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Compact-Transportable Iodine Stabilized Laser Setup for LISA Mission Grounds Tests Operation

lundi 20 novembre 2023 10:00 (15 minutes)

The French activities for LISA (Laser Interferometer Space Antenna) mission include assembly, integration, validation and testing of the payload by a consortium of several partners led by CNES.
SYRTE has developed for several years a laser activity for the different tests and interferometric measures realized by the consortium. A partnership with eXail led to a major technological step in the maturation and development of a reference laser stabilized on iodine. This frequency-stabilized laser setup is compact and transportable over several hundreds of kilometer and don't need any realignment after transport.
The whole laser setup is composed of two Nd:YAG lasers operating at the nominal wavelength of LISA at 1064.49 nm. These two lasers are phase locked one to another and on a telecom reference laser at 1596.7 nm which is frequency-stabilized over a hyperfine transition of Iodine vapour at 532.245 nm. The frequency gaps between the infrared and the green ranges are bridged using second-harmonic generation and third-harmonic generation. The spectroscopic bench for the Iodine interrogation is totally monolithic and doesn't need any realignment after transport.
The whole setup has been characterized with the metrological frequency chain of the LNE-SYRTE Laboratory to ensure that the LISA Mission specifications were achieved before testing with interferometric measurement.
The laser setup was transported successfully by road from SYRTE-Observatoire de Paris to LAM-Marseille in July and brought to nominal operation in just 1 hour. It has been used over several weeks for great precision interferometric measures without any intervention.
The preliminary analysis of the interferometric measurements, which lasted for more than 20h each, led to results about one order of magnitude better than the LISA Mission specification. Especially, in the high frequency band where the residual noise of the laser is predominant, sub-pm/√Hz resolution has been obtained.

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