The Data and Diagnostics Subsystem for LISA

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LISA Pathfinder was an European Space Agency (ESA) pioneering mission designed to enable gravitational wave detection in space. In order to do so, it was designed to measure the acceleration between to two test masses in nominal free-fall to unprecedented sensitivities in a ultra-stable environment, reaching a final performance of $(1.74 \pm 0.05) fm\,s^2/\sqrt{Hz}$ above $2\,\mathrm{mHz}$ [1]. The data and diagnostics subsystem —the Spanish contribution to the mission— was a crucial element of the satellite. It had a twofold objective: on one side, to monitor with high sensitivity and stability the environmental fluctuations on-board and also to produce controlled perturbations to study the effect of these perturbations on the test mass geodesic motion. On the other side, to handle the payload data and control different several subsystems. This subsystem consisted of: the temperature diagnostic subsystem [2] (24 NTC sensors and 16 high precision heaters) [2]; the magnetic diagnostic subsystem (four flux-gate magnetometers and two coils) [3]; the radiation monitor and the Data Management Unit (DMU) —the payload computer.

Based on the LISA Pathfinder experience, Spain is planning to support the Data and Diagnostics system for LISA. The definition and development of this subsystem entails an increased level of complexity in comparison with the one flown on-board LISA Pathfinder. First, because LISA is a constellation of three satellites and therefore the subsystem is in reality three replicas flying in three different space-crafts. But also some improvements in sensitivity and stability —it is important to stress the 100Hz measuring band in that respect— are already envisaged.

In this talk we will review the main lessons learnt from the diagnostics subsystem during LISA Pathfinder operations and report on the current status of the design of the LISA Data and Diagnostics subsystem which, as the rest of LISA subsystems, is now undergoing the phase A study.

[1] M. Armano et al. (2018) Beyond the required lisa free-fall performance: New lisa pathfinder results down to 20Hz. Phys. Rev. Lett., 120:061101, Feb 2018

[2] Sanjuán J. et al., Thermal diagnostics front-end electronics for LISA Pathfinder, Rev. Sci. Instrum., 78, 2007

[3] Diaz-Aguiló, M et al. (2013). "Design of the magnetic diagnostics unit on-board LISA Pathfinder". In: Aerospace Science and Technology 26.1, pp. 53 –59.