BepiColombo

ESA cornerstone

Discovering planet

Mercury

bepicolombo

Prepared by

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BEPICOLOMBO MISSION ITALIAN OUTREACH

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The Mission

Launch: October 2018

Launcher: Ariane 5

Launch site: Kourou - French Guiana

MPO

(Mercury Planetary Orbiter)

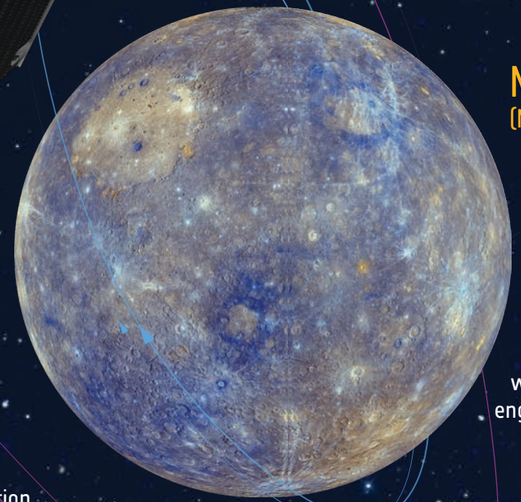
Mass: 1180 kg
Orbit: 480x1500 km
Orbital Period: 2h36min
Data Rate: up to 350 kbps

The MPO, built by the European Space Agency, is a masterpiece of technology.

11 on-board instruments will work together to collect as much information as possible concerning the interior, the surface, the exosphere, the magnetic and the gravitational field of the planet.

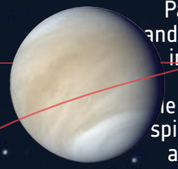
The MPO is designed to withstand the extreme environment of Mercury, characterised by a strong solar radiation (up to 13,000 W/m^2), comparable to about 20 times the radiation received at midday in a desert on the Earth.

The scientific phase of the mission will last one Earth year, with a possible extention to a second year.



Cruise

The spacecraft will spend 7 years on its journey to Mercury, carrying out nine fly-bys: the first one with the Earth, two with Venus and six with Mercury.



MCS

(Mercury Composite Spacecraft)

During the journey to Mercury, MPO and MMO will be "packed" into the MCS, which includes a solar shield and a transfer module (MTM) with innovative ion engines.

MMO - みお

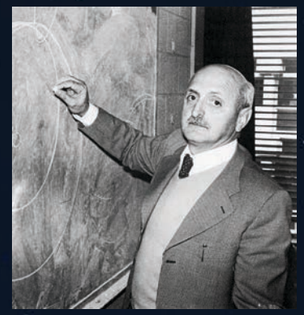
Mass: 288 kg
Orbit: 890x11640 km
Orbital Period: about 9h30min

The Mercury Magnetospheric Orbiter, built by JAXA, the Japanese space agency, embarking 5 instruments, will gather information on the magnetosphere, the exosphere and on the interplanetary medium around Mercury. The MMO will spin around itself every 4 seconds, to investigate, in a 360-degrees view, the electromagnetic fields, the particles and the interplanetary dust around the planet.

Giuseppe Colombo

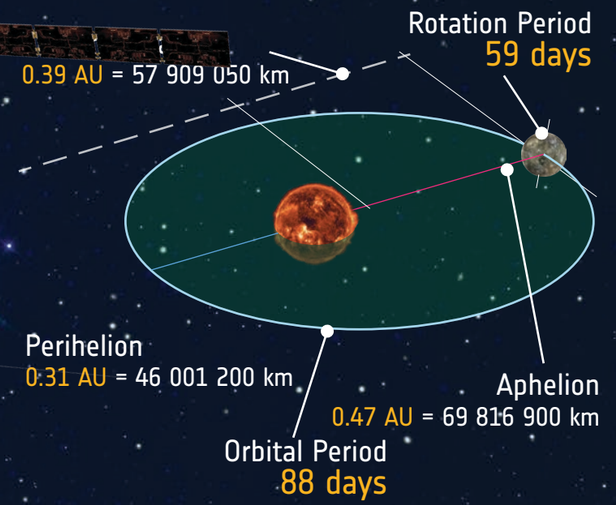
also known as "Bepi" (1920-1984) was a Paduan mathematician and engineer, specialised in celestial mechanics.

He discovered Mercury's spin-orbit 3:2 resonance and contributed to the calculation of the NASA Mariner 10 probe's orbit to visit Mercury with three fly-bys.



Following its contribution to Mercury science and exploration, ESA decided to name the mission designed to discover the misteries of the Planet.

Mercury Orbit



BepiColombo: discovering planet Mercury

Relativity

Mercury is the closest planet to the Sun. It is so close that the space-time curvature caused by the mass of the Sun on Mercury's orbit produces measurable effects. The most apparent one is the perihelion precession, which is known since the 19th century. However, the General Relativity Theory cannot be considered an ultimate theory, since it is not in accordance with quantum mechanics.

MORE will test the General Relativity Theory by measuring the space-time curvature with an accuracy of one part per million.

Our Sun

The radiation of the Sun at Mercury's distance is up to 13,000 W/m^2: ten times larger than at the Earth. The flux of photons and particles coming from the Sun is so intense that it can divert the MPO trajectory.

ISA will measure this kind of “thrust” acting on the MPO due to the large flux of photons coming from the Sun. At the same time, the SERENA ionised particles detectors will measure the solar wind composition, while the SIXS spectrometers will focus on the protons, electrons and solar X-ray fluxes.

Surface

Widespread lava flows characterise the planet's crust. These volcanic plains are "wrinkled" because of the surface global contraction due to core solidification. The surface can reach +430°C when hit by sunlight, and -170°C on its darkest and coldest places.

SIMBIO-SYS will study the surface in detail to understand the nature of the volcanic plains and their geological evolution with two cameras and a spectrometer.

BELA, the laser alimeter, will detect the surface altimetry and reconstruct its topography.

MERTIS, an infrared spectrometer, will investigate the surface composition.

MGNS will study the radioactive isotopes of the surface and will help finding ice deposits.

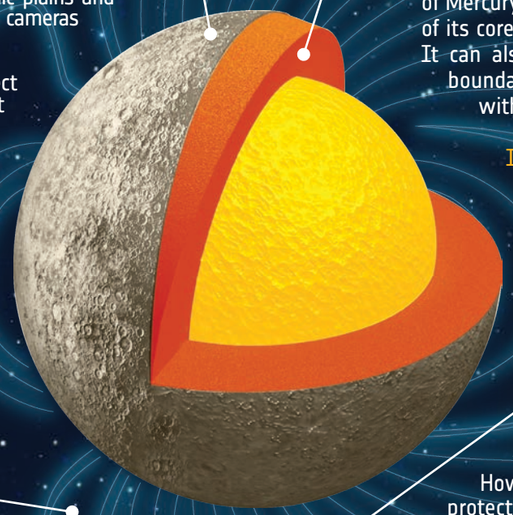
Also MIXS, an X-ray spectrometer, will help uncover the mineralogical composition of the surface.

Exosphere

The atmosphere of Mercury is so tenuous that its atoms never collide. However, it is so dynamic that can suggest us how Mercury's surface is eroded by the Sun radiation or by micrometeorite impacts.

SERENA will provide information on the surface-exosphere-magnetosphere coupled system and the processes involved with 2 units of complementary neutral particle detectors.

PHEBUS will investigate the exosphere composition with 2 ultraviolet spectrometers.



Interior

The planet's core occupies 80% of a total diameter of 4880 km. Its liquid outer part is slowly becoming colder.

MORE will investigate the interior structure of Mercury and estimate the size and density of its core by studying the gravitational field. It can also help studying the crust-mantle boundary depth by integrating its data with those of BELA.

ISA will help MORE to account for the effects of non-gravitational accelerations, in order to reconstruct Mercury's gravitational field with high accuracy.

Magnetosphere

Mercury has a dipolar magnetic field, similar to that of the Earth. However the field is too weak to protect Mercury from the hulking presence of the Sun and the strong solar wind.

MAG will measure intensity of Mercury magnetic field and, together with MMO instruments, will help reconstructing a 3D map of the field.

SERENA will provide information on the surface-exosphere-magnetosphere coupled system and the processes involved with 2 units of complementary ionised particle detectors.

SIXS will measure the X-radiation and amount of protons and electrons coming from the Sun.

Four instruments over eleven are headed by Italy

ISA - (Italian Spring Accelerometer) is a three-axis accelerometer able to detect the tiny effects (10^{-8} m/s^2) of the non-gravitational perturbations affecting the spacecraft orbit.
The accelerometer allows to take into account all these effects in order to reconstruct the Mercury gravity field.

MORE - (Mercury Orbiter Radioscience Experiment) is a Radioscience experiment that, by using on-ground antennas and an on-board Ka-band translator (KaT), will allow to measure the Earth-related distance and velocity of the spacecraft with an accuracy of the order of tenths of cm and micron/s, respectively. The goal is to reconstruct the gravitational field, to study the Mercury interior and to carry out a test of General Relativity.

SERENA - (Search for Exospheric Refilling and Emitted Natural Abundances) is a suite of 4 detectors of neutral atoms and ions which will study the environment around Mercury, by measuring the composition and dynamics of the exosphere. In such a way, it will be understood how this tenuous atmosphere is generated and how it interacts with the surface, with the magnetic field of Mercury and with the particles and the solar radiation as well.

SIMBIO-SYS - (Spectrometer and Imagers for MPO BepiColombo Integrated Observatory SYStem) is a suite of three optical instruments: a high resolution camera for a detailed study of Mercury's surface features, a stereo-camera, which will make a global 3D reconstruction of the surface and color composite images and a Visible-NIR spectrometer for studying the surface composition.

INAF Istituto Nazionale di Astrofisica National Institute for Astrophysics
Sapienza Università di Roma
agenzia spaziale italiana
esa
JAXA
ThalesAlenia Space
AIRBUS
LEONARDO