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BepiColombo: Exploring Mercury

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Abstract

BepiColombo is an interdisciplinary mission to explore Mercury, the planet closest to the sun, carried out jointly between the European Space Agency and the Japanese Aerospace Exploration Agency. The mission consists of two orbiters dedicated to the detailed study of the planet and of its magnetosphere, the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO).

The MPO is ESA's scientific contribution to the mission and comprises 11 science instruments. It is a three-axis-stabilized, nadir-pointing spacecraft which will be placed in a polar orbit with a period of approximately 2.3 hours, a periapsis of 480 km and an apoapsis of 1500 km, providing excellent spatial resolution over the entire planet surface. The interplanetary transfer is performed by an Electric Propulsion Module, which is jettisoned when Mercury is reached. It will set off in July 2016 on a journey to the smallest and least explored terrestrial planet in our Solar System. When it arrives at Mercury in January 2024, it will endure temperatures in excess of 350 °C and gather data during its 1 year nominal mission, with a possible 1-year extension.

The difficulty of reaching, surviving and operating in the harsh environment of a planet so close to the sun, makes BepiColombo one of the most challenging planetary projects undertaken by ESA so far. A range of major challenges need to be overcome to enable the mission including the electric propulsion system, development of a new Multi-Layer Insulation able to withstand the high temperatures, an original solar panel design, stringent pointing requirements to be maintained in extreme conditions varying from a solar flux of 10 solar constants to eclipse conditions etc.

The scientific payload of both spacecraft will provide the detailed information necessary to understand the origin and evolution of the planet itself and its surrounding environment. The scientific objectives focus on a global characterization of Mercury through the investigation of its interior, surface, exosphere and magnetosphere. In addition, instrumentation onboard BepiColombo will be used to test Einstein's theory of general relativity. Major effort was put into optimizing the scientific return of the mission by defining a payload complement such that individual measurements can be interrelated and complement each other. This paper gives an in-depth overview of BepiColombo spacecraft composite and the mission profile. It describes the suite of scientific instruments on board of the two BepiColombo spacecraft and the science goals of the mission.

This paper gives an overview of the mission, describes the science case together with the payload suite as well as the latest status of the spacecraft development.