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The BepiColombo Laser Altimeter (BELA) during Near-Earth Commissioning Phase (NECP)

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Abstract

The ESA/JAXA joint mission BepiColombo to Mercury was launched successfully on October 20, 2018 (UTC) from Kourou, French Guiana. Currently BepiColombo is on its nominal 7-years cruise to the innermost planet. BepiColombo consists of two spacecraft, the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO), both targeted for different orbits around Mercury after arrival in December 2025. The BepiColombo Laser Altimeter (BELA) is one of ten payloads on the MPO. After launch the spacecraft and the instruments entered the Near-Earth Commissioning Phase (NECP), including a first switch-on of BELA on November 24, 2018. Here we report on the status of the instrument based on the analysis of NECP data and on data from a second switch-on, planned for June 2019.

1. The BELA instrument

BELA is a single beam laser altimeter operating at 10 Hz shot frequency and at a wavelength of 1064 nm. The detector is a silicon avalanche photo diode (APD) which transfers the return signal to analogue-digital converters (ADCs) with a sampling frequency of 80 MHz. The digitized return pulse is analysed in the range finder module where high-precision range and parameters for the shape of the return pulse are retrieved for each shot.

2. Scientific objectives of BELA

Main objective of BELA is the acquisition of range measurements to obtain the topography of the planet on global, regional and local scales. This is essential for studying the evolution of the planet and for understanding the processes that had shaped Mercury's surface. In addition BELA will aim at measuring the periodic tidal deformation of the surface which would provide insight into Mercury's interior, in particular the rheological state of its iron core. Analysis of the return pulse of the laser shots allows for measuring the surface roughness on the scale of the laser footprint, which is a few tens of meters, depending on the orbiters altitude. By providing active albedo measurements at the laser wavelength of 1064 nm, BELA will obtain return signals from permanently shadowed regions at both poles of Mercury thereby searching for characteristics of volatiles trapped in deep craters at these high latitudes.

3. Results of the BELA NECP

The BELA commissioning phase included functional testing of the subunits and first operation of the detector. The data retrieved during NECP showed that BELA is functioning nominally and no issues were detected after launch. The NECP was also used to obtain the first calibration of the range finder clock and the dark noise of the APD. Unfortunately, the BELA lasers could not be operated during NECP due to the location of the instrument right in front of the BepiColombo transfer module. The risk of damage due to back-reflections of the strong laser light was considered too high and therefore operating the lasers was not planned during NECP.