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Measurement, stability and prediction of the pointing of the BepiColombo Laser Altimeter during the simulation of the environmental conditions

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The first European laser altimeter, designed for interplanetary flight, BELA (BepiColombo Laser Altimeter on BepiColombo mission to Mercury), will be launched in July 2016. It is one of the eleven instruments onboard the MPO (Mercury Planetary Orbiter, one of the two spacecrafts of the BepiColombo mission) and will be nominally in a 400 km x 1508 km around Mercury with an orbital period of 2.3 h.
BELA consists of two subsystems, the transmitter and the receiver, and these two subsystems have to remain aligned during the orbital mission under varying thermal load. A setup to characterize the angular movements of BELA during the simulation of the environment that the instrument will encounter when orbiting Mercury has been designed at the University of Bern. Translational movements between the two subsystems have no effect on the misalignment between the pointing directions of the Rx and Tx but small rotations can have major consequences. Tests of the Engineering Qualification Model on this setup have shown that the instrument was stable enough to work properly during its mission at Mercury. This is the first laser altimeter which is required to cover a 91°C temperature range and to have been subjected to this kind of test. Further analysis during tests on the Flight Model of BELA confirmed that the instrument design was good and that the instrument was stable enough. The higher quality of the FM measurements has allowed a better understanding of the behavior of the misalignment between the transmitter and the receiver. It is possible to predict with an accuracy of ≈ 10 μrad the misalignment at a given temperature and the position of the BELA laser spot inside the field of view of the BELA receiver on the surface.