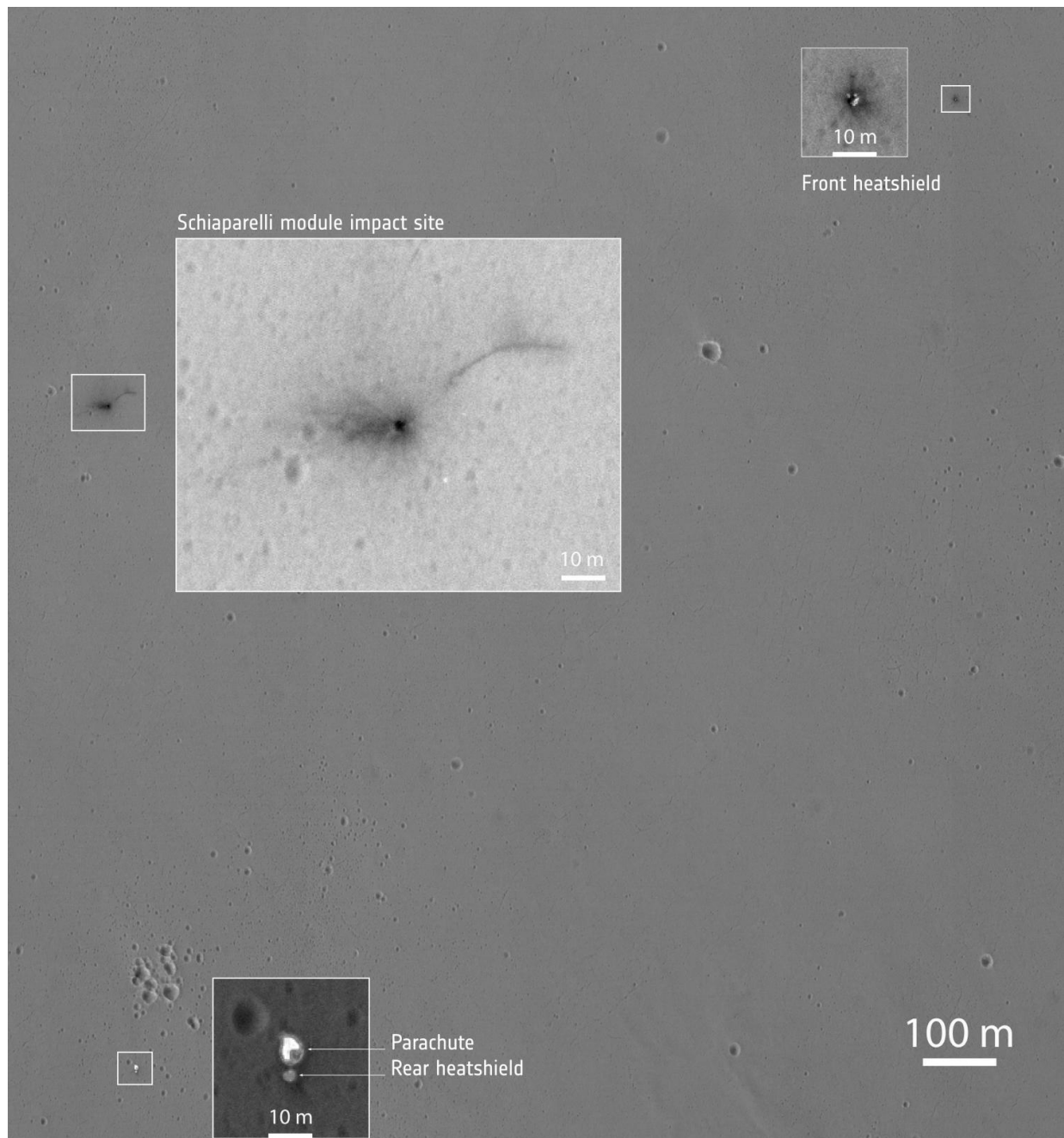


Detailed images of Schiaparelli and its descent hardware on Mars

October 27 2016



NASA's Mars Reconnaissance Orbiter High Resolution Imaging Science Experiment (HiRISE) imaged the ExoMars Schiaparelli module's landing site on 25 October 2016, following the module's arrival at Mars on 19 October. The zoomed insets provide close-up views of what are thought to be several different hardware components associated with the module's descent to the martian surface. These are interpreted as the front heatshield, the parachute and the rear heatshield to which the parachute is still attached, and the impact site of the module itself. In the image, north is up; west to the left. Schiaparelli was travelling from west to east. The image scale is 29.5 cm/pixel. The brightness of the individual zooms have been adjusted to best reveal the features against the martian surface in each case. The 100 m scale bar in the main image is only indicative, as the HiRISE image was taken at an oblique angle. The distances given between the various components in the main text have been corrected for this effect. Credit: NASA/JPL-Caltech/University of Arizona

A high-resolution image taken by a NASA Mars orbiter this week reveals further details of the area where the ExoMars Schiaparelli module ended up following its descent on 19 October.

The latest image was taken on 25 October by the high-resolution camera on NASA's Mars Reconnaissance Orbiter and provides close-ups of new markings on the planet's surface first found by the spacecraft's 'context camera' last week.

Both cameras had already been scheduled to observe the centre of the landing ellipse after the coordinates had been updated following the separation of Schiaparelli from ESA's Trace Gas Orbiter on 16 October. The separation manoeuvre, hypersonic atmospheric entry and parachute phases of Schiaparelli's [descent](#) went according to plan, the module ended up within the main camera's footprint, despite problems in the

[final phase.](#)

The new images provide a more detailed look at the major components of the Schiaparelli hardware used in the descent sequence.

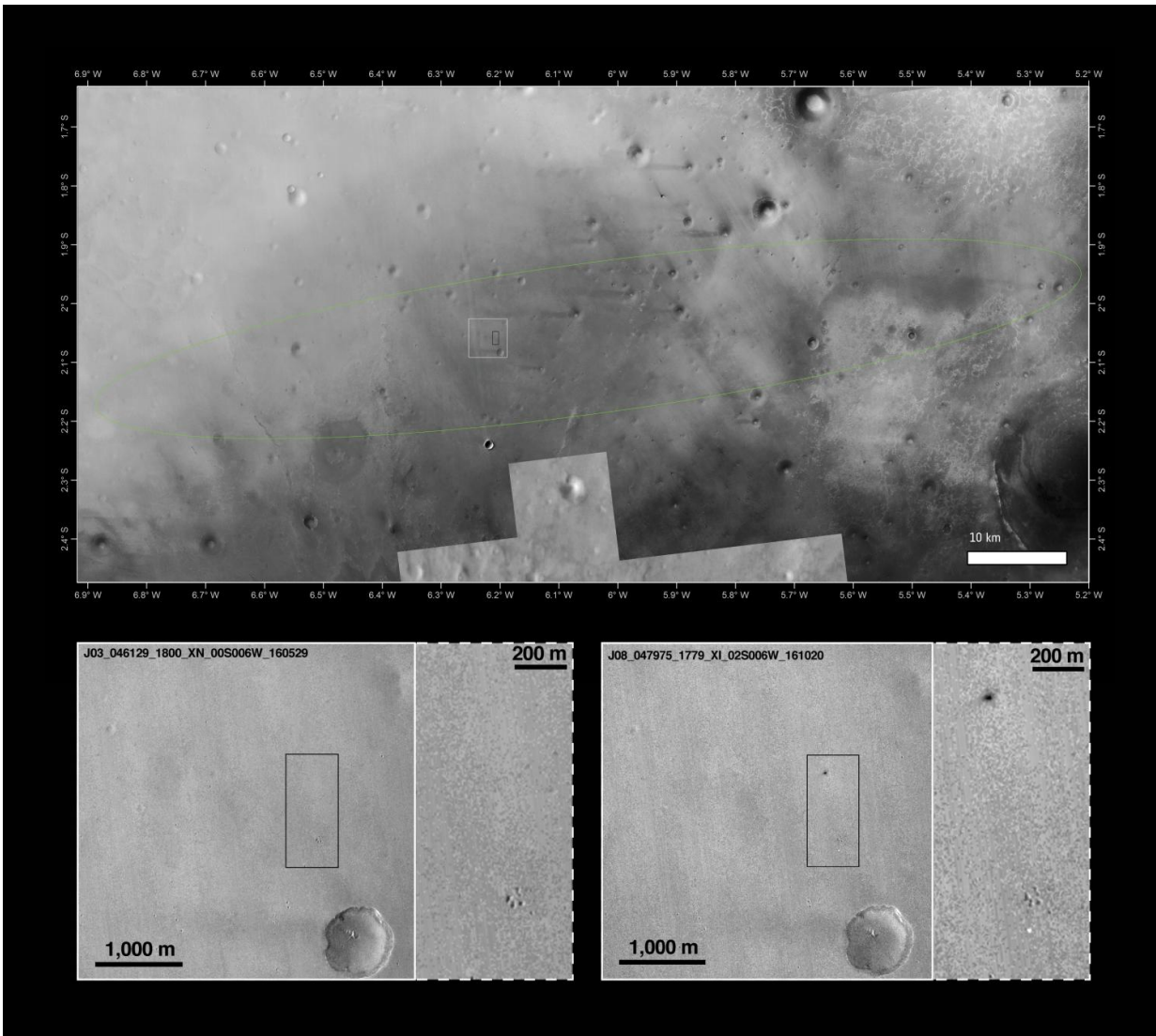
The main feature of the context images was a dark fuzzy patch of roughly 15 x 40 m, associated with the impact of Schiaparelli itself. The high-resolution images show a central dark spot, 2.4 m across, consistent with the crater made by a 300 kg object impacting at a few hundred km/h.

The crater is predicted to be about 50 cm deep and more detail may be visible in future images.

The asymmetric surrounding dark markings are more difficult to interpret. In the case of a meteoroid hitting the surface at 40 000–80 000 km/h, asymmetric debris surrounding a crater would typically point to a low incoming angle, with debris thrown out in the direction of travel.

But Schiaparelli was travelling considerably slower and, according to the normal timeline, should have been descending almost vertically after slowing down during its entry into the atmosphere from the west.

It is possible the hydrazine propellant tanks in the module exploded preferentially in one direction upon impact, throwing debris from the planet's surface in the direction of the blast, but more analysis is needed to explore this idea further



The landing site of the Schiaparelli module within the predicted landing ellipse in a mosaic of images from the Context Camera (CTX) on NASA's Mars Reconnaissance Orbiter and the Thermal Emission Imaging System (THEMIS) on NASA's 2001 Mars Odyssey orbiter. Below the main image are a pair of before-and-after images, taken by the CTX camera on 29 May 2016 (left) and 20 October 2016 (right), respectively. The 20 October image shows two new features appearing following the arrival of the Schiaparelli test lander module on the martian surface on 19 October. One of the features is bright and can be associated with the 12-m diameter parachute used in the second stage of Schiaparelli's descent, after the initial heat shield entry. The parachute and the associated back shield were released from Schiaparelli prior to the final phase,

during which its nine thrusters should have slowed it to a standstill just above the surface. The other new feature is a fuzzy dark patch roughly 15 x 40 metres in size and about 1 km north of the parachute. This is interpreted as arising from the impact of the Schiaparelli module itself following a much longer free fall than planned, after the thrusters were switched off prematurely. The landing ellipse is 100 km x 15 km, and is centred on 2 degrees south in latitude and 353 degrees east longitude, in the Meridiani Planum region of Mars, close to the planet's equator. The image measures about 100 km; north is up. The dark spot on the image, associated with the Schiaparelli module, is located approximately 5.4 km west of the centre of the landing ellipse. Credit: Main image: NASA/JPL-Caltech/MSSS, Arizona State University; inserts: NASA/JPL-Caltech/MSSS

An additional long dark arc is seen to the upper right of the dark patch but is currently unexplained. It may also be linked to the impact and possible explosion.

Finally, there are a few white dots in the image close to the impact site, too small to be properly resolved in this image. These may or may not be related to the impact – they could just be 'noise'. Further imaging may help identify their origin.

Some 1.4 km south of Schiaparelli, a white feature seen in last week's context image is now revealed in more detail. It is confirmed to be the 12 m-diameter parachute used during the second stage of Schiaparelli's descent, after the initial heatshield entry into the atmosphere. Still attached to it, as expected, is the rear heatshield, now clearly seen.

The parachute and rear heatshield were ejected from Schiaparelli earlier than anticipated. Schiaparelli is thought to have fired its thrusters for only a few seconds before falling to the ground from an altitude of 2–4 km and reaching the surface at more than 300 km/h.

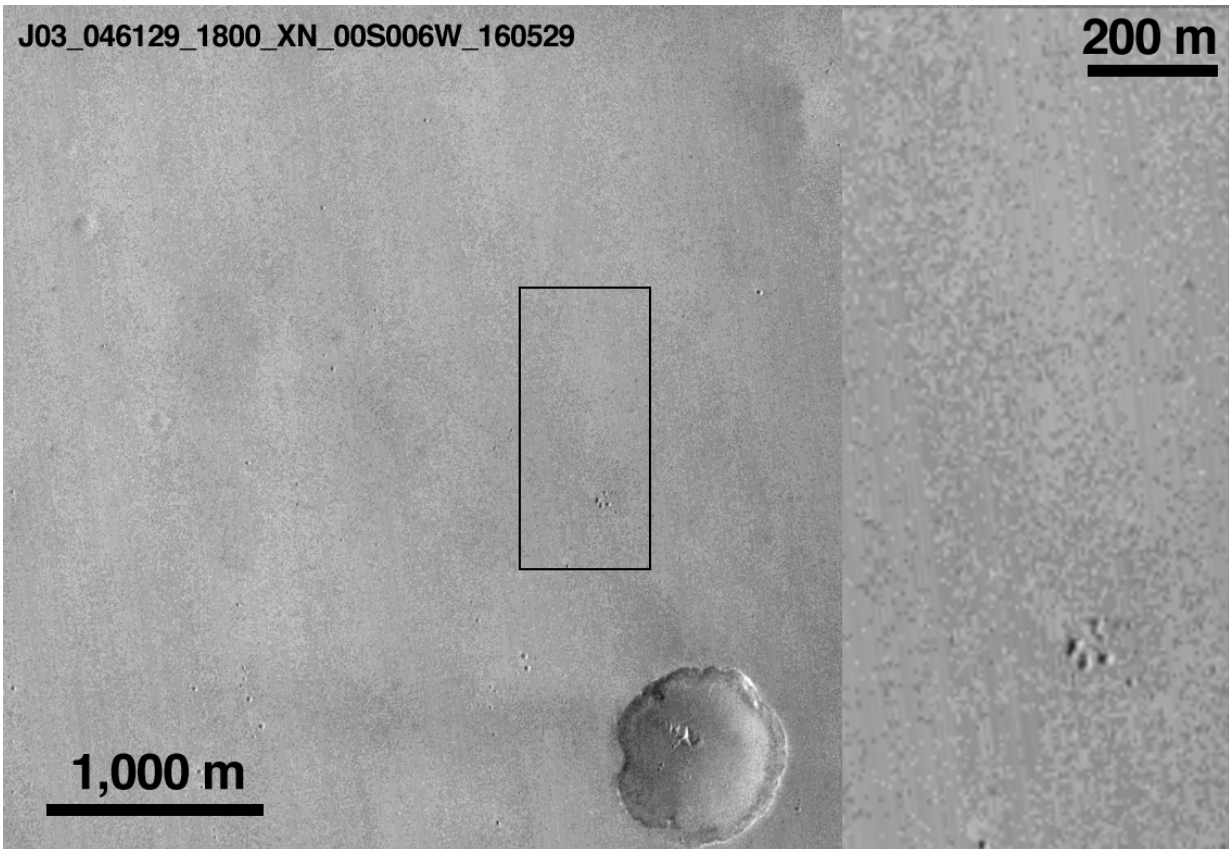
In addition to the Schiaparelli impact site and the parachute, a third feature has been confirmed as the front heatshield, which was ejected about four minutes into the six-minute descent, as planned.

The ExoMars and MRO teams identified a dark spot last week's image about 1.4 km east of the impact site and this seemed to be a plausible location for the front heatshield considering the timing and direction of travel following the module's entry.

The mottled bright and dark appearance of this feature is interpreted as reflections from the multilayered thermal insulation that covers the inside of the front heatshield. Further imaging from different angles should be able to confirm this interpretation.

The dark features around the front heatshield are likely from surface dust disturbed during impact.

Additional imaging by MRO is planned in the coming weeks. Based on the current data and observations made after 19 October, this will include images taken under different viewing and lighting conditions, which in turn will use shadows to help determine the local heights of the features and therefore a more conclusive analysis of what the features are.



A pair of before-and-after images taken by the Context Camera (CTX) on NASA's Mars Reconnaissance Orbiter on 29 May 2016 and 20 October 2016 show two new features appearing following the arrival of the Schiaparelli test lander module on 19 October. One of the features is bright and can be associated with the 12-m diameter parachute used in the second stage of Schiaparelli's descent, after the initial heat shield entry. The parachute and the associated back shield were released from Schiaparelli prior to the final phase, during which its nine thrusters should have slowed it to a standstill just above the surface. The other new feature is a fuzzy dark patch roughly 15 x 40 metres in size and about 1 km north of the parachute. This is interpreted as arising from the impact of the Schiaparelli module itself following a much longer free fall than planned, after the thrusters were switched off prematurely. The main image covers an area about 4 kilometres wide, at about 2 degrees south latitude, 354 degrees east longitude, in the Meridiani Planum region of Mars. The scale bars are in metres. North is up. Credit: NASA/JPL-Caltech/MSSS

A full investigation is now underway involving ESA and industry to identify the cause of the problems encountered by Schiaparelli in its final phase. The investigation started as soon as detailed telemetry transmitted by Schiaparelli during its descent had been relayed back to Earth by the Trace Gas Orbiter.

The full set of telemetry has to be processed, correlated and analysed in detail to provide a conclusive picture of Schiaparelli's descent and the causes of the anomaly.

Until this full analysis has been completed, there is a danger of reaching overly simple or even wrong conclusions. For example, the team were initially surprised to see a longer-than-expected 'gap' of two minutes in the telemetry during the peak heating of the module as it entered the atmosphere: this was expected to last up to only one minute. However, further processing has since allowed the team to retrieve half of the 'missing' data, ruling out any problems with this part of the sequence.

The latter stages of the descent sequence, from the jettisoning of the rear shield and parachute, to the activation and early shut-off of the thrusters, are still being explored in detail. A report of the findings of the investigative team is expected no later than mid-November 2016.

The same telemetry is also an extremely valuable output of the Schiaparelli entry, descent and landing demonstration, as was the main purpose of this element of the ExoMars 2016 mission. Measurements were made on both the front and rear shields during entry, the first time that such data have been acquired from the back heatshield of a vehicle entering the martian atmosphere.

The team can also point to successes in the targeting of the module at its separation from the orbiter, the hypersonic atmospheric entry phase, and the parachute deployment at supersonic speeds, and the subsequent

slowing of the module.

These and other data will be invaluable input into future lander missions, including the joint European–Russian ExoMars 2020 rover and surface platform.

Finally, the orbiter is working well and being prepared to make its first set of measurements on 20 November to calibrate its science instruments.

Provided by European Space Agency

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