Curiosity - a heavyweight Mars explorer

25 November 2011

Researchers at DLR and Kiel University will conduct the first investigations about radiation levels on the Martian surface

The US 'Curiosity' rover began its journey to Mars at 16:02 CET on 26 November on board an Atlas V 541 / Centaur launcher that lifted off from Launch Complex 41 at Cape Canaveral Air Force Station in Florida. With 10 instruments on board, Curiosity will gather information about how hostile to or favourable for life the Red Planet was in the past – and might be for future manned missions. The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and Christian Albrecht University in Kiel are part of the team that is sending a Radiation Assessment Detector (RAD) to Mars. The objective is to measure radiation levels at the Martian surface for the first time ever, thereby establishing the potential radiation dose for future astronauts and determining the depth below the surface at which living organisms might be able to survive. The spacecraft will land in Gale Crater – a destination that DLR planetary researcher Ernst Hauber favoured during workshops with NASA.

The Mars Science Laboratory (MSL) mission is a genuine heavyweight. The Curiosity rover weighs almost a ton and will employ a complex hovering manoeuvre to land on the surface of Mars. Twice as long and five times heavier than its precursors, 'Spirit' and 'Opportunity', the rover, almost as big as a passenger car, will perform a range of different tasks. These include recording the Martian surface with cameras, drilling into the ground and analysing the composition of soil and rock samples, as well as measuring radiation levels at ground level and in the atmosphere. The RAD instrument is no bigger than a shoebox; its sensor head was developed and financed by DLR and Kiel University. For two years, RAD will measure and identify all high-energy radiation at the Martian surface, including protons, energetic ions of various elements, neutrons and gamma rays. This will include not only direct radiation from space, but also secondary radiation produced by the interaction of incoming radiation with the Martian atmosphere and surface rocks and soils. Measurements will also be conducted on the way to Mars: "There is not much data about radiation in interplanetary space," explains radiation biologist Günther Reitz from the DLR Institute of Aerospace Medicine. The first measurements will be taken on the planet's surface as soon as the rover lands on Mars. "So far, the only available data was obtained from measurements taken in orbit around Mars; now, for the first time, we will be recording these levels on the surface," says Reitz. The researchers will compare the measured radiation levels with existing model calculations and further refine them.

Measurements for future Mars astronauts

Using the radiation level data sent back to Earth by Curiosity, researchers will estimate the exposure levels to which astronauts on Mars could be subjected. "Earth is protected by its atmosphere; Mars' atmosphere, however, is very thin, so the planet is relatively unshielded from cosmic radiation," explains Reitz. Radiation biologists at DLR have already conducted evaluations showing the radiation level to which astronauts on board the International Space Station (ISS) are exposed. Researchers also hope that this new radiation monitor will help answer another question: "These investigations are important because they will enable us to determine the depth below the surface at which earlier life forms may have survived the radiation environment on Mars, or indeed may still survive today," adds Robert Wimmer-Schweingruber from Kiel University.

Gale Crater, in which Curiosity will start its journey of exploration, has a diameter of more than 150 kilometres. In the race to be selected as the most interesting landing site, it finally won against Eberswalde Crater, Holden Crater and Mawrth Vallis. Not only does it offer sufficient room to ensure the safest possible landing, it is also fascinating to planetary researchers for two

reasons. "Mineralogists will be delighted because multispectral measurements have already shown that there are minerals in Gale Crater that were probably formed in the presence of liquid water," explains Ernst Hauber, a Mars expert at the DLR Institute of Planetary Research. Hauber attended several workshops in the United States, during which the landing sites and their respective advantages and disadvantages were scrutinised from a scientific point of view. For Hauber, it was primarily the geomorphology of this crater that convinced him of its suitability as a landing site. "Inside the crater, there is a kind of stack of layered sediments – we planetary researchers naturally want to find out how this stack of sediments was formed," explains Hauber. "Was it the wind, or was it formed by water? We can find out with this mission."

Following its successful launch, the Mars Science Laboratory is scheduled to land on Mars on 6 August 2012. Two Earth years later – which correspond to one Mars year – the researchers will confess whether their curiosity has been satisfied. Günther Reitz is already absolutely certain about one thing: "This mission will pave the way for manned spaceflight to Mars."

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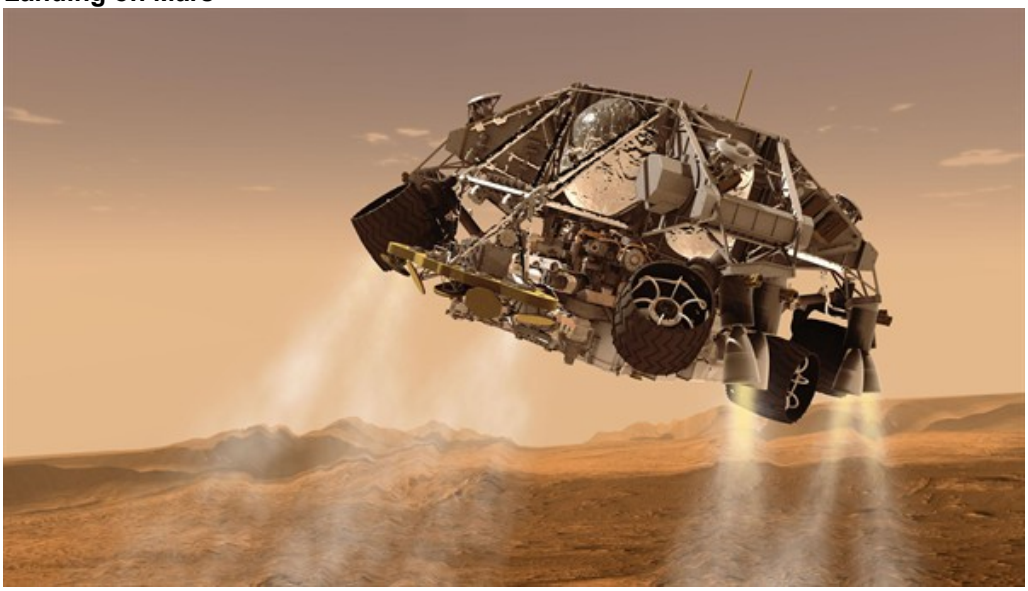
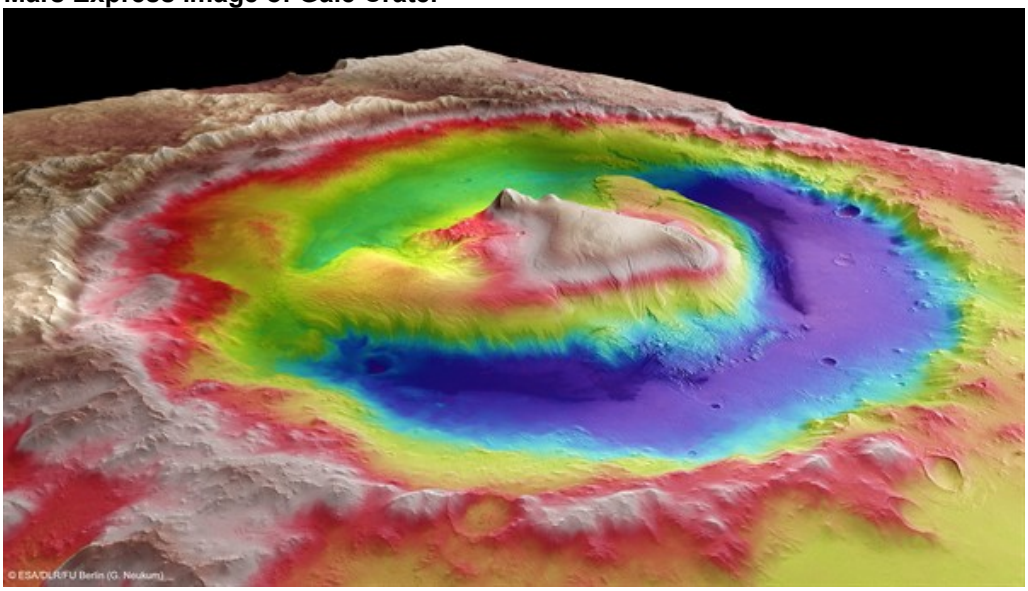
Landing on Mars



The Mars Science Laboratory will employ a complex hovering manoeuvre to land on the surface of Mars.

Credit: NASA.

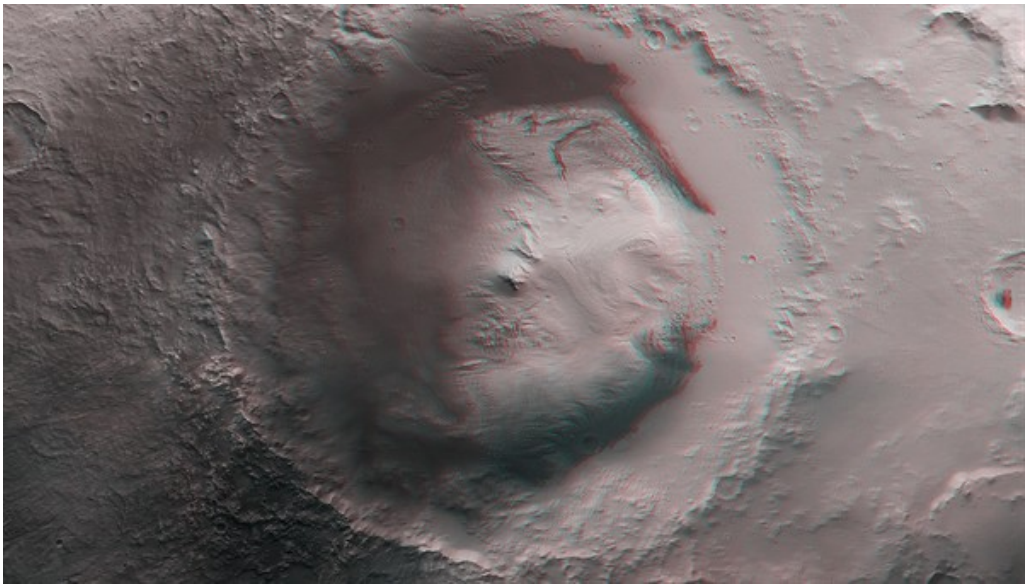
Mars Express image of Gale Crater



Gale Crater, the landing site for the Mars rover 'Curiosity', has a diameter of more than 150 kilometres. At its centre is an elevated area made up of sedimentary layers.

Credit: ESA/DLR/FU Berlin (G.Neukum).

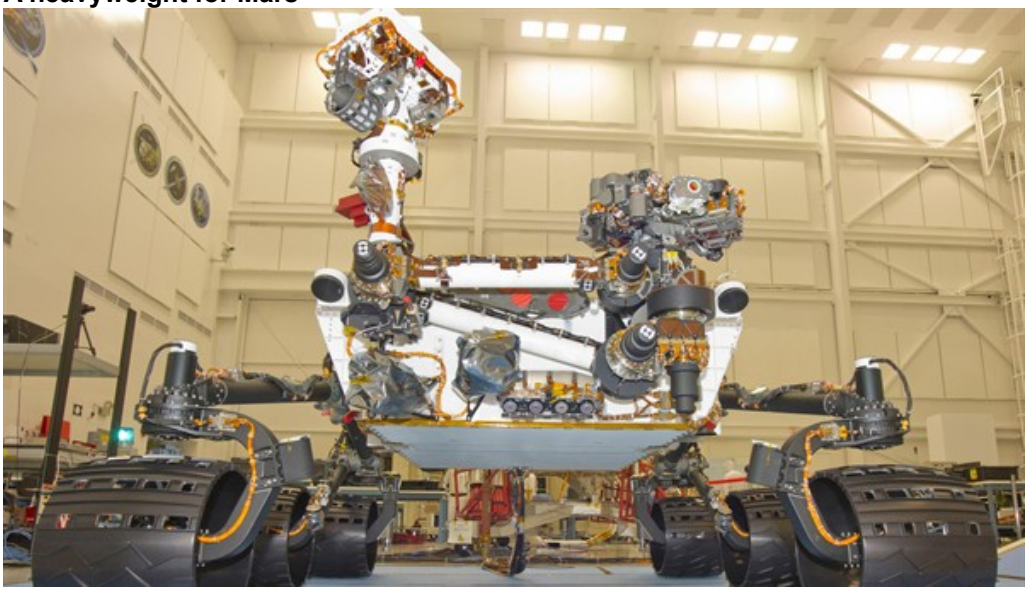
Gale Crater in 3D



Anaglyph image of the Mars Science Laboratory landing site in Gale Crater. Using red-green spectacles it is possible to view the elevation differences.

Credit: ESA/DLR/FU Berlin (G.Neukum).

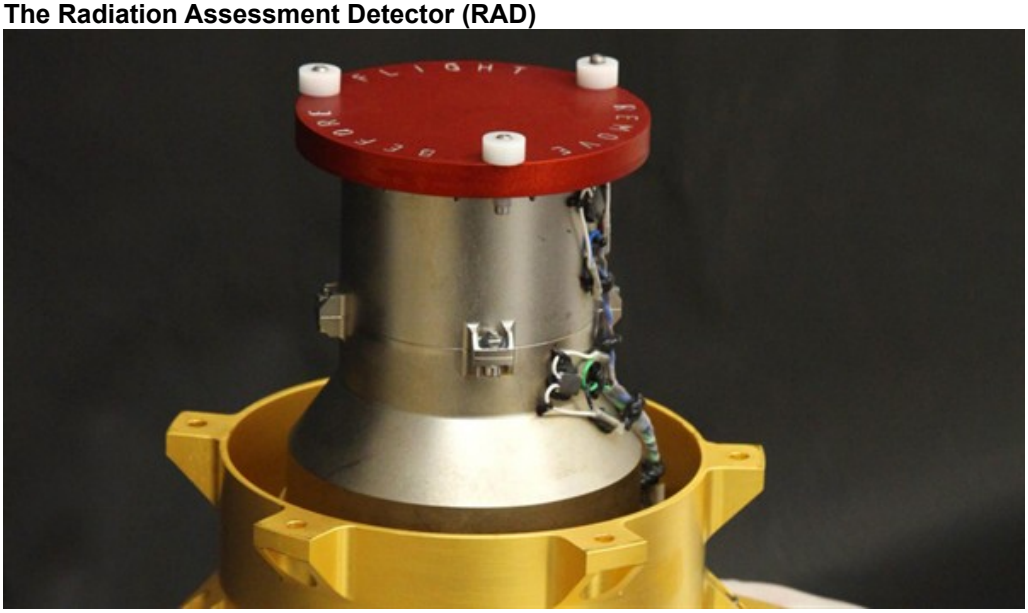
A heavyweight for Mars



Twice as long as and five times heavier than its predecessors, Mars rovers 'Spirit' and 'Opportunity', 'Curiosity' weighs almost a ton and is as big as a car.

Credit: NASA.

The Radiation Assessment Detector (RAD)



The Radiation Assessment Detector (RAD) was developed by the German Aerospace Center (DLR), Christian Albrecht University in Kiel and the Southwest Research Institute (SWRI) in Boulder, Colorado. The German contribution consisted of the development, construction and calibration of the detector head.

Credit: NASA.

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