

**Attachment Number B to the
Memorandum of Understanding (LIGO-M950037-00-M)
between the
University of Colorado
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
February 15, 2000**

This Attachment to the Memorandum of Understanding LIGO-M950037-00-M covers the role of the University of Colorado 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 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 University of Colorado and the LIGO Laboratory concerning the activities of the University of Colorado 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 - University of Colorado 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 University of Colorado members are included in the Attachment Z to the Memorandum of Understanding LIGO-M950037-00-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. The JILA Gravity Group (JILAGG) consists of James Faller (Division Chief, NIST Quantum Physics Division at JILA, NIST Senior Scientist), John Hall (JILA Fellow, NIST Senior Scientist), Peter Bender (JILA Fellow), Robin Stebbins (Senior Research Associate at JILA), and Giles Hammond (Research Associate at JILA). The JILAGG is currently carrying out NSF-funded active seismic isolation research with possible future applications to LIGO.

During the period February 15, 2000 to August 15, 2000, the entire JILAGG will continue research on advanced isolation/suspension systems in cooperation with the Isolation/Suspension/Thermal Noise Development Group (ISTNDG). During this period JILAGG will:

- a) Collaborate with other members of the ISTNDG to develop a reference design for a LIGO II SEI system based on a stiff suspension and active isolation. This includes developing the conceptual design and analyzing the design studies to determine the expected performance.
- b) Testing a two-stage active prototype with researchers from MIT, LSU, and Stanford. The prototype is intended to demonstrate the robustness and low frequency isolation performance appropriate for LIGO II. The prototype will be installed in a vacuum tank at MIT and extensively tested for isolation performance, robustness and control strategies such as sensor blending, feed-forward and multi-input, multi-output (MIMO) topologies.
- c) Continue work on JILA's low-frequency active isolation platform, a technology demonstrator for active seismic isolation. This is a 3-stage platform designed to isolate a 60 kg payload from ground vibration by approximately 40 dB per stage. During this period a digital control-

ler for implementing a MIMO control system will be designed and purchased.

d) Continue work on monolithic fused silica suspensions. The machining of fused silica ribbons will be continued. This approach will be explored to manufacture 0.1 mm thick by 5 mm wide ribbons in order to produce geometrically precise flexures for the final suspensions in LIGO II. JILAGG's collaboration with GEO researchers at the University of Glasgow on the manufacture of fibers by pulling their assembly into pendulum suspensions and the testing of monolithic suspensions will continue

e) Continue work on phase modulators. J. Hall is working on a test model using iodine molecules to correct the spatial noise that phase modulators introduce on lasers. A control scheme to improve the FM purity will be investigated. This is important for reducing technical noise at the LIGO dark port.

f) Collaborate with the Development Group on planning and study leading to a construction plan for LIGO II suspensions.

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 B will be coordinated by Robin Stebbins and Syd Meshkov on behalf of University of Colorado 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 JILAGG investigators while on LIGO research assignment at Caltech, and/or LIGO sites.

Approved:

Barry Barish
Barry Barish
LIGO Laboratory Director

Robin Stebbins
Robin Stebbins
JILAGG Principal Investigator

4-19-00
Date

9 Jun. 00
Date