



**Attachment LAS to the
Memorandum of Understanding LIGO-M970077-00
between the German/British Collaboration (GEO 600) for the
Detection of Gravitational Waves (GEO600)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
For The Period
August 15, 2007 - August 14, 2008**

This Attachment LAS to the Memorandum of Understanding LIGO-M970077-00 defines the role of the German/British Collaboration (GEO 600) for the Detection of Gravitational Waves (GEO600) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Lasers Development Group (LDG). The period of performance for the activities in this Attachment is from August 15, 2007 - August 14, 2008.

1. Collaboration

The Lasers Development Group (LDG) is the scientific collaboration for defining and developing future high power lasers for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers.

MOU Attachment LAS defines the roles and responsibilities of groups in this development group.

2. Participation

During the period August 15, 2007 - August 14, 2008, the members of GEO600 will participate in in LDG in the following areas:

a. Laser Development

The GEO group is taking the leading role in the Advanced LIGO pre-stabilized laser system (PSL) development. This includes overseeing the laser development at the Laser Zentrum Hannover (LZH) as well as the development of the power and frequency stabilization feed-back control loops and spatial control of the laser beam. Furthermore a diagnostic tool to measure all relevant PSL fluctuations and its spatial mode content is being developed. The Advanced LIGO PSL and the diagnostic tool is part of the capital contribution of the GEO group to the Advanced LIGO project. In addition the GEO group will work in the LSC laser working group on techniques towards pre-stabilized laser systems for third generation detectors. Specifically we will work on injection-locking studies and high-sensitivity power-fluctuations measurements with photodiodes and other techniques to allow

measurements at the $1\text{E-}9/\text{sqrt}(\text{Hz})$ level.

(i) Work on the development of the Advanced LIGO laser system will continue at the LZH. The 200W laser will pass from the laboratory prototype phase to the functional prototype phase during this MOU period. The goal is to simultaneously demonstrate all power and noise requirements with a laser that is close to the final design.

In more detail we will test the spatial filtering of the first pre-modecleaner and its behaviour under thermal loading by investigations of the transmitted beam with a diagnostic breadboard (DBB) which by itself is an AdvLIGO PSL subsystem. The DBB design will be finalized during this MOU period and the production phase at AEI will begin.

The intensity fluctuations of the laboratory prototype were too high to test the power stabilization since the range of the actuator was too small. We plan to perform these tests on the functional prototype. In addition we will continue the research on high power InGaAs photodiodes with special emphasis on the pointing-to-RIN coupling and to the $1/f$ noise under high power illumination which limits the currently achievable power stability below 100Hz.

Furthermore the optimization of the resonator design of the 200W slave cavity and the thermal design of the laser heads will play an important role. Both points not only determine the spatial beam profile of the laser but are as well key ingredients to allow for a stable laser operation at various pump powers.

(ii) The GEO group will provide the laser for Enhanced LIGO. During this MOU period we will deliver three 35W laser systems for Enhanced LIGO (for two interferometers and one spare). We will help during installation and commissioning and will work with the commissioners to improve the lasers if required.

(iii) Benno Willke will continue to serve as the chair of the lasers group for the second year of his term.

b. Other Contributions

Not Applicable

3. Resource Sharing

The LIGO Laboratory will contribute resources including allocation of appropriate scientific and engineering personnel, research facilities, and funding in support of the effort in Item No. 2, as indicated below.

a. Research accommodations for GEO600 group members while on LIGO research assignment at any LIGO Laboratory site.

Not Applicable

b. Access to LIGO data through established LSC channels in support of this work.

Not Applicable

4. Coordination and Reporting

GEO600 will perform research within the structures established by the LIGO Laboratory and the LSC where appropriate. In particular, activities described in Item 2 will be carried out within the Lasers Development Working Group of the LSC.

This includes keeping the Group leaders informed of activities and plans, reporting to the group at meetings and telecons, and through technical documents submitted to the LIGO Document Control Center.

In addition, an annual report will be submitted with the update to this Attachment, giving a summary status on research by topic as indicated in Item No. 2, including progress against the milestones if any, significant accomplishments such as new insights/discoveries or publications, issues of concern if any, and an indication of invested time.

This Attachment will be updated at least annually with a plan of activities for the succeeding one-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. Computer Code

All computer code delivered to the LSC under this Attachment must be developed in consultation with the LSC Data Analysis Software Working Group (DASWG) and archived, documented and reviewed as determined by that group.



Jay Marx
LIGO Laboratory Director



Karsten Danzmann
**Principal Investigator(s)
GEO600**



David Reitze
LSC Spokesperson