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LISA Optical Bench Testbed

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Abstract. The optical bench (OB) is a part of the LISA spacecraft, situated between the telescope and the testmass. For measuring the inter-spacecraft distances there are several interferometers on the OB. The elegant breadboard of the OB for LISA is developed for the European Space Agency (ESA) by EADS Astrium, TNO Science & Industry, University of Glasgow and the Albert Einstein Intitute (AEI), the performance tests then will be done at the AEI. Here we present the testbed that will be used for the performance tests with the focus on the thermal environment and the laser infrastructure.

Introduction. The main part of the OB are three interferometers reading out different pathlength changes. In the science interferometer the beam from the remote spacecraft is combined with a local laser beam to measure the inter-spacecraft distance. The testmass interfermometer reads out the distance between the OB and the free floating testmass inside the spacecraft. The point ahead angle mechanism (PAAM) interferometer is for correcting the point ahead angle to the remote spacecraft. In addition there is a reference interferometer on the OB to substract common noise from the testmass and PAAM interferometer.

An elegant breadboard (EBB) of the OB will be build at the University of Glasgow. For the performance testing in the lab at the AEI a simulator for the testmass and the beam from the remote spacecraft is developed. This will be realized on a second zerodur baseplate placed on top of the EBB (see poster of M. Tröbs et al.).

Test Facility. Currently at the AEI in Hannover the test facility for the performance tests of the EBB is built up and pre-tests are done. We do have a vacuum tank placed on air-damped feet for vibration isolation. To be able to measure the required pathlength stability of a few pm/$\sqrt{\mathrm{Hz}}$ a very high temperature stability of the experiment is needed. A stability of 10^{-7} K / $\sqrt{\mathrm{Hz}}$ with a 1/f slope to lower frequencies is required. Therefor we do have several thermal shielding stages (see figure 1) and the required temperature stability is nearly achieved (see figure 2). At higher frequencies the measurement is sensor noise limited.

The laser beams needed on the EBB and the testmass and telescope simulator are coupled in through quasi-monolithic fiber injectors. For the EBB a high power beam (about 1.6 W) and a local oscillator beam are injected. The local oscillator laser is a frequency stabilized system on which the other lasers are offset phaselocked.

For the telescope simulator a third laser is used for the simulated beam from the remote spacecraft and a reference interferometer. For the simulated beam the laser is highly attenuated to a few hundred picowatts and expanded through a lens system.

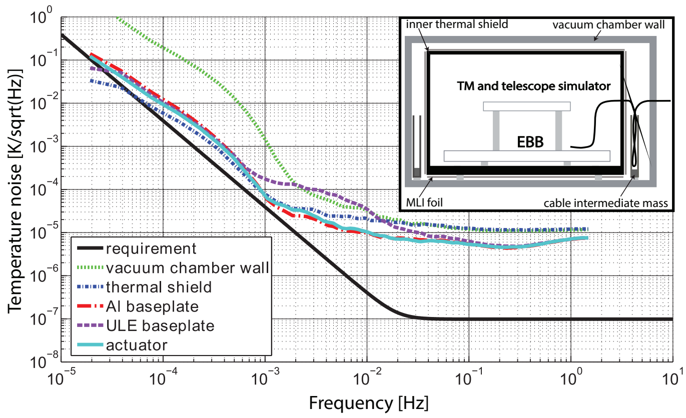

Figure 1. Measured temperature stability and scheme of the vacuum chamber with temperature shielding

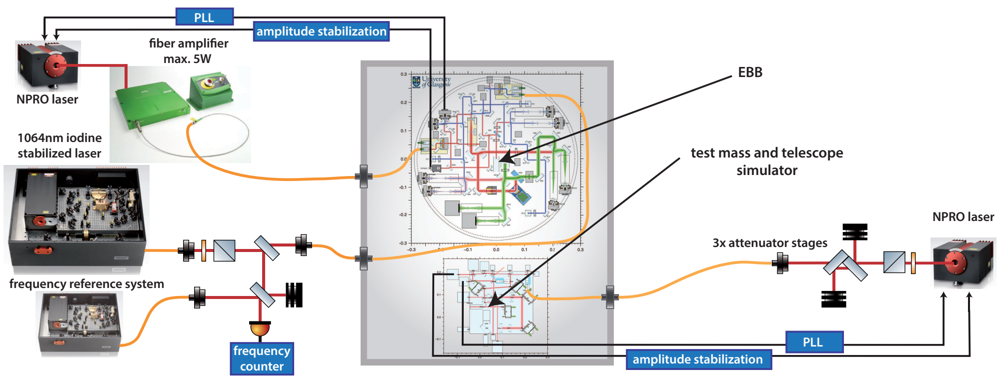

Figure 2. schematic of laser infrastructure for the EBB test facility

For simulating the testmass motion and to align the telescope simulator, linear and tip-tilt piezo actuators are used. These have to be mounted on thermally compensated mounts because of their big thermal expansion coefficient.

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