Attachment Number C to the

Memorandum of Understanding (LIGO-M970077-00-M)

between the

German/British Collaboration for the Detection of Gravitational Waves (GEO 600)

and the

Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory

February 15, 2000

This Attachment to the Memorandum of Understanding LIGO-M970077-00-M covers the role of GEO 600 as a Charter Member of the LIGO Scientific Collaboration (LSC) and a member of the Lasers/Optics Development Group (LODG). The period of performance for the activities in this Attachment is from February 15, 2000 to August 15, 2000. This period may be modified by agreement to a revision of this Attachment.

1. LIGO Scientific Collaboration - The LIGO Scientific Collaboration is organized as a separate organization from the LIGO Laboratory. It includes scientists from the LIGO Laboratory, and those from collaborating institutions, and has its own leadership and governance. The Collaboration will ensure equal scientific opportunity for individual participants and institutions. It will organize the research, publications, and all other scientific activities. The Collaboration will report to the Laboratory Directorate for final approval of its research program, technical work, observational physics publications, and talks announcing new observations and physics results. This will be done through regular reports to the Directorate and its PAC.

2. Charter Membership - An initial period for formation of the Charter group of institutions in the LIGO Scientific Collaboration commenced on March 1, 1997 and ended following the first full meeting of the Collaboration at which the Collaboration Council assumed its role.

   Following the charter period proposals will be evaluated through the Collaboration Council. With Collaboration approval, an MOU with the LIGO Laboratory, including Attachments defining specific work, will be required for any participating institutions.

3. This document is an agreement between the German/British Collaboration for the Detection of Gravitational Waves (GEO 600) and the LIGO Laboratory concerning the activities of GEO 600 as a Collaborating Institution in the LIGO Scientific Collaboration (LSC) and in the Lasers/Optics Development Group (LODG), and as indicated in Item No. 8 below.

4. Lasers/Optics Development Group - The Lasers/Optics Development Group (LODG) is the scientific collaboration for defining and developing future high power lasers and required improvements in optics for use in advanced subsystems for the initial LIGO interferometers or

in entirely new advanced interferometers. A specific Attachment will define the roles and responsibilities of groups in this development group. Members of this group will normally be authors on publications reporting the work of the group and will normally be eligible to participate in data runs and science beyond the LIGO I data run.

5. Report of Progress - GEO 600 will provide a status report on its activities in support of LIGO every six months. The report will consist of: a) a summary status on research by topic as indicated Item No.8 below 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, b) updated List of Collaborators, and c) a plan of activities for the succeeding six-monthly period. The report will be due one month before the close of the period of performance under the Attachment in question.

6. Term of Membership - The Membership will be renewed every six months upon evidence of satisfactory performance of agreed upon duties.

   The coordinates of GEO 600 members are included in the Attachment Z to the Memorandum of Understanding LIGO-M970077-00-M.

7. During the period February 15, 2000 to August 15, 2000 the following GEO 600 personnel will participate in LODG activities:

   University of Hannover, Institut fur Atom und Molekulphysik and Max Planck Institute fur Quantenoptik, Garching

Faculty:	Danzmann (10%)
Postdocs:	Willke (20%)
Grad. Students:	Quetschke (100%), Kirchner (100%), Leonhardt (50%)
Engineers:	Weidner (20%), Haupt (20%), zur Mühlen (50%)

8. During the period February 15, 2000 to August 15, 2000 the GEO 600 group will continue investigations of cross-coupling between laser stabilization control loops of a Nd:YAG laser-system, relevant to Enhanced and Advanced LIGO interferometers. Special emphasis will be put on the amplification process (injection-locking vs. MOPA). In addition GEO 600 personnel will take part in the design of the LIGO II PSL.

   a) The Systems under development for GEO 600 has the following subsystems:

   1. A 12 Watt injection-locked Nd:YAG laser-system with a control-system topology similar to the LIGO prestabilized laser (PSL).

   2. Frequency control to a reference cavity as an inner loop including an acousto-optic frequency shifter as an actuator for the outer frequency stabilization loop.

   3. An Intensity stabilization loop with feedback to the injection-locked slave pump diode.

4. The GEO600 modecleaners to measure cross coupling introduced by the spatial filtering.

5. A rigid analyzer cavity to measure out-of-loop frequency noise and cross coupling transfer functions.

b) Planned research includes:

1. The suspension of the reference cavity and the analyzer cavity to reduce the "out-of-loop" frequency noise. The suspension will have one vertical and one pendulum stage, both damped on their resonance.

2. Design of the outer frequency-stabilization-loop, including investigations of the noise added by the AOM actuator. Measurements will be made with respect to the GEO600 mode-cleaner.

3. Optimization of the "current-lock" performance by increasing the bandwidth of the feed-back loop. ("Current lock" is a new frequency stabilization scheme which uses the intensity of the pump laser-diodes as a frequency tuning element to avoid cross coupling introduced by the laser PZT frequency actuator.)

4. Intensity stabilization of the 12W system.

5. Visits to Caltech, Stanford, and Hanford to work on the design of the LIGO II-PSL.

9. During the period February 15, 2000 to August 15, 2000 the LIGO Laboratory will share, as requested and appropriate, LIGO data of relevance to the research topics in Item No. 8 above.

10. The research effort pursuant to this Attachment C will be coordinated by Benno Willke and Syd Meshkov on behalf of GEO 600 and the LIGO Laboratory, respectively.

11. 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. 8, as indicated below. These resources will be in addition to the coordination effort and data to be made available per Item No. 9 above.

    a) Provide accommodations for GEO 600 investigators while on LIGO research assignment at Caltech, and/or LIGO sites.

Approved:

Barry Barish
Barry Barish
LIGO Laboratory Director

6-12-00
Date

Karsten Danzmann
GEO 600 Principal Investigator

28.3.00
Date

James Hough
James Hough
GEO 600 Principal Investigator

18/03/00
Date

Bernard Schutz
Bernard Schutz
GEO 600 Principal Investigator

24/3/00
Date