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The BepiColombo mission to Mercury and the role of the ISA accelerometer in the Radio Science Experiments: status and perspectives

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Mercury's exploration is one of the most important challenges of modern planetary sciences. The results of such an exploration — in particular in the context of BepiColombo mission — are a way to constrain the physics of the terrestrial planets formation and, at the end, of the whole solar system. Moreover, as the closest body, among the planets, to the Sun, Mercury represents a unique "laboratory" in order to verify Einstein's theory of general relativity with respect to other metric and non-metric theories of gravitation. The level of knowledge that can be reached in the above fields is strongly conditioned by the accuracy of the Radio Science Experiments (RSE) that will be performed using Earth–bound radar tracking stations. Such very ambitious objectives need an onboard accelerometer in order to measure and remove, *a posteriori*, the complex to model, strong and subtle, non–gravitational accelerations of the very severe radiation environment the probe will face. To this purpose, the Italian Spring Accelerometer (ISA) has been selected to fly onboard the BepiColombo Mercury Planetary Orbiter (MPO). After a brief review of the RSE objectives, we describe the advantages arising from the new position of ISA inside the MPO, away from the spacecraft center–of–mass. We then focus on the accelerometer characteristics and performance, its functional tests, and on the accelerometer calibration with special emphasis on the precise determination of the sensing axes directions with respect to the body of the spacecraft. We then describe additional gravimetric measurements that can be achieved with the accelerometer under favorable flight conditions. We finally describe the accelerometer capability to measure the MPO speed variations during the onboard reaction wheels desaturation manoeuvres. These manoeuvres directly impact on the accuracy of the propagated state-vector of the satellite at the beginning of the subsequent observed arc, with an overall degradation of the RSE accuracy. ISA measurements of the speed variations, both in time and frequency domains, will be an essential ingredient in order to preserve the accuracy of the BepiColombo RSE and of the pointing accuracy of other onboard instruments. This additional capability of ISA strengthens once more the key role of the accelerometer in the BepiColombo mission.