

LISA Pathfinder final noise performance: effect of disturbances on the low frequency noise and projection to LISA

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Abstract

LISA Pathfinder (LPF) was a European Space Agency mission with the aim to demonstrate free-fall motion of test bodies with a level of precision never achieved in other missions. It was operated between December 3rd, 2015 and July 18th, 2017, delivering outstanding results that exceeded the original requirements and are fundamental in view of space-based gravitational wave detectors like LISA.

Its final noise performance is presented by thoroughly describing the analysis performed in the course of the operations on a series of uninterrupted noise-only measurements. Eleven acceleration noise runs were analyzed using a modification of the Welch periodogram method, in order to evaluate both their noise spectra and the excess low frequency noise with respect to the noise sources modeled so far, which arises at frequencies down to 20 μHz .

Moreover, the investigation of spurious signals occurring in the noise is provided, together with statistical considerations about their source and suggested torsion pendulum experiments to identify them.

The analysis of the physical origin of these noise sources contributes not only to the understanding of LPF final results, but their projection to the LISA noise performance plays a crucial role in the characterization of LISA in the sub-mHz frequency band, where the test masses acceleration noise is prevailing.