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The BepiColombo mission to Mercury: ISA accelerometer on-ground and in-flight calibration procedures

V. Iafolla (1), D. Lucchesi (1,2), E. Fiorenza (1), M. Lucente (1), C. Lefevre (1), C. Magnafico (1), R. Peron (1), F. Santoli (1), S. Nozzoli (1), and A. Argada (1)

(1) INAF/IAPS Via Del Fosso del Cavaliere,100 (00133) Rome Italy (Valerio.Iafolla@ifsi-roma.inaf.it), (2) ISTI/CNR Via G. Moruzzi 1, 56124 Pisa, Italy (David.Lucchesi@ifsi-roma.inaf.it)

The key role of the Italian Spring Accelerometer (ISA) in the radio science measurements of the ESA BepiColombo mission to Mercury is to remove, aposteriori, the non-gravitational accelerations acting on the Mercury Planetary Orbiter (MPO) due to the very strong radiation environment around Mercury. This presentation is devoted to describe the main on-ground and in-flight calibration procedures that are necessary to guarantee the accelerometer performance in order to reach the very ambitious objectives of the Radio Science Experiments (RSE) of the ESA mission: the accelerometer sensitivity has to be 10^{-8} m/s^2/$\sqrt{}$Hz in the frequency band $3{\cdot}10^{-5}$ -10^{-1} Hz.

ISA is a three axes torsional accelerometer and the calibration procedures are necessary in order to estimate scale factors and axes misalignments and couplings.

The on-ground calibration procedures are primarily finalized to the determination of the actuator transducer factor of the proof-masses capacitor plates and to the determination of the proof-masses axes orthogonality and orientation with respect to a reference optical cube.

The in-flight calibration procedures are devoted to the determination of the accelerometer pick-up transducer factors, which are different from those determined on-ground during the calibration of ISA's actuators, and to the determination of the axes alignment in order to check if launch shocks have produced possible variations with respect to their nominal orientation in the MPO body-fixed frame as determined during the pre-launch characterization and calibration. A by-product of the in-flight calibration procedures is the determination of ISA proof-masses position with respect to spacecraft effective center-of-mass. This allows to check if the MPO center-of-mass variations are in line with on-ground estimates based on fuel consumption computations and the mass distribution of the spacecraft appendices and movable parts, as in the case of the orientation of the solar array panels and of the High Gain Antenna (HGA). The presentation will focus in the description of the above calibration procedures and their corresponding error budget estimate.