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Updates on the project: Schiaparelli for ExoMars

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Abstract. The ExoMars program is progressing and it is now time to dedicate part of the mission to G.V. Schiaparelli, who firstly performed a systematic study of the Mars geography in the second half of the 19th century. In particular the Landing Demonstrator Module (EDM) that will explore the Mars surface on January 2016 will bring the name SCHIAPARELLI. Here we shortly review the life and the main scientific results achieved by Schiaparelli, giving and update on the process that ESA is following to dedicate the probe to the great Italian astronomer.

1. Introduction

In the year 2010 we have successfully celebrated the figure of G.V. Schiaparelli, one of the most successful and famous scientists and astronomers of the 1800s, on the occasion of the l00th anniversary of his death. The Brera Astronomical Observatory - INAF organized the celebrationsi (see Trinchieri & Manara 2011), with the active participation of several research institutes and Italian institutions (ASI among them), under the high Patronage of the President of the Italian Republic and of the Patronage of the Senate of the Italian Republic.

The name Schiaparelli is unquestionably intertwined with the planet Mars for everybody, scientists and common people alike: the famous querelle on Mars canals has given him everlasting fame that goes well beyond the scientific world, and includes literature, political science and neuroscience.

For this, and for his many scientific accomplishments and his significant legacy, we propose to dedicate the ExoMars EDM (Fig. 1) to Schiaparelli.

2. Schiaparelli: man of science and culture of the 1800's

Schiaparelli obtained his most important scientific results at the Brera Observatory, where he came after a short period abroadi, in Berlin and in Russia, and which he directed it until 1900. In Brera he was able to explain the nature of meteors and their relation to comets. With the modern telescopes he managed to obtain for the Observatory, he observed and measured the orbital parameters of more than 1000 double stars, using the techniques of observation with a refractor telescope, which he had learned at the Pulkovo Observatory (Fig. 2) from his mentors Otto Struve and Friedrich Winnecke.

His fame is unquestionably related to his observations of Mars, which he started in 1877 (Schiaparelli 1878) and continued for over 40 years. With his first systematic studies of the

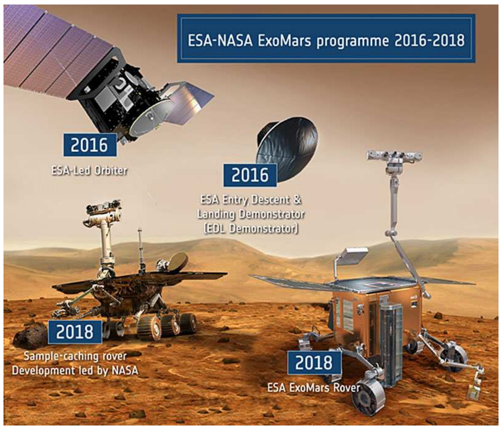

Fig. 1. The ExoMars Programme timeline. Credits: ESA

Fig. 2. The portrait of Giovanni Virginio Schiaparelli in 1880, painted by Maestro G. Landriani, currently at the Round Hall of the Pulkovo Observatory. Curtesy of V. K. Abalakin

planet, he mapped the surface of Mars in great details. All his discoveries are meticulously reported in his diaries, with incredibly detailed topographical maps of Mars's surface. The nomenclature that he used, still in use today, can be considered the birth of "Aerography", a novel way of describing the topography and the morphology of the planet (Schiaparelli 1883). Even some of the features he drew can be recognized in some of the modern pictures taken at a distance from Mars.

Mars features and discoveries are also published in a series of articles for the general public, and they express deep intuitions in a simple and yet rich language and beautiful style.

The relevance of his work can be summarized in a few words (Abetti et al. 1910): Schiaparelli was able to translate into scientific rigor what was before a visual impression and simple drawings of the planet's surface. He applied topographic methods to what he could see through his good, though not excellent, telescope. He was conscious that his work was but a first step, since optics and astronomy in general would soon improve and produce better quality images. In an article written for the general public and published in `Nuova Antologia` he wrote:

I hope that not long from now the map that I present here will be a relict of the past, and will be looked upon by aerographer as we now look at the maps of Eratosthenes and Ptolemy.

For all of this, and all of his other accomplishments and successes, we believe that Schiaparelli would be an excellent name for the ExoMars program (Fig. 1), at least for one payload related to the mission.

3. The ExoMars programme 2016-2018 and the name of Schiaparelli

Establishing if life ever existed on Mars is one of the outstanding scientific questions of our time. To address this important goal, the European Space Agency (ESA) has established the ExoMars programme to investigate the Martian environment and to demonstrate new technologies paving the way for a future Mars sample return mission in the 2020's. Two missions are foreseen within the ExoMars programme: one consisting of an Orbiter plus an Entry, Descent and Landing Demonstrator

Module, to be launched in 2016, and the other, featuring a rover, with a launch date of 2018. Both missions will be carried out in cooperation with the Russian agency Roscosmos.

The ExoMars programme will demonstrate a number of essential flight and in-situ enabling technologies that are necessary for future exploration missions, such as an international Mars Sample Return mission. These include:

- Entry, descent and landing (EDL) of a payload on the surface of Mars;
- Surface mobility with a rover;
- Access to the subsurface to acquire samples;
- Sample acquisition, preparation, distribution and analysis.

At the same time a number of important scientific investigations will be carried out, for example:

- Search for signs of past and present life on Mars;
- Investigate how the water and geochemical environment varies;
- Investigate Martian atmospheric trace gases and their sources.

The 2016 mission includes a Trace Gas Orbiter (TGO)and an Entry, Descent and Landing Demonstrator Module (EDM). **ESA will celebrate Schiaparelli dedicating the EDM to his name**.

While the Orbiter will carry scientific instruments to detect and study atmospheric trace gases, such as methane, the EDM will contain sensors to evaluate the lander performance as it descends, and additional sensors to study the environment at the landing site. The 2018 mission includes a rover that will carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. Roscosmos will provide a Proton launcher for both missions.

3.1. The first ExoMars mission and the EDM module devoted to Schiaparelli

The first mission of the ExoMars programme, scheduled to reach Mars in 2016, consists of a Trace Gas Orbiter plus an Entry, Descent and Landing Demonstrator Module (EDM). The main objectives of this mission are to search for evidence of methane and other trace atmospheric gases that could be signatures of active biological or geological processes and to test key technologies in preparation for ESA's contribution to subsequent missions to Mars.

The Orbiter and EDM will be launched together in January 2016 on a Proton rocket and will fly to Mars in a mated configuration. By taking advantage of the positioning of Earth and Mars the cruise phase can be limited to about 9 months. Three days before reaching the atmosphere of Mars, the EDM will be ejected from the Orbiter towards the Red Planet. The EDM capsule will then coast towards its destination, entering the Martian atmosphere and landing on the surface of the planet. From its coasting to Mars till its landing, the EDM will communicate with the Orbiter. Once on the surface, the communications of the EDM will be supported from a NASA Relay Orbiter. The ExoMars Orbiter will be inserted into an elliptical orbit around Mars and then sweep through the atmosphere to finally settle into a circular, $\sim$400 km altitude orbit ready to conduct its scientific mission.

The ExoMars Entry, Descent and Landing Demonstrator Module devoted to Schiaparelli will provide Europe with the technology for landing on the surface of Mars with a controlled landing orientation and touchdown velocity. The design of the EDM maximises the use of technologies already in development within the ExoMars programme. These technologies include: special material for thermal protection, a parachute system, a radar Doppler altimeter system, and a final braking system controlled by liquid propulsion. The EDM is expected to survive on the surface of Mars for a short time, from 19 October to 23 October 2016, by using the excess energy capacity of its batteries. The science possibilities of the EDM are limited by the absence of long term power and the fixed amount of space and resources that can be accommodated within the module; however, a set of scientific sensors will be included to perform limited, but useful, surface science.

After launch and throughout the cruise phase, the spacecraft unit made up of the Orbiter and the EDM is operated by ESA through the space communications network of ESA's European Space Operations Centre (ESOC). After separation, the Orbiter will monitor the UHF transmission from the EDM from its coasting to Mars till its landing. A NASA Relay Orbiter will act as a data relay for the EDM during its surface operations. Furthermore, ground-based communication arrays will also track the UHF signal during the entry, descent and landing phases. ESA will be in full control of the Orbiter during all phases of its mission, including insertion into Mars orbit, orbit control, aero-braking, science operations and Mars communications operations.

4. Conclusions

Today, the name Schiaparelli can be found in many contexts: an asteroid, a lunar and a Martian crater, a mountain chain on Mercury are named after him. Streets with his name can be found in various cities around the world, and stamps have been issued with his portrait. More than this, we can now appreciate the influence and the legacy that he has left us. In a recent meeting held in October 2010, (Trinchieri & Manara 2011) on the occasion of the centenary of his death, different aspects of his past achievements and present legacy in a broad scientific context and even everyday life have been presented and discussed.

The dedication of a space probe as ExoMars EDM will continue the heritage of Schiaparelli's scientific legacy. We expect that the dedication will be formalized by ESA by the end of 2013.

All information on the ExoMars programme can be found at `http://exploration.esa.int/`.

References

Abetti, A., & Abetti, G. 1910, ApJ, 32, 313
Schiaparelli, G. 1878, Memorie della Società degli Spettroscopisti italiani, 7, B21
Schiaparelli, G. 1883, Memorie della Società degli Spettroscopisti italiani, 11, B25
Trinchieri, G.,& Manara, A. 2011, Schiaparelli and his legacy, Mem. Soc. Astron. Italiana, 82, (2)