



JUICE – mission to the icy moons of Jupiter

22 February 2013

Mission involvement for the German Aerospace Center

Last week, the European Space Agency (ESA) announced its choice of scientific experiments for the JUICE Mission (JUper ICy moons Explorer). The decision taken involved two experiments developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) Institute of Planetary Research.

As the first big mission in the ESA Cosmic Vision 2015-2025 programme, JUICE is scheduled to spend three years exploring the Jovian system. The launch is scheduled for 2022, and the spacecraft should reach its destination in 2030, where it will make detailed observations of the largest planet in the Solar System and the Galilean satellites Io, Ganymede, Callisto and Europa. The focus here is on the oceans of water below the thick, ice-encrusted surfaces of the individual moons, accurate measurements of these satellites and their interaction with the giant 'particle accelerator' that is Jupiter and its magnetic field.

En route to the gas giant with JANUS and GALA

The payload of the JUICE spacecraft will include a total of 11 instruments, including cameras, a spectrometer, a laser altimeter and a ground radar for ice. Fifteen ESA member states as well as the United States and Japan are involved in this project. DLR will play a key role on this mission with its JANUS camera system (an acronym for Jovis, Amorurum ac Natorum Undique Scrutator) and GALA (GANymede Laser Altimeter). "This selection showcases great technological performance capability as well as recognition of DLR's outstanding international scientific standing," said Tilman Spohn, Director of the DLR Institute of Planetary Research in Berlin, as he welcomed the decision by ESA.

The JANUS camera system is being developed in a collaborative venture with Italian scientists. This camera, developed jointly by Ralf Jaumann from the DLR Institute of Planetary Research and Pasquale Palumbo, of the Università degli Studi di Napoli 'Parthenope' in Naples, will map the surface of the icy moons of Jupiter and, in the case of Ganymede, will perform a full global mapping. "In this way, we can investigate local regions of these moons that either recently were, or perhaps still may be geologically active, and can do so to a resolution of just a few metres," announced Jaumann. Recordings will also be made of changes in Jupiter's atmosphere and of possible volcanic eruptions on Io.

The second experiment, GALA, is a laser altimeter which will be used to measure the topography of Ganymede, and is capable of height readings accurate to within 15 centimetres. DLR planetary researchers, under the direction of Hauke Hussmann, with some Japanese involvement, are developing GALA. This height-measuring instrument precisely determines topographical height from elapsed time; that is, the time for a laser pulse to be transmitted to the surface of the satellite and reflected back to the spacecraft. When the flight path of the spacecraft is known, hundreds of millions of these individual measurements enable a very accurate topographic model of the moon to be built up. "This will be the first time we will have managed to produce a detailed terrain map, not an easy task given the relative absence of physical relief on Europa, Ganymede and Callisto," explained Hussmann. "Furthermore, from this data we can extrapolate information about the internal structure and the rotational characteristics of the Jovian satellites."

Admittedly, the probe's two flybys of Europa and its 12 flybys of Callisto will not be sufficient to provide complete global coverage, but nonetheless some extremely accurate topographical profiles of these satellites can be obtained. The combination of the laser altimeter, the JANUS

camera and the 3GM radio wave experiment constitutes a geophysical-geodetic package that can help determine the nature of these moons, their geological activity and their internal structure.

Jupiter – an archetype among gas giants

With an equatorial diameter of approximately 143,000 kilometres, Jupiter is the largest planet in the Solar System and is therefore your typical gas giant. With its four large Galilean moons, Jupiter is a small planetary system in its own right. Below the surface of Ganymede, Europa and Callisto, scientists believe there are giant oceans of liquid water that might conceivably harbour life, as we know it. The JUICE Mission aims to gain a comprehensive understanding of the Jovian system and decipher its history and origins. As well as the conditions for planetary formation, this mission will explore the fundamental question of how the Solar System really functions. By exploring the gas giant, located almost 800 million kilometres from the Sun, and by finding out more about its satellites, scientists hope to be able to draw conclusions about the origin and development of life. These insights can, in turn, help to track down life in systems similar to Jupiter beyond the Solar System.

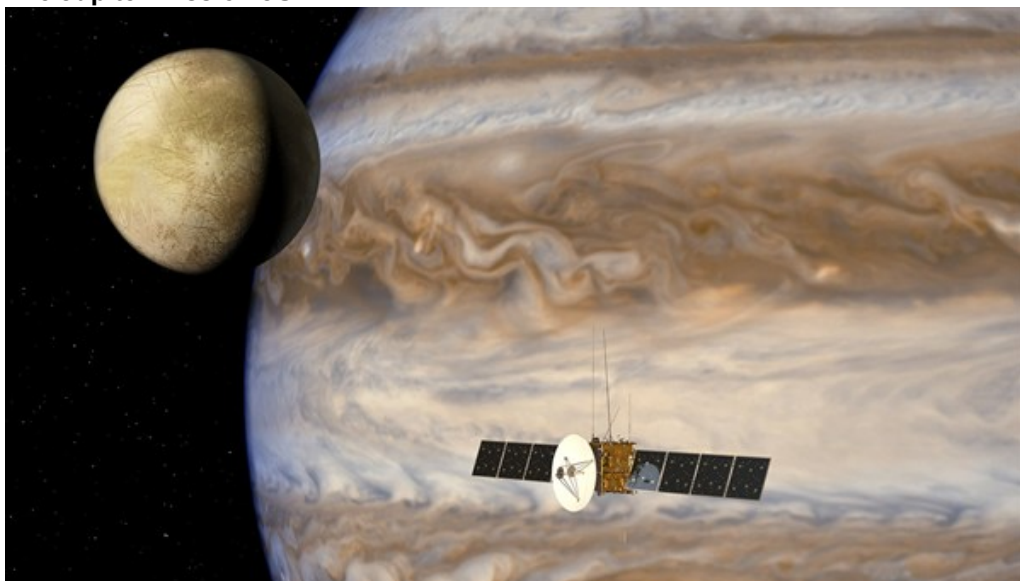
Contacts

Melanie-Konstanze Wiese
German Aerospace Center (DLR)
Tel.: +49 30 67055-639
Fax: +49 30 67055-102
melanie-konstanze.wiese@dlr.de

Prof.Dr. Ralf Jaumann
German Aerospace Center (DLR)
Institute of Planetary Research, Planetary Geology
Tel.: +49 30 67055-400
Fax: +49 30 67055-402
Ralf.Jaumann@dlr.de

Dr Hauke Hußmann
German Aerospace Center (DLR)
Conceptual design of scientific payload and preparation of planetary missions
Tel.: +49 30 67055-315
Fax: +49 30 67055-402
Hauke.Hussmann@dlr.de

The Jupiter Mission JUICE

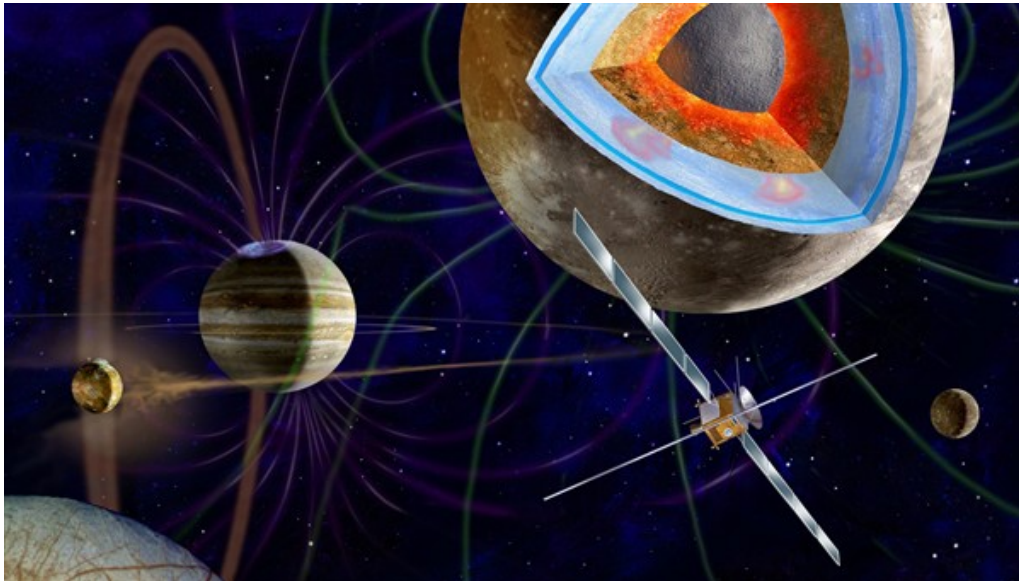


Artist's impression of the JUICE Mission (JUper ICy moons Explorer) to Jupiter and its 67 moons. JUICE is scheduled to launch in 2022, and DLR is involved in the mission. The mission focuses on the planet itself, as well as three of its moons, Ganymede, Callisto and Europa.

Scientists believe that oceans of water are present beneath the thick ice on their surfaces – and it is even conceivable that life, as we know it, may have evolved here. Arrival at Jupiter is scheduled for 2030. After a three-year observation period, JUICE is scheduled to complete its mission in 2033.

Credit: ESA/AOES.

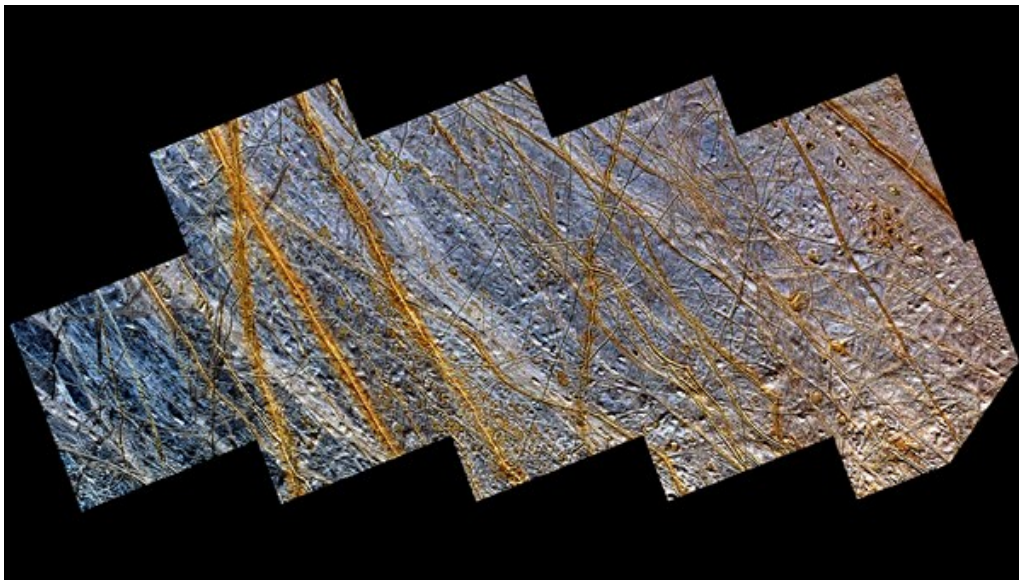
Artist's impression of the JUICE space probe together with Jupiter and its four Galilean moons



The JUICE space probe together with Jupiter and its four Galilean moons. Ganymede is shown in cross-section to display its supposed internal structure. You can see a thin blue line marking an ocean of water sandwiched between ice shells, surrounding a core of metal and rock. The small moon to the left is Io, which has no icy armour but does have sulphur geysers. JUICE will not fly to Io.

Credit: ESA.

Jovian moon Europa – double mountain ridges, dark patches and smooth plains of ice



This composite image of a region in the southern hemisphere of Jupiter's moon Europa contains numerous surface features that are typical of the icy crust on this moon. Double mountain ridges of a brownish hue run in straight lines across this section of the image. These could be the frozen vestiges of one-time cryovolcanic activity on this moon. Dark patches extending over several kilometres can be seen almost right across the section of image shown here. There is no clear explanation of the substances forming these mountain ridges, or of the dark patches. A (geologically older) blue surface consisting almost entirely of pure water ice is located under the double ridges. This section of image covers a surface area of 800 by 350 kilometres. The image resolution is 230 metres per pixel. The colour contrasts have been enhanced to highlight morphological details and the surface composition more clearly. These images were recorded using the digital camera system on board the NASA spacecraft Galileo during two different orbits. During the E15 close flyby of Europa on 31 May 1998, high-resolution images were taken from a distance of about 25,000 kilometres. These were combined on the computer with image data from two other colour filters on the camera that captured lower resolution images during the G1 orbit of Galileo on 28 June 1996.

Credit: NASA/JPL.

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