exomars

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What is ExoMars?

The ExoMars programme is a joint endeavour between ESA and the Russian space agency, Roscosmos.

The primary goal of the ExoMars programme is to address the question of whether life has ever existed on Mars. This relates to its name, with the 'exo' referring to the study of exobiology – the possible existence of life beyond Earth (sometimes also referred to as astrobiology).

The programme comprises two missions. The first will be launched in March 2016 and consists of the Trace Gas Orbiter (TGO) and Schiaparelli, an entry, descent and landing demonstrator module. The second is planned for launch in 2018 and comprises a rover and surface science platform.

TGO's main objectives are to search for evidence of methane and other trace atmospheric gases that could be signatures of active biological or geological processes. Schiaparelli will test key technologies in preparation for ESA's contribution to subsequent missions to Mars.

The 2018 rover that will carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. The 2016 TGO will act as a relay for the 2018 mission.

Why are we going to Mars?

Earth's planetary neighbour Mars has been a primary target for international robotic exploration efforts since the 1960s. Numerous US, Soviet, Japanese and European missions have flown to the Red Planet to understand the similarities and differences between Earth and Mars, with an emphasis on whether life ever existed on the Red Planet. There is ample evidence that liquid water existed and flowed on the surface of Mars in the past. Since on Earth, water is fundamentally linked to life, the obvious question arises: if there was water on Mars, has there ever been life? This remains one of the biggest unanswered questions in martian exploration and one that lies at the heart of the ExoMars programme.

The surface of Mars is dry and bathed in harsh radiation, and thus it is unlikely that life could exist there today. The best possible opportunity for the emergence of life on Mars was in the first billion years after the planet formed, when it was much warmer and wetter than today – similar to those present on the young Earth. Therefore, there might be evidence of past life preserved underground. Sampling the subsurface down to 2 m to search for such biomarkers is a key goal of the ExoMars 2018 rover.

In the meantime, the ExoMars 2016 Trace Gas Orbiter will follow a different approach by seeking out signs of life from Mars orbit. One of its key goals is to follow up on hints from previous missions that methane has been detected in the atmosphere, and in particular whether it is produced by geological or biological activity.

The ExoMars Trace Gas Orbiter (TGO) has the precision necessary to analyse the planet's gases such as methane to a much higher sensitivity than any previous or current mission at Mars. It will also image and characterise features on the martian surface that may be related to sources such as volcanoes.

How ExoMars 2016 will get to Mars

The ExoMars 2016 mission will be launched on a four-stage Proton-M/Breeze-M rocket, provided by Roscosmos, from Baikonur during the 14–25 March 2016 window. About ten-and-a-half hours after launch, the spacecraft will separate from the rocket and deploy its solar wings.

After separation, command and control of the spacecraft will be done by ESA's mission control teams at ESOC, supported by experts from flight dynamics, ground stations and software systems.

In the first six weeks following launch the spacecraft will be commissioned, when all the systems and instruments are checked out and verified. Then it enters the cruise phase. At the end of July the Trace Gas Orbiter carries out one of the most critical activities during its cruise to Mars: a very large engine burn that changes its direction and speed, to intersect the Red Planet on 19 October.

Critical arrival activities begin on 16 October. Prior to dispatching Schiaparelli, TGO will perform a slew, rotating about its axes to a specific orientation in space. About 12 hours after Schiaparelli has separated, TGO will fire its engine to raise its trajectory to several hundred kilometres above the planet. Otherwise, like Schiaparelli, it would also enter the atmosphere.

Thus Schiaparelli will enter the atmosphere and land on Mars on 19 October, while TGO enters orbit around the Red Planet.

How Schiaparelli will land on Mars

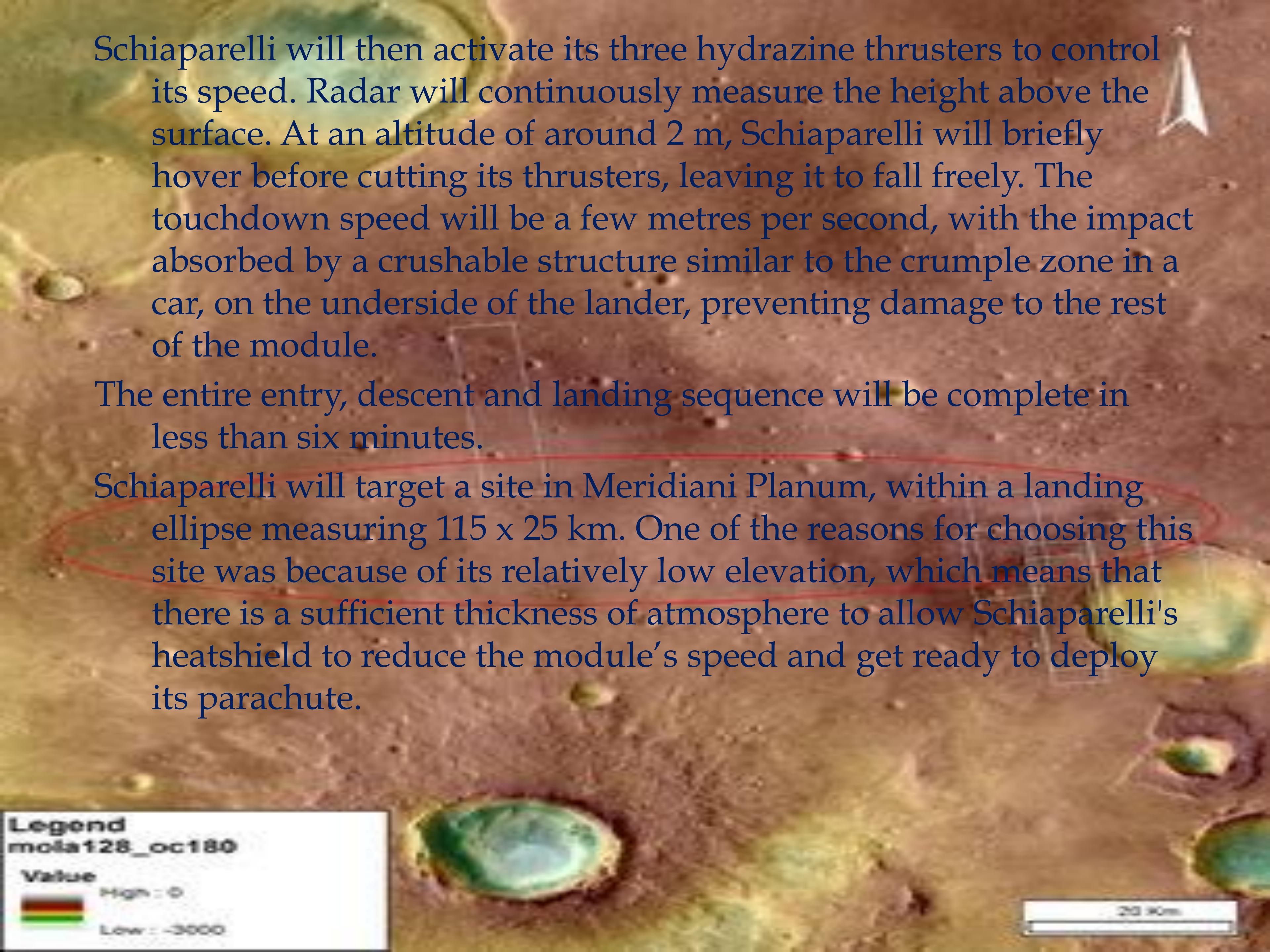
Schiaparelli is scheduled to separate from TGO on 16 October 2016, three days before arriving at Mars. On 19 October, Schiaparelli will enter the atmosphere at an altitude of about 121 km and a speed of nearly 21 000 km/h. In the three to four minutes that follow, it will be slowed by the increasing atmospheric drag, with the front shield of the aeroshell bearing the brunt of the heating. This will slowly melt and vaporise, allowing the absorbed heat to be carried away from the rest of the spacecraft.

Once the speed has decreased to around 1700 km/h Schiaparelli will be 11 km above the surface and a parachute will be deployed. The parachute canopy will unfurl in less than a second, and, 40 seconds later, allowing for oscillations to die down, the front shield of the aeroshell will be jettisoned. The parachute will slow Schiaparelli to around 250 km/h, and then the back half of the aeroshell, with the parachute attached to it, will also be jettisoned. It will be drawn rapidly away from Schiaparelli, which will now be completely free of the aeroshell that kept it safe en route to Mars.

Schiaparelli will then activate its three hydrazine thrusters to control its speed. Radar will continuously measure the height above the surface. At an altitude of around 2 m, Schiaparelli will briefly hover before cutting its thrusters, leaving it to fall freely. The touchdown speed will be a few metres per second, with the impact absorbed by a crushable structure similar to the crumple zone in a car, on the underside of the lander, preventing damage to the rest of the module.

The entire entry, descent and landing sequence will be complete in less than six minutes.

Schiaparelli will target a site in Meridiani Planum, within a landing ellipse measuring 115 x 25 km. One of the reasons for choosing this site was because of its relatively low elevation, which means that there is a sufficient thickness of atmosphere to allow Schiaparelli's heatshield to reduce the module’s speed and get ready to deploy its parachute.



How TGO will orbit Mars

While Schiaparelli is landing on Mars, TGO will conduct a critical engine burn with its main engine – the Mars Orbit Insertion manoeuvre. This will slow TGO sufficiently to be captured into an initial orbit, and will last for over two hours. Upon completion, it will mark the second time that ESA has placed a spacecraft into orbit around the Red Planet.

The initial highly eccentric orbit is dubbed the '4 Sol' orbit, as it will take TGO four martian days to complete one revolution, with its altitude above Mars varying between a few hundred kilometres at its closest point and nearly 100 000 km at its furthest.

In January 2017 TGO's orbit will be adjusted to an inclination of 74°, which is optimised for its science and radio relay missions, and it will move from a 4-day to a 1-day orbit.

During 2017 it will employ sophisticated aerobraking techniques – the first time ESA will do so to attain a science orbit around another body in our Solar System – to steadily lower itself to a circular, 400 km orbit.

With aerobraking, the TGO solar array will experience tiny amounts of drag owing to the wisps of martian atmosphere at very high altitudes, which will slow the craft and lower its orbit. While aerobraking takes time, it uses very little fuel and will itself provide scientific insight into the dynamics of Mars' atmosphere.

Used sites

1.) http://www.esa.int
2.) https://yandex.kz
3.) http://ria.ru