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BepiColombo – The next step of Mercury Exploration with two orbiting spacecraft

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Abstract

The BepiColombo mission is ready for launch from the European spaceport in French Guyana. A mission overview is provided with the latest information from the launch site, followed by an overview of the science objectives of the mission,

1. Introduction

Mercury is in many ways a very different planet from what we were expecting. In October 2018 BepiColombo [1] will be launched to follow up on answering the fundamental questions about the evolution history of the planet nearest to the sun.

BepiColombo is a joint project between the Euro- pean Space Agency (ESA) and the Japanese Aero- space Exploration Agency (JAXA). The Mission con- sists of two orbiters, the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). From their dedicated orbits the two space- craft will be studying the planet and its environment.

The mission has been named in honor of Giuseppe (Bepi) Colombo (1920–1984), who was a brilliant Italian mathematician, who made many significant contributions to planetary research and celestial mechanics.

2. Science goals

BepiColombo will study and understand the composition, geophysics, atmosphere, magnetosphere and history of Mercury, the least explored planet in the inner Solar System. In particular, the mission objectives are:

• to understand why Mercury's uncompressed density is markedly higher than that of all other terrestrial planets, Moon included

• to understand and determine the nature of the core of Mercury

• to understand why such a small planet pro- cesses an intrinsic magnetic field and investigate Mercury's magnetized environment

• to investigate if the permanently shadowed craters of the Polar Regions contain Sulphur or water ice

• to study the production mechanisms of the exosphere and to understand the interaction between planetary magnetic field and the solar wind in the absence of an ionosphere

• to obtain new clues about the composition of the primordial solar nebula and about the formation of the solar system

• to test general relativity with improved accu- racy, taking advantage of the proximity of the Sun. Since and considering that the advance Mercury's perihelion was explained in terms of relativistic space-time curvature.

3. Science Payload

The MPO scientific payload comprises eleven instruments/instrument packages and the MMO comprises 5 instruments/instrument packages to study the planet itself and its environment,

respectively. The MPO will focus on a global characterization of Mercury through the investigation of its interior, surface, exosphere and magnetosphere. In addition, it will be testing Einstein's theory of general relativity. The MMO will focus on the plasma and particle environment and the magnetosphere.

4. Expected results

Together, the scientific payload of both spacecraft will provide the detailed information necessary to understand Mercury and its Magnetospheric environment and to find clues to the origin and evolution of a planet close to its parent star. The BepiColombo mission will complement and follow up the work of NASA's MESSENGER [2] mission by providing a highly accurate and comprehensive set of observations of Mercury. In addition, the BepiColombo mission will provide a rare opportunity to collect multi-point measurements in a planetary environment. This will be particularly important at Mercury because of short temporal and spatial scales in the Mercury's environment. The foreseen orbits of the MPO and MMO will allow close encounters of the two spacecraft throughout the mission.

References: [1] Benkhoff, J., et al. (2010) *Planet. Space Sci.* 58, 2-20. [2] McNutt R.L., S.C. Solomon, R.E. Gold, J.C. Leary and the MESSENGER Team (2006) *Adv. in Space Res. 38*, 564-571