

# The BepiColombo/SERENA package: first signal from space

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## Abstract

The ESA-JAXA BepiColombo mission to Mercury has been launched with success on 20 October 2018 from Europe's Spaceport in Kourou.

After completing the launch and early orbit phase on 22 October, an extensive series of in-orbit commissioning activities started. During this Near Earth Commissioning Phase (NECP), which was concluded on 16 December, the European and Japanese mission teams performed tests to ensure the health of science instruments, its propulsion and other spacecraft platform systems.

This is an essential phase, since it provides the green light for the next steps of the mission.

The most important activities related to the BepiColombo/MPO/SERENA NECP operations, held in ESOC from 12 to 15 of December 2018, are here reported. NECP operations confirmed functionality of ELENA, STROFIO, PICAM, and MIPA, simultaneously operated by the System Control Unit (SCU), with very promising results.

## 1. Introduction

NECP operations for SERENA have been both single sensor commissioning and SERENA-level test with all the unit in Science mode (reduced voltage) and different configuration. The fully operational with nominal high voltage will be reached for all the units in the second NECP slot at the end of July 2019.

## 2. SERENA package

SERENA (Search for Exospheric Refilling and Emitted Natural Abundances) is a package of four instruments devoted to Hermean environment investigation [1], located on BepiColombo/MPO as shown in Figure 1. Mercury's environment is a complex and tightly-coupled system where the magnetosphere, exosphere, and surface experience temporal and spatial variations linked to each other. The interaction between energetic plasma particles, solar radiation and micrometeorites with the Hermean surface gives rise to both thermal and energetic neutral particle populations in the near-planet space; such populations will be recorded by the SERENA neutral particle analysers: a mass spectrometer and an Energetic Neutral Atom imager (STROFIO and ELENA).

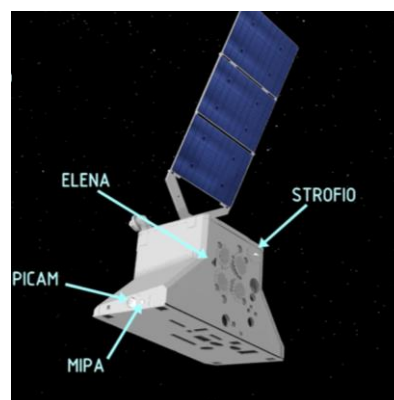


Figure 1: SERENA 4 units on board of MPO

The photo-ionised or charged component of the surface release processes as well as the precipitating and circulating plasma in the Hermean magnetosphere will be recorded by the SERENA ion spectrometers: two ion sensors (PICAM and MIPA). SERENA is a key experiment for the investigation of the Mercury environment having both neutral and ionised particles detection systems. Nevertheless it is the only particle experiment on board the MPO, able to provide a unique link with the MMO plasma instrumentation.

## 2.1 SERENA NECP philosophy

Two slots of NECP for SERENA have been planned. The unit teams have selected the tests done in the first NECP (December 2018) to check the overall functionality of the instrument in view of the second NECP planned for July 2019. In particular we did during the first slot:

- ELENA “Reduced Test” with limited High Voltage (HV) values and reduced time acquisition;
- MIPA Low Voltage (LV) Commissioning;
- STROFIO condition and activation of one of the two cathodes (2B) and LV and HV checkout;
- PICAM LV and HV checkout;
- SERENA level test switching on SCU (System Control Unit) and all 4 sensors in science mode with the HV-ON but at limited selected value.

After the first slot of SERENA NECP operation we can say that SCU has been tested successfully, managing the foreseen data rate.

For ELENA the MCP detector operated with nominal HV, up to register the nominal dark count rate, as well as the first switch on of deflection system, in limited HV values, has gone without problem.

MIPA operated in test mode with pulse generator in nominal behavior (No HV used). For PICAM the MCP operated properly with limited HV and science packets has been correctly received. For STROFIO the MCP detector has been successful commissioned, as well as conversion and activation of cathode 2B. Unfortunately one of the STROFIO electrodes (D5) was reporting zero volts when commanded to its nominal 1000V. Further tests have been performed to investigate this problem during delta NECP in March/April that have shown promising results. Packets lost by ELENA during the SERENA level test (with MIPA in Test mode) have been reported in a percentage less than 1%, and considered acceptable with the present SCU software.

‘Extended test’ of SERENA in science mode and nominal HV will be performed during the second NECP slot in July 2019.

## 3. Summary and Conclusions

The first switch-on and testing of SERENA during the first slot of NECP has been successful: all the MCP detectors worked well, several HVs were tested and verified. The 4 units worked nominally, except for some minor anomalies and a STROFIO issue further investigated during a delta NECP, done in March/April 2019, with very optimistic results. SCU properly managed all the units for several days.

## Acknowledgements

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## References

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