Press Release

Detecting gravitational waves in space

Successful launch of LISA Pathfinder

Zurich, 3 December 2015

After the successful lift-off of the Vega rocket in French Guiana, the LISA Pathfinder satellite uncoupled from its booster rocket at approximately 7.00 a.m. this morning. The satellite will spend the next 9 months floating in space. There it will enable scientists to test key measurement techniques for the detection of gravitational waves, which Albert Einstein predicted about 100 years ago in his general theory of relativity.

Scientists at ETH Zurich and the University of Zurich have been working toward this moment for 12 years. This morning, a European Space Agency (ESA) Vega rocket was launched from the spaceport at Korou, sending the LISA Pathfinder satellite into space. If the mission is successful, the satellite will send data back to earth over the coming months that should show whether the concept and technology of LISA Pathfinder function well enough to detect gravitational waves in space during a later mission.

In his work, Einstein predicted the existence of gravitational waves, which are caused by high-energy cosmic events, such as exploding stars or black holes. In spite of intensive efforts, experimental proof for his theory has so far eluded scientists.

LISA Pathfinder is an international project of the ESA and a preliminary project for eLISA (LISA = evolved Large Interferometry Space Antenna), a mission to prove the existence of gravitational waves, which is planned for 2034.

Development of highly sensitive measuring instruments
The concept for detection of gravitational waves in space is based on the fact that the distance between two widely separated masses changes minimally when a gravitational wave passes through the

space between them. The required accuracy of measurement is just a few picometres, a fraction of the diameter of an atom.

In collaboration with Ruag Space, scientists working with Domenico Giardini, Professor of Seismology and Geodynamics at ETH Zurich, developed the electronics responsible for measurement and control of the satellite's detection device. The mission measures precisely the smallest changes in the distance between two cubes made of a gold-platinum alloy. ETH Zurich's control electronics also ensure that these cubes float freely in the satellite.

Excluding adverse effects in space

Philippe Jetzer, Professor of Physics at the University of Zurich, and his team investigated the theoretical aspects in relation to the general theory of relativity and astrophysics. "In space, we can rule out unwanted effects on the measurements, such as ground vibration," Jetzer explains. This is one reason why the researchers are turning to outer space in order to detect gravitational waves.

A more significant reason is the increased sensitivity: in the follow-up eLISA project, three satellites will be interconnected, which will allow the observation of two test masses about a million kilometres apart, approximately 25 times the circumference of the earth. The interferometer used to measure the gravitational waves emitted by the most energetic processes in the Universe is so precise and of such exceptional dimensions that it could not be built on the ground.

As members of the 10-member eLISA Consortium Board, Giardini and Jetzer will participate in the analysis of the gravitational waves that it is hoped eLISA will detect.

Lift-off under a lucky star

Domenico Giardini appeared relieved following the successful launch of LISA Pathfinder: "We are delighted that our instruments are travelling to space after so many years. We are confident we will be able to gather highly precise data in the coming months which will prove our capacity to measure gravitational waves and will significantly advance the project." This morning, the satellite was launched into a slightly elliptical parking orbit. With the help of an integrated drive module, it will gradually enlarge its orbit around the earth over a two-week period, before beginning its two-month journey to its deployment orbit.

For Jetzer from the University of Zurich, a lucky star shines over today's date: "It's almost 100 years to the day since Albert Einstein first published his findings on the general theory of relativity," he says.

TV and visual material: http://sci.esa.int/lisa-pathfinder →
Fact sheet: www.erdw.ethz.ch/en/news-veranstaltungen/news/archiv/2015/11/lisa-pathfinder-countdown.html→

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