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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.
 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.

Webstreaming
ESA will cover the launch live from 03:15 CEST at esa.int/live

Twitter
For live updates throughout the launch period, follow @BepiColombo, @esaoperations and @esascience on Twitter.

Follow JAXA at @JAXA_jp or @JAXA_en for tweets in Japanese or English, respectively.

The three spacecraft modules also have personalised accounts (@JAXA_MMO, @ESA_Bepi and @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 and from the @ESA_MTM account on Twitter in the first instance, once available.

The official hashtag is #bepicolombo

Information for general public: esa.int/bepicolombo
In-depth information: sci.esa.int/bepicolombo

Facebook.com/EuropeanSpaceAgency
Youtube.com/ESA
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

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

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

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

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

Understanding how a planet close to the Sun forms and evolves

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

Knowledge gained for future mission Solar Orbiter
BEPICOLOMBO SCIENCE THEMES

- The structure, composition, origin and dynamics of Mercury's exosphere
- The structure and dynamics of Mercury's magnetosphere
- The planet's interior structure and composition
- Characteristics and origin of its internal magnetic field
- The origin and evolution of a planet close to its parent star
- Surface processes, such as cratering, tectonics, polar deposits and volcanism
- Einstein's General Theory of Relativity (by making precise measurements of the spacecraft's orbit and position)
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.

VOLCANIC ACTIVITY

Messenger imaged a range of geological features associated with past volcanic activity.

SHADOWED CRaters

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

UNIQUE SURFACE FEATURES

Messenger identified new surface features, such as the so-called ‘hatrock’, that appear to be young and unique to Mercury.

SHRINKING PLANET

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

CARBON’S ORIGIN

Messenger’s measurements suggested that graphic 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’s two spacecraft, from their different orbits, will provide unique insight into the relationship between the Sun’s activity, the magnetosphere and surface processes.

DYNAMIC MAGNETOSPHERE

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

CHANGING EXOSPHERE

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.

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

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

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.
MERCURY PLANETARY ORBITER'S SCIENCE INSTRUMENTS

SERENA
Search for Exosphere Refilling and Emitted Neutral Abundances (neutral and ionised particle analyser)
Studying the gaseous interaction between Mercury's surface, exosphere, magnetosphere and the solar wind and interplanetary medium

BELA
BepiColombo Laser Altimeter
Characterising and measuring the topography and surface morphology of Mercury to create digital terrain models

MIXS
Mercury Imaging X-ray Spectrometer
Producing a global map of Mercury's surface atomic composition at high spatial resolution

MERTIS
Mercury Radiometer and Thermal Imaging Spectrometer
Detailing the mineralogical composition of Mercury's surface, its temperature and thermal inertia, important for models of the origin and evolution of the planet

SIMBIO-SYS
Spectrometers and Imagers for MPO BepiColombo Integrated Observatory
Examining with stereo and colour imaging, and spectroscopic analysis, Mercury's surface geology, volcanism, global tectonics, surface age and composition

MPO-MAG
Magnetic Field Investigation
Measuring Mercury's magnetic field, the interaction of the solar wind, and the formation and dynamics of the magnetosphere, and understanding the origin, evolution and current state of the planet's interior

ISA
Italian Spring Accelerometer
Providing information on Mercury's interior structure and testing Einstein's theory of General Relativity to an unprecedented level of accuracy

MGNS
Mercury Gamma-ray and Neutron Spectrometer
Determining the elemental compositions of the surface and subsurface of Mercury, and identifying the regional distribution of volatiles in permanently shadowed polar regions

MORE
Mercury Orbiter Radio science Experiment
Determining the gravity field of Mercury, and the size and physical state of its core; measuring the gravitational oblateness of the Sun and testing the most advanced interplanetary tracking system ever built

SIXS
Solar Intensity X-ray and particle Spectrometer
Monitoring the flux of X-rays and particles of solar origin
MERCURY MAGNETOSPHERIC ORBITER’S SCIENCE INSTRUMENTS

**PWI**
Mercury Plasma Wave Instrument
In situ and remote-sensing analysis of electric fields, plasma waves and radio waves in Mercury’s plasma environment

**MMO-MAG**
Mercury Magnetometer
Providing a detailed description of Mercury’s magnetosphere and of its interaction with the planetary magnetic field and the solar wind

**MSASI**
Mercury Sodium Atmosphere Spectral Imager
Measuring the abundance, distribution and dynamics of sodium in Mercury’s exosphere to investigate its sources and related processes

**MDM**
Mercury Dust Monitor
Studying the distribution of interplanetary dust in the orbit of Mercury

**MPPE**
Mercury Plasma Particle Experiment
Seven sensors studying plasma and energetic particles in the magnetosphere and the interaction between the solar wind and Mercury’s magnetosphere
**LAUNCH AND SEPARATION**

1. **L + 2 mins**
   - Booster separation

2. **L + 3 mins**
   - Fairing separation

3. **L + 9 mins**
   - Main stage separation

4. **L + 27 mins**
   - Spacecraft separation

5. **L + 40 mins**
   - First acquisition of signal expected L+36-44 mins

6. **L + 74 mins**
   - Solar array deployment completed

7. **L + 18 hours**
   - MGA deployment completed

8. **L + 29.5 hours**
   - HGA deployment completed

9. **L + 3 days**
   - Spacecraft subsystem and instrument checkouts, start of cruise phase

10. **L + 2 months**
    - Start of first electric propulsion arc

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Lift-off with Ariane 5
19-10-2018: 22:45:28 GMT
20-10-2018: 01:45:28 GMT
02:45:28 CEST
10:45:28 JST

Times are approximate and subject to change.
JOURNEY TO MERCURY

9 billion km
Total distance to travel

240 million km
Maximum distance between BepiColombo and Earth

60 km/s
Speed of BepiColombo at its fastest, twice as fast around the Sun than Earth’s orbital speed

13 min
Maximum one way signal travel time between BepiColombo and Earth

18 orbits
around the Sun

19/20 October 2018
Launch

13 April 2020
Earth flyby
11 264 km

16 October 2020
1st Venus flyby
10 907 km

11 August 2021
2nd Venus flyby
1 007 km

2 October 2021
1st Mercury flyby
200 km

23 June 2022
2nd Mercury flyby
200 km

20 June 2023
3rd Mercury flyby
200 km

5 September 2024
4th Mercury flyby
345 km

2 December 2024
5th Mercury flyby
40 000 km

9 January 2025
6th Mercury flyby
345 km

5 December 2025
Arrival at Mercury

The Sun’s enormous gravity means that even more energy is needed to enter a stable orbit around Mercury than to send a mission to Pluto.

Flyby distances at closest approach
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.

- **Atmosphere studies**
  - Temperature and density profiles
  - Chemical composition
  - Energetic particles
  - Global circulation

- **Internal structure**
  - Probing the internal structure of the planet

- **Interactions between the Sun and Venus**
  - Solar radiation
  - Plasma interactions
  - Local interplanetary magnetic field
  - Electric field, plasma and radio waves

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

24 October 2025
Mercury Transfer Module releases Mercury Planetary Orbiter and Mercury Magnetospheric Orbiter

5 December 2025
The science orbiters, still attached, are captured by Mercury’s gravity onto a 674 x 178 000 km orbit

20 December 2025
The Mercury Planetary Orbiter releases the Mercury Magnetospheric Orbiter onto its 590 x 11 640 km altitude orbit

26 December 2025
The Mercury Planetary Orbiter ejects the sunshield, and continues to its own orbit at 480 x 1500 km altitude

14 March 2026
The Mercury Planetary Orbiter arrives in its final orbit

March 2026
Science begins
**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.

- A sunshield protects MMO on the journey.
- MMO will spin 15 times per minute to distribute the Sun's heat over its solar cells.
- 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**

- **Diameter**: 4,879 km (0.38 Earths)
- **Surface area**: 74.8 million square km (0.147 Earths)
- **Gravity**: 3.7 m/s² (38% of Earth’s gravity)
- **Mass**: 3.3 x 10²³ kg (0.055 Earths)
- **Density**: 5,430 kg/m³ (Earth: 5,515 kg/m³)
- **Surface temperature**: -180°C to 430°C
- **Exosphere**: ~10⁻¹⁴ bar
  - oxygen (42%)
  - sodium (23%)
  - hydrogen (22%)
  - helium (8%)
  - and trace gases
- **Distance from Sun**: 46,001,200 – 69,816,900 km (Earth: 149,597,900 km)
- **Solar irradiance**: 6,272 – 14,448 W/m² (Earth: 1,366 W/m²)

**Mercury Facts**

- **1 day**: Mercury rotates about its own axis three times in every two orbits of the Sun.
- **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.
- **88 Earth days**: to orbit the Sun.
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VISIOGRAPHIC CONTENT

→ 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

coming soon!
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Livestream of media event

ESA will cover the launch of BepiColombo at 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

BepiColombo online
Information for general public: esa.int/bepicolombo
In-depth information: sci.esa.int/bepicolombo

BepiColombo on social media

Twitter
@bepicolombo
@ESA_Bepi
@ESA_MTM
@JAXA_MMO

Official hashtag: #bepicolombo

Multimedia

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

ESA Space in Images
ESA Space in Videos
ESAs Photo Library for Professionals
ESAs Video Library for Professionals

See also pages 17-20 in this media kit for recommended multimedia products
THANK YOU FOR JOINING US FOR
THE LAUNCH OF BEPICOLOMBO TO MERCURY!