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MICROSTAR, AN ACCELEROMETER TO STUDY THE GRAVITATION IN THE SOLAR SYSTEM

Abstract

For space Fundamental Physics experiments, an accelerometer is mandatory, either as drag-free sensor to control the spacecraft to follow a geodesic, as in the case of CNES MICROSCOPE and ESA/NASA LISA missions, or as payload instrument to measure the non-gravitational forces acting on the spacecraft, in order to reconstruct the geodesic motion of the spacecraft by on-ground processing combined to the radio science data. The verification of the General Relativity at Solar System scale needs in particular accurate acceleration measurement at low frequency. For this purpose, MICROSTAR, a ready-to-fly technology instrument, designed by ONERA and based on electrostatic accelerometer heritage from the Earth gravity missions CHAMP, GRACE and GOCE, is proposed with new and original improvements aiming to significantly reduce power consumption, size and weight. With a measurement range of 5 10^{-6} $m.s^{-2}$, the MICROSTAR instrument has a noise budget better than 10^{-11} $m.s^{-2}/Hz^{1/2}$ in frequency measurement bandwidth from 1 mHz to 100 mHz. A bias rejection system can be associated with the accelerometer in order to ensure high performance at very low frequency. In the frame of the recent Cosmic Vision selection, the Fundamental Physics Advisory Group of ESA suggested to use an accelerometer on future interplanetary missions, for testing the gravitation at Solar System scale and to finely analyse the flyby anomalies, as in the Odyssey and Rebond proposed missions. This instrument is presently the heart of the Gravity Advanced Package experiment for the Jupiter Ganymede Orbiter mission selected for assessment phase by ESA. Beyond the objectives in Fundamental Physics, such an instrument could also be used for planetary aeronomy or gravity field mapping.