

**Attachment Number B to the
Memorandum of Understanding (LIGO-M950060-A-M)
between the
Stanford Advanced Gravitational Wave Interferometry Group
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
August 15, 2003**

This Attachment to the Memorandum of Understanding LIGO-M950060-A-M covers the role of the Stanford Advanced Gravitational Wave Interferometry Group (Stanford Group) 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, 2003 to February 15, 2004. 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 Stanford Group and the LIGO Laboratory concerning the activities of the Stanford Group 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.

4. Isolation/Suspension/Thermal Noise Development Group - The Isolation/Suspension/Thermal Noise Development Group (ISTNDG) is the scientific collaboration for defining and developing 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 - The Stanford Group 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 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 Stanford Group coordinates are included in Attachment Z to the Memorandum of Understanding LIGO-M950060-A-M.

7. Intellectual Property Rights - The rights to intellectual property developed under this Attachment will be subject to the National Science Foundation Grant Policy as indicated in Section 730, Intellectual Property.
8. During the period August 15, 2003 through February 15, 2004, Professors Dan DeBra and Martin Fejer; Senior Research Associate Roger Route; Research Associates Norna Robertson, Sheila Rowan and Brian Lantz; Visiting Researcher Eric Gustafson; and Graduate Students Wensheng Hua, Corwin Hardham, and Amit Ganguli will continue work on suspensions and test mass materials and their fabrication techniques as well as active alignment, isolation and control systems for Advanced LIGO. The Stanford group will carry out:

Materials, Suspensions and Thermal Noise (S. Rowan, E. Gustafson, R. Route, M. Fejer)

- a) Investigations into the level of excess loss introduced by dielectric mirror coatings applied to fused silica and sapphire samples;
In collaboration with the University of Glasgow, MIT, Syracuse and Hobart and William Smith Colleges we will continue our studies of the Q factor of fused silica samples, of 3-inch diameter by 1-inch thick, supplied by LIGO to study, and reduce, the mechanical losses of coatings.

We will:

- i) Continue to study samples with coatings of different materials,
- ii) Carry out measurements of the elastic properties of the coating materials themselves
- iii) Investigate other sources of noise associated with the coatings, eg. thermoelastic loss

b) We will continue theoretical studies to model analytically the effects of inhomogeneous mechanical loss on the expected thermal noise from a finite sized test mass.

c) Silicate bonding studies;

We will continue evaluations of the design of silica ears for future detectors in collaboration with Glasgow and Caltech.

d) Q measurements on crystalline materials;

In collaboration with Glasgow we will continue our investigations of the Q factors of samples of sapphire cut along different axes.

e) Studies of excess loss in silica/sapphire silicate bonds;

We will continue our studies to estimate the effect of silicate bonding on the expected thermal noise of test masses with bonded attachments

Active Alignment, Isolation, Control and Suspension Design (D. DeBra, B. Lantz, N. Robertson, Graduate Students: W. Hua, C. Hardham, J. van Niekerk, C. Campbell)

f) We will control the Technology Demonstrator and use it to get isolation from ground motion.

g) We will work with the LIGO lab and Alliance Space Systems, Inc (ASI) to design the prototype isolation system for Advanced LIGO. Systems are being designed for both the BSC and HAM chambers. We expect the first system to be built will be for the LASTI BSC chamber (to be delivered ~4th quarter 2004).

h) We will carry out further development of the design of suspension systems for controls prototypes at LASTI and for Advanced LIGO in general. This work will include the controls prototype quad ETM design and the beamsplitter design. For the latter the aim is to finish the analysis to allow a decision to be reached on the use of a triple or a quad suspension, and to establish the overall footprint.

- We will finish updating the Advanced LIGO Suspension System Conceptual Design (T010103) and submit to DCC.

- We will contribute to updating the Cavity Optics Suspension Subsystem Design Requirements Document (T010007).

- We will carry out further work as required on general issues of integration of suspension and isolation systems.

- We will continue work on issues of eddy current damping of multi-stage suspensions with the aim of submitting a paper on this topic.

- All of the above will be carried out in collaboration with colleagues in LIGO and GEO.

9. As part of the research collaboration under this agreement the LIGO Laboratory will share, as requested and appropriate, LIGO data of relevance to the research topics in Item No. 8.
10. The research effort pursuant to this Attachment B will be coordinated by Roger Route and David Shoemaker on behalf of the Stanford Advanced Gravitational Wave Interferometry Group and the LIGO Laboratory, respectively.
11. Resource Sharing:

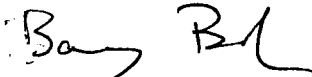
LIGO Laboratory will:

- a) 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.
- b) Provide accommodations for the Stanford Advanced Gravitational Wave Interferometry Group investigators while on LIGO research assignment at Caltech, and/or LIGO sites.
- c) Exchange its fused silica and sapphire samples with the Stanford Advanced Gravitational Wave Interferometry Group.

Stanford Advanced Gravitational Wave Interferometry Group will:

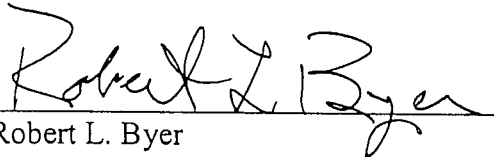
- a) Exchange its sapphire samples with the LIGO Laboratory.
- b) Provide facilities for the LIGO/Caltech personnel while on training in the silicate bonding technique.

Approved:



Barry Barish
LIGO Laboratory Director
12-29-03

Date



Robert L. Byer
Principal Investigator
12/8/03

Date