

**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, 2002**

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, 2002 to February 15, 2003**. 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 below.

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 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 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, 2002 through February 15, 2003**, Professors Dan DeBra, and Martin Fejer; Senior Research Associate Roger Route; Research Associates Sheila Rowan and Brian Lantz; Visiting Researcher Eric Gustafson, Graduate Students Wensheng Hua, Corwin Hardham, Jeremy Faludi, and Amit Ganguli; and Undergraduate Student Graham Allen 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, and
- ii) Embark on studies of the loss factor of coated sapphire samples.

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) We will carry out bonding of ears to the Suprasil SV beamsplitter for GEO 600.

e) 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.

f) 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 and Control (D. DeBra, B. Lantz, Grad Students: W-s Hua, C. Hardham, A. Ganguli, J. Faludi)

g) Collection of data from the Rapid Prototype; and

We will finish collected data from the Rapid Prototype and move the high quality displacement sensors back to the Technology Demonstrator.

h) Measurement of the transfer function of the Technology Demonstrator.

We will measure transfer functions of the Technology Demonstrator so as to establish certain critical aspects of its performance. In particular, we mean to qualify its low frequency tilt-horizontal coupling, and the frequency and level of collocation of the bending modes of the tables.

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 above.

10. The research effort pursuant to this Attachment B will be coordinated by Roger Route and Gary Sanders on behalf of Stanford 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 Stanford Group investigators while on LIGO research

assignment at Caltech, and/or LIGO sites.

c) Exchange its fused silica and sapphire samples with the Stanford Group.

Stanford 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:

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Barry Barish  
LIGO Laboratory Director

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Date

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Robert L. Byer  
Principal Investigator

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Date