MASCOT - an asteroid lander with a sense of direction

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Cooperation between DLR and Japanese Aerospace Exploration Agency (JAXA)

When the Japanese Hayabusa-2 mission is launched towards asteroid 1999 JU 3 in 2014 to collect surface samples, MASCOT – the Mobile Asteroid Surface Scout – an asteroid lander developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) will be on board. On arrival at the asteroid in 2018, it will be released from the main spacecraft, land on the asteroid, automatically orient itself and 'hop' from one measurement site to the next. DLR and the Japanese Aerospace Exploration Agency (JAXA) signed a memorandum of understanding on 1 October 2012, at the International Astronautical Congress (IAC) in Naples.

Upon arrival at 1999 JU 3, the Japanese Hayabusa-2 spacecraft will first make a close approach to the asteroid and take measurements of the body's surface from there. Following this initial cartographical phase, the MASCOT asteroid lander, which is being developed by DLR in collaboration with French space agency (Centre National d'Etudes Spatiales; CNES) and JAXA, will be put to work. A mechanism will push the 10-kilogram lander with its four instruments away from the spacecraft. "MASCOT will free-fall to the asteroid from an altitude of around 100 metres," explained project leader Tra-Mi Ho from the DLR Institute of Space Systems in Bremen. Sensors will then ensure that MASCOT knows which way is up and down, so it can orient itself and, if necessary, correct its attitude.

"This collaboration will enable us to consolidate and strengthen our existing cooperation with JAXA," said Johann-Dietrich Wörner, Chairman of the DLR Executive Board. "There is also a special 'first' with the Hayabusa-2 mission; it will be the first time that a lander on the surface of an asteroid is able to move around and perform scientific measurements in more than one place."

In-situ measurements

While Hayabusa-2 remains above the surface of the asteroid, the four instruments on MASCOT will carry out in-situ investigations into the properties of the surface. The DLR radiometer will measure the temperature, a magnetometer developed by Technische Universität Braunschweig will investigate the magnetisation of the rock, and the spectrometer supplied by CNES will analyse the minerals and rocks that make up the asteroid. The fourth instrument, a DLR camera, will image the fine structure of the surface to enable scientists to learn about the properties, size and shapes of the particles on the surface of the asteroid and map the area around the landing site.

Asteroid 1999 JU 3 is of particular interest to researchers because it consists of 4.5-billion-year-old material that has been altered very little. "Measurements taken from Earth also indicate that the asteroid's rock may have come into contact with water," explains Ralf Jaumann, a DLR planetary researcher and scientific spokesman for the experiments on the lander. "MASCOT is due to take measurements of the regolith itself, which will provide reference data about the surface and enable the samples subsequently brought back by Hayabusa-2 to be interpreted in the correct context." 1999 JU 3 belongs to a type of asteroid that is one of the most common among near-Earth asteroids, so information about its properties will be important in the event that one of these bodies is ever on a collision course with Earth.

At operation for two asteroid-days

Meanwhile, the Hayabusa-2 spacecraft will be using a suction nozzle to collect samples kicked up from the surface by impactor projectiles, and then return these to Earth for laboratory analysis. "MASCOT is the central piece of the puzzle in all the measurements," said project leader Tra-Mi Ho. "That is, it is the link between the data on the asteroid that the probe collects remotely and the laboratory analyses of the samples." Once the DLR asteroid lander has carried out all its measurements at one site, it will then 'hop' to the next site and start taking measurements there. This mechanism is being developed at the DLR Institute of Robotics and Mechatronics. MASCOT will work on the asteroid for a total of 16 hours – two full asteroid-days.

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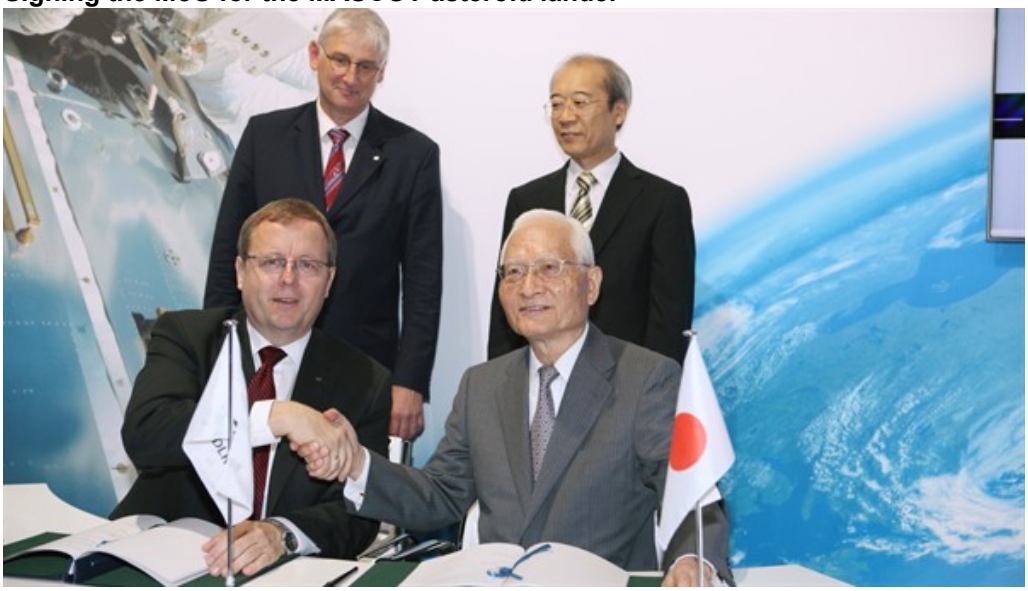
Signing the MoU for the MASCOT asteroid lander



DLR Executive Board Chairman Johann-Dietrich Wörner (front left), Keiji Tachikawa, President of the Japanese Aerospace Exploration Agency (JAXA) (front right), DLR Executive Board Member for Space Research and Technology Hansjörg Dittus (rear left) and Yuichi Yamaura, Associate Executive Director for Space Exploration JAXA signing the Memorandum of Understanding for cooperation in the Hayabusa-2 mission on 1 October 2012.

MASCOT asteroid lander in microgravity

DLR researchers use parabolic flights to test the MASCOT asteroid lander's functions in microgravity. MASCOT is due to separate from the Japanese Hayabusa-2 spacecraft above asteroid 1999 JU 3 and fall to the surface.

Credit: DLR (CC-BY 3.0).

Integration of MASCOT

DLR researchers are developing MASCOT, the Mobile Asteroid Surface Scout asteroid lander. The lander will fly to asteroid 1999 JU 3 on board the Japanese Hayabusa-2 spacecraft.

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