

# bepicolombo

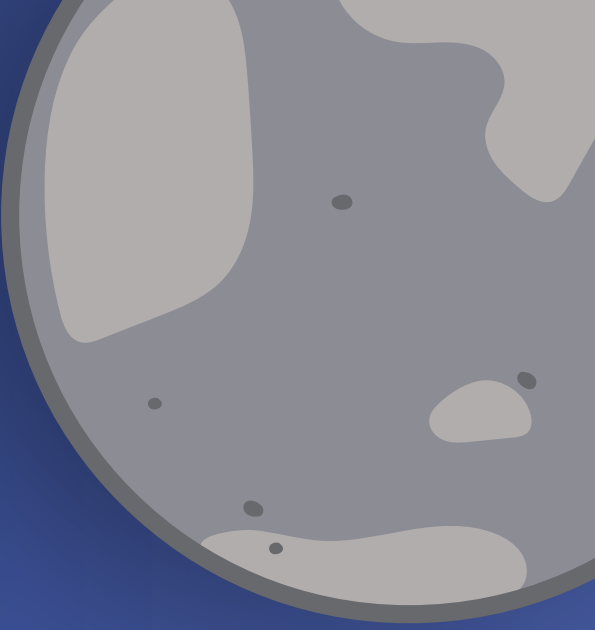
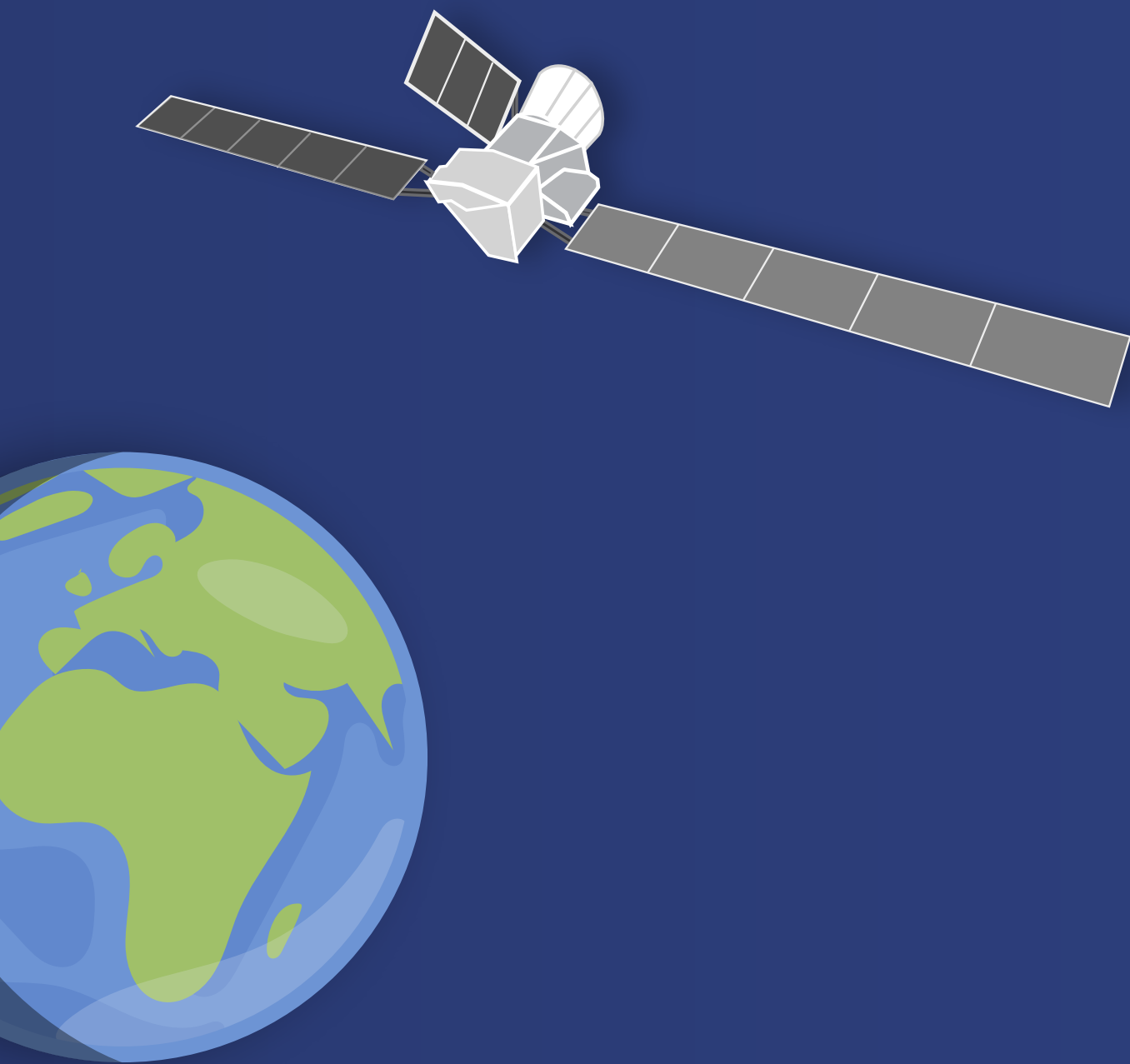
→ LAUNCH MEDIA KIT

#bepicolombo



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## → INTRODUCTION

BepiColombo – a joint ESA-JAXA mission to Mercury – is scheduled to launch aboard an Ariane 5 from Europe's Spaceport in Kourou, French Guiana at 01:45 GMT on 20 October 2018.

BepiColombo is the first European mission to Mercury, the smallest and least explored planet in the inner Solar System. It is the first Mercury mission to send two spacecraft to make complementary measurements of the planet's dynamic environment at the same time.

It will build on the discoveries and questions raised by NASA's Messenger mission, which orbited the planet between 2011 and 2015, to provide the best understanding to date of the Solar System's innermost planet. BepiColombo will deliver information about solar system evolution in general – not just about our own, but regarding how planets orbiting close to their stars in exoplanet systems form and evolve, too.

The mission comprises two science orbiters: ESA's Mercury Planetary Orbiter (MPO) and JAXA's Mercury Magnetospheric Orbiter (MMO). The ESA-built Mercury Transfer Module (MTM) will carry the orbiters to Mercury using a combination of solar electric propulsion and gravity assist flybys. Over seven years, the mission will make one flyby of Earth, two at Venus, and six at Mercury. The orbiters will be able to operate some of their instruments during the cruise phase, affording unique opportunities to collect scientifically valuable data at Venus, for example.

A big challenge for the mission is the Sun's enormous gravity, which makes it difficult to place a spacecraft into a stable orbit around Mercury – even more energy is needed than sending a mission to Pluto. After launch, and having escaped the 'gravity well' of Earth, BepiColombo has to constantly brake against the gravitational pull of the Sun. Ion thrusters on the MTM will

provide the needed low thrust over long durations of the cruise phase. The ion thruster technology was demonstrated previously in ESA's GOCE mission to study Earth's gravity and in the SMART-1 mission to the Moon.

The high solar intensity experienced during the journey and operations at Mercury also demanded new technologies and materials to be developed, such as high-temperature coatings and multi-layered insulation, a radiator for the MPO, and a novel spin-technique for MMO, to avoid overheating. During the cruise phase, however, it will not be spinning, so it is protected by a sunshield. Many of the technologies developed for operating BepiColombo in extreme temperature conditions, both hot and cold, are relevant for future missions such as ESA's upcoming Solar Orbiter and Jupiter Icy moons Explorer (Juice).

### Why "BepiColombo"?

The mission is named after the Italian mathematician and engineer Giuseppe (Bepi) Colombo (1920–84). He is known for explaining Mercury's peculiar characteristic of rotating about its own axis three times in every two orbits of the Sun. He also proposed to NASA the interplanetary trajectories that would allow Mariner 10 multiple Mercury flybys, by using gravity assists at Venus for the first time.

### Partners

BepiColombo is the result of major international cooperation, with ESA being responsible for the overall mission design:

- Airbus Defence and Space in Germany is the prime contractor for the design and procurement of the ESA parts of the spacecraft, including MPO, MTM, MMO's sunshield, and the


interface between MPO and MMO. It provided the design and development of the data management, attitude and orbit control subsystems, and solar arrays.

- Thales Alenia Space Italy is the co-prime contractor for the development of the MPO's electrical power, thermal control and communications systems and for the integration and test activities.

- In the UK, Airbus Defence and Space is co-prime contractor for the electrical and chemical propulsion systems, for the structure of all modules and for the thermal control of MTM. Airbus Defence and Space in France has developed the onboard software.

- MMO was designed and developed by JAXA, who in turn was responsible for procuring the spacecraft from an industrial team led by NEC Corporation.

### About this media kit

This is an interactive media kit. Navigate between pages from the contents page or with the arrows at the bottom of each page. Explore scientific and technological themes of the BepiColombo mission through the series of infographics. Roll over the graphic elements to discover hyperlinks to more information on related webpages. Click on the symbol  to directly access the infographic download page. Links to recommended images, videos and animations are provided towards the end of this media kit. An internet connection is required to access the external webpages.

## → EVENT PROGRAMME

Provisional schedule at ESA's mission control centre in Darmstadt, Germany, 20 October (all times in local CEST)

**02:30** Doors open

**03:00** Programme begins

Scientists and mission operations experts present the mission, with live transmissions from Kourou including the moment of launch at 03:45 CEST. This will be followed by the announcement of acquisition of signal from the Main Control Room.

**04:30** Q&A and individual interview opportunities

**05:00** End of event – media invited to join team breakfast with representatives of ESA, industry and the scientific community.

## → LIVE UPDATES



Webstreaming

ESA will cover the launch live from 03:15 CEST at [esa.int/live](https://esa.int/live)



Twitter

For live updates throughout the launch period, follow [@BepiColombo](https://twitter.com/BepiColombo), [@esaoperations](https://twitter.com/esaoperations) and [@esascience](https://twitter.com/esascience) on Twitter.

Follow JAXA at [@JAXA\\_jp](https://twitter.com/JAXA_jp) or [@JAXA\\_en](https://twitter.com/JAXA_en) for tweets in Japanese or English, respectively.

The three spacecraft modules also have personalised accounts ([@JAXA\\_MMO](https://twitter.com/JAXA_MMO), [@ESA\\_Bepi](https://twitter.com/ESA_Bepi) and [@ESA\\_MTM](https://twitter.com/ESA_MTM)); follow for extra content and a unique take on the mission.

Note that images from the MTM's monitoring camera, showing the deployed solar arrays of the MTM, and the MPO's antennas, will only be taken approximately 12 hours and 1.5 days after launch, respectively. They will be shared on [esa.int/bepicolombo](https://esa.int/bepicolombo) and from the [@ESA\\_MTM](https://twitter.com/ESA_MTM) account on Twitter in the first instance, once available.

The official hashtag is [#bepicolombo](https://twitter.com/hashtag/bepicolombo)



Information for general public: [esa.int/bepicolombo](https://esa.int/bepicolombo)  
In-depth information: [sci.esa.int/bepicolombo](https://sci.esa.int/bepicolombo)



[Facebook.com/EuropeanSpaceAgency](https://Facebook.com/EuropeanSpaceAgency)



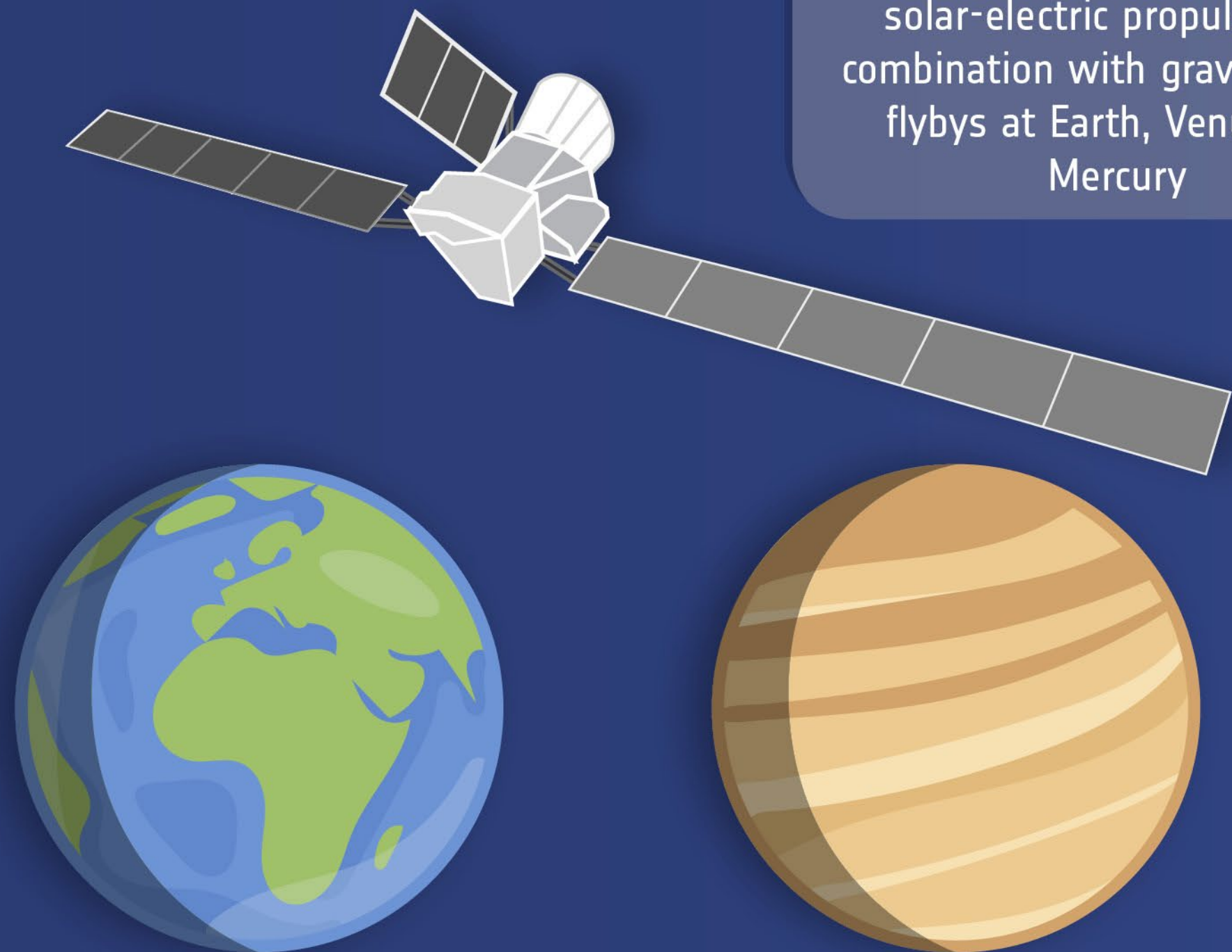
[Youtube.com/ESA](https://Youtube.com/ESA)



[Instagram.com/europeanspaceagency](https://Instagram.com/europeanspaceagency)



## → BEPICOLOMBO: KEY MESSAGES



Preparing the technological future of space exploration by using solar-electric propulsion in combination with gravity assist flybys at Earth, Venus and Mercury

A major world class scientific mission led by ESA in close cooperation with JAXA

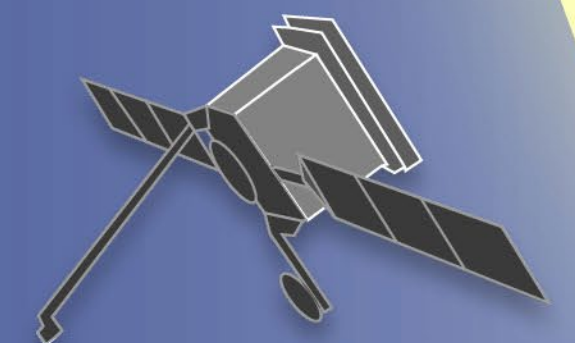
First European mission to Mercury, the least explored planet in the inner Solar System

First mission to Mercury comprising two science orbiters, enabling unique and complementary measurements

Investigating unsolved mysteries at Mercury to provide the best understanding of the planet to date

New high-temperature technologies and more experience in space operations close to the Sun

Understanding how a planet close to the Sun forms and evolves

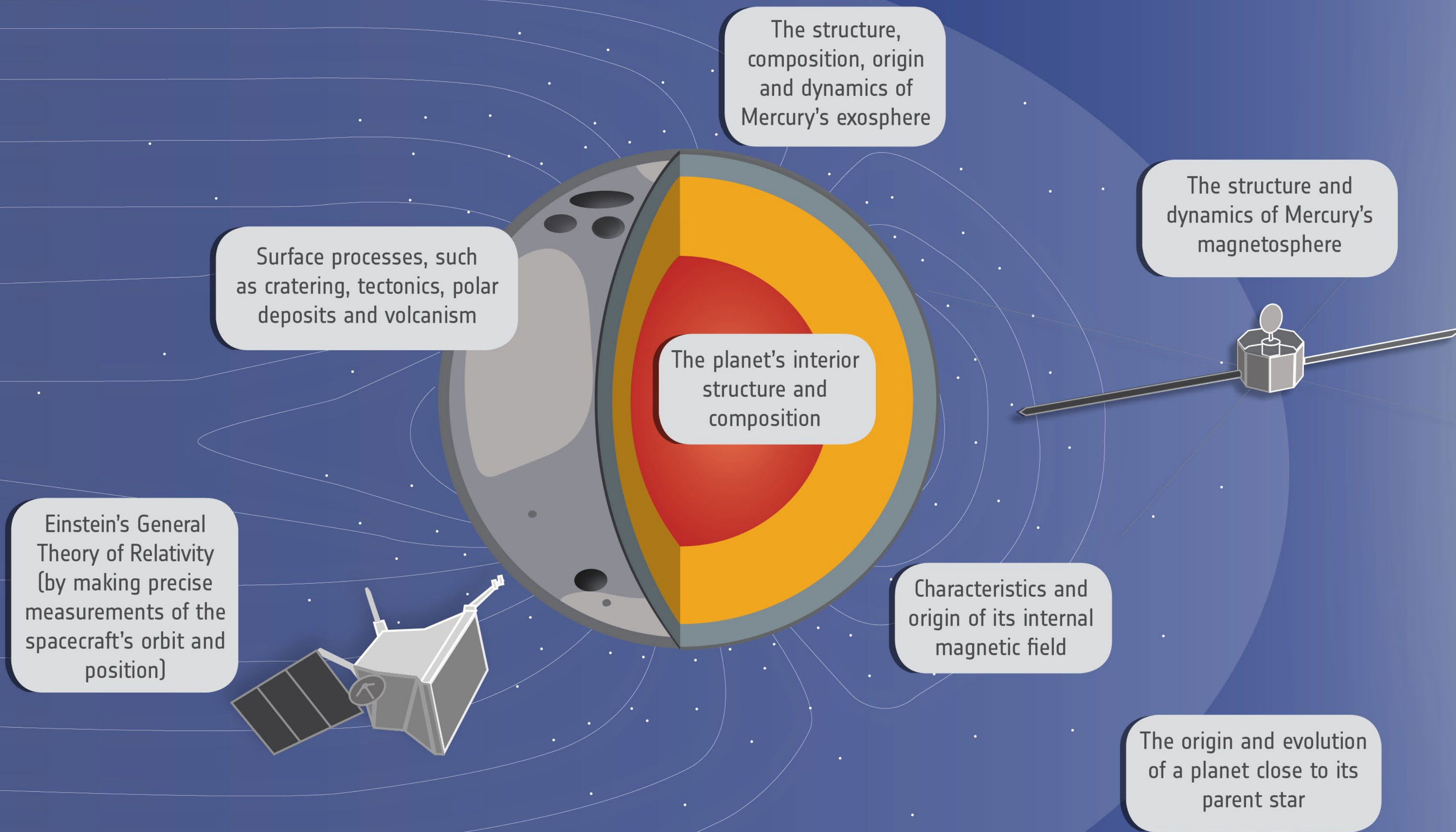


Knowledge gained for future mission Solar Orbiter





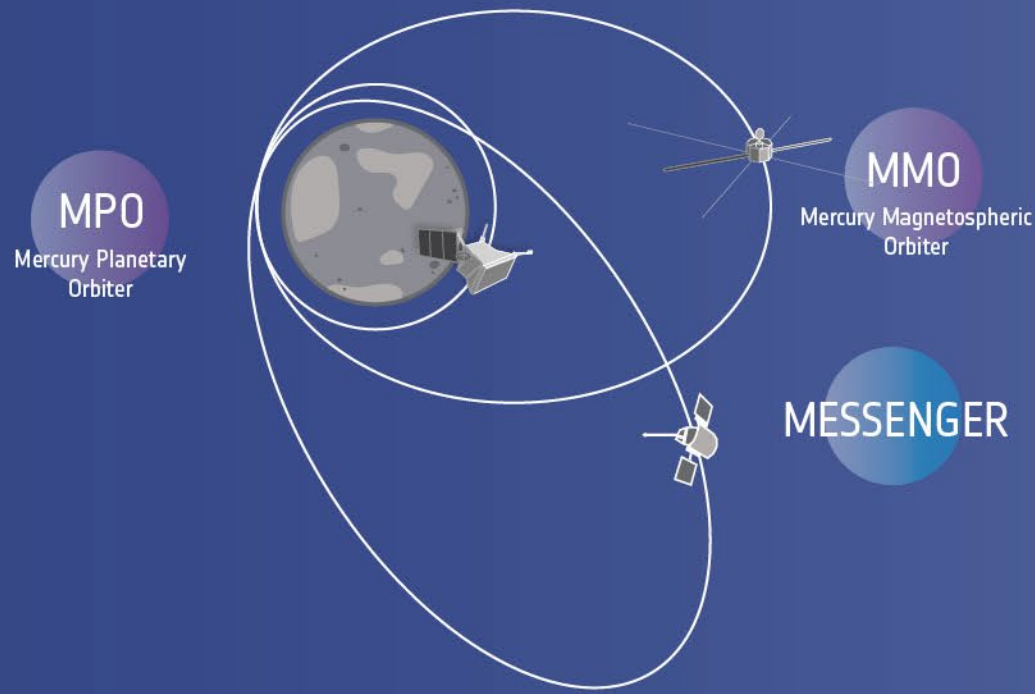
## → BEPICOLOMBO SCIENCE THEMES





# → FROM MESSENGER TO BEPICOLOMBO

Examples of how BepiColombo will follow up on discoveries made by NASA's Messenger mission



### OFFSET MAGNETIC FIELD

Messenger's observations showed that the centre of origin of Mercury's magnetic field is offset from the centre of the planet by about 20% of its radius

BepiColombo will obtain detailed measurements in the southern hemisphere, complementing the details obtained by Messenger in the northern hemisphere, in order to provide a more complete view of the situation

### SHADOWED CRATERS

Messenger identified deposits in shadowed craters at the poles that are thought to be water-ice

BepiColombo, with its polar orbit, will provide a more comprehensive coverage of these areas with many different instruments

### UNIQUE SURFACE FEATURES

Messenger identified new surface features, such as the so-called 'hollows', that appear to be young and unique to Mercury

BepiColombo's high resolution imaging, from ultraviolet to thermal infrared, will determine the chemical composition, helping to home in on how they form

### DYNAMIC MAGNETOSPHERE

Messenger monitored Mercury's highly dynamic magnetosphere as it responded to the Sun's activity

BepiColombo's two spacecraft, from their different orbits, will provide unique insight into the relationship between the Sun's activity, the magnetosphere and surface processes

### VOLCANIC ACTIVITY

Messenger imaged a range of geologic features associated with past volcanic activity

BepiColombo is capable of improving the understanding of the variations in volcanic eruptive style over time

### SHRINKING PLANET

Messenger's results found that Mercury has shrunk by as much as 7 km in radius as its interior cooled and contracted

BepiColombo will image surface features, in particular at higher resolution in the southern hemisphere, to help determine how this contraction was distributed over time, improving our knowledge of the cooling history of a planet without plate tectonics

### CARBON'S ORIGIN

Messenger's measurements suggested that graphitic carbon is responsible for Mercury's dark surface, but did it come from external sources or rather from a global ocean of molten magma in the planet's early history?

BepiColombo will provide information on the nature and abundance of the carbon to help pinpoint its origin

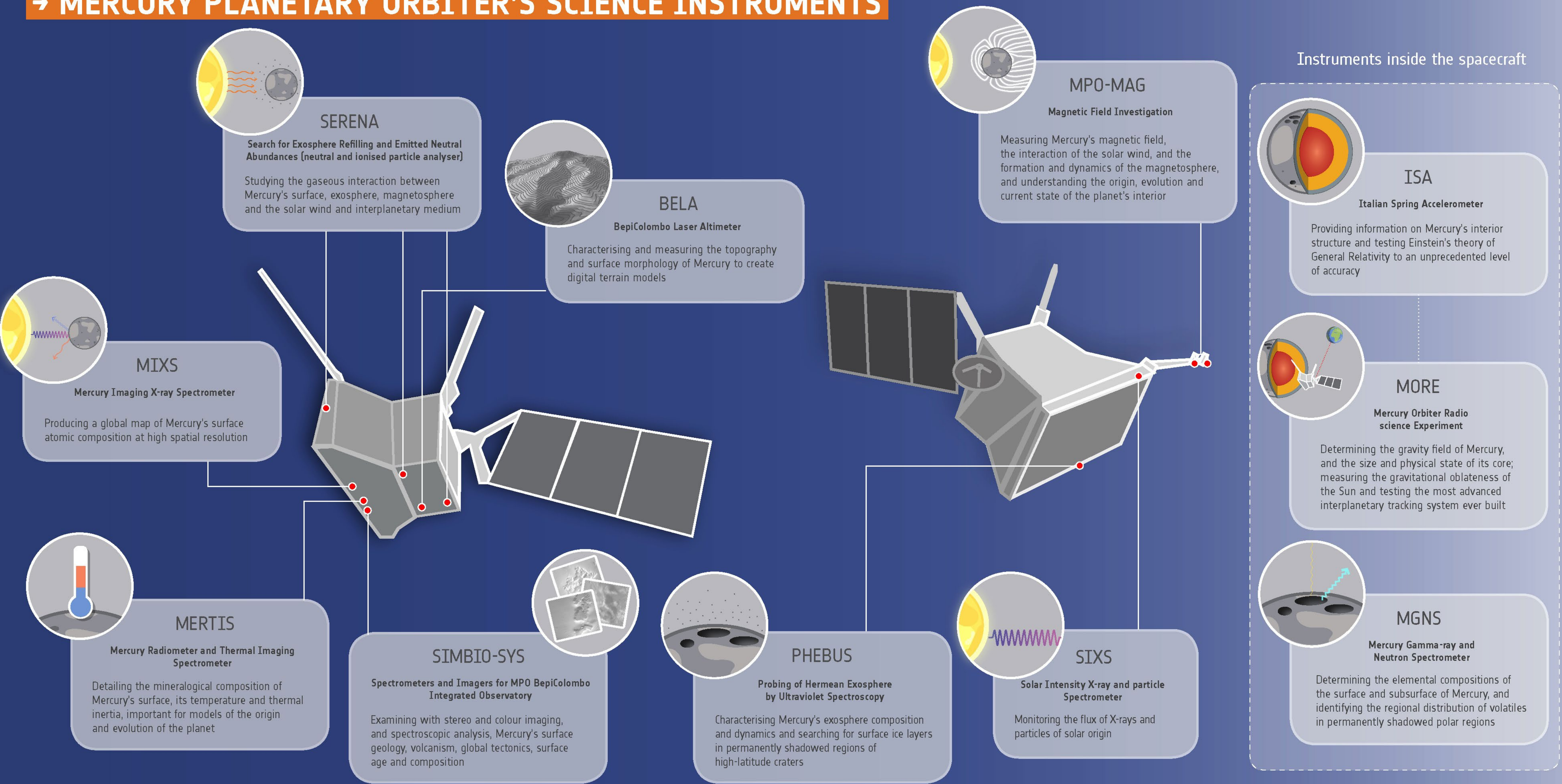
### CHANGING EXOSPHERE

Messenger monitored Mercury's constantly changing exosphere, finding that species such as sodium, potassium, calcium and magnesium all exhibit different distributions that do not fit with standard models

BepiColombo will provide additional insight into the temporal evolution of the structure and composition of the exosphere, and is expected to detect other species as well

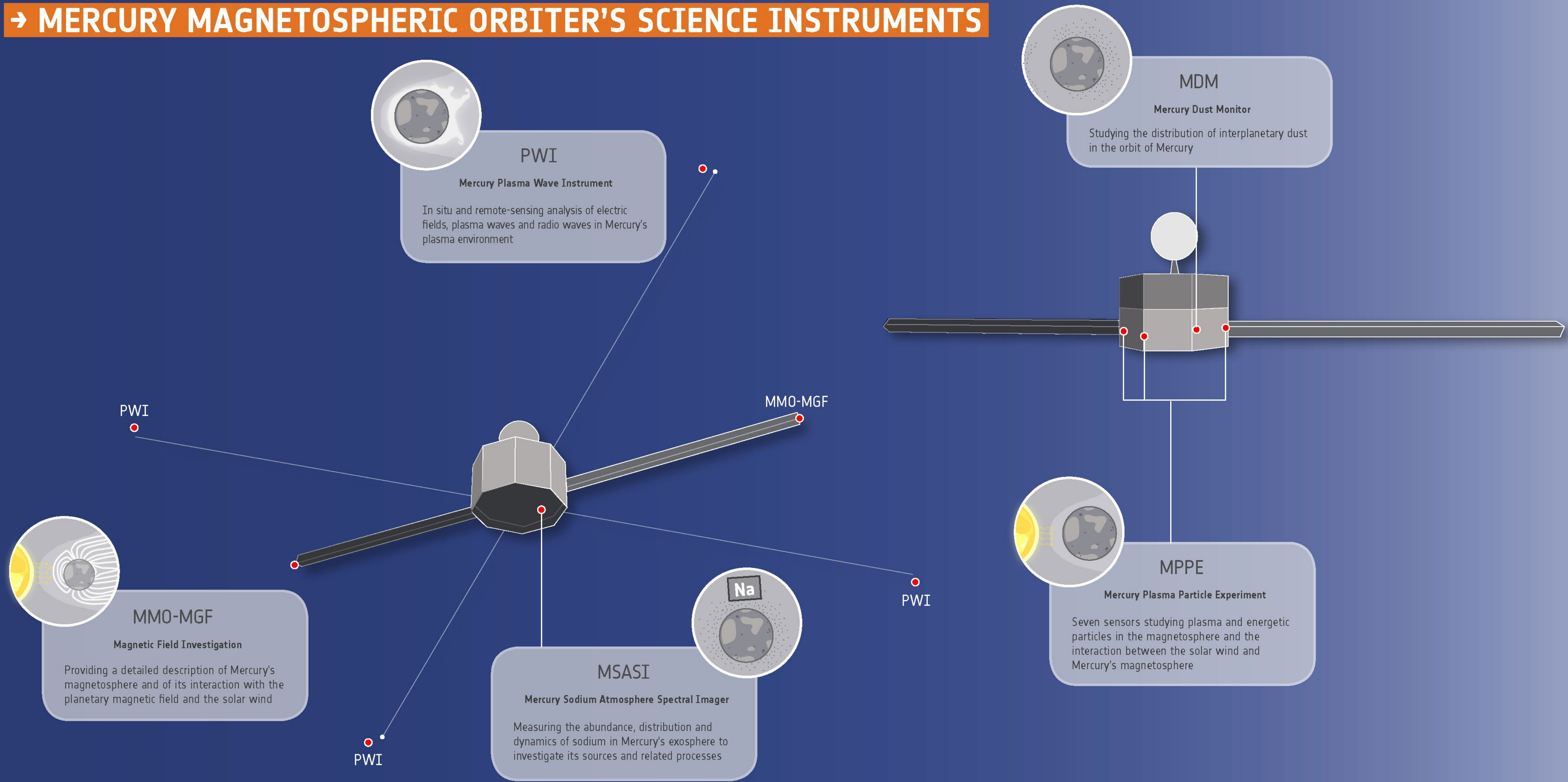


# → MERCURY PLANETARY ORBITER'S SCIENCE INSTRUMENTS





→ MERCURY MAGNETOSPHERIC ORBITER'S SCIENCE INSTRUMENTS

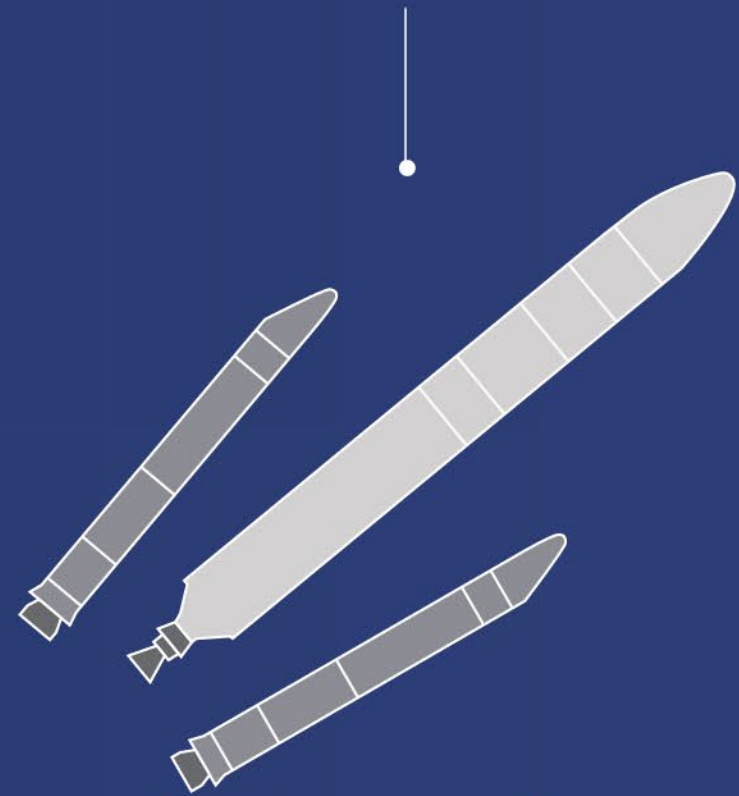




# → LAUNCH AND SEPARATION

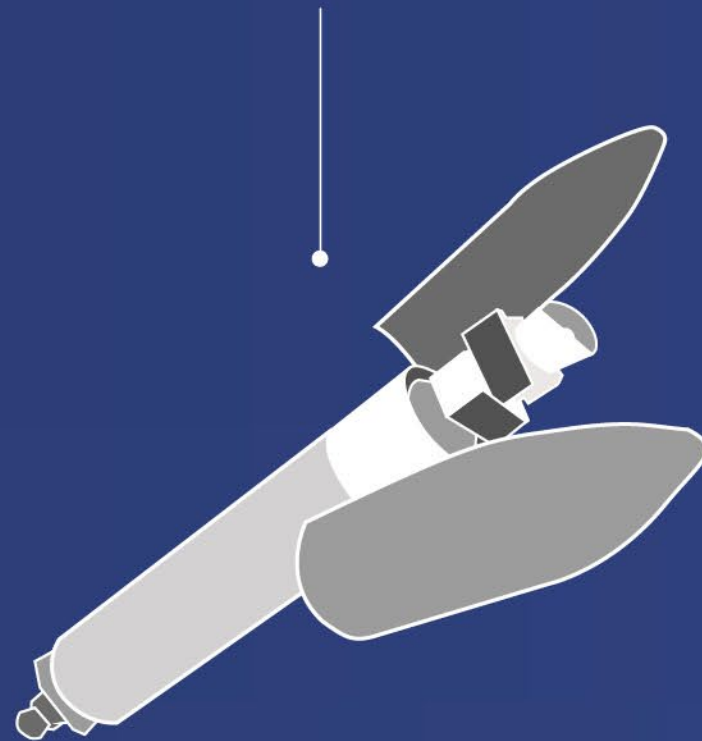


L + 2 mins



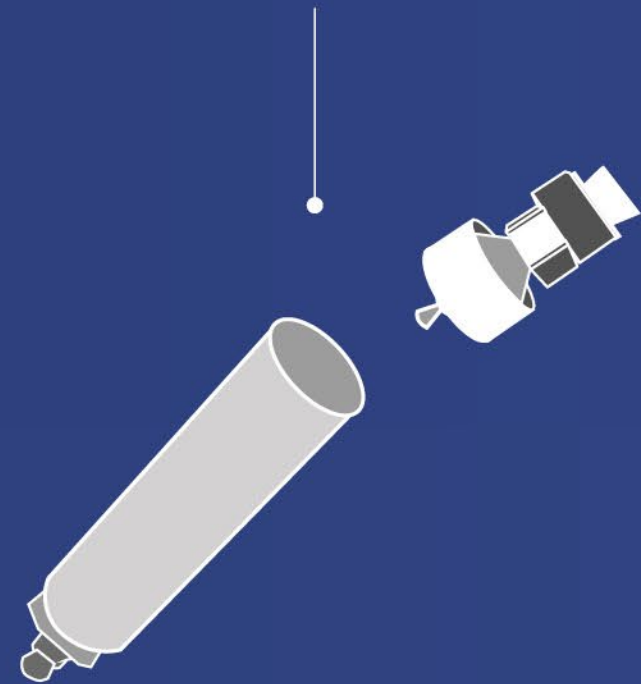
Booster separation

L + 3 mins



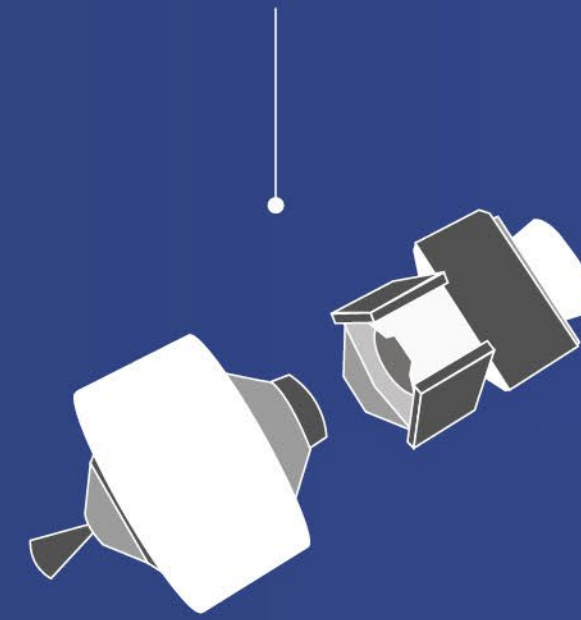
Fairing separation

L + 9 mins



Main stage separation

L + 27 mins



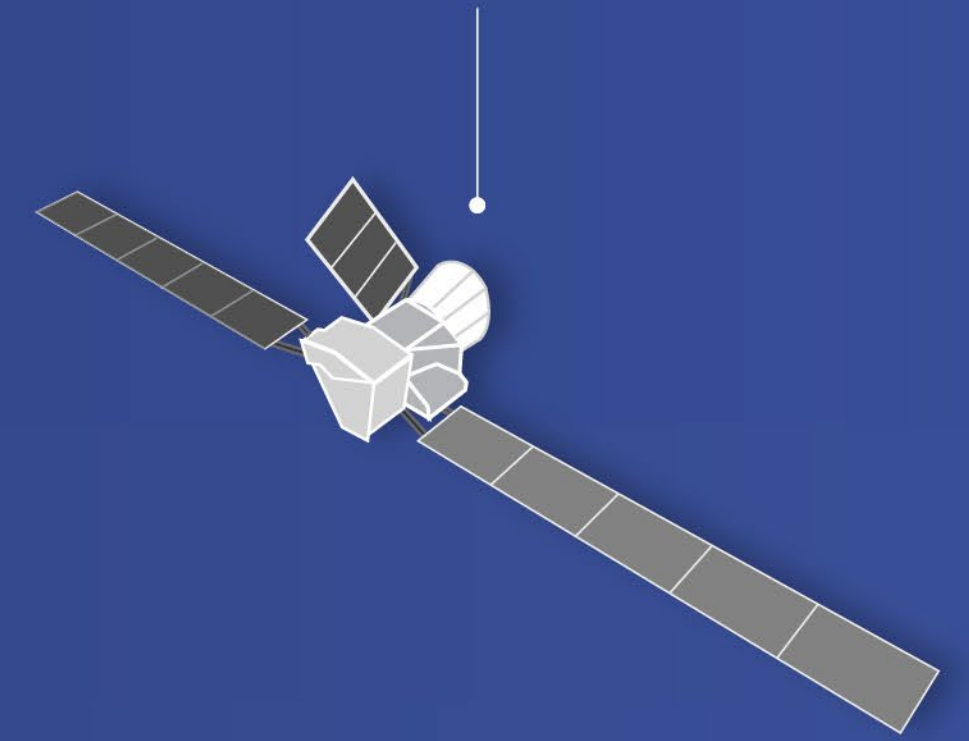
Spacecraft separation

L + 40 mins



First acquisition of signal  
expected L+36-44 mins

L + 74 mins



Solar array deployment  
completed

L + 18 hours

MGA deployment  
completed

L + 29.5 hours

HGA deployment  
completed

L + 3 days

Spacecraft subsystem  
and instrument checkouts,  
start of cruise phase

L + 2 months

Start of first electric  
propulsion arc

Lift-off with Ariane 5

19-10-2018: 22:45:28 GFT

20-10-2018: 01:45:28 GMT

03:45:28 CEST

10:45:28 JST

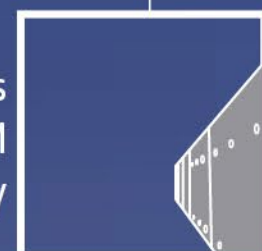


Monitoring cameras  
image deployed MGA



L + 1.5 days

Monitoring cameras  
image deployed MTM  
solar array



L + 12 hours

Monitoring cameras  
image deployed HGA



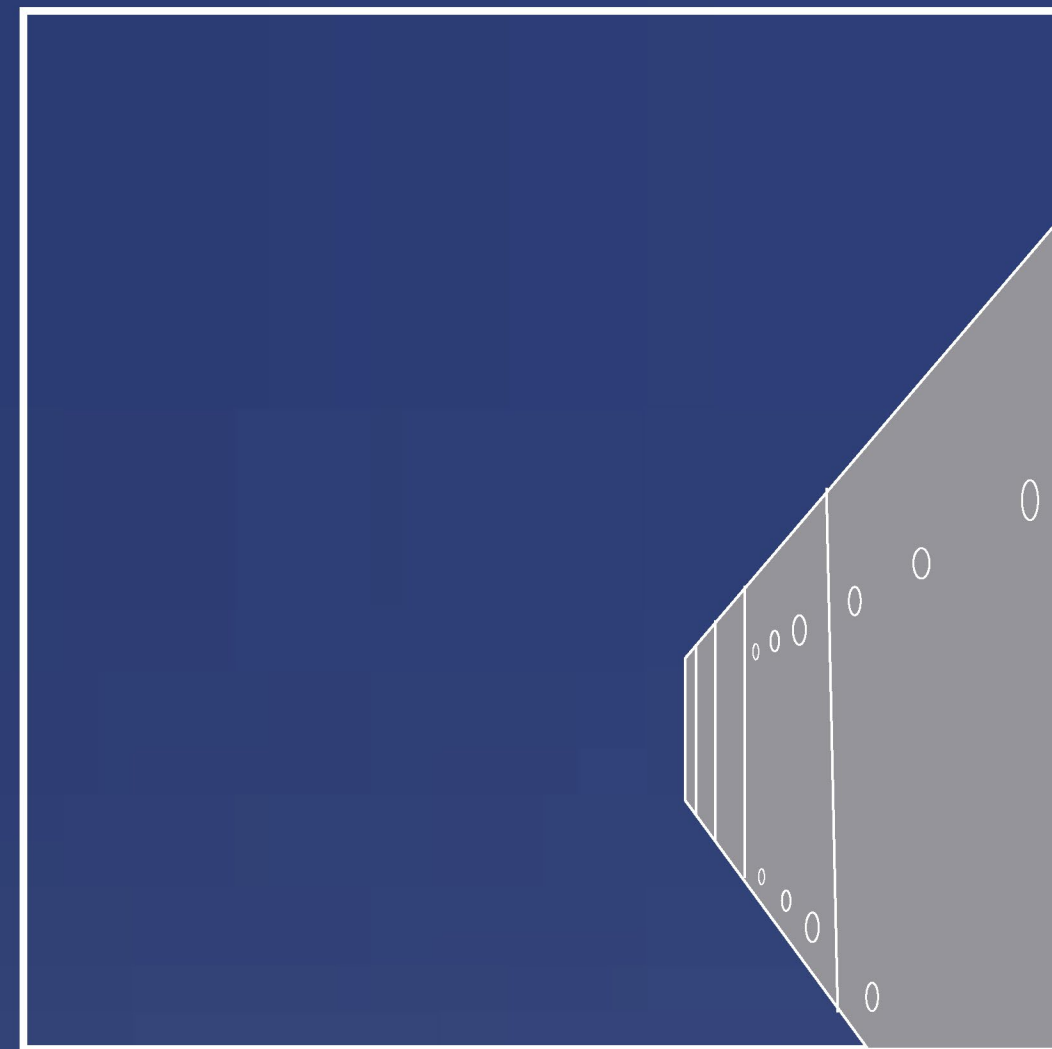
L + 1.5 days



## → MERCURY TRANSFER MODULE CAMERAS

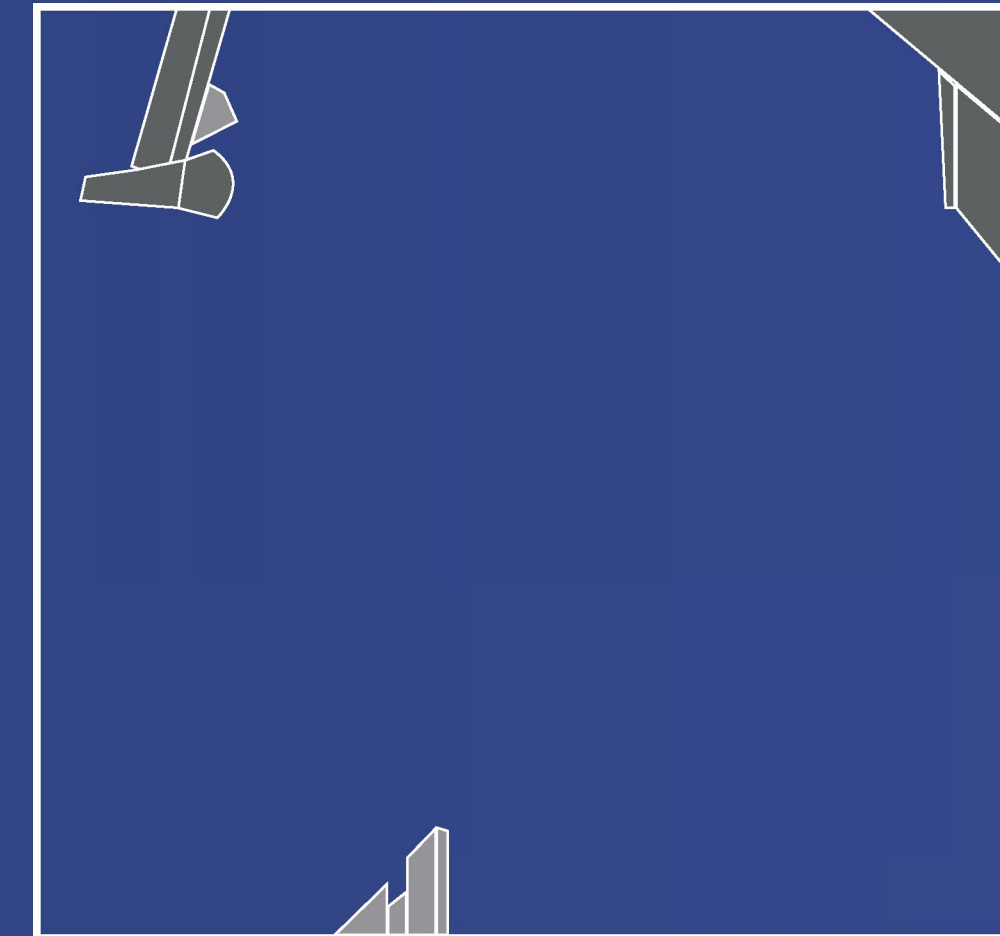
The BepiColombo Mercury Transfer Module has three monitoring cameras to provide black-and-white snapshots with different fields of view

### 1 M-CAM 1

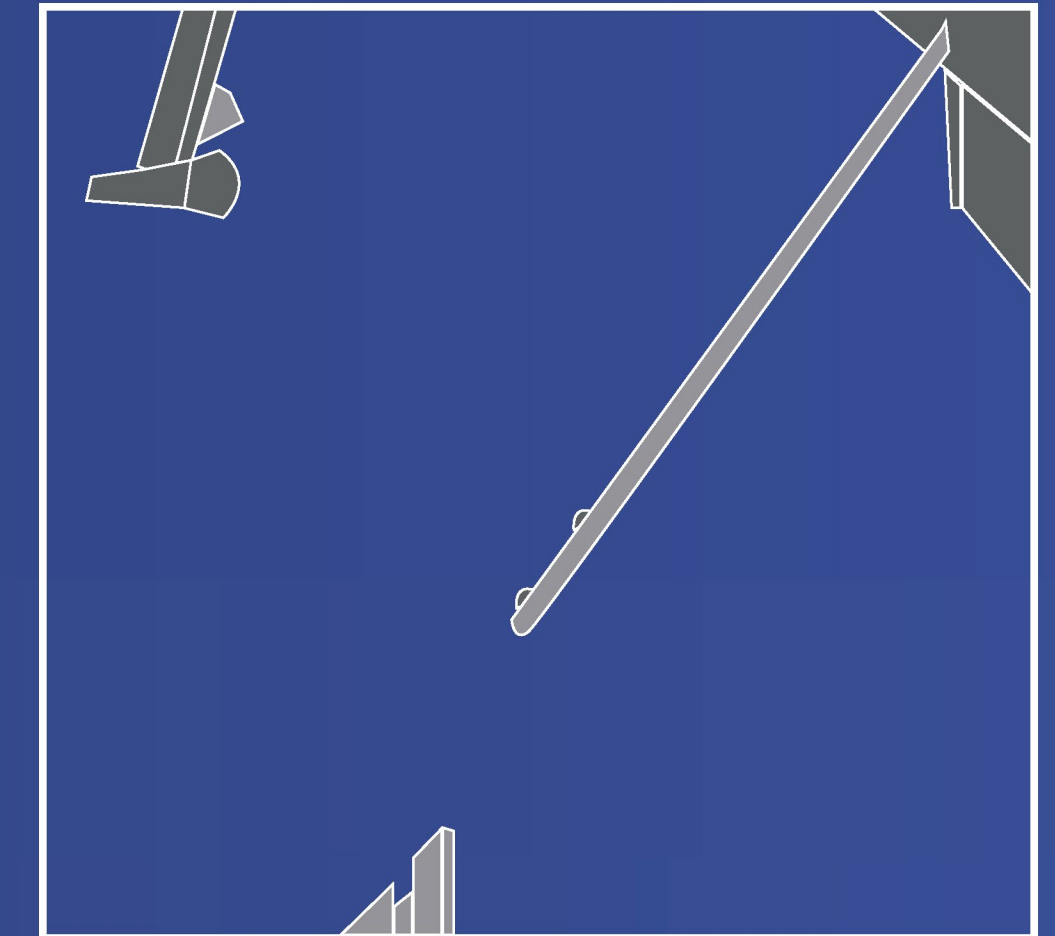


Example view of the deployed MTM solar array

### 2 M-CAM 2

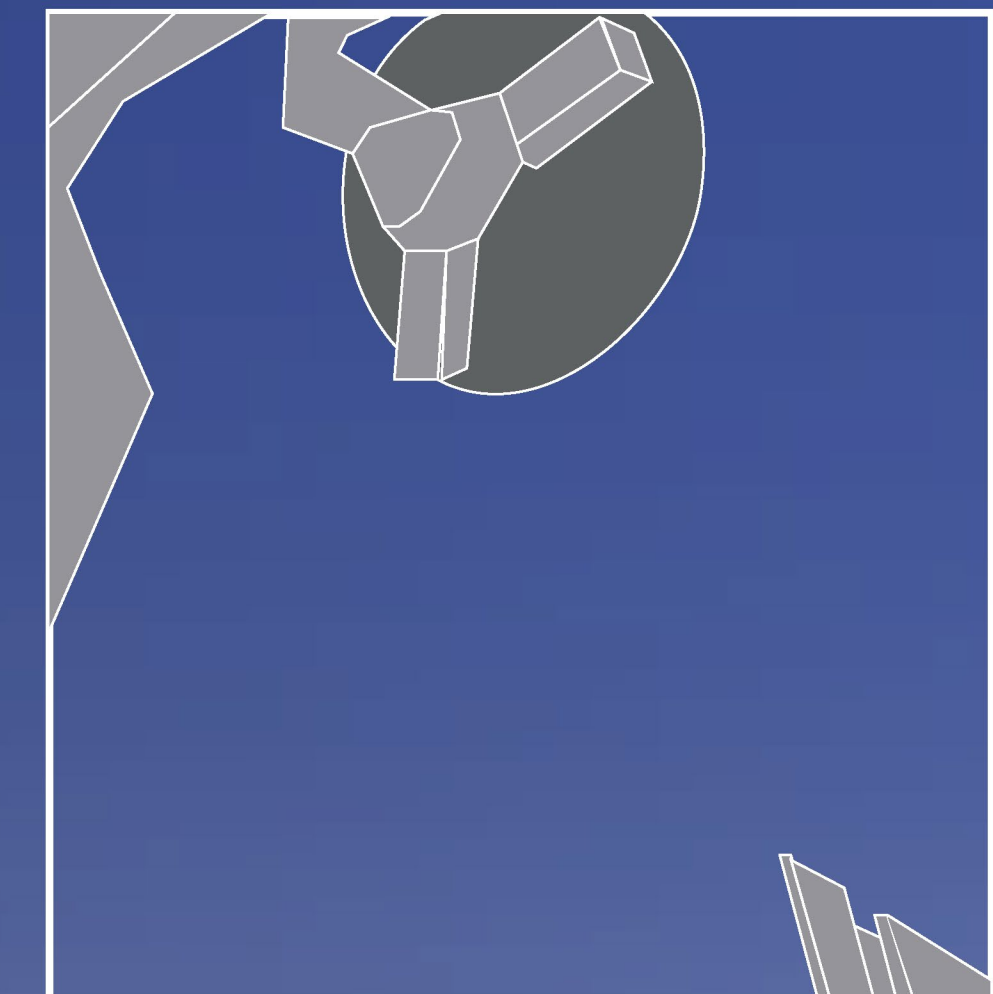


Example view of the deployed medium-gain antenna on the MPO

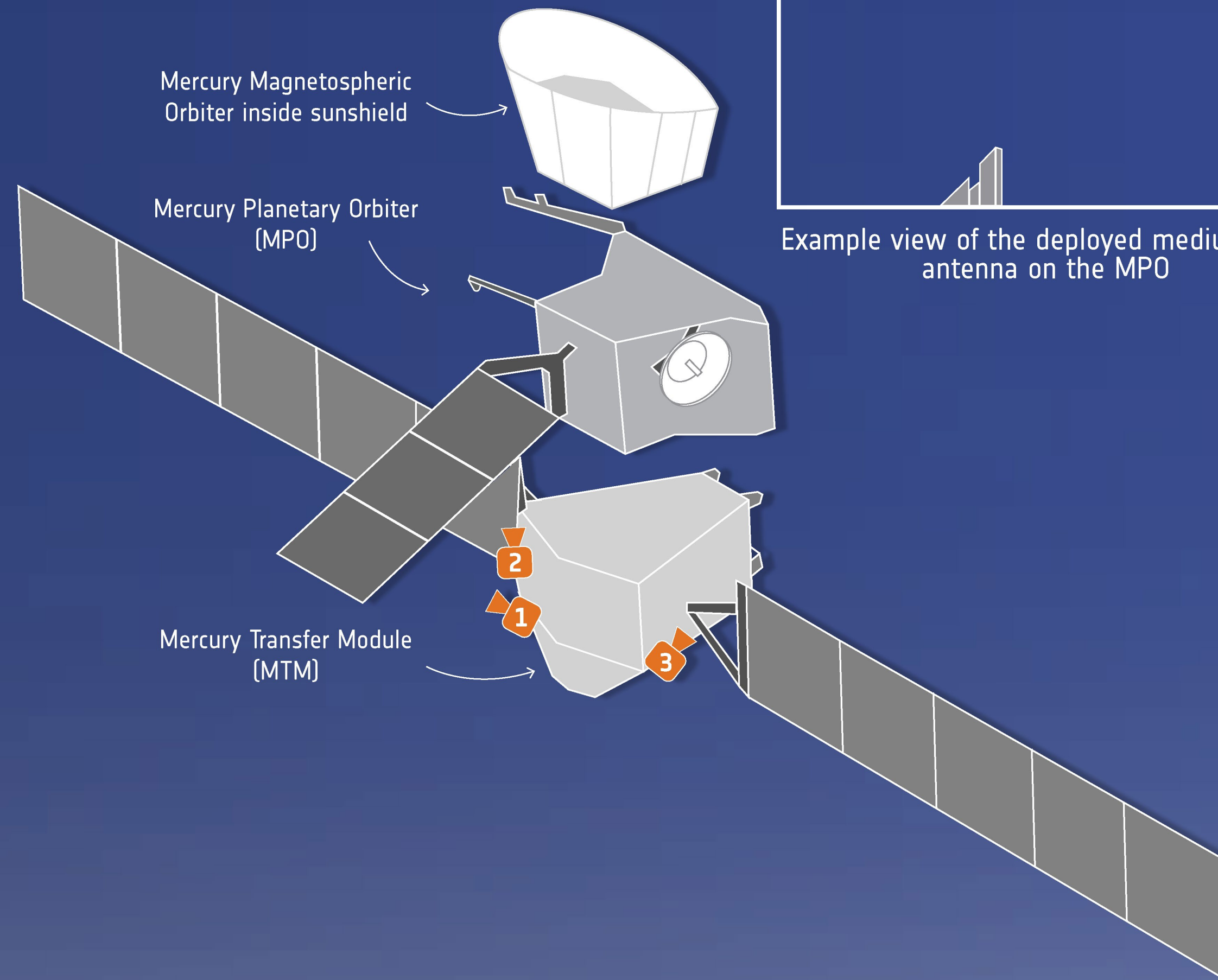


Example view of the deployed medium-gain antenna and the magnetometer boom on the MPO

### 3 M-CAM 3

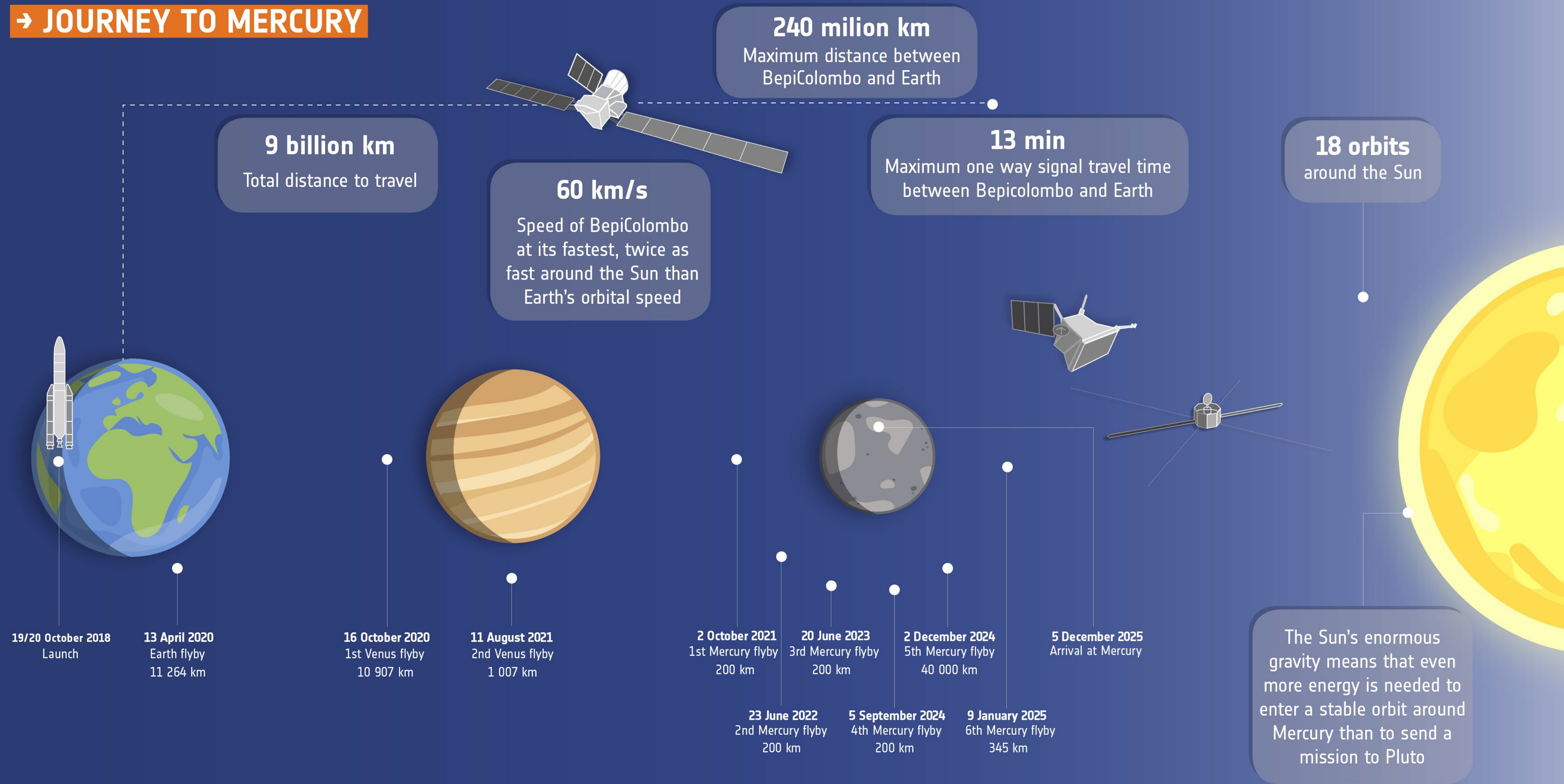


Example view of the deployed high-gain antenna on the MPO





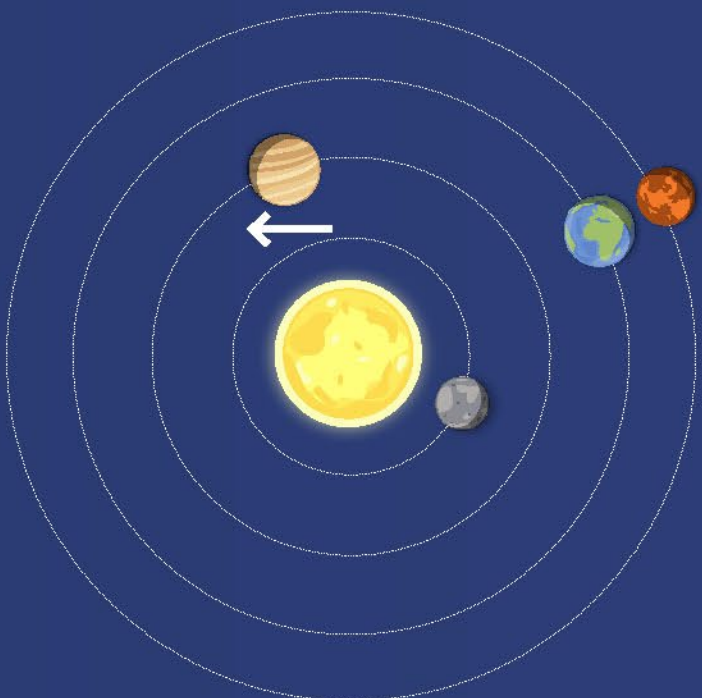
→ JOURNEY TO MERCURY



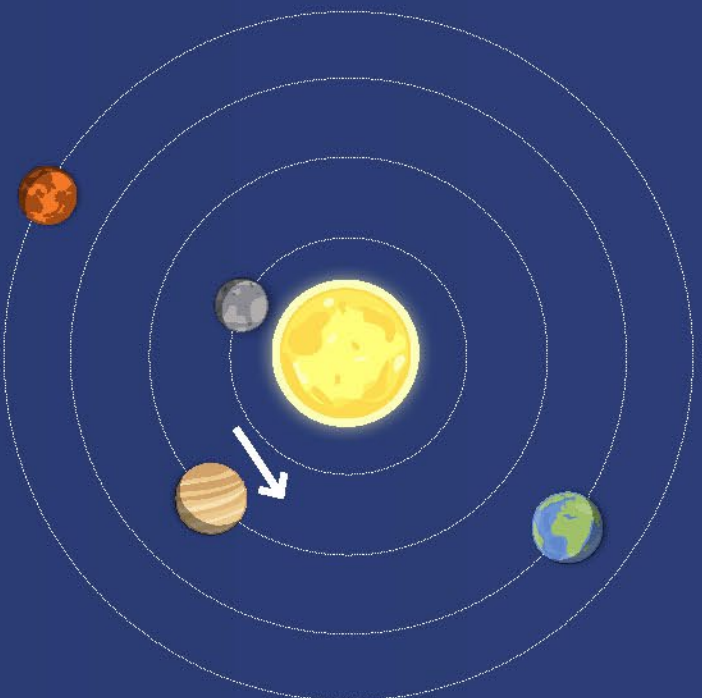


# → VENUS FLYBY SCIENCE OPERATIONS

BepiColombo teams are planning to operate eight out of eleven science instruments on the Mercury Planetary Orbiter and three out of five on the Mercury Magnetospheric Orbiter during the two flybys of Venus



First flyby  
16 October 2020  
10 907 km



Second flyby  
11 August 2021  
1 007 km

Flyby distances at closest approach

## Atmosphere studies

Temperature and density profiles

Chemical composition

Global circulation

## Internal structure

Probing the internal structure of the planet

## Interactions between the Sun and Venus

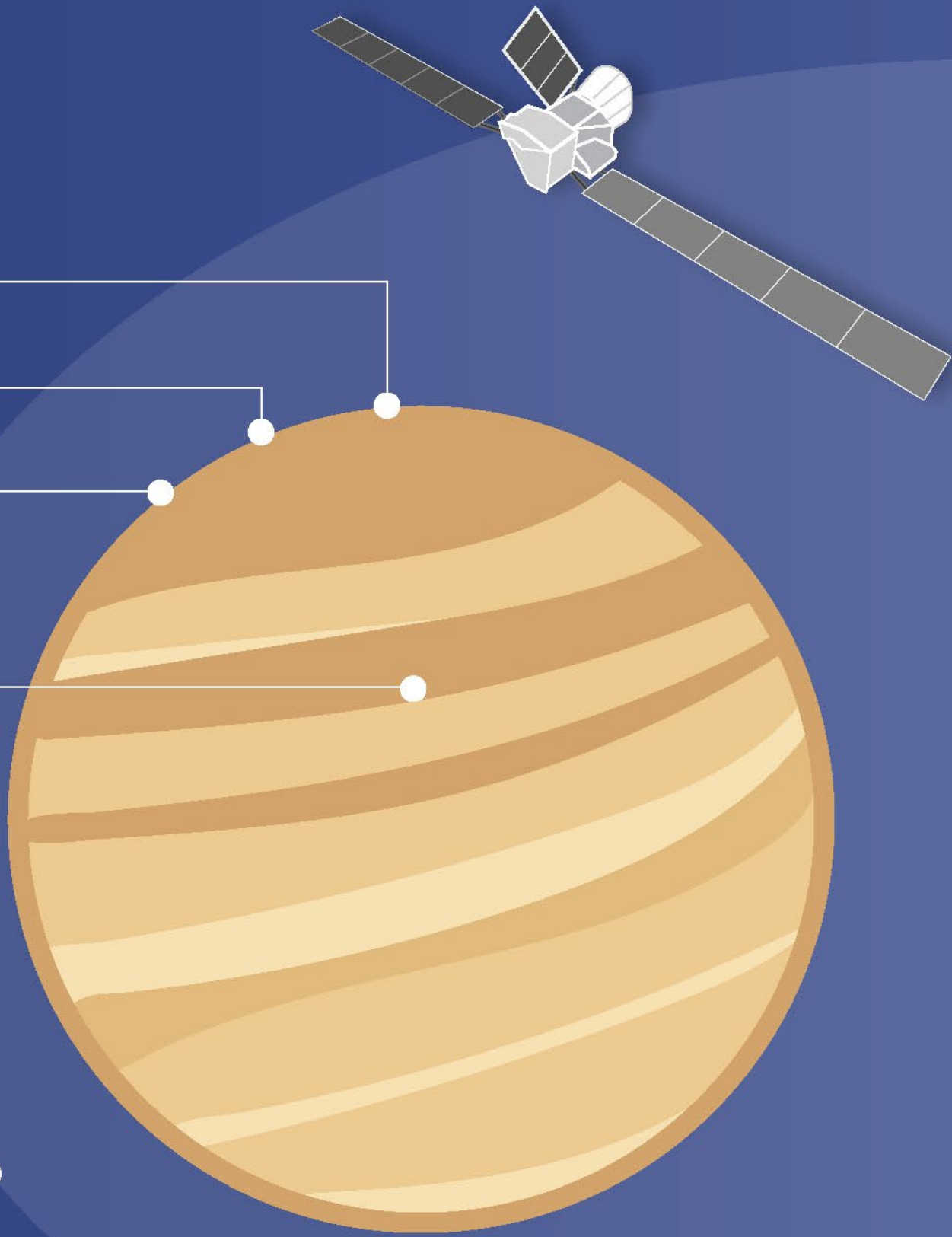
Solar radiation

Energetic particles

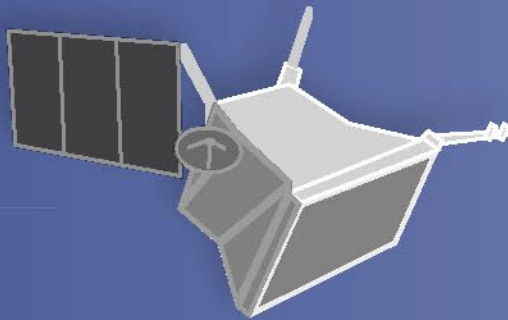
Plasma interactions

Local interplanetary magnetic field

Electric field, plasma and radio waves

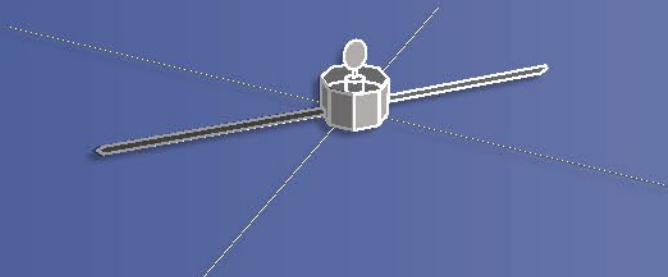


## Instruments active during flyby



Mercury Planetary Orbiter

- BELA*
- ISA**
- MERTIS**
- MGNS**
- MIXS*
- MORE**
- MPO-MAG**
- PHEBUS**
- SERENA**
- SIMBIO-SYS*
- SIXS**



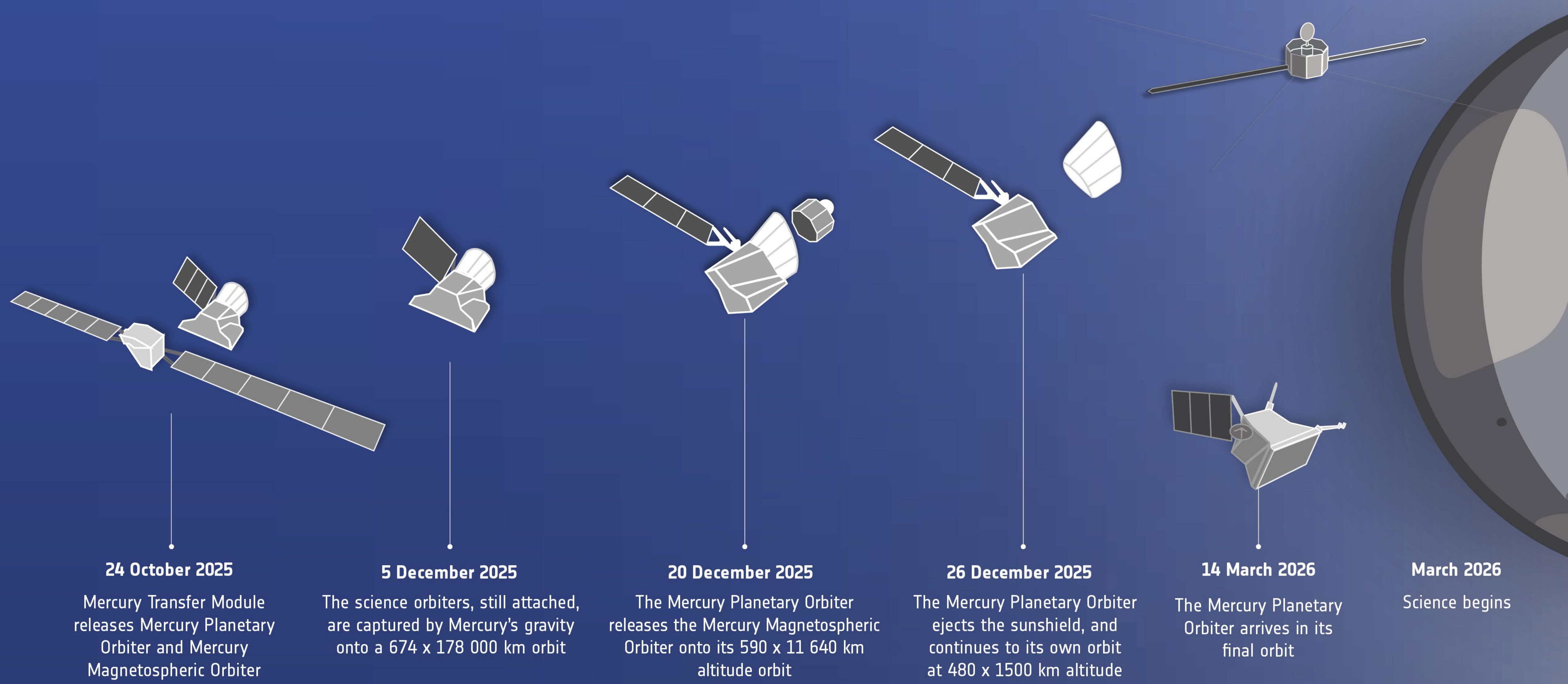
Mercury Magnetospheric Orbiter

- MDM*
- MMO-MGF**
- MPPE**
- MSASI*
- PWI**

Science operations at Venus are in the planning stage, and may change closer to the event



## → ARRIVAL AT MERCURY





## → OPERATING IN EXTREME ENVIRONMENTS



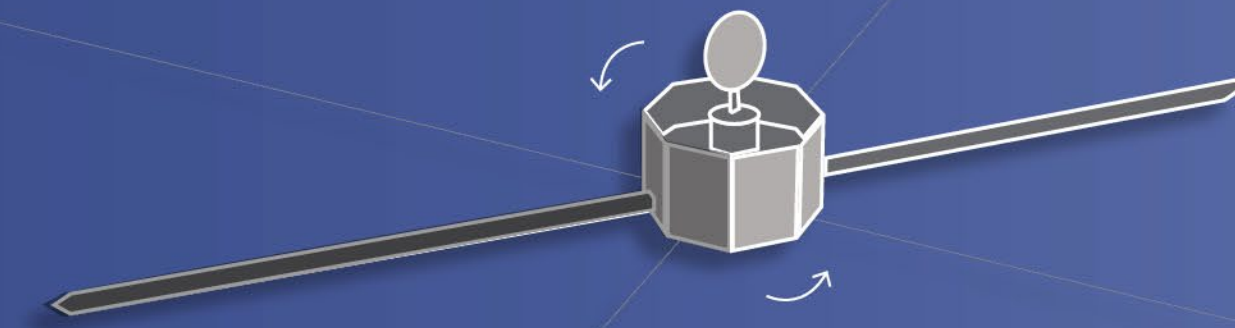
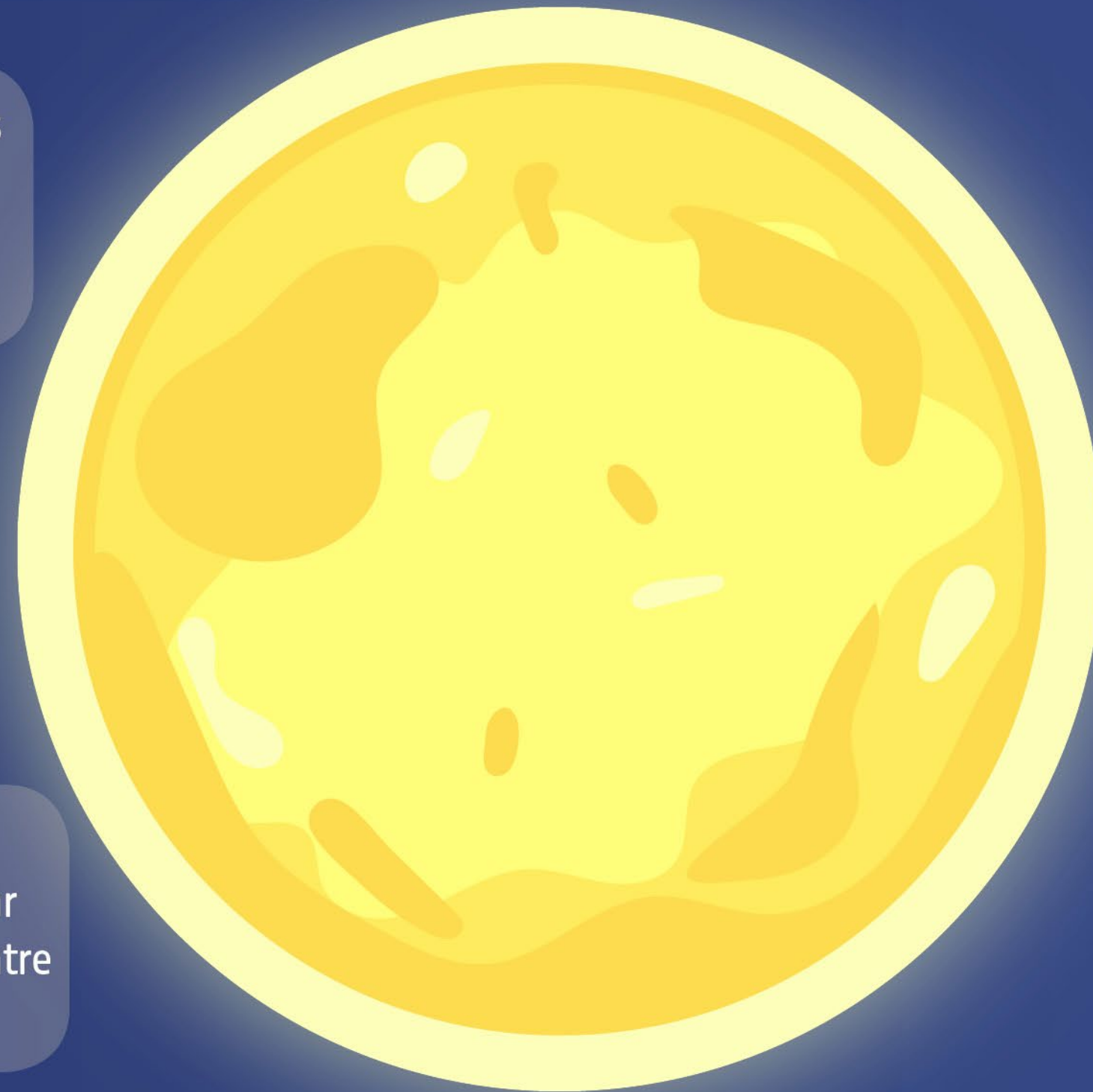
The solar intensity at Mercury is about 10 times that at Earth

Large temperature changes will be experienced at Mercury, from  $-180^{\circ}\text{C}$  to  $+450^{\circ}\text{C}$

New high-temperature coatings, multi-layered insulation, and high-temperature mechanisms were required for BepiColombo

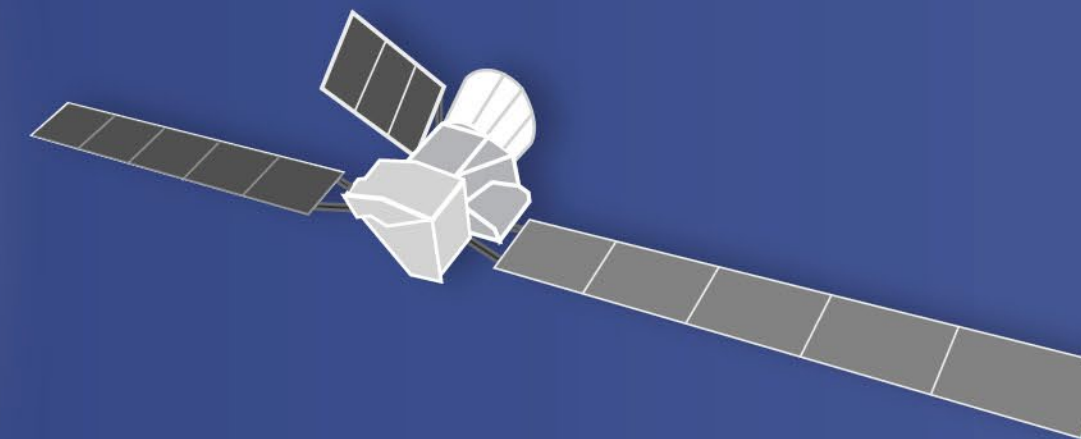
To have representative test conditions, the solar simulator at ESA's test centre had to be modified

Over 80% of materials had not been tested in such an extreme environment before

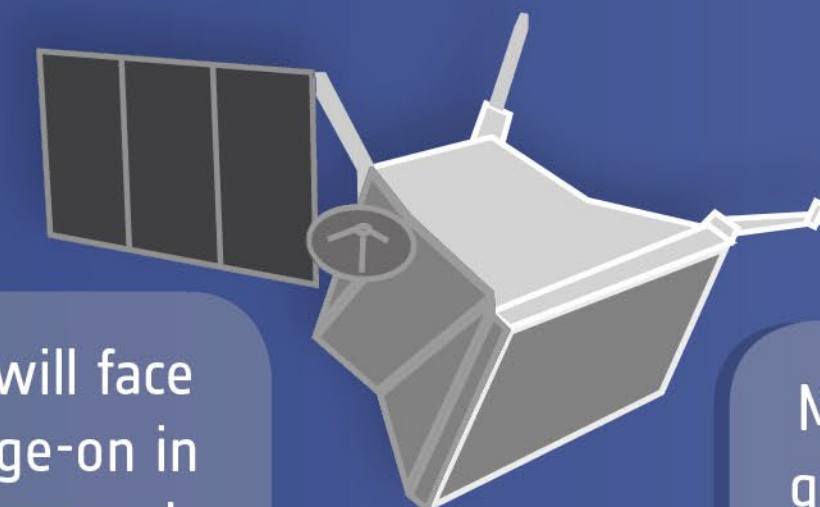


MMO will spin 15 times per minute to distribute the Sun's heat over its solar cells

A sunshield protects MMO on the journey



MTM's solar arrays are rotated away from the Sun to prevent damage and therefore need a large area to meet the power requirements

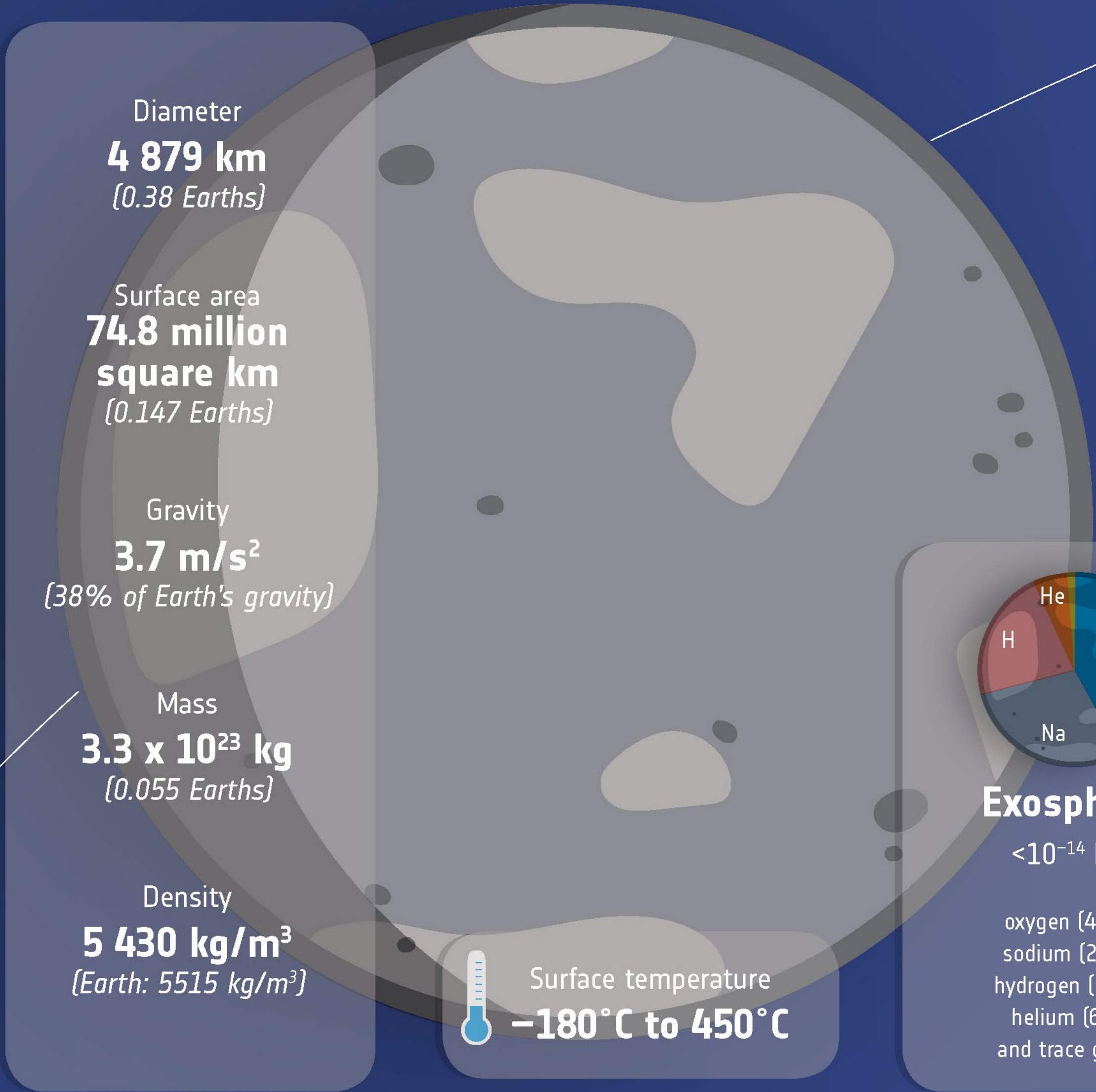


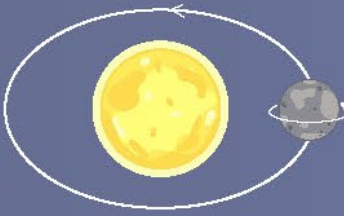
MPO's solar array will face the Sun almost edge-on in order to not be damaged by solar radiation

MPO's radiator will carry away heat generated by the spacecraft, as well as from the Sun and Mercury's surface



→ QUICK LOOK MERCURY FACTS



**x2**  **x3**

Mercury rotates about its own axis three times in every two orbits of the Sun

**1 day**

**58 Earth days**  
to turn once on its axis

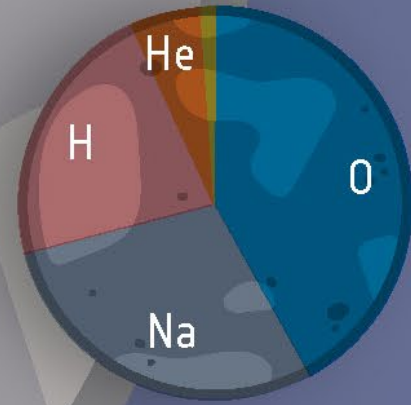
**176 Earth days**  
for the Sun to return to the same spot in the sky, as seen from a fixed point on the surface

**1 year**

**88 Earth days**  
to orbit the Sun

Distance from Sun  
**46 001 200 – 69 816 900 km**  
*[Earth: 149 597 900 km]*

Solar irradiance  
**6 272 – 14 448 W/m<sup>2</sup>**  
*[Earth: 1 366 W/m<sup>2</sup>]*

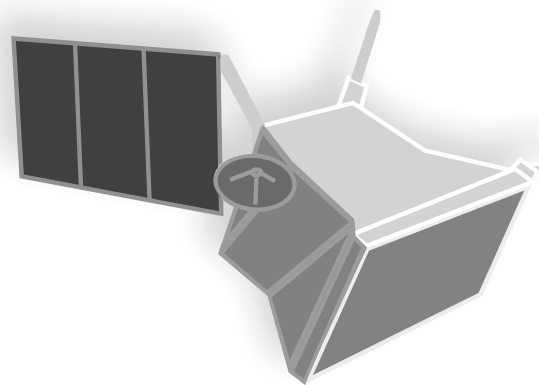


**Exosphere**  
**<10<sup>-14</sup> bar**

oxygen [42%]  
sodium [29%]  
hydrogen [22%]  
helium [6%]  
and trace gases



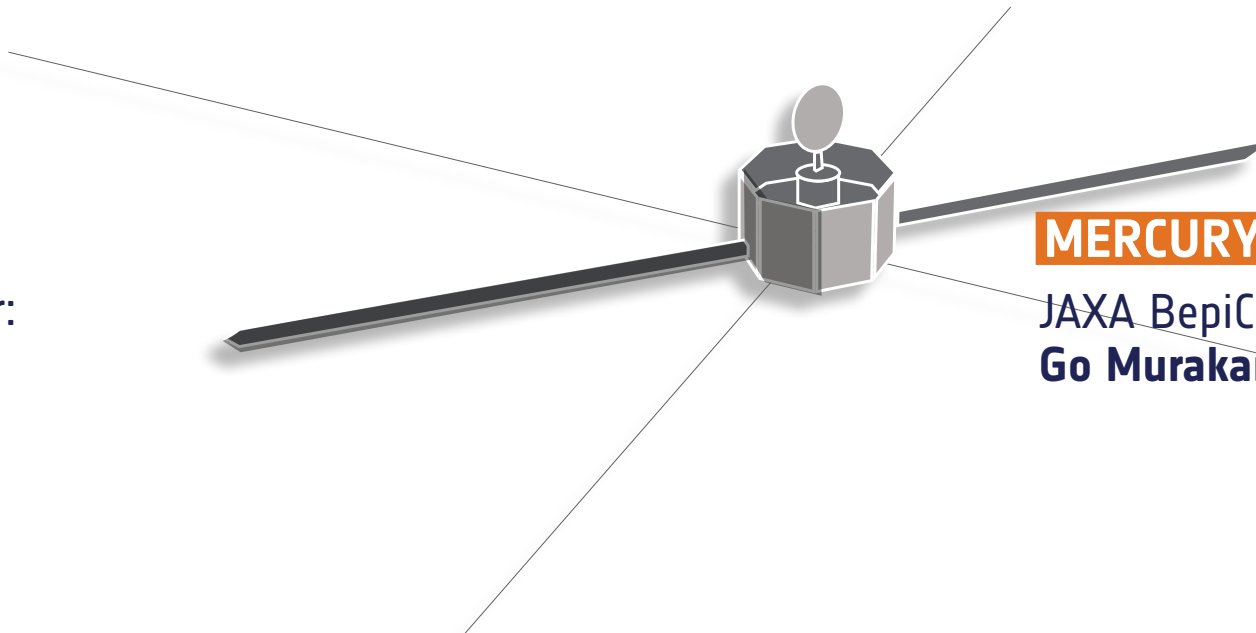
→ MPO AND MMO PRINCIPAL INVESTIGATORS



MERCURY PLANETARY ORBITER

ESA BepiColombo project scientist:  
**Johannes Benkhoff**  
ESA BepiColombo deputy project scientist:  
**Joe Zender**

ESA BepiColombo project manager:  
**Ulrich Reininghaus**  
ESA BepiColombo MTM manager:  
**Orson Sutherland**



MERCURY MAGNETOSPHERIC ORBITER

JAXA BepiColombo project scientist:  
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DLR Institut für Planetenforschung, Berlin, Germany.

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MGNS  
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MIXS  
**Emma Bunce**  
Space Research Centre, University of Leicester, UK.

MORE  
**Luciano Iess**  
University of Rome 'La Sapienza', Italy.

MPO-MAG  
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PHEBUS  
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SERENA  
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SIMBIO-SYS  
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SIXS  
**Juhani Huovelin**  
University of Helsinki, Department of Physics, Finland.

MDM  
**Masanori Kobayashi**  
Chiba Institute of Technology, Japan.

MMO-MGF  
**Wolfgang Baumjohann**  
Austrian Space Science, Graz, Austria.

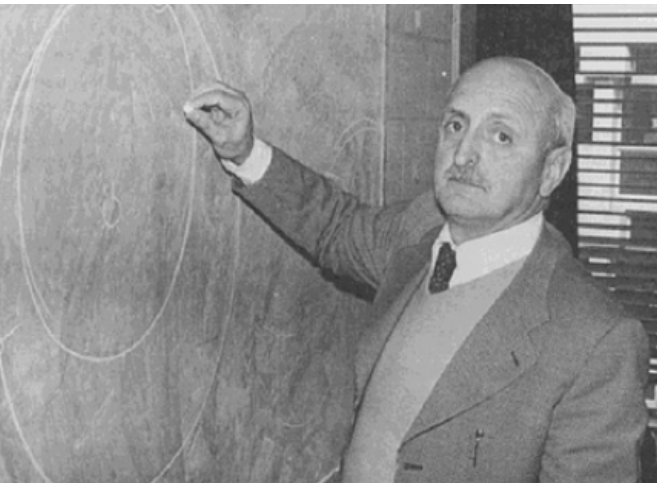
MPPE  
**Yoshifumi Saito**  
Institute of Space and Astronautical Science, Kanagawa, Japan.

MSASI  
**Ichiro Yoshikawa**  
University of Tokyo, Japan.

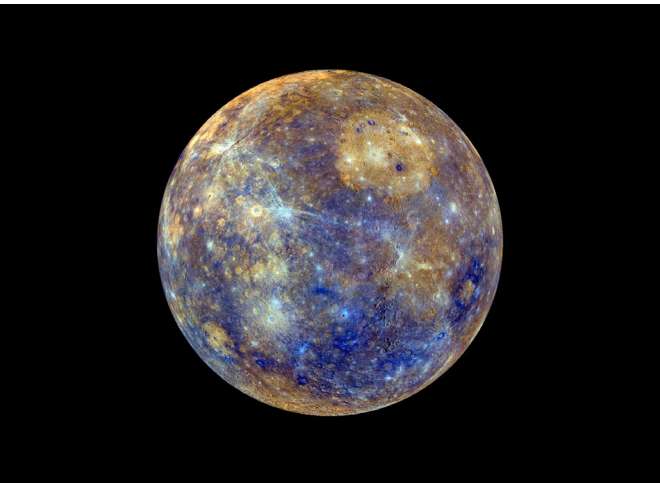
PWI  
**Yasumasa Kasaba**  
Tohoku University, Sendai, Japan.



PHOTOS



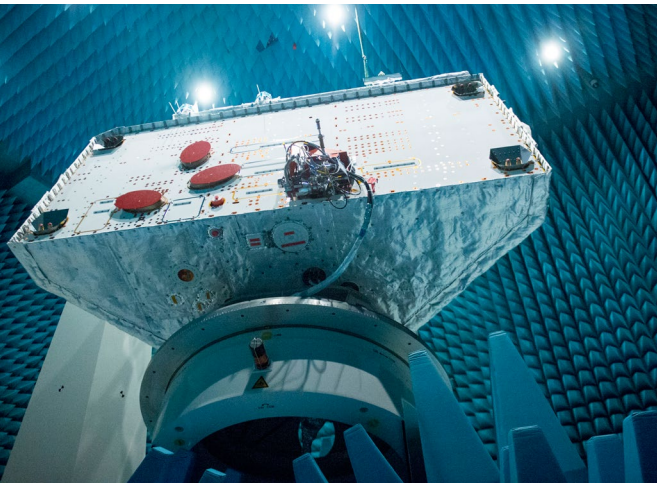
PROFESSOR GIUSEPPE COLOMBO



MESSENGER'S VIEW OF IRIDESCENT MERCURY



MESSENGER'S GLOBAL COVERAGE OF MERCURY



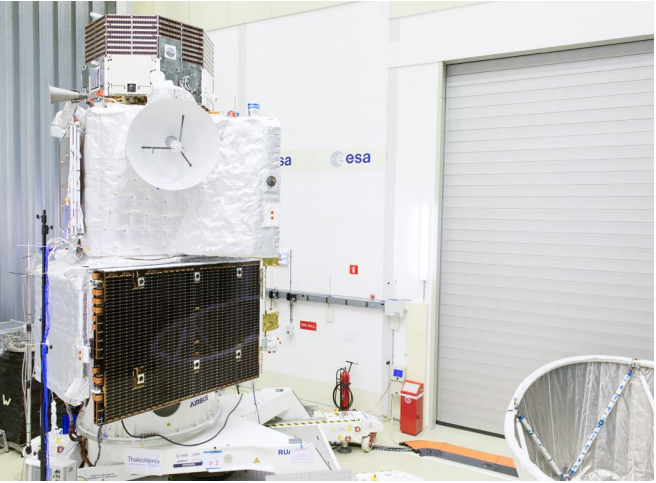
RADIO TESTING OF BEPICOLOMBO ORBITER



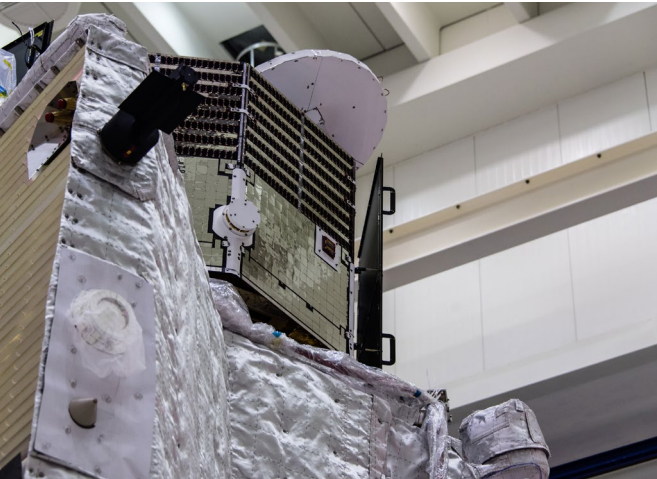
BEPICOLOMBO STACK



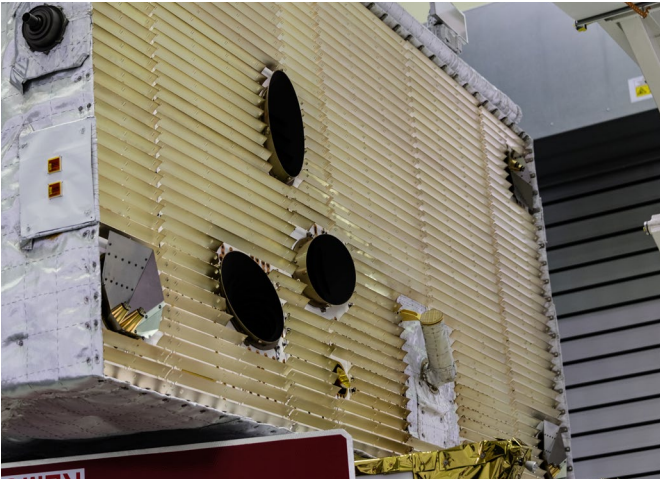
MERCURY TRANSFER MODULE SOLAR WING DEPLOYMENT



BEPICOLOMBO AT ESA'S TEST CENTRE



MERCURY MAGNETOSPHERIC ORBITER ON TOP OF MERCURY PLANETARY ORBITER



MERCURY PLANETARY ORBITER – RADIATOR PANEL AND INSTRUMENTS



BEPICOLOMBO ACOUSTIC TEST



LOADING THE ANTONOV



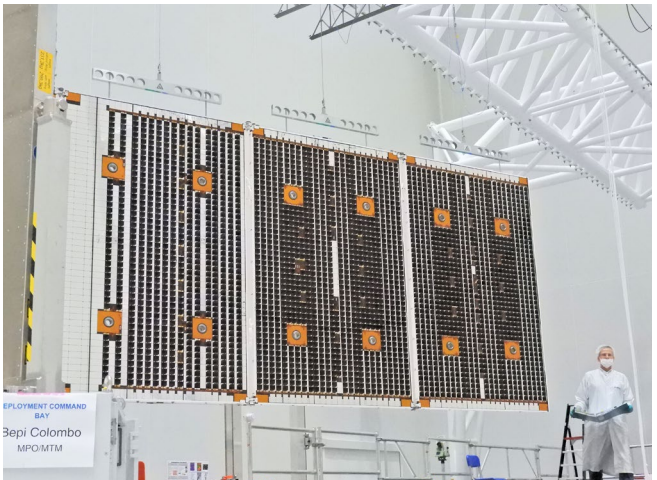
MPO UNPACKED AT EUROPE'S SPACEPORT



SEWING MTM INSULATION BLANKETS



HAND-SEWN INSULATION BLANKETS



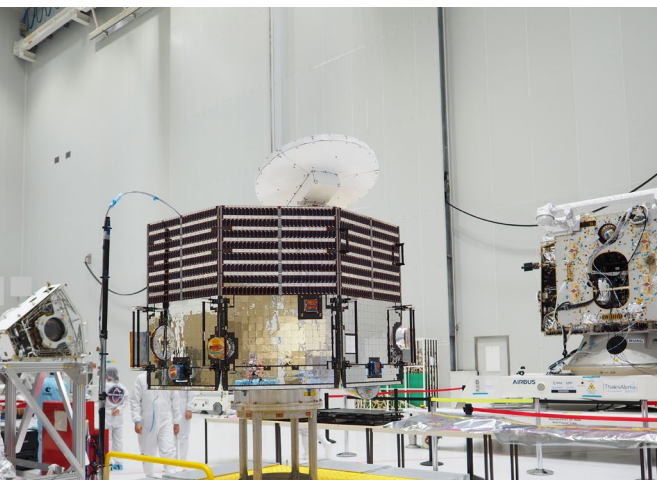
BEPICOLOMBO MPO SOLAR ARRAY DEPLOYMENT



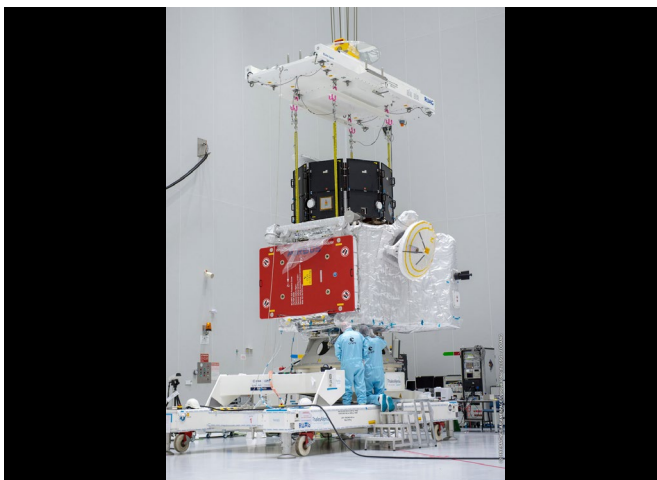
MERCURY TRANSFER MODULE PREPARATIONS



BEPICOLOMBO SUNSHIELD



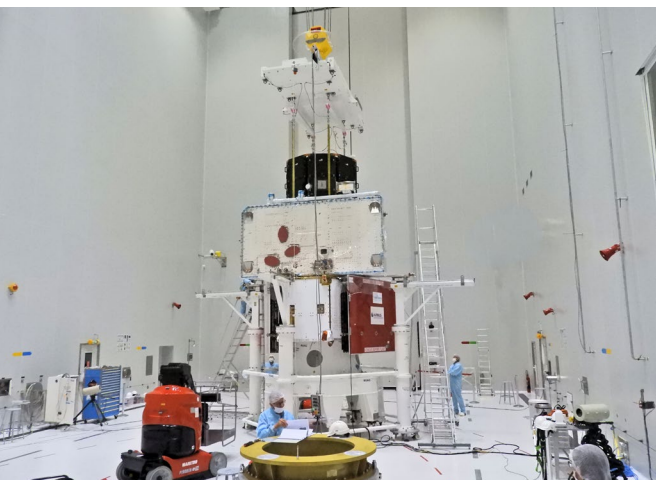
MMO UNPACKED AT EUROPE'S SPACEPORT



MPO AND MMO IN LAUNCH CONFIGURATION



COMPLETING THE BEPICOLOMBO STACK



COMPLETING THE BEPICOLOMBO STACK



ARTIST IMPRESSIONS



BEPICOLOMBO FAIRING RELEASE



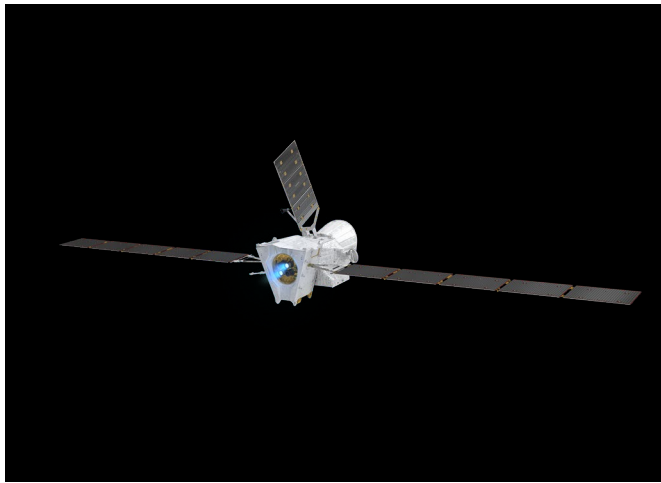
BEPICOLOMBO IN LOW EARTH ORBIT



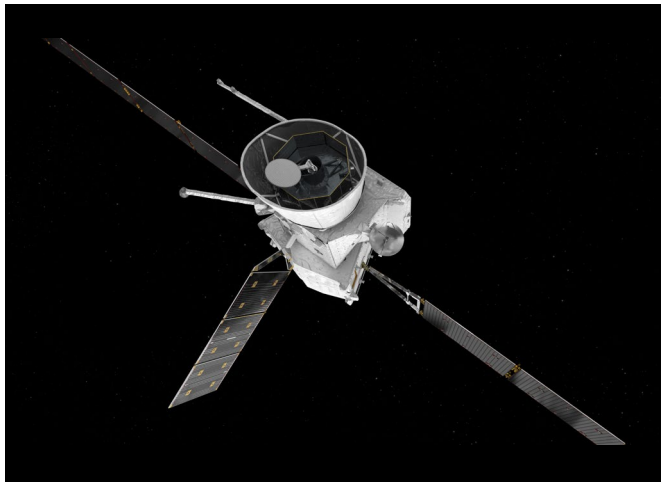
SEPARATION AFTER LAUNCH



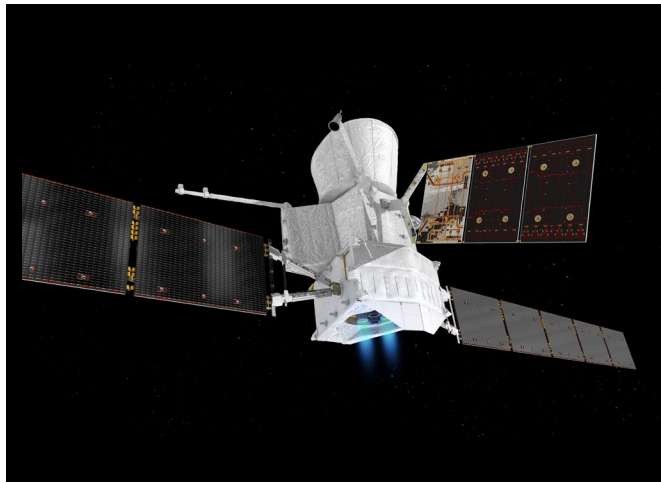
BEPICOLOMBO EARTH FLYBY



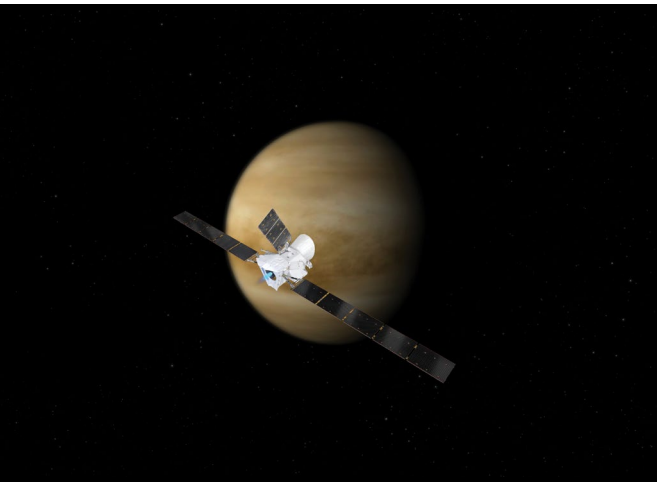
BEPICOLOMBO IN CRUISE CONFIGURATION



BEPICOLOMBO CRUISE CONFIGURATION



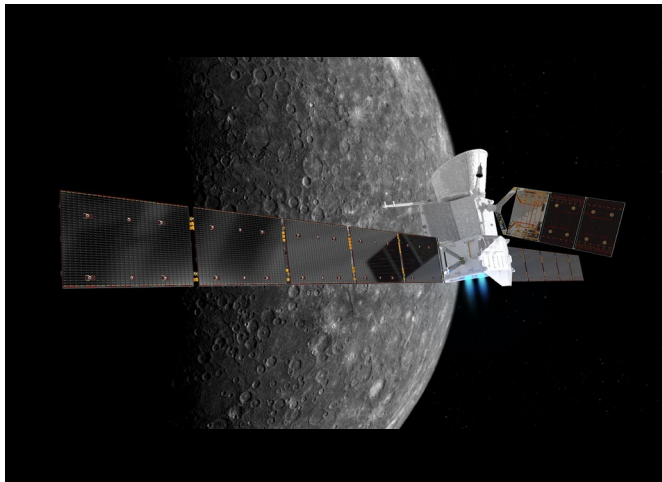
BEPICOLOMBO CRUISE CONFIGURATION



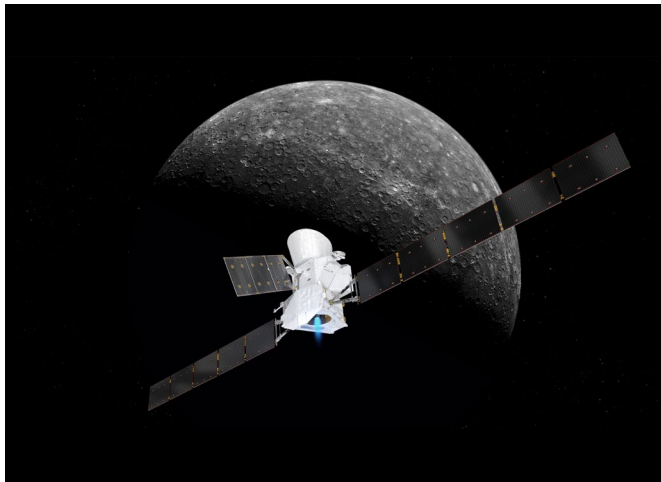
BEPICOLOMBO AT VENUS



BEPICOLOMBO APPROACHING MERCURY



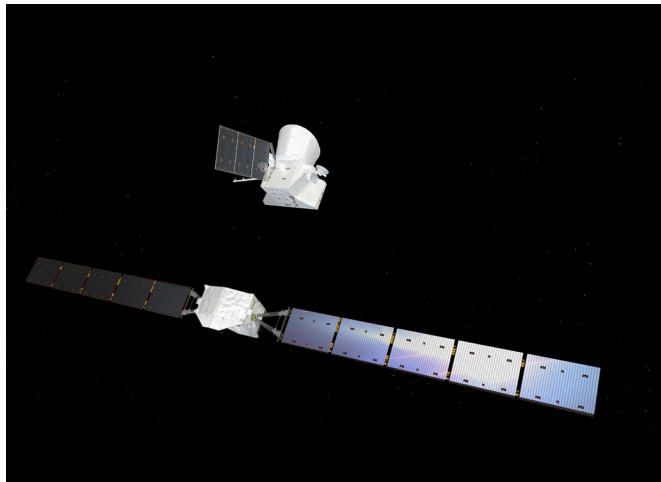
BEPICOLOMBO AT MERCURY



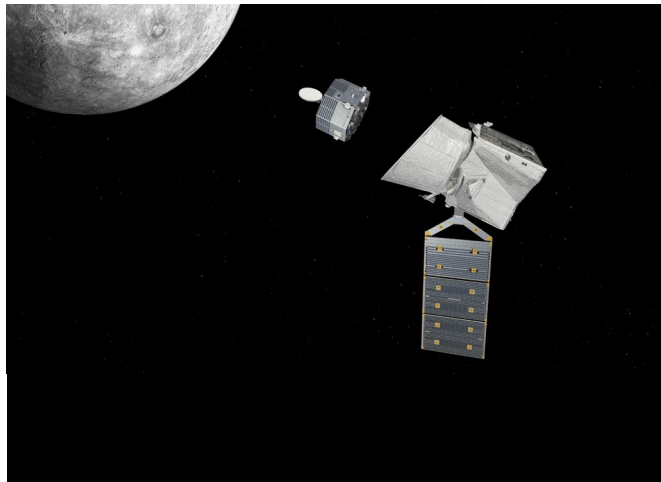
BEPICOLOMBO APPROACHING MERCURY



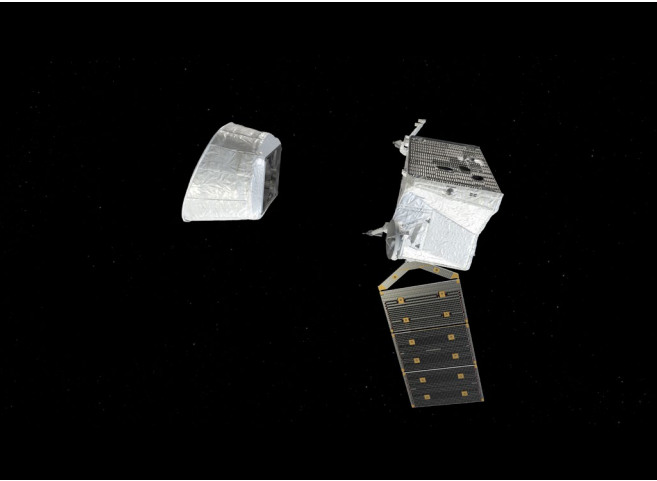
MERCURY TRANSFER MODULE SEPARATION



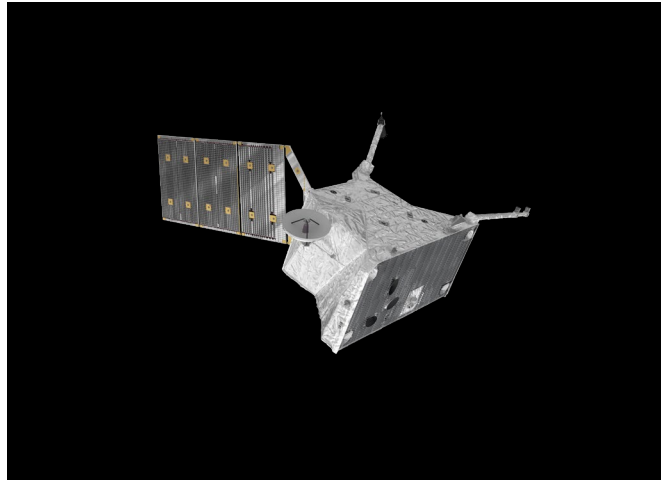
MERCURY TRANSFER MODULE SEPARATION



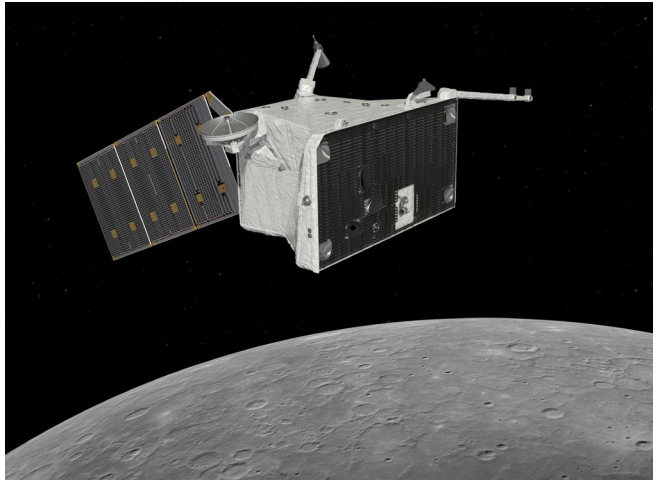
SEPARATION OF MERCURY  
MAGNETOSPHERIC ORBITER



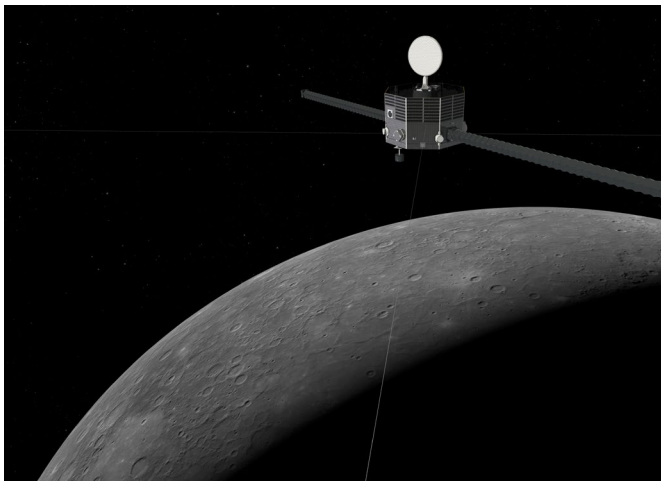
SUNSHIELD EJECTION



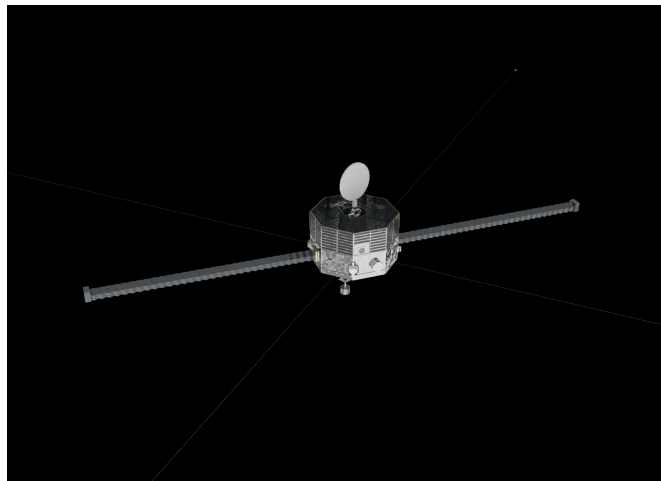
MERCURY PLANETARY ORBITER



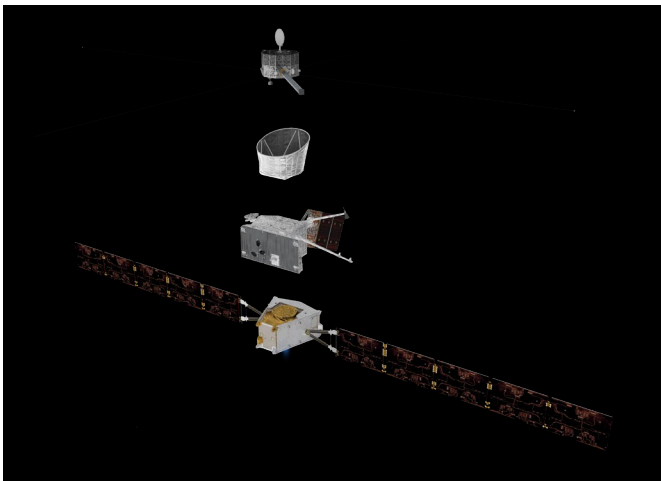
MERCURY PLANETARY ORBITER AT MERCURY



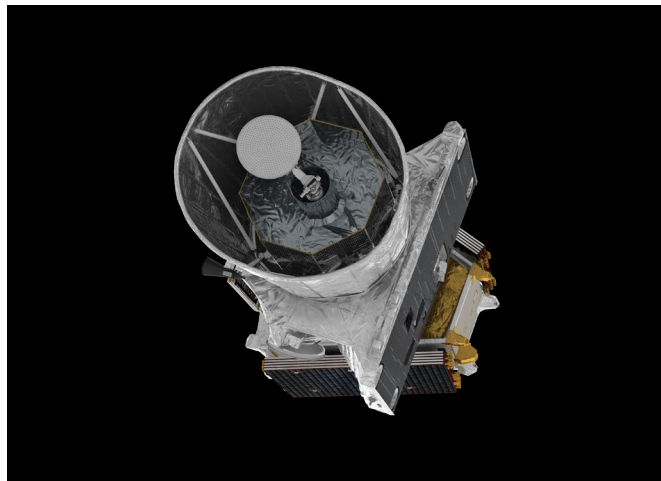
MERCURY MAGNETOSPHERIC ORBITER AT MERCURY



MERCURY MAGNETOSPHERIC ORBITER



BEPICOLOMBO EXPLODED VIEW



BEPICOLOMBO STACK

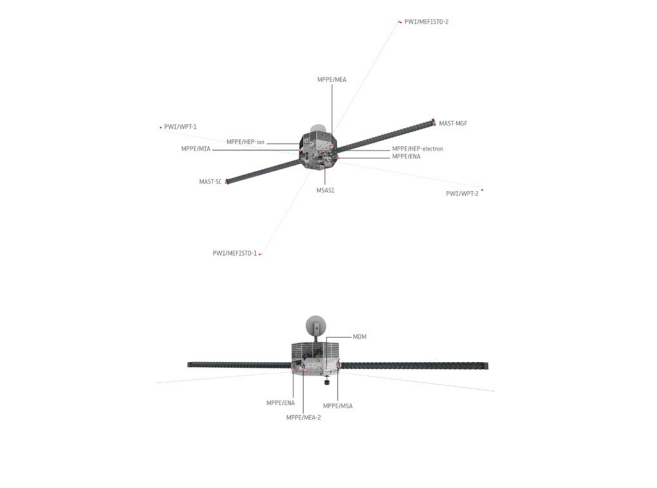


GRAPHICS

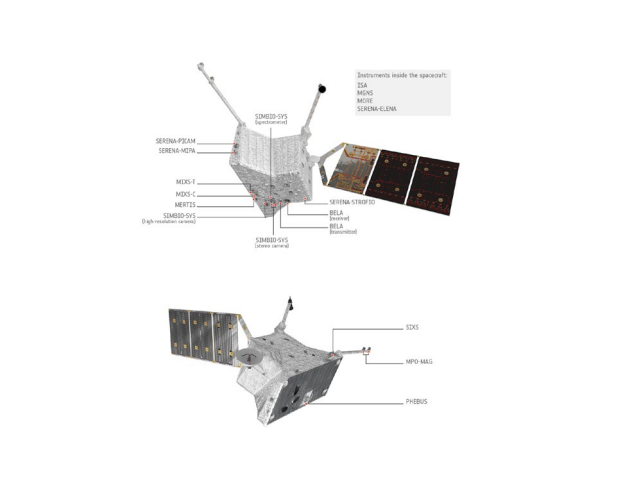


BEPICOLOMBO MISSION LOGO

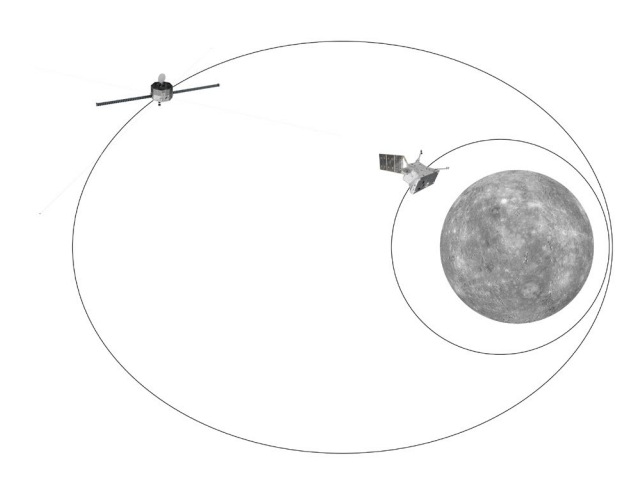
BEPICOLOMBO MISSION POSTER



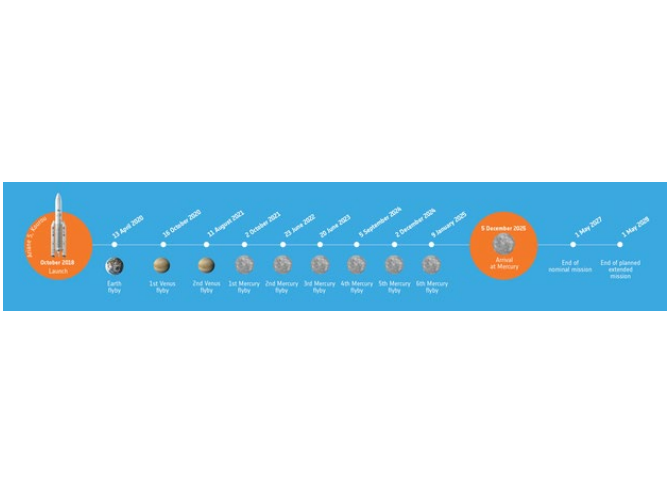
BEPICOLOMBO MMO'S SCIENCE INSTRUMENTS



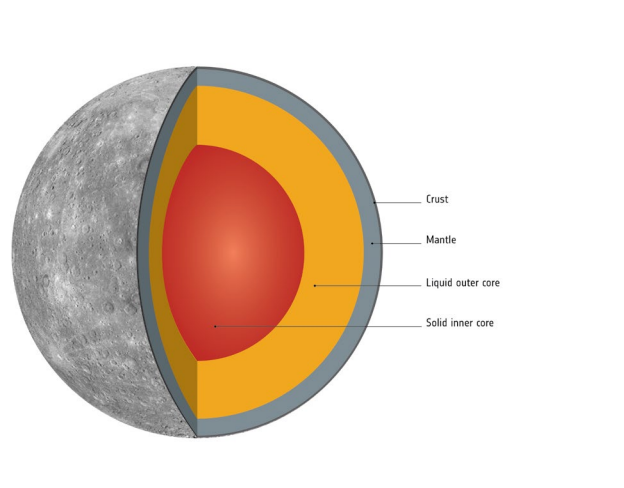
BEPICOLOMBO MPO'S SCIENCE INSTRUMENTS



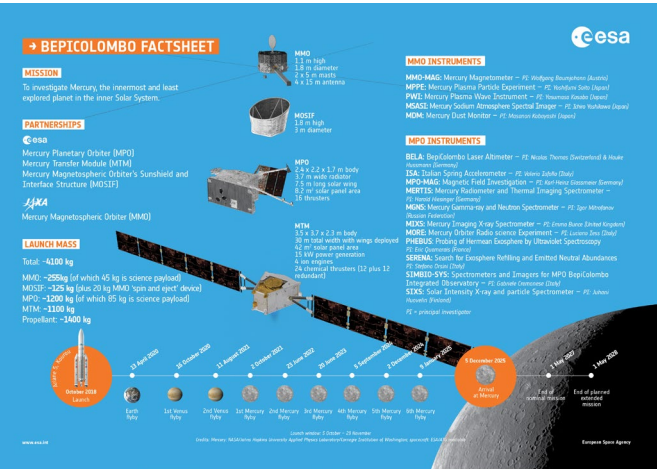
BEPICOLOMBO ORBITS



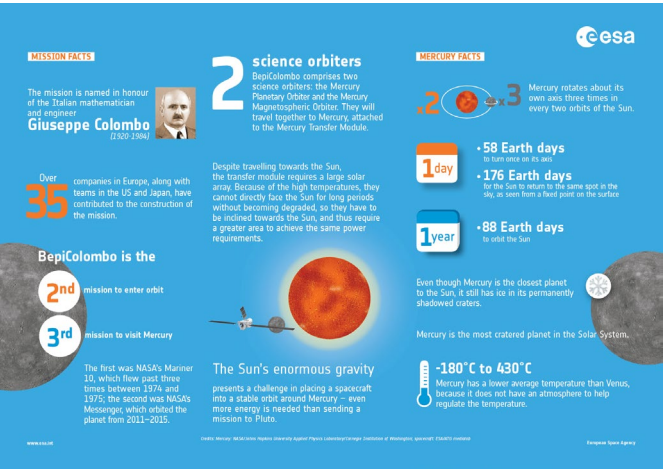
BEPICOLOMBO JOURNEY TIMELINE



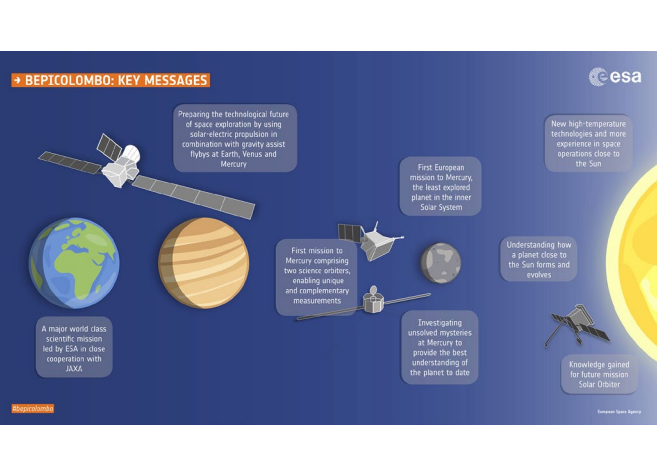
INTERIOR OF MERCURY - ANNOTATED



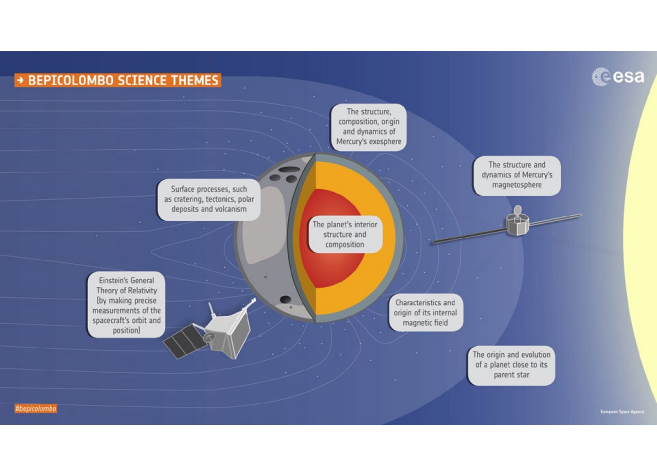
BEPICOLOMBO SPACECRAFT FACTS



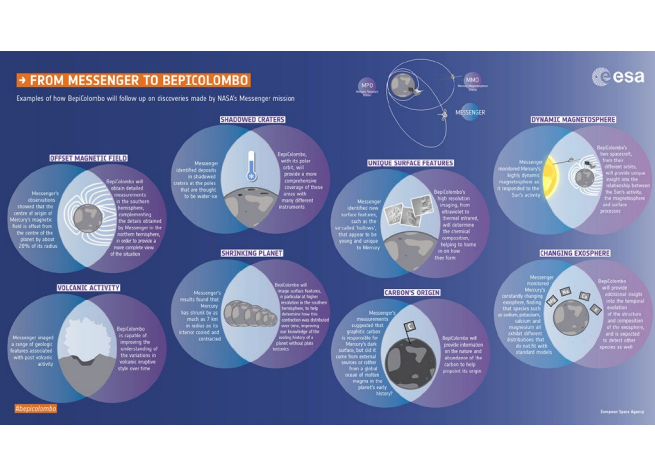
BEPICOLOMBO MISSION AND MERCURY FACTS



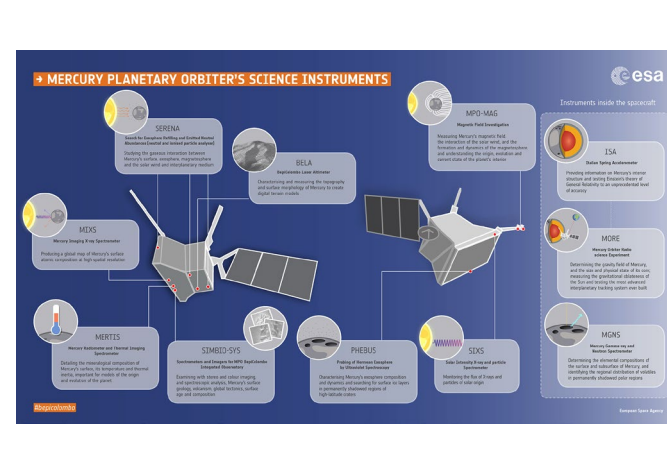
BEPICOLOMBO: KEY MESSAGES



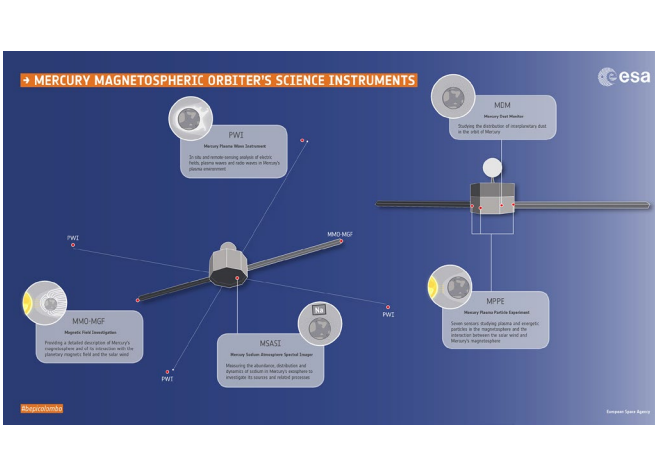
BEPICOLOMBO SCIENCE THEMES



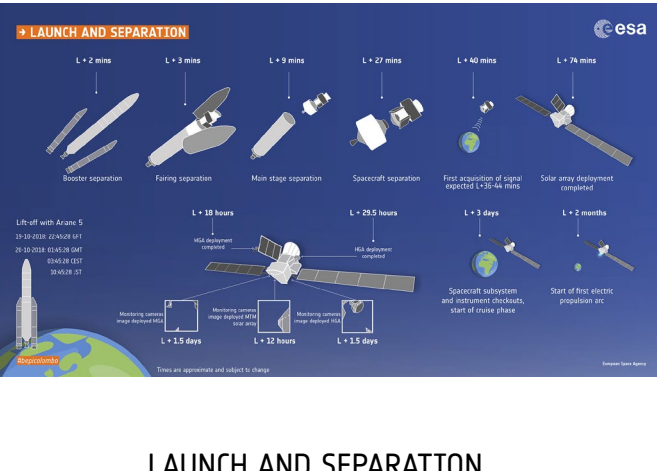
FROM MESSENGER TO BEPICOLOMBO



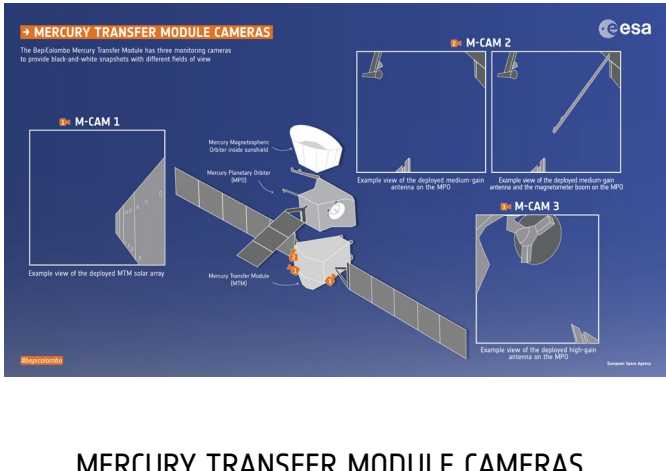
MPO'S SCIENCE INSTRUMENTS



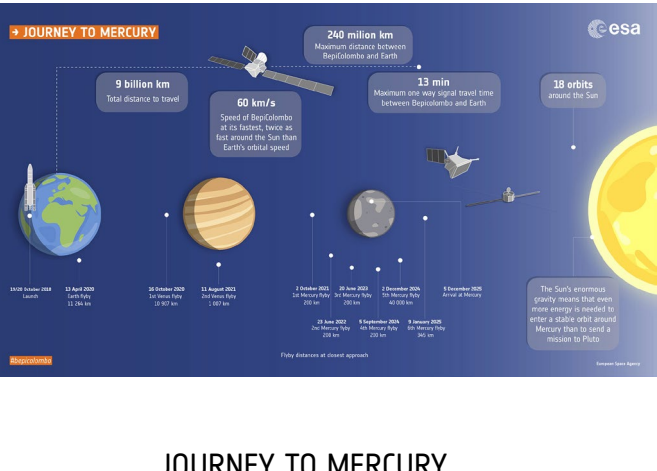
MMO'S SCIENCE INSTRUMENTS



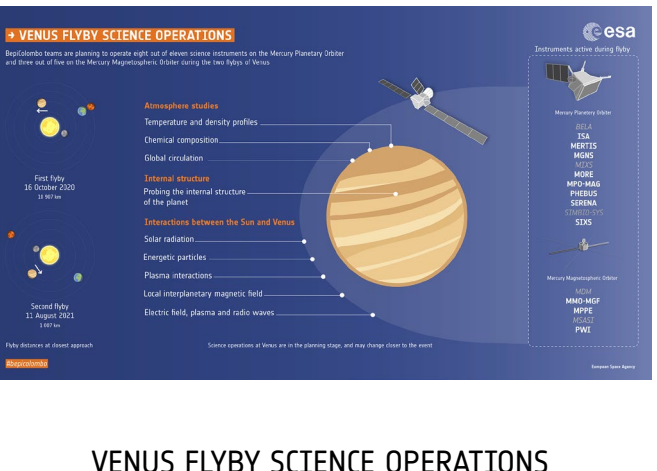
LAUNCH AND SEPARATION



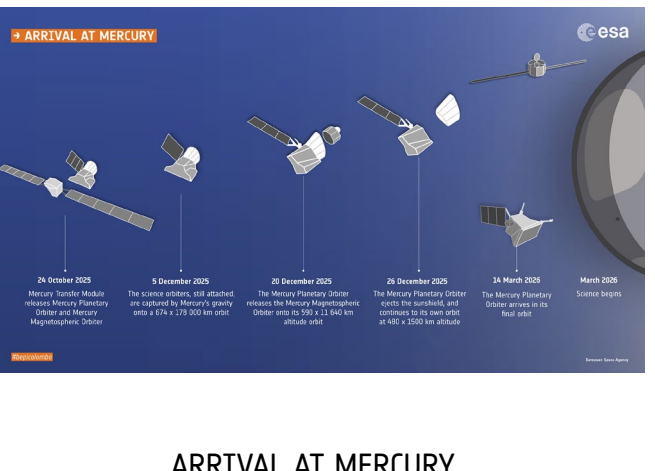
MERCURY TRANSFER MODULE CAMERAS



JOURNEY TO MERCURY



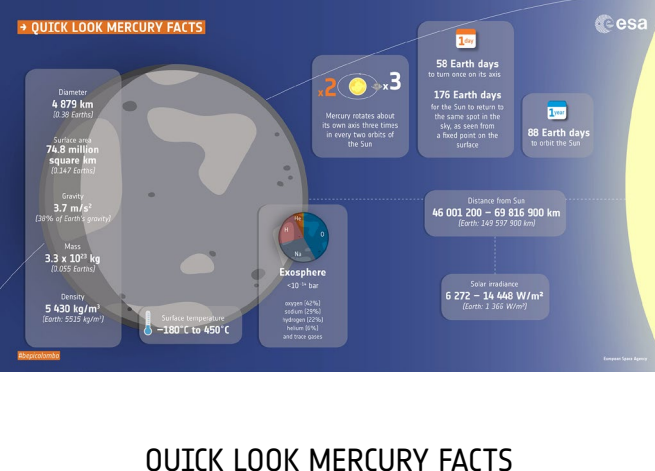
VENUS FLYBY SCIENCE OPERATIONS



ARRIVAL AT MERCURY



OPERATING IN EXTREME ENVIRONMENTS



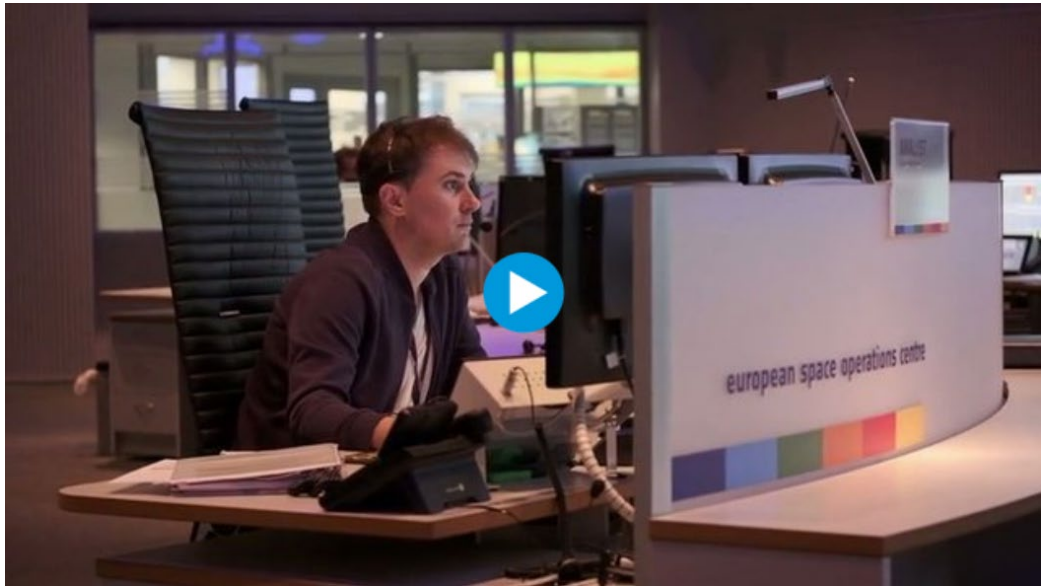
QUICK LOOK MERCURY FACTS



→ VIDEOS & ANIMATIONS



INSIDE THE CLEANROOM WITH BEPICOLOMBO



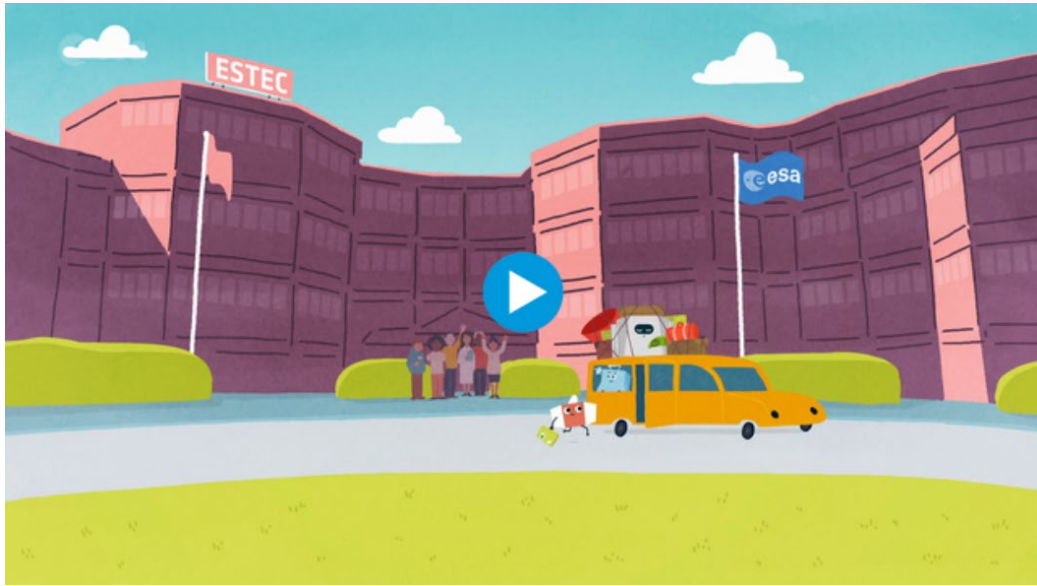
BEPICOLOMBO SIMULATION



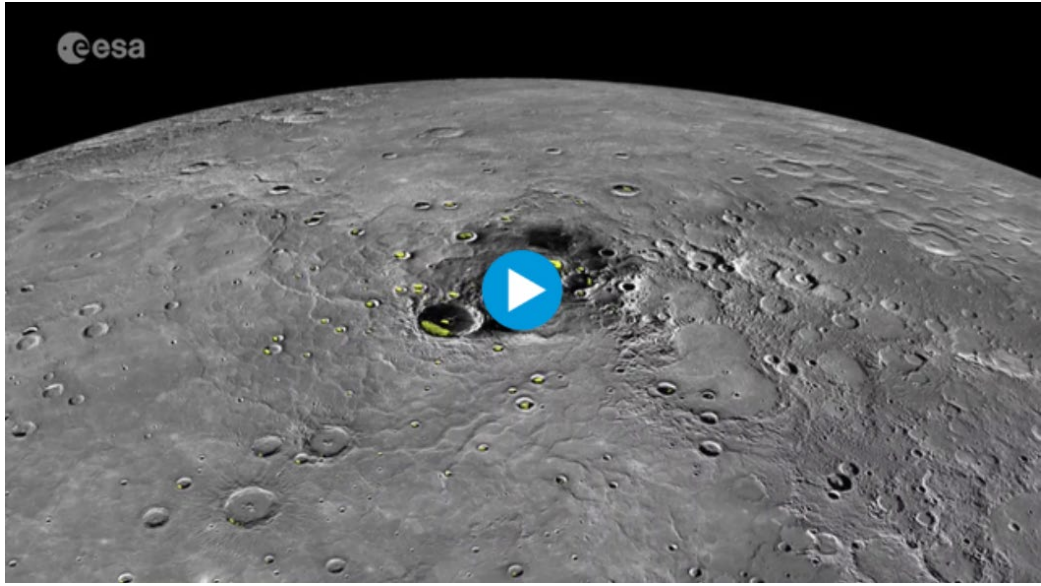
BEPICOLOMBO LAUNCH TO MERCURY



TO MERCURY, VIA EUROPE'S SPACEPORT!



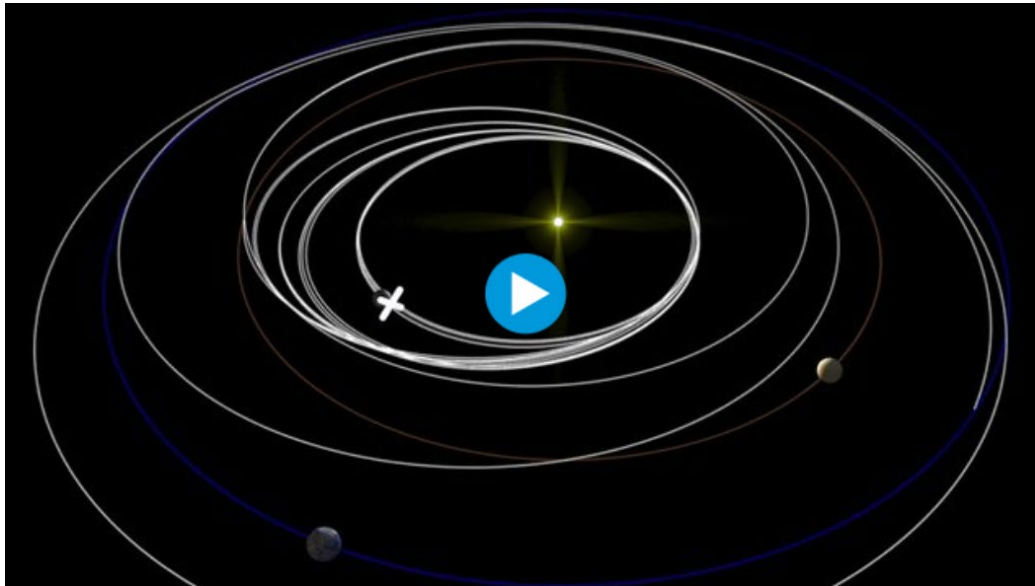
CARTOON: TO EUROPE'S SPACEPORT!



BEPICOLOMBO PREPARES FOR MERCURY



MERCURY TRANSFER MODULE  
SOLAR WING DEPLOYMENT



BEPICOLOMBO'S JOURNEY TO MERCURY



CARTOON:  
THE EPIC ADVENTURES OF BEPICOLOMBO PART 1



## → MEDIA SERVICES

### Media services

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+33 1 53 69 72 99

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#### Space Research Institute of the Austrian Academy of Sciences (IWF/OeAW)

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### Livestream of media event

ESA will cover the launch of BepiColombo at [esa.int/live](https://esa.int/live) on 20 October, 03:15–04:30 CEST. It will cover the liftoff at 03:45 CEST, and the acquisition of signal approximately 40 minutes later.

### ESA TV productions

ESA TV productions are available at [television.esa.int](https://television.esa.int)

### BepiColombo online

Information for general public: [esa.int/bepicolombo](https://esa.int/bepicolombo)  
In-depth information: [sci.esa.int/bepicolombo](https://sci.esa.int/bepicolombo)

### BepiColombo on social media



Twitter

[@bepicolombo](https://twitter.com/bepicolombo)  
[@ESA\\_Bepi](https://twitter.com/ESA_Bepi)  
[@ESA\\_MTM](https://twitter.com/ESA_MTM)  
[@JAXA\\_MMO](https://twitter.com/JAXA_MMO)



[Facebook.com/EuropeanSpaceAgency](https://Facebook.com/EuropeanSpaceAgency)



[Youtube.com/ESA](https://Youtube.com/ESA)



[Instagram.com/europeanspaceagency](https://Instagram.com/europeanspaceagency)

Official hashtag: **#bepicolombo**

### Multimedia

A variety of photographs, illustrations, graphics and animations are available via:

[ESA Space in Images](#)  
[ESA Space in Videos](#)  
[ESA's Photo Library for Professionals](#)  
[ESA's Video Library for Professionals](#)

See also pages 18-21 in this media kit for recommended multimedia products



A detailed illustration of the BepiColombo spacecraft in orbit above Earth. The spacecraft features a central body with a large circular antenna, two long solar panel wings with a grid of solar cells, and various instruments and antennas. The Earth's horizon is visible at the bottom, showing a blue atmosphere and white clouds over a brownish landmass. A bright sun is in the upper center, creating a lens flare effect.

**THANK YOU FOR JOINING US FOR  
THE LAUNCH OF BEPICOLOMBO TO MERCURY!**