BEPICOLOMBO INSIGHTS

Why Mercury?

Because it is the least explored of the rocky planets and it still retains many mysteries and questions to answer in order to understand not only how our Solar System has evolved but also its dynamics. Moreover, its unfavorable position makes it suitable to understanding Sun phenomena and fundamental physics. So here we are! The BepiColombo spacecraft, the ESA Cornerstone space mission in collaboration with the Japanese agency JAXA, dedicated to the famous scientist from Padua, Giuseppe (Bepi) Colombo (1920-1984), was launched from the spaceport of Kourou in French Guiana, to reach the planet Mercury. Mercury referred to as the morning star, which bears the name of the Greek God, messenger of the gods, will fully reveal itself thanks to the instrumentation in flight on the two space probes. The two probes (MPO and MMO) that make up BepiColombo will reach the planet in 2025, after a journey of 7 years, and will orbit around the celestial body collecting fundamental data to reveal the secrets of this interesting planet.

Let's get to know Mercury better

Together with Venus, Earth and Mars, Mercury is part of the group of rocky or "terrestrial" planets of the Solar System. Its surface is strongly marked by impact craters but has not yet been studied in detail. The planet has no satellites or rings, and it does not have an atmosphere that protects it (because of its small size), but only a thin layer of atoms and plasma that form the exosphere.
Being "only" 58 million kilometers away from the Sun and between 79 and 218 million kilometers from the Earth, Mercury is very difficult to observe, also because it is visible, being very close to the Sun, just before dawn or just after sunset, while it is obscured by sunlight the rest of the time.
Among many characteristics, what makes Mercurio truly unique is its orbit: not only because it is very elliptical (so called crushed), but because it runs in "only" 88 days, it is faster than any other planet in the Solar System (remember that the motion of terrestrial revolution – which is one year - is 365 days). On the contrary, Mercury slowly rotates on itself: the duration of a day, a complete rotation, is equal to 58.6 days on earth. Performing three rotations every two revolutions around the Sun, if a human being were to be on the surface of Mercury, he would remain exposed to solar rays for 176 Earth days. In addition, the conditions would be even more prohibitive, since the temperature of Mercury during the insolation phase can reach 420 ° C, while on the "night" side it falls down to 180 ° C below zero. This has made even more challenging to plan the phase of the two orbiter considering that they will have to face extreme heat and cold at the same time.

The goals of the mission

BepiColombo mission was designed to collect the data necessary for the study of Mercury as a whole, from the composition to the geophysics, from the exosphere to the magnetosphere, trying to reconstruct the history of Mercury backwards. Both the surface and the exosphere of this planet are strongly influenced by the solar wind and various tools will be necessary to understand the relationship between Mercury and our mother star. Other experiments will be useful to validate or update the theoretical models related to the formation and evolution of the planet and of the entire Solar System. The main scientific objectives of the mission are: to study the origin, evolution and motion of a planet that orbits so close to its star; analyze the planetological characteristics (shape, structure, surface composition and internal structure); examine Mercury's exosphere, its composition and its dynamics of interaction with the surrounding environment; to probe the origins of the magnetic field and the characteristics of the magnetosphere; investigate polar deposits, their composition and their origin; and finally validate the predictions of Einstein's general theory of relativity.

The italian instruments

Many of these objectives will be achieved thanks to the 4 Italian experiments plus an international collaboration, all coordinated by the head of scientific missions at ASI Raffaele Mugnuolo. The ASI responsible for the scientific team of SIMBIOSYS, ISA, and PHEBUS is Marilena Amoroso. For SERENA and MORE, Angelo Olivieri is responsible instead.

SIMBIO-SYS stands for Spectrometers and Imagers for MPO BepiColombo Integrated Observatory and is an integrated surface observation and characterization of the planet Mercury composed of three channels for stereoscopic (STC), high spatial (HRIC) and hyperspectral (VIHI) observations in the visible and near infrared. Developed by Selex and carried out by ASI, the tool will be fundamental for the geological and geochemical study of the planet. Leading the team of scientists who will use the tool is Gabriele Cremonese of the INAF of Padua, supported by the 3 managers of the 3 instruments: Pasquale Palumbo, of the Parthenope University of Naples, for the HRIC high-resolution camera; Maria Teresa Capria, of INAF-IAPS, for the STC stereo camera; Fabrizio Capaccioni, of INAF-IAPS, for the VIHI hyperspectral chamber.

Then there is **ISA**, ie Italian Spring Accelerometer: led by Valerio Iafolla of INAF-Rome Astrophysics and Space Planetology Institute, a high sensitivity accelerometer developed by INAF and Thales Alenia Space that will deal with gravitational measurements.

SERENA (Search for Exosphere Refilling and Emitted Neutral Abundances) is the experiment for the study of the particle environment of Mercury, namely the exosphere, using the two neutral particle analyzers ELENA and STOFIO, the latter realized by Southwest Research Institute-USA, and two MIPA and PICAM ion spectrometers. The scientific responsibility is of Stefano Orsini (INAF-Institute of Astrophysics and Space Planetology of Rome).

MORE is the Mercury Orbiter Radio science Experiment and it is a radioscience experiment based on the Ka (KaT) band transponder, realized by Thales Alenia Space

again but based on Earth. For MORE, the scientific responsibility lies with the University of Rome "La Sapienza" (Luciano Iess) with the support of JPL / NASA.

Finally, **PHEBUS** (Probing of Hermean Exosphere by Ultraviolet Spectroscopy) a French spectrometer in Ultraviolet Estenim band (EUV) and Far Ultraviolet (FUV) aimed at investigating the composition and dynamics of the Mercury exosphere, and among the main features there is certainly the ability to observe gas such as Elio, Argon and Nitrogen. The Italian contribution is regulated by a bilateral ASI-CNS agreement involving CNR and the University of Padua.

Who was Giuseppe Colombo?

The mission is dedicated to Giuseppe Colombo (called Bepi), eminent physicist, mathematician, astronomer and engineer from Padua, renowned professor of the University of Padua. Colombo was awarded the NASA gold medal for outstanding scientific achievements; in 1971, he obtained the Feltrinelli award and numerous other awards. His name is mainly related to studies on the orbit of Mercury: he suggested exploiting the gravitational thrust of Venus, allowing the American probe Mariner 10 to make three laps around the planet in 1974 and 1975. His calculations of the period of rotation of Mercury are also very famous. He was also responsible for the project of the NASA-Aeritalia "satellite on a leash".

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