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Fact sheet

ExoMars: Europe and Switzerland take the next step to Mars

The European Space Agency ESA will be launching the first of its two missions to Mars on 14 March. The 2016 mission's primary scientific objectives are to determine in detail the Martian atmosphere's composition, in particular the amount of trace gases present, and to acquire high-resolution stereo images of the planet's surface from orbit. Furthermore, the mission will serve to demonstrate and test key technologies needed to successfully land on the Red Planet. Switzerland is participating to this mission with a research instrument and various other technologies.

Why Mars?

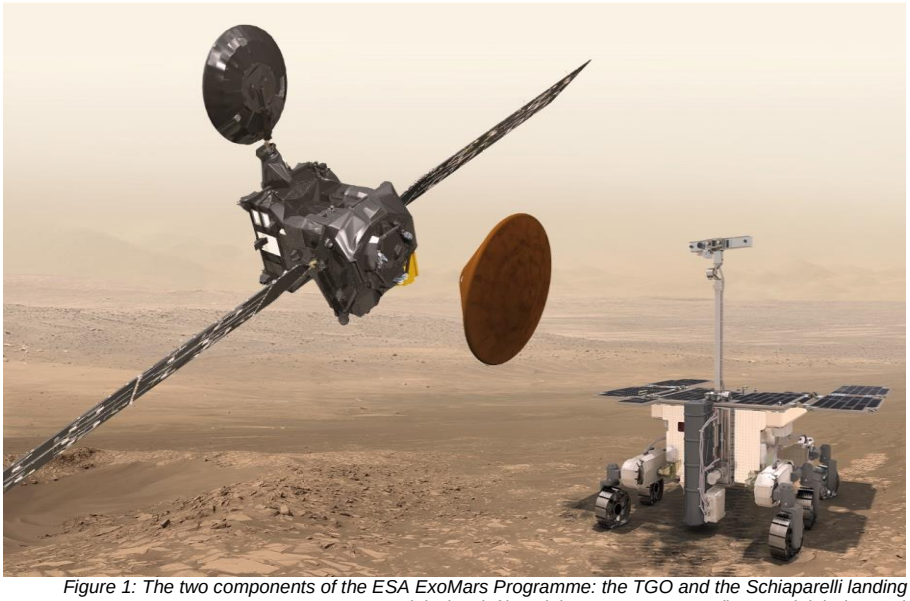

Figure 1: The two components of the ESA ExoMars Programme: the TGO and the Schiaparelli landing module (top left) and the ExoMars Rover (bottom right). (© ESA)

Being the most similar to Earth out of all of the planets in our solar system, Mars has long fascinated humanity and led many to ask if there is or ever has been life on our neighbouring planet. In the 1970s, the US launched two space probes to answer this very question. According to the methods of measurement used, the answer – so far – has been negative. Mars exploration was resumed in the 1990s with robots, which has massively expanded our knowledge of this planet. In 1997, 2003 and 2012, the US launched a total of four missions with automated motor vehicles (called rovers) to take various scientific measurements on the planet's surface. The aim is to find signs of existing or past life. These missions are backed by satellites in orbit that, in addition to measuring instruments, also carry communication equipment that is vital for transferring data to and from the rovers on the ground.

ESA on the international Mars research scene

Like the US and Russia – the latter's missions having been unsuccessful so far – the European Space Agency ESA has become actively involved in Mars exploration. The Mars Express mission, launched in 2003, aimed at providing detailed cartographic data of the planet's surface and studying the Martian atmosphere. Unfortunately, the small landing spacecraft (the Beagle 2) was lost on the surface of Mars. Only two years later, in 2005, ESA decided to develop its next mission to Mars. This mission, called ExoMars, aimed at landing on the planet's surface and was to include its own rover. ExoMars went through numerous changes over the course of its lengthy development period. It finally evolved

into an international programme comprising two missions and including Russian cooperation (see figure 1). The first mission will launch on 14 March 2016, the second will follow in 2018.

2016 ExoMars mission objectives

The 2016 ExoMars mission comprises a satellite (the Trace Gas Orbiter, TGO) and a landing module (called Schiaparelli, see figure 2). The scientific objective of the TGO is to collect data that will allow a more detailed assessment of Martian atmosphere, in particular to measure trace gases and identify their origins and flows on the surface, as well as any changes over time and geographical areas. In addition to communication equipment, which will be used with current and future rovers, the TGO includes the following scientific payload of four instruments designed to fulfil this objective:

NOMAD: spectrometers to identify trace elements and other components of the Martian atmosphere. This instrument was developed under Belgian leadership.

ACS: infrared instruments for investigating the chemistry of the Martian atmosphere. The ACS was developed by Russia.

FREND: a neutron detector for mapping water ice on and underneath the surface of Mars. This instrument was also developed by Russia.

CaSSIS: a high-resolution stereo camera that will take detailed pictures of Mars' surface, especially of those areas in which NOMAD and ACS detect trace gases. Development of this instrument (see figure 3) was led by the University of Bern and completed in cooperation with Swiss industry and partners in Italy, Poland and Hungary. It is one of Switzerland's key contributions to the ExoMars programme. It was funded by Switzerland's participation in the ESA's PRODEX programme.

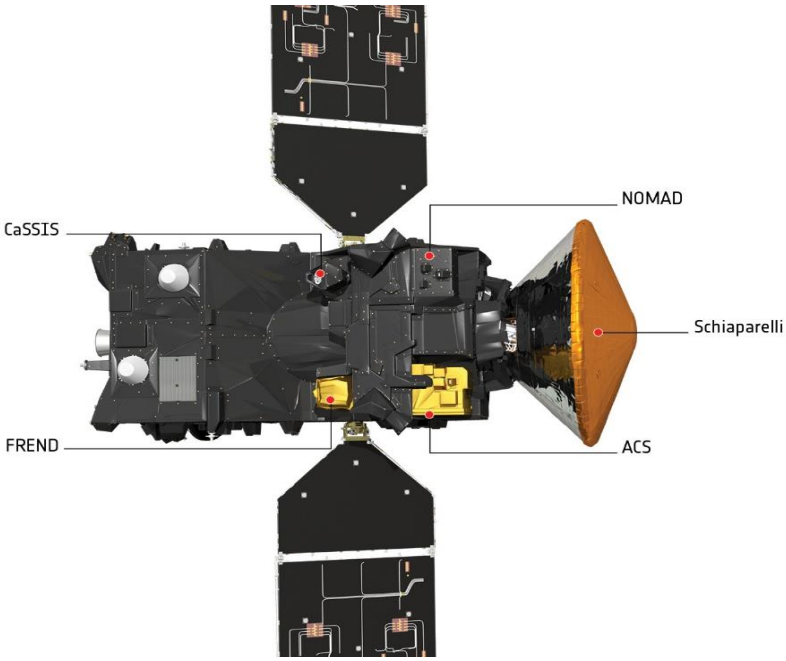

Figure 2: The ExoMars TGO with the attached Schiaparelli landing module (right) and the CaSSIS, NOMAD, ACS and FREND scientific instruments. (© ESA)

The Schiaparelli landing module's primary objective is to demonstrate technology and to show that Europe can perform a controlled landing on Martian ground. The technologies in question are Schiaparelli's heat shield, Doppler radar altimeter and its retro rockets. After landing, Schiaparelli will transmit a radio signal, which will serve not only as confirmation of mission success, but also include scientific data collected by the instruments on board.

2018 ExoMars mission objectives

The second ExoMars mission, which is scheduled to launch in two years, will land a European rover on the Red Planet. This rover will contain precise scientific instruments with which it will search for life on Mars. This mission will benefit from the experience gained through the 2016 mission, in particular regarding landing navigation, the composition of the Martian atmosphere, communication equipment and mission operations.

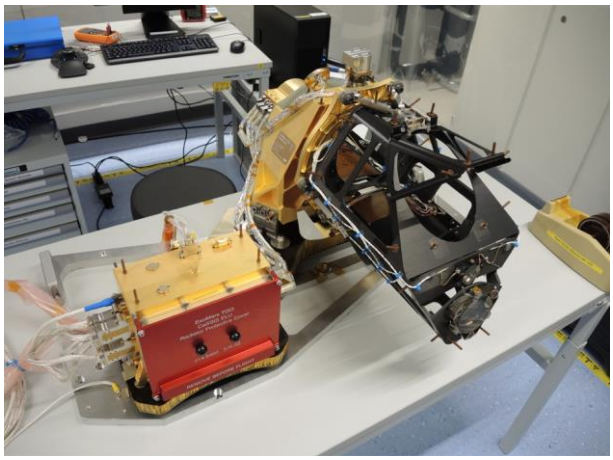

Figure 3: CaSSIS before its installation on the TGO. (© Universität Bern)

Swiss contributions

In addition to the CaSSIS instrument mentioned above, which was developed in cooperation with Swiss academic and industry players, Swiss companies have also made valuable contributions to the TGO itself. For instance, the main separating

mechanism between the TGO and Schiaparelli – a critical element for mission success – was developed by RUAG Space in Zurich. RUAG's Nyon division supplied the slip rings for the rotating parts of the TGO's solar panels. APCO Technologies in Aigle built the mechanical ground support equipment (including the special transport container, see figure 4). The company Clemessy in Basel contributed electrical components for the ground test facilities and Adelsy in Riazzino conducted system conception and development activities related to the design of the avionics system. Further Swiss contributions are planned for the 2018 mission.

Figure 4: Unloading Schiaparelli from its transport container in Baikonur. (© ESA)

Mission progress

The 2016 ExoMars mission will be launched on a proton rocket from Baikonur, Kazakhstan, on 14 March and will embark on a seven-month flight path to Mars. Three days before reaching the planet, Schiaparelli will eject from the TGO. On 16 October, the landing module will enter the Martian atmosphere and touch down on the planet's surface. Through a series of manoeuvres, the TGO will be placed in orbit around Mars and begin its scientific mission in December. Simultaneously, the satellite will serve as a data relay station for NASA's rover – a function it will also fulfil for the 2018 ExoMars mission.

The European Space Agency (ESA) has developed over 70 satellites and is currently conducting 18 missions including Rosetta and Mars Express. The new European satellite navigation system Galileo, several environmental observation satellites, as well as the Ariane and Vega launch vehicles have all been developed under ESA leadership. Switzerland contributes approximately EUR 140 million annually to the ESA, whose total budget for 2016 amounts to EUR 5.3 billion. Thanks to Switzerland's contributions, Swiss research institutes and space industry can apply and further extend their excellent scientific and technological expertise. What is more, they can benefit from competitive access to international projects and markets.

Together with Luxemburg, Switzerland has been co-president of the ESA Council at Ministerial level since 2012. This co-presidency will continue until the next Ministerial Council Meeting, which will be held in Lucerne in December 2016.

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Links

- The ESA's ExoMars webpage: http://exploration.esa.int/mars/46124-mission-overview/
- The University of Bern's CaSSIS webpage: http://space.unibe.ch/pig/science/projects/cassis.html
- RUAG Space: http://www.ruag.com/space/space-home/
- APCO Technologies SA: http://www.apco-technologies.ch/space.php
- Clemessy: http://www.clemessy.ch/