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Mercury Science Objectives and Traceability within the BepiColombo project: Optimizing the Science Output of the next mission to Mercury

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Abstract

BepiColombo is Europe's first mission to Mercury. It will set off in 2018 on a journey to the smallest and least explored terrestrial planet in our Solar System. When it arrives at Mercury in late 2025, it will gather data during its 1 year nominal mission, with a possible 1-year extension. The mission comprises two spacecraft: the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). BepiColombo is a joint mission between ESA and the Japan Aerospace Exploration Agency (JAXA), executed under ESA leadership..

1. Science at Mercury

The scientific interest in going to Mercury lies in the valuable information that such a mission can provide to enhance our understanding of the planet itself as well as the formation of our Solar System; information which cannot be obtained with observations made from Earth. The science mission will consist of two separate spacecraft that will orbit the planet. ESA is building one of the main spacecraft, the Mercury Planetary Orbiter (MPO), and the Institute of Space and Astronautical Science (ISAS) at the Japan Aerospace Exploration Agency (JAXA) will contribute the other, the Mercury Magnetospheric Orbiter (MMO).

The BepiColombo mission relies on the valuable observations and science discoveries obtained by the MESSENGER and Mariner 10 missions in the past years and decades. Those discoveries shape the description of science objectives to be performed by the 11 instruments onboard the MPO spacecraft, and the 5 instruments onboard the MMO. In order to optimize the science planning and outcome of the mission, the BepiColombo Science Ground Segment (SGS) is developing strategies, tools, and workflows that will enable the science teams of the MPO spacecraft to maximize the science to be performed at Mercury.

2. Science Objectives and Traceability

As for every mission, the overall scientific goals are discussed in numerous documents. For Bepicolombo, those objectives are well summarized in [1]. They cover three main areas of scientific investigation of Mecury: Surface, Interior, and Exosphere. The BepiColombo Science Working Team (SWT) is supported by three scientific Working Groups (WG) that represents these science themes, 1) Surface and Composition, 2) Geodesy and Geophysics, and 3) Hermean Environment. Following the mission science objectives, those working groups provide a more detailed Science Traceability Matrix (WG-TMX) that helps to define the observation strategies and priorities.

To close the gap between the WG-TMX and the implementation of observations performed by individual instrument teams, the SGS is developing, in collaboration with the instrument teams, targeted science traceability matrix of each instruments (Inst-TMX). These Inst-TMX (linked to the WG-TMX) represent the essence of the science objectives of Bepicolombo. The SGS is using the TMX concept in a similar way to other projects (e.g., Cassini, JUICE), with an emphasisis on tracking them.

The Inst-TMX are defined in such a way that they can be tracked (using specific IDs) during the observation lifecycle (request, planning, commanding to the spacecraft, and downlink) until product generation. For instance, requirements on the spacecraft and instruments operations are listed (e.g., pointing, duration, etc..). This information is critical to ensure:

- the evaluation of observations success needed to perform science investigations, and
- a progress report on the evolution of the observations, in order to reschedule if needed and optimize the planning

In addition, measurements performed and received data will be analysed, quality checked, and traced back to the TMX.

During the conference, we will present the developement status of the science-observation tracking system for BepiColombo. The SGS welcomes any suggestions, improvements, and new or refined science goals that will help improving the science done at Mercury.

References

[1] Benkhoff et al. (2010) *PSS*.