Possible LISA Technology Applications for Other Missions

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Abstract: The Laser Interferometer Space Antenna (LISA) has been selected as the third large class mission launch opportunity of the Cosmic Visions Program by the European Space Agency (ESA). LISA science will explore a rich spectrum of astrophysical gravitational-wave sources expected at frequencies between 0.0001 and 0.1 Hz and complement the work of other observatories and missions, both space and ground-based, electromagnetic and non-electromagnetic. Similarly, LISA technology may find applications for other missions. This paper will describe the capabilities of some of the key technologies and discuss possible contributions to other missions.

Ultra-stable Structures: Optical Bench

LISA Pathfinder Optical Bench

Using hydroxy-catalysis bonding techniques, we can build complex optical structures with picometer-level dimensional stability and high mechanical strength. The optical bench [1] for LISA Pathfinder enabled stable precision laser interferometry that enabled the spectacular results show below. The LISA optical bench will use the same construction methods, and they may be applied to other instruments (see below) and missions that require large stable telescopes.

Reference
2. M. Armano et al. Beyond the Required LISA Free-Fall Performance: New LISA Pathfinder Results.Reference

High Output Power Frequency Stabilized Lasers

Frequency-stabilized lasers enable high-precision metrology for gravitational wave detectors and other applications, including GRACE-Follow On, and laser communications.

Reference

Colloid Micro-Newton Thrusters for LISA Pathfinder

Very low noise thrusters enabled the high precision drag free operation in LISA Pathfinder and may find application in other missions that require precision position of structures, such as starshades.

Reference

Ultra Stable Structures: Telescopes

The basic requirements are similar to those for any good quality imaging telescope, but are supplemented by two additional requirements that are specific to the displacement measurement application: picometer-level dimensional stability and low scattered light.

Silicon Carbide Meets Dimensional Stability Requirement

A silicon-carbide metering structure has demonstrated it is limited by laboratory temperature fluctuations. On orbit temperature fluctuations are a factor of 100X lower, so it will meet requirements.

Reference

Tunable Frequency Stabilized Lasers

We have demonstrated that the carrier frequency of the main laser source can be made to tune in frequency without sacrificing the noise performance.

Reference

Flight-Ready Phasemeter: GRACE-Follow-On

A phasemeter originally developed for the LISA Mission is ready to fly on the Gravity Recovery and Climate Experiment (GRACE) Follow-On Mission.

Reference