

**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**  
**August 15, 1999**

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 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 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), Peter Bender (JILA Fellow), John Hall (JILA Fellow, NIST Senior Scientist), Robin Stebbins (Senior Research Associate at JILA), Giles Hammond (Research Associate at JILA) and Matthew Taubman (Postdoctoral Fellow). JILA is a joint institute of the University of Colorado at Boulder and of the National Institute of Standards and Technology (NIST). The JILAGG is currently carrying out NSF-funded active seismic isolation research with possible future applications to LIGO.

During the period August 15, 1999 to February 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 defining a conceptual design and analyzing the design studies to determine the expected performance.
- b) Design and build 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 for testing.
- 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. Performance of some of the compo-

nents will be re-evaluated.

d) Continue work on monolithic fused silica suspensions. Direct machining of fused silica ribbons will be attempted. This approach will be explored to manufacture 0.1 mm thick by 5 mm wide ribbons in order to produce flexures for the final suspensions in LIGO II. The 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 and M. Taubman are working on a test model using iodine molecules to correct the spatial noise that phase modulators introduce on lasers. They will be investigating a control scheme to improve the FM purity. This is important for reducing technical noise at the LIGO dark port.

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

9. During the period August 15, 1999 to February 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

4-19-00

Date

Robin Stebbins

Robin Stebbins  
JILAGG Principal Investigator

17 MAR. 2000

Date