German Aerospace Center

Radiation measurements with 'Curiosity'

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Researchers at DLR and the University of Kiel obtain the first measurements during Curiosity's journey from Earth to Mars

A mere seven minutes on 6 August 2012 will decide whether the Mars Science Laboratory (MSL) will be successful. Then, the 900-kilogram capsule enclosing the Curiosity rover will begin decelerating 125 kilometres above the Martian surface before being lowered on cables by a rocket-powered 'sky crane'. For researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and Christian-Albrechts-Universität in Kiel, however, the first results are already available; using the Radiation Assessment Detector (RAD), radiation has already been measure on the flight to the Red Planet. Upon landing, RAD will, for the first time, take direct measurements of the radiation levels on the planet's surface. "These results will help us to determine how to protect future astronauts from the radiation on Mars," explains Günther Reitz, a DLR researcher.

The RAD radiometer has worked non-stop since the spacecraft was launched on its journey to Mars on 26 November 2011. "We have been able to obtain measurements during three solar storms – in February, March and May 2012," says Reitz. Firstly, these measurements have provided scientists with valuable data that give them insights into the radiation environment in the Solar System. Secondly, they are now certain that the shoe-box-sized RAD is reliable. Curiosity is equipped with a suite of 10 instruments; among these are multiple cameras, spectrometers and a mini-laboratory to analyse soil samples. The RAD radiometer has been partly funded by the DLR Space Administration as part of the German space programme. In this project, DLR and the University of Kiel are partners of the US Southwest Research Institute, which is responsible for RAD.

First measurements of radiation on the Red Planet

Over the next two years, the radiometer will perform the first radiation measurements ever made on the surface of Mars itself. "We can calculate a lot, but only by measuring actual values on site can we determine the radiation environment," says the astrobiologist from the DLR Institute of Aerospace Medicine. The researchers will compare the measured radiation levels with existing model calculations and further refine them. Since Mars has almost no magnetic field, and only a very thin atmosphere, the radiation levels will be significantly higher than on Earth. "We want to monitor the number of particles and their energy."

Curiosity's landing on 6 August 2012 at 07:31 CEST will be quite unusual; the small-car-sized rover is too large and heavy to land using airbags, as its predecessors Spirit and Opportunity did. When the 4.5-metre pod carrying Curiosity enters the Martian atmosphere, it will be traveling at 21,000 kilometres per hour. Slowed down by the atmosphere, at 11 kilometres above the surface, it will be travelling at about 1500 kilometres per hour; at that point it will deploy its special parachute that, together with eight rocket engines and a sky crane, will provide a smooth descent over the last one and a half kilometres before reaching the planet's surface. As it reaches descent speed, half of its eight engines will shut down and four nylon cords will lower the rover the last 7.5 metres to the ground. Once the spacecraft senses touchdown, the wheels will unfold.

Searching for traces of life

If everything goes as planned, Curiosity will land in Gale Crater, an area near the Martian equator. "The crater has a very diverse topography," says Ernst Hauber of the DLR Institute of Planetary Research. "The landing site in the crater itself is likely composed of very old rocks."

This is very promising for the scientists, because Curiosity is intended to search for traces of the chemical ingredients of life – and the probability of finding these is in old rocks is greater because, in its early history, Mars had a denser atmosphere and a warmer, more humid climate. Then, the rover will travel in the direction of Mount Sharp, a peak in the centre of the 150-kilometre crater. "This peak is a layered mound of debris, where we hope to find minerals that were formed as a result of the presence of liquid water."

Now all the scientists are hoping that Curiosity will land smoothly on the sandy soil of the Red Planet. The NASA spacecraft 'Mars Odyssey' and 'Mars Reconnaissance Orbiter' together with ESA's 'Mars Express' spacecraft will receive signals from Curiosity during the approach and landing and send them to Earth. "Those will be some tense minutes," says Robert Wimmer-Schweingruber of the University of Kiel. Günther Reitz adds: "We will obtain spectacular one-of-a-kind data sets." The data analysis will take two years, he estimates. But then it is important to carefully assess the precautions that must be taken to protect future astronauts. "We could say that this is the precursor mission for a manned mission to Mars."

NASA will livestream the landing of the Mars Science Laboratory.

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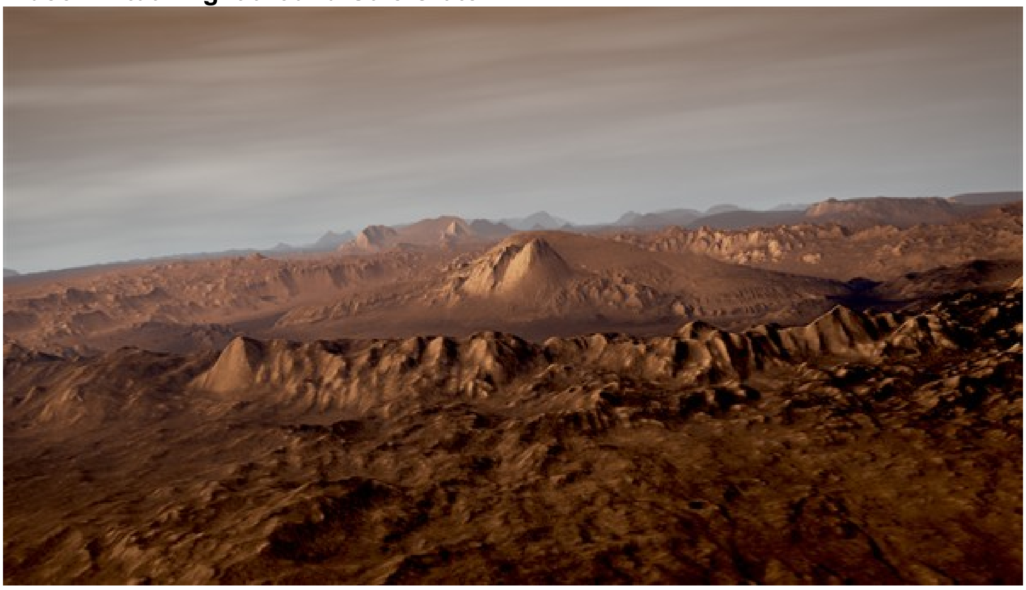
Video: Virtual flight around Gale Crater



Using images acquired by the High Resolution Camera (HRSC) on board ESA's Mars Express spacecraft, DLR researchers have created a 3D virtual flight over the landing site of the Mars Science Laboratory in the 150-kilometre-sized Gale Crater. The landing scenario is also visible at the end.

Credit: ESA/DLR/FU Berlin (G. Neukum)/Animation: Stephan Elgner, DLR.

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