

**Attachment Number B 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
August 15, 1999**

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 Isolation/Suspension/Thermal Noise Development Group (ISTNDG). The period of performance for the activities in this Attachment is from August 15, 1999 to February 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 Isolation/Suspension/Thermal Noise Development Group (ISTNDG), and as indicated in Item No. 8 below.
4. Isolation/Suspension/Thermal Noise Development Group - The Isolation/Suspension/Thermal Noise Development Group (ISTNDG) is the scientific collaboration for defining and develop-

ing future isolation and suspension improvements 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.

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

6. Term of Membership - The Membership will be renewed every six months upon evidence of satisfactory performance of agreed upon duties.
7. During the period August 15, 1999 to February 15, 2000, the following GEO 600 personnel will participate in ISTNDG activities:

University of Glasgow, Department of Physics and Astronomy

Faculty: Hough (50%), Robertson (30%), Ward (30%)
 Postdocs: Plissi (100%), Rowan (25%), Strain (40%), Cagnoli (80%)
 Grad. Students: Torrie (100%), McIntosh (80%), Husman (100%), Sneddon (80%)
 Engineers: Craig (80%)

Universitat Hannover, Institut fur Atom und Molekulphysik

Faculty; Danzmann (5%), Aufmuth (20%)
 Grad. Students: Lueck (30%), Mossavi (100%), Kloevekorn (100%)
 Engineer: Weidner (10%)

Max-Planck-Institute fur Quantenoptik, Garching

Equivalent Faculty: Ruediger (10%)

8. The GEO 600 team will work on suspension developments relevant to the Enhanced/Advanced LIGO as follows:
 - a) Systems Under Development
 1. Double/triple pendulum system with reaction masses, the assembly being suspended from

one passive stack on top of one active stage.

2. Two extra stages of vertical isolation are provided by cantilever springs in the suspensions of the top and intermediate pendulum masses.
3. The active stage at the base of the system is provided to reduce seismic noise in order to ease acquisition of lock of the servo systems in the interferometry and to allow low frequency movements to be reduced to a level where non-linear coupling of various noise sources will not be a problem.
4. The possibility of using active isolation on the supporting mass for the double pendulum is a future development area.
5. The last stage of the pendulum will use fused silica fibres (or ribbons) bonded in a low loss, high vacuum compatible way to the bottom and intermediate masses.
6. In particular the technique of silicate bonding of fused silica to fused silica and of fused silica to sapphire will be studied further, with particular reference to evaluation of losses associated with the bonding. This work will be carried out in collaboration with the Department of Applied Physics, Ginzton Laboratory, Stanford University.
7. Demonstration of suspension of masses of $\sim 10\text{kg}$ on 4 silica fibres.

b) Required Performance of System

1. Isolation at 50 Hz of 6×10^6 in the vertical and 6×10^9 in the horizontal
2. Reduction of rms microseismic noise around 0.3 Hz by a factor of ~ 10

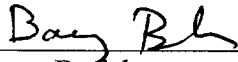
c) Planned Research

An experiment to measure the off resonance thermal noise spectrum in a small suspended sample of fused silica is currently being carried out in Hannover. This will allow the frequency dependence of the damping factor of the material (+ jointing) to be investigated.

9. During the period August 15, 1999 to February 15, 2000, the LIGO Laboratory will share, as requested and appropriate, the LIGO data of relevance to the planned research in Item No. 8 above.
10. The research effort pursuant to this Attachment B will be coordinated by Norna Robertson 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 in Item No. 7 above while on research assignment on LIGO at Caltech.

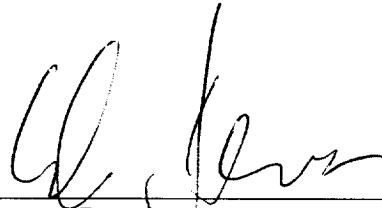
Approved:



Barry Barish
LIGO Laboratory Director

3-6-00

Date



Karsten Danzmann
GEO 600 Principal Investigator

March 14, 2000

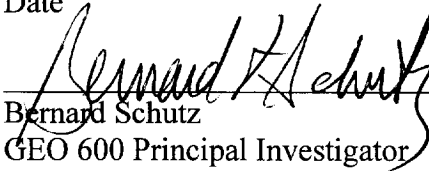
Date



James Hough
GEO 600 Principal Investigator

March 21, 2000

Date



Bernard Schutz
GEO 600 Principal Investigator

15 March 2000

Date