functional tests. The thrusters achieved their maximum thrust of 30 micronewtons, equivalent to the weight of a mosquito. This level of precision is necessary to counteract small forces on the spacecraft such as the pressure of sunlight, with the result that the spacecraft and the instruments inside are in near-perfect free-fall. A mission to detect gravitational waves would need that level of stability.

"We reached a major milestone with this technology development," said Phil Barela, Disturbance Reduction System project manager at JPL. "The DRS is helping point the way to a system that could be used to detect gravitational waves in the future."

Gravitational waves are one of the last unverified predictions from the theory of General Relativity, which Albert Einstein published about a century ago. Einstein wrote that as massive bodies accelerate, such as black holes, they produce distortions in space-time. Scientists are interested in observing and characterizing these ripples in space-time so that they can learn more about the astrophysical systems that produce them, and about gravity itself. Proposed experiments to detect them from space, such as a future LISA mission, would need to measure how two freely-falling objects move ever so slightly, relative to each other, as a result of gravitational waves. In order to rule out any disturbances that could mask these waves, there must be a system to compensate for solar pressure and other factors. The Disturbance Reduction System on LISA Pathfinder will demonstrate this technology.

The Disturbance Reduction System could also lead to advanced thruster systems for other space applications. Space telescopes need to be very stable to detect distant planets in other solar systems, for example, and

could use a similar system. A set of thrusters like the Disturbance Reduction System's could also be used in small satellites to help synchronize flying patterns.

LISA Pathfinder will reach its final orbit on Jan. 22, and begin science operations on March 1. For the first phase of the mission's science operations, a thruster technology system designed by the European Space Agency will be used. JPL's Disturbance Reduction System will then take over in June or July, operating for 90 days.

Provided by NASA