A distributed chip-scale magnetic diagnostic subsystem for LISA

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Gravitational wave detectors, both from space and on-ground, require a precise knowledge of all non-gravitational forces applied on the test masses. In LISA, one of the main contributors to the total acceleration noise budget is the surrounding magnetic field inside the spacecraft, created by the interplanetary magnetic field, electronic units and other components such as the micro-thrusters, batteries, solar panel cells, etc. [1]. These elements can produce dc and fluctuating magnetic fields and gradients which must be kept below certain values in order to ensure proper science operation of the GW observatory.

The magnetic diagnostic subsystem on board LISA requires sensitivities below 10 $\mathrm{nT}/\sqrt{\mathrm{Hz}}$ down to the very stable measuring bandwidth of 0.1 mHz. On top of that, the sensors need to be located close to the free-falling test mass —a condition that can not be achieved with fluxgate sensors, the ones used in LISA Pathfinder [3]. For that reason, our group already started the development of a magnetic diagnostic subsystem by means of an Anisotropic Magnetoresistors (AMR) [3]. This would allow several improvements when compared to fluxgate sensors: (i) a more compact design, allowing more of these sensors to be distributed in the spacecraft improving the spatial resolution of the magnetic field mapping; (ii) low magnetic and thermal back-action enabling a closer location to the TM and (iii) low noise performance in the LISA band down to 0.1 mHz.

In this work we propose a setup to test the LISA magnetic diagnostics subsystem in a realistic distribution, ie. with the sensors in a configuration close to the one in orbit and evaluate the capabilities of the sensor configuration to estimate magnetic field and gradients in the test mass position.

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