

LSC Six-Month Progress Report

Organization: German/British Collaboration for Detection of Gravitational Waves
(GEO600)

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Attachment C / Lasers and Optics

Over the last six months the following progress has been made:

We continued the investigations on the GEO600 laser system, which is similar to the front end of the Advanced LIGO laser. The LabView control channels (sampling rate <10Hz) will be connected to the data acquisition system. This will allow us to focus in this MOU period on the long-term behaviour and long-term correlations between the different laser channels

The LabView program was extended to accommodate more remote control and sensing possibilities. A long-term analysis of a couple of laser channels revealed some problems which were mostly specific problems for the GEO system (broken ND-Filter due to a too high power on that component). The temperature dependence of the reflectivity of a mirror hit under a slightly different than the design angle was found to cause power deviations of up to 10% over 24h periods. This mirror was replaced. The range of the slave cavity length actuator was found to be sufficient (range > 3 times rms fluctuations over 24h).

The AdLIGO laser will consist of a front end and one or two high power stages. A 20W Nd:YAG system based on the GEO laser design is under development. An output power of more than 20W was achieved in single mode operation in a ring resonator design.

A copy of the LIGO I PSL frequency stabilization was installed and tested in the lab in Hannover. Peter King and Rich Abbott spend two weeks in Hannover to install the Software (VxWorks and EPICS) and electronics (servo card, AD, DA, digital IO, cross connect, etc). A NPRO was locked to a reference cavity. The availability of this system will allow the Hannover group to understand, test and assess the interfaces between the AdLIGO PSL stabilization electronics and the global AdLIGO control system.

Experiment toward a 100W demonstration laser was performed at the LZH. Single mode single frequency operation of slave system locked to a 2W NPRO was achieved. The power of this system however was rapidly decreasing and some damaged lenses were found to cause this problem. Some dirt on the lenses, which causes increased absorption might have caused this damage. The lenses were replaced and the system was set up again to be tested according to the AdLIGO PSL prototype test protocol developed by I. Zawischa from LZH.

The diagnostic breadboard to measure the performance of different 100W lasers was improved to allow for easy transportation and a dither lock of the PMC to the laser system under test. This design does not need an EOM put in the beam under test which might changed the spatial beam parameter. A photodiode was included, which can measure up to 150mW of light with a bandwidth of approx. 50MHz. Such a diode is needed to evaluate the laser power noise at rf Frequencies.

Benno Willke co-coordinated the work of the laser working group of the LSC. Monthly teleconferences were organized and minutes of these calls were circulated.