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In orbit calibration of LISA Pathfinder dynamics: results and implications for LISA

In 2015 LISA Pathfinder (LPF), the LISA technological demonstrator, was launched from Kourou, French Guyana. The main goal of the demonstrator was to measure the differential acceleration noise between two freely falling test-masses, $\Delta g(t)$, such that $S_{\Delta g}^{1/2} < 30$ fm/s$^2/\sqrt{\text{Hz}}$ at 1 mHz. The in-orbit results showed an unprecedented level of differential acceleration noise, much better than the mission requirement, giving a new impulse to the LISA mission, the gravitational wave observer in the mHz band from space. A key step toward reaching this result was the correct calibration of the dynamics of LPF. In this talk, I will present the calibration procedures adopted, the physical parameters of the dynamical model, and the analysis of the performed experiments. The results demonstrate that the dynamics of the system was accurately modeled on-ground and the dynamical parameters were stationary throughout the mission, with impacts on the LISA mission that is now been developing. The possibility to calibrate the system dynamics for future space-based gravitational wave observatories is also briefly discussed.

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