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Improved modelling of BELA altimetry observation for MPO orbit reconstruction

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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, Mercury. The mission comprises two spacecrafts: the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). The BepiColombo Laser Altimeter (BELA) is one of the instruments of MPO and it has been developed by a consortium led by the Physikalisches Institut - University of Bern (WP) and the DLR Institute of Planetary Research Berlin. The main goal of BELA is to provide information on Mercury's topography. However, when combined with Doppler tracking data, it is also possible to use the laser altimetry data to improve the probe orbit reconstruction.

The goal of this work is to improve the modeling of MPO altimetry observation in the form of crossovers, by using the end-to-end test results of BELA calibration in the "Starsim" laboratory of the University of Bern. With respect to previous studies, we use a more accurate modelling of BELA instrument, where we consider the impact of local slopes and pointing uncertainties on the noise characteristics and on the probability of false detection model.

The relative noise characteristics will define the weights of the cross-over pseudo-observations to be used, together with Doppler data, in the orbit determination process. We analyze the weighting using our updated laser altimetry model and compare the result with earlier studies. We also use an improved approach for the detection of the crossover points and we compare the number of detected crossovers (that will have a high impact on orbit reconstruction) with previous studies. For this simulation we use the planetary extension of the Bernese GNSS Software that is developed at the Astronomical Institute of the University of Bern (AIUB). The final goal of this study, which will be the subject of future talks is to use this model for BELA in-flight performance evaluation and to study the orbit determination improvement of MPO using altimetry data.