Design of an electromagnetic antenna in the audio-frequency band for LISA

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After the performance of LISA Pathfinder (LPF), the analysis of the data showed that the experiment was definitely successful, achieving better results than expected [1]. The mission results indeed demonstrated that the Amplitude Spectral Density of the relative acceleration noise of the two free-falling test masses (TMs) was lower than the LISA requirements, and much below than the LISA Pathfinders.

Notwithstanding, some well-identified quasi-impulse force events or glitches were removed from the data in order to reach the reported results. These glitches can affect the results by adding an excess noise in the low frequencies. Thus, a series of hypothesis have been made to give them an explanation. One of them is the coupling of the force noise sources into the bulk of the TMs. That is, magnetic fields of frequencies above 10 Hz, which are above the measuring band of the LISA Pathfinder magnetic diagnostics subsystem [2], may down-convert into the LPF band. This phenomenon can be tested by audio-range antennas, which are sensitive to signals from, approximately, 15 Hz to 20 kHz.

This work is motivated by the need of introducing these audio-range antennas in LISA to detect possible magnetic fields in the audio frequency band that could down-convert into the LISA detectable frequency region. For that, a design of a pick up coil is developed, whose sensitivity needs to fulfil the requirements that are requested for the LISA mission.

[1] M. Armano et al. (2016) Sub-Femto-g Free Fall for Space-Based Gravitational Wave Observatories: LISA Pathfinder Results Phys. Rev. Lett. 116, 231101

[2] Diaz-Aguil, M et al. (2013). Design of the magnetic diagnostics unit onboard LISA Pathfinder. In: Aerospace Science and Technology 26.1, pp. 53 59.