

**Attachment Number D 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 Advanced Detector Configurations Development Group (ADCDG). 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 Advanced Detector Configurations Development Group (ADCDG), and as indicated in Item No. 8, below.
4. Advanced Detector Configurations Development Group - The Advanced Detector Configurations Development Group (ADCDG) is the scientific collaboration for defining and develop-

ing entirely new advanced interferometers. It is expected that this development group will pursue research in dual recycling, resonant sideband extraction, Sagnac interferometers, systems with non-transmitting optics and other advanced configurations. 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 the ADCDG activities:

Universitat Hannover, Institut fur Atom und Molekulphysik: Max-Planck-Institute fur Quantenoptik, Garching, and Glasgow University, Glasgow.

Faculty:	Danzmann (5%), Hough (5%)
Equivalent Faculty:	Ruediger (30%), Schilling (20%), Winkler (10%)
Postdocs:	Strain (40%), Skeldon (20%), McNamara (10%), Robertson (10%)
Ph. D. Students:	Freise (100%), Clubley (10%)
Engineers:	Weidner (20%)

8. The GEO 600 group will continue investigations of Advanced Interferometer Configurations, relevant to Enhanced/Advanced LIGO Interferometers, as follows:

a) System Under Development for GEO 600

1. The GEO 600 concept is a dual-recycled interferometer, using four-pass delay lines in its 600m arms
2. Signal recycling (power recycling is considered standard for all current detectors) is a unique feature of GEO 600, but one that could find future application in other detectors
3. Resonant Sideband Extraction, also being investigated, has many configurational similarities with signal recycling. It is being considered by several groups as a promising future con-

figuration.

b) Planned Research

1. Current and future activities at Garching (30m prototype), Glasgow (10m prototype), and Hannover (GEO site) are indicated below. Several of these activities are part of the construction of GEO and have a high priority.
2. Automatic alignment of dual recycling system (30m), for all 12 degrees of freedom
3. Investigation of dual recycling with increased recycling factors
4. Analysis and reduction of measurement noise with dual recycling
5. Development of control systems for dual recycling on GEO
6. Development of output modecleaner designs for GEO
7. Planning of dual recycling/ resonant sideband extraction experiments (10m), and initial preparation of interferometer
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, b) above.
10. The research effort pursuant to this Attachment D will be coordinated by Kenneth Strain 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:

*Bar Barish*

Barry Barish  
LIGO Laboratory Director

*3-6-00*

Date

*Karsten Danzmann*

Karsten Danzmann  
GEO 600 Principal Investigator

*March 14, 2000*

Date

*James Hough*

James Hough  
GEO 600 Principal Investigator

*March 21, 2000*

Date

*Bernard Schutz*

Bernard Schutz  
GEO 600 Principal Investigator

*15 March 2000*

Date