NASA selects DLR experiment for InSight mission to Mars

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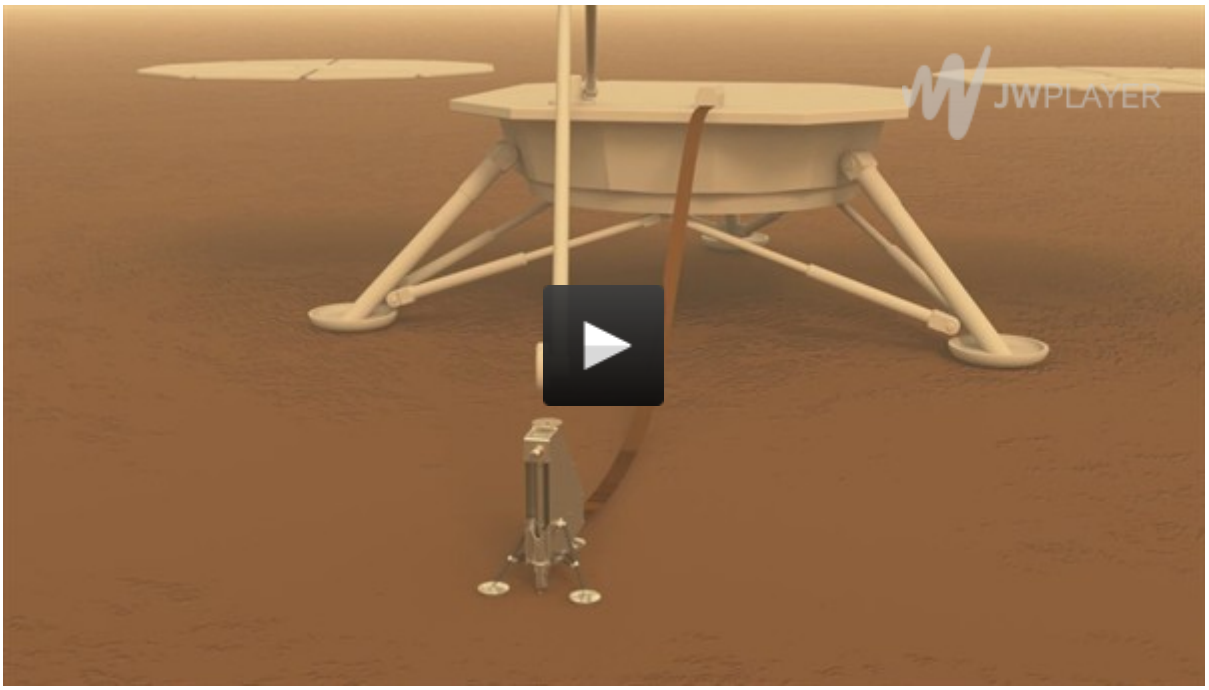
After the successful landing of the Mars Science Laboratory Curiosity rover, NASA has selected one more lander mission to Mars. The InSight mission will reach Mars in September 2016, after a six-month journey; it has been designed to take a 'look' into the deep interior of the Red Planet; it will do this with geophysical experiments including DLR's HP^3, which will penetrate several metres into the Martian subsurface to measure the soil's thermo-physical and electrical properties.

"The selection of the mission InSight by NASA demonstrates the importance of exploring our planetary neighbour. I am very pleased that DLR can contribute with their own experiment on this lander to unveiling the mysteries of the Red Planet," said Johann-Dietrich Wörner, Chairman of the DLR Executive Board.

InSight stands for 'Interior Exploration using Seismic Investigations, Geodesy and Heat Transport'. The mission name clearly explains that geophysical experiments are conducted on and underneath the Martian surface; for example, measuring the velocity of seismic waves or the heat flow. One of the aims of the mission is to understand the structure and state of the core and crust, as well as the thermal evolution of Mars. The HP^3 experiment for the InSight mission was developed at the German Aerospace Center (Deutsches Zentrum für Luft-und Raumfahrt; DLR). HP^3 is short for 'Heat Flow and Physical Properties Package'.

"So far, the exploration of Mars has been carried out by observations from orbit and directly on the surface," explains Tilman Spohn, scientific lead of HP3 and Director of the DLR Institute of Planetary Research in Berlin-Adlershof. "But the study of the planet’s interior is only the beginning. HP^3 could drive Mars research significantly forward." After the Radiation Assessment Detector (RAD) , which was jointly developed by the University of Kiel and DLR for the current Curiosity mission, and the High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft, HP^3 is the third DLR experiment to investigate our planetary neighbour.



Video: HP3 experiment will measure the heat flow in the interior of Mars. Source: DLR (CC-BY 3.0).

Into the Martian surface with an electro-mechanical mole

For some time now, planetary research has dealt with the question of why Mars is so different compared to Earth; for example, the lack of plate tectonics or continental drift. This process is fundamental to the carbon cycle on Earth, and could determine why, on Earth, conditions for life are much more favourable than on Mars. "In its earlier history, water flowed on Mars, so it is likely that the conditions were favourable for life at some point; for example, those influenced by the effect of volcanic activity on the temperatures of the atmosphere," explains Professor Spohn. "Mars continues to be the likeliest place beyond Earth in the Solar System where life could have originated."

DLR's HP^3 experiment uses an electromechanical impact mechanism capable of driving an instrument container into the Martian surface to a depth of up to five metres. "Until now, a fully-automatic mole of this kind has never been used on any planetary body in our Solar System," states Tim van Zoest, a physicist at the DLR Institute of Space Systems in Bremen, where the impact mechanism was developed. "Comparable experiments to analyse material below the planet's surface have only been conducted manually on the Moon during the US Apollo missions 15 and 17 in the early seventies. But the tools used then were similar to conventional drills."

The sensors on HP^3 were developed at the DLR Institute of Planetary Research in collaboration with the Space Research Institute of the Austrian Academy of Science in Graz. In particular, the mole will monitor the heat flow inside the Martian surface. The precise and direct measurement of heat flow under the surface will enable the determination of the heat produced deep inside Mars. This will give insights into the composition of the Red Planet and its ongoing cooling process, which is related to its present volcanic activity. HP^3 will also study the geological stratification of the first five metres below the Martian surface – especially the presence of ice – through the measurement of the geoelectrical properties of the ground.

InSight is the twelfth mission in NASA's Discovery programme, which is characterised by cost-efficient projects with a relatively small budget of about 500 million US dollars. The trademark of the Discovery missions is their strong focus on specific scientific questions. The mission is headed by Bruce Banerdt of the Jet Propulsion Laboratory (JPL), one of the United States' most prestigious Mars researchers. In addition to DLR, the French Space Agency CNES is also involved.

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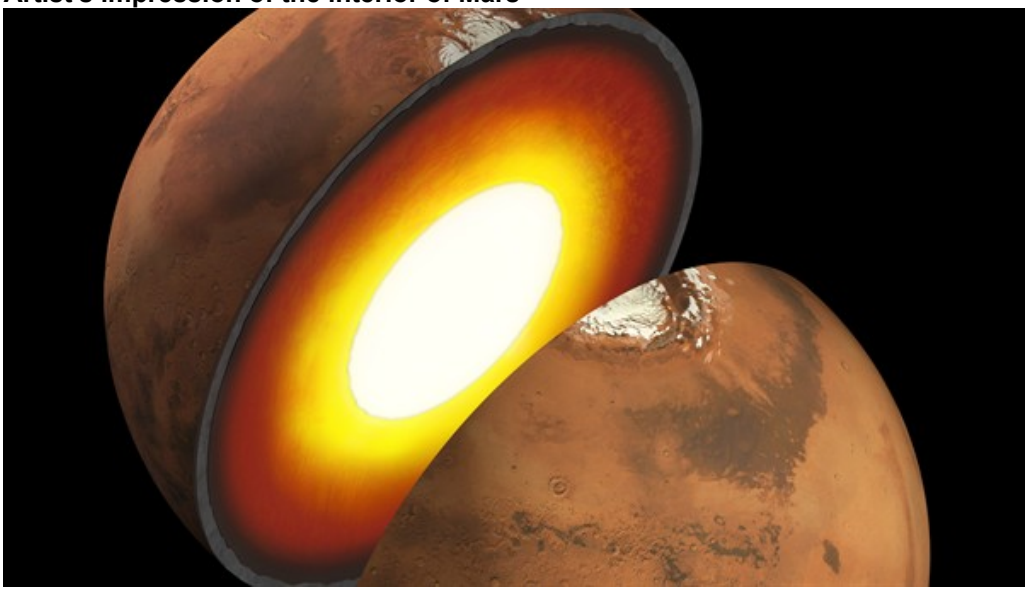
Artist's impression of the interior of Mars



With a diameter of about 6800 kilometres, Mars is only half as large as Earth. Its internal structure is not well known. With the gephyisical InSight lander planned for 2016/17, NASA expects to gain new insights into the structure and thermal evolution of the planet. Mars has, much like all rocky planets, a shell structure. The relatively small, hot iron core is surrounded by a presumably largely solidified shell of iron-rich, siliceous rocks. There is evidence that Mars, in its early history had magnetic field (probably a weak one).

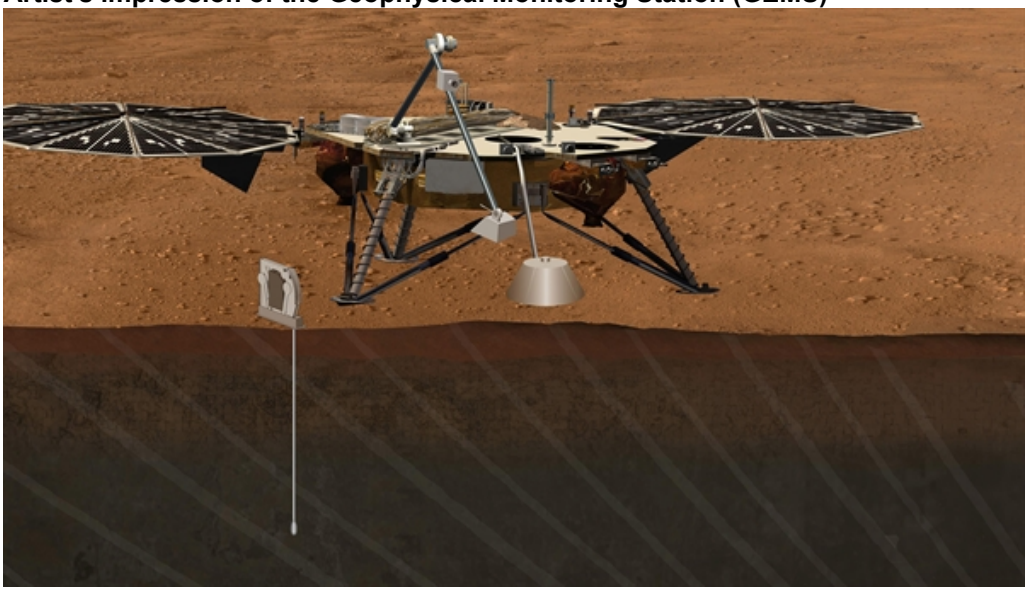
Credit: JPL/NASA.

DLR's HP3 experiment

DLR's HP3 experiment uses an electromechanical impact mechanism capable of driving an instrument container into the Martian surface to a depth of up to five metres. Behind the cylindrical drill is a flat cable with thermal sensors. These sensors measure the temperature profile and the heat conductivity of the soil, from which the heat flow can be determined. Until now, a fully-automatic mole of this kind has never been used on any planetary body in our Solar System.

Credit: DLR (CC-BY 3.0).

Artist's impression of the Geophysical Monitoring Station (GEMS)



The 'mole' experiment 'HP3' (Heat Flow and Physical Properties Package) is intended to determine the heat flow in the Martian interior and to determine the planet's physical composition. For this purpose, a special electromechanical impact mechanism drives an instrument container down to a depth of up to five metres below the surface of Mars (left). In these first five metres below the surface, the geoelectrical properties of the ground are to be measured as part of the search for subsurface ice deposits.

Credit: NASA/JPL.

Logo of the NASA InSight mission

Logo of the NASA InSight mission, scheduled to reach Mars in 2016. On the lander itself is the DLR Experiment HP3 (Heat Flow and Physical Properties Package. It will penetrate the Martian surface to a depth of five metres to measure the heat flow and thus provide new insights into the thermal evolution of Mars and hidden water sources under the surface.

Credit: JPL/NASA .

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