



Visual contact with dwarf planet Ceres

05 December 2014

With a diameter of nearly 1000 kilometres, it was the largest known asteroid – and yet Ceres, which was 'promoted' from asteroid to dwarf planet in 2006, is just nine pixels wide in the image acquired by the Dawn spacecraft on 1 December 2014. The dwarf planet appears tiny in the image as 1.2 million kilometres still separate the spacecraft and its target. In March 2015, the US spacecraft, which has already orbited and studied the asteroid Vesta, will reach Ceres. The dwarf planet could not only have a thick crust of ice, but might even be hiding an ocean of water underneath the ice. "I'm already certain that we will get many answers about the origin of the Solar System – and also plenty of new questions," says Ralf Jaumann, a planetary scientist at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and Co-Investigator (Co-I) on the Framing Camera team.

New worlds to map and survey

The NASA Dawn spacecraft was launched on 27 September 2007 and reached the asteroid Vesta on 16 July 2011. For planetary researchers, this opened a door into an unexpectedly diverse world. A mountain twice as high as Mount Everest, rugged slopes and surfaces, a giant impact crater at the South Pole, deeply furrowed landscapes and a fractured crust made Vesta a treasure trove for scientists. "28,000 images were acquired and each one was full of surprises for us," explains Jaumann. Within a year, DLR planetary researchers were able to survey the elliptical asteroid, map it and create a three-dimensional model of the terrain. A first look at the dawn of the Solar System, as the planets formed 4.6 billion years ago, had been achieved.

Now, with Ceres, comes another never previously explored celestial body. The dwarf planet is the largest body in the asteroid belt between Mars and Jupiter, representing more than one third of the total mass of the belt. It was its size that made it the first asteroid to be discovered; Italian astronomer Giuseppe Piazzi first observed Ceres on New Year's Eve 1801. Between the already visited Vesta and the future target of Ceres there are not only 168 million kilometres, but also the frost line, which the Dawn spacecraft has just reached: "In the inner asteroid belt, closest to the Sun, we find rock bodies such as Vesta, whose water vapour has already disappeared," explains Jaumann. "In the outer asteroid belt, which we are flying through now, there is plenty of ice because the Sun no longer has much effect."

From rocky to icy

With Vesta and Ceres, not only are the two largest and intact asteroids being observed and studied, but also two extremely contrasting celestial bodies. "Another stroke of luck is that we are simultaneously investigating Comet 67P/Churyumov-Gerasimenko with the Rosetta orbiter and the Philae lander," says Jaumann. Since 6 August 2014, the main spacecraft has been orbiting the comet with 11 instruments on board and, since 12 November 2014, the lander, with 10 instruments, has been on the surface of 67P/Churyumov-Gerasimenko. "So we can, for example, compare the ice-mineral mix of the comet with that of Ceres." It is very probable that, like Churyumov-Gerasimenko, the icy crust of Ceres is covered by dust deposits.

In addition, images acquired by the Hubble Space Telescope have already shown from a distance that Ceres has probably given off water vapour and other gases into its surroundings. The dwarf planet could even be active and have a thin atmosphere of water vapour. "This is incredibly exciting for us." At the least, it should be possible to determine the change in the surface of Ceres from orbit around the dwarf planet with the camera. "If there is gas flowing out from geysers, it would freeze immediately and fall on the surface as snow." The possible activity suggests yet another idea to the DLR planetary scientist: "Underneath the ice crust, there

should be internal heat and thus an ocean in which there could also be biological reactions.' The source of the energy that heats the dwarf planet internally remains an unsolved mystery.

In orbit around the icy Ceres

More images will be acquired in the next few months, during the approach. In March 2015, the Dawn spacecraft will have reached its target and will enter an observation orbit around Ceres. Gradually, the distance to Ceres will be reduced until the spacecraft's camera will finally look at the surface of the dwarf planet from a distance of only a few hundred kilometres. Dawn will orbit icy Ceres and explore the dwarf planet for one year. For this celestial body too, the DLR Institute of Planetary Research will then compute a three-dimensional model of the terrain and study the topography of Ceres. "There are many questions for which we want to find an answer. What does the surface look like, and how has it changed over the course of time? Is there tectonic activity? That is, does the ice crust of Ceres move? And do the deposits, the dirt on the surface, come from the interior of the dwarf planet or were they brought to the surface by external impacts?" Ralf Jaumann is certain of one thing: "With the Dawn mission, we have a good chance of finding out and thus better understand the origin of the Solar System."

The mission

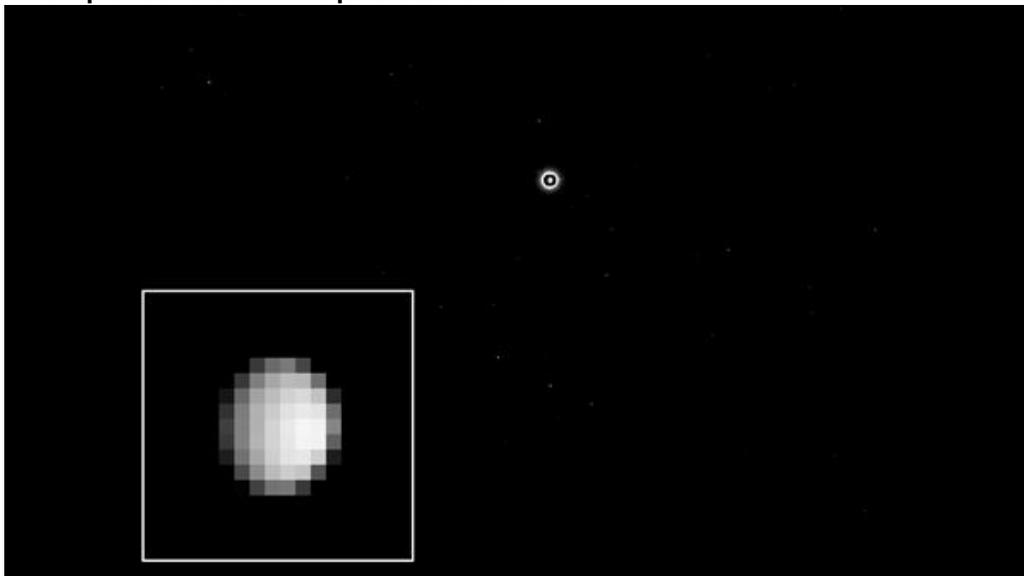
The Dawn mission is managed by NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology. The University of California, Los Angeles, is responsible for overall Dawn mission science. The Dawn Framing Cameras have been developed and built under the leadership of the Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany, with significant contributions by DLR German Aerospace Center, Institute of Planetary Research, Berlin, and in coordination with the Institute of Computer and Communication Network Engineering, Braunschweig. The Framing Camera project is funded by the Max Planck Society, DLR, and NASA/JPL.

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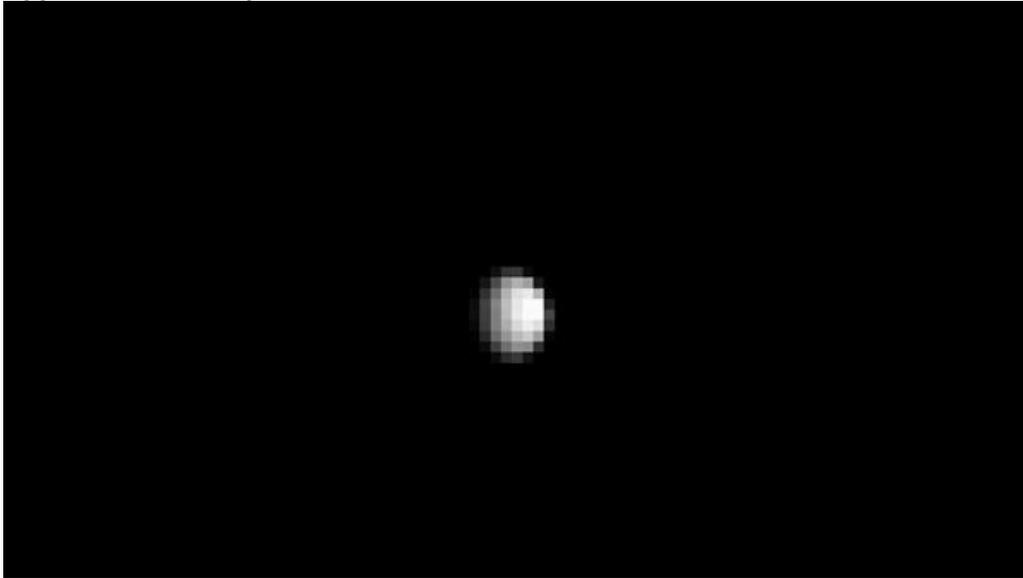
Dwarf planet Ceres – nine pixels across



On 1 December 2014, the Framing Camera system on board the Dawn spacecraft acquired an image of the dwarf planet Ceres from a distance of 1.2 million kilometres. At this distance, the celestial body, which is nearly 1000 kilometres across, is only nine pixels wide. The German Aerospace Center (DLR) is participating in the mission and will use the data acquired by the camera to create a three-dimensional terrain model of Ceres. In this image, Ceres is the bright spot in the centre. To compensate for the distortion caused to the long exposure time, the resulting incorrect size of the dwarf planet has been corrected in the image.

Credit: NASA/JPL-Caltech/MPS/DLR/IDA.

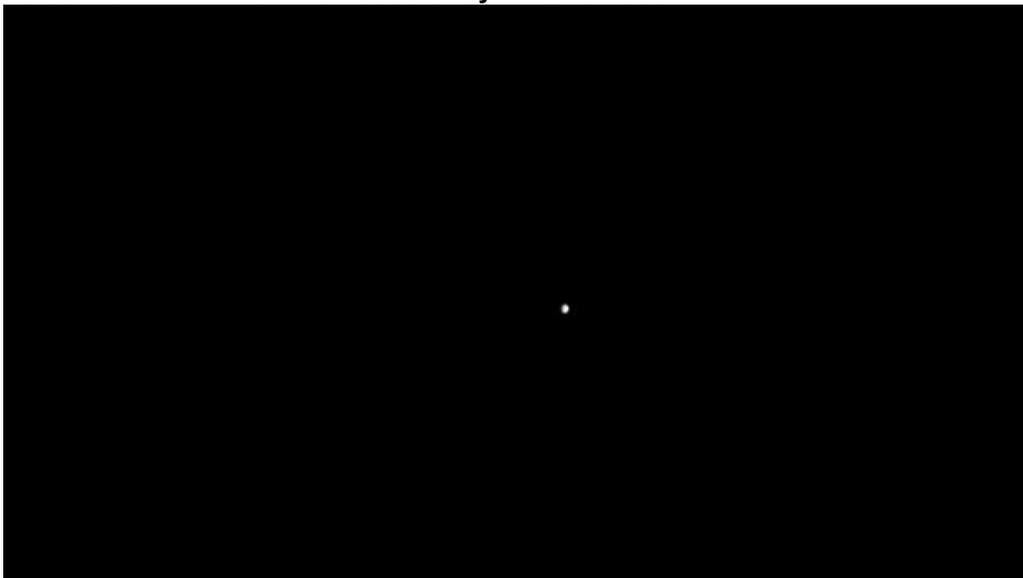
Approach to dwarf planet Ceres



In March 2015, the US Dawn spacecraft, which is carrying a German camera system on board, will reach the dwarf planet Ceres. This image was acquired on 1 December 2014 from a distance of 1.2 million kilometres. In the image, Ceres is just nine pixels across; it is actually approximately one kilometre in diameter and the largest body in the asteroid belt.

Credit: NASA/JPL-Caltech/MPS/DLR/IDA.

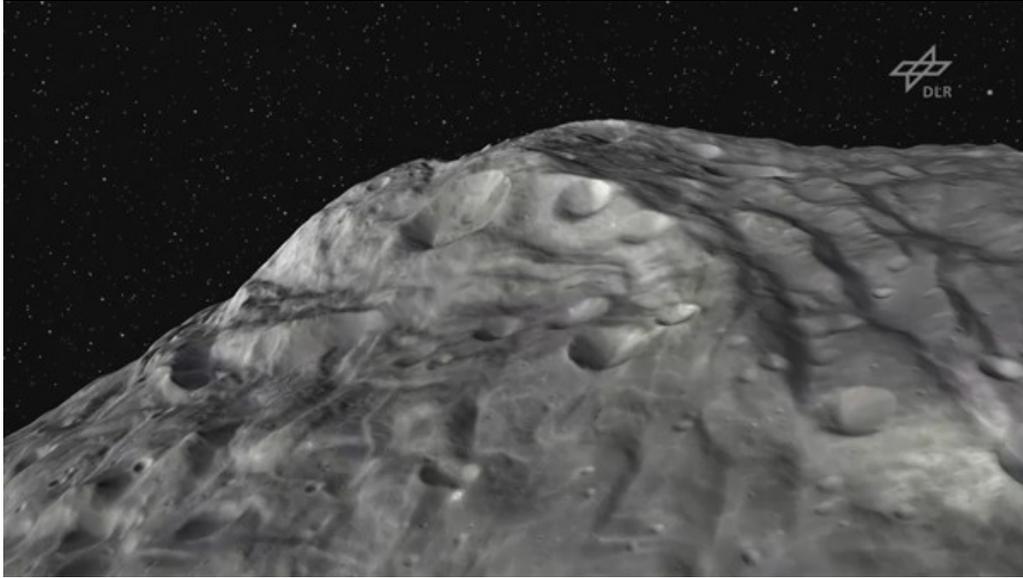
Ceres from 1.2 million kilometres away – a small dot



From a distance of 1.2 million kilometres, the dwarf planet Ceres is just a small, bright dot. In March 2015, the Dawn spacecraft will reach its target and image Ceres from a few hundred kilometres with a German camera system. The German Aerospace Center (DLR) will use the data acquired by the camera to create a three-dimensional terrain model of Ceres.

Credit: NASA/JPL-Caltech/MPS/DLR/IDA.

Video – the best of Dawn’s year at Vesta



From the more than 28,000 images acquired by Dawn between July 2011 and August 2012, DLR scientists computed a global digital surface model of Vesta. Ralf Jaumann, head of DLR's Dawn scientific team, explains a few spectacular observations with the help of this virtual flight over Vesta. The animation was computed by DLR using the highest resolution images acquired on this mission, and shows details down to a size of just 70 metres.

Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA.

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