

**Attachment Number 1 to the**  
**Memorandum of Understanding (LIGO-M950037-0-M)**  
**between the**  
**University of Colorado**  
**and the**  
**Laser Interferometer Gravitational Wave Observatory (LIGO) Project**  
**August 1, 1995**

This Attachment to the Memorandum of Understanding LIGO-L950037-0-M describes the activities of the Low Frequency Isolation(LFI) Project of the University of Colorado in developing a prototype two-stage vibration isolation system. The period of performance for the activities in this Attachment is from August 1, 1995 - July 31, 1996. This period may be modified by agreement to a revision of this Attachment.

During the last three years, the University of Colorado has been working toward development of a prototype two-stage vibration isolation system capable of achieving a factor  $10^4$  isolation in all 6 degrees of freedom over the frequency band from 1 Hz to 100 Hz. The internal noise level for the last stage is expected to  $[1 \times 10^{-13} \times (1 \text{ Hz}/f)^{2.5} + 3 \times 10^{-15}] \text{ m}/(\text{Hz})^{1/2}$ . This work has been done under support from the NSF and under an earlier Memorandum of Understanding with the LIGO Project. In order to permit testing of the two-stage isolation system at the University of Colorado, a preliminary 6 degree of freedom isolation system has been constructed as part of this program, and its performance has been demonstrated.

It is now planned that the construction and testing of the prototype two-stage isolation system will be completed by September, 1996. Any necessary refinements of the system will then be made, and the system will be used as a quiet platform for direct thermal noise measurements in pendulums at frequencies roughly 2 or 3 times the resonance frequency. Starting in July, 1997, the information obtained from the construction and testing of the two-stage isolation system will be used to provide a conceptual design for a low-frequency active isolation system which could be used in an advanced LIGO detector. This task will make use of information from the LIGO Project on the design of the end stations and on design constraints due to the requirements of the overall LIGO detector development program. It is expected to be completed in July, 1998

It is recognized that the LIGO Project cannot commit itself at this time to participation in a future program to use active isolation in an advanced detector which emphasizes low frequency measurements. However, collaboration between the Low Frequency Isolation (LFI) Project and the LIGO Project in all of the areas described above is necessary in order to make the results as useful as possible to the LIGO Project and to achieve as rapid progress as possible by the LFI Project. To achieve these objectives, the LIGO Project and the LFI Project approve the following agreement:

1. The LFI Project will provide design information on the mechanical system for the two-stage active vibration isolation system and preliminary design information on its electronic control system, its motion sensors, and their interferometric readout systems to the LIGO Project. It also will provide information on the preliminary design for the off-resonance measurements of pendulum thermal noise. The LFI will utilize suggestions from the LIGO Project in the final design of the overall isolation system, in the testing of the system, and in the use of the system for pendulum thermal noise measurements. During the conceptual design for an active isolation system for possible use in a future advanced LIGO detector system, the LFI Project will rely heavily on information and suggestions from the LIGO Project concerning the design of the system.
2. The LIGO Project will provide information and advice to the LFI Project concerning various aspects of the active isolation and off-resonance pendulum thermal noise measurement program. In addition, the LIGO Project will supply information, subject to available resources, on the design of the LIGO end stations and on design constraints due to the requirements of the overall LIGO detector development program. This information will be used by the LFI Project in the conceptual design of a low-frequency active isolation system for possible future use in advanced LIGO detectors.
3. In order to achieve a necessary level of interaction between the two projects, annual joint meetings of the LFI Project and the LIGO Project will be held, either in conjunction with other LIGO meetings or separately.

Approved:

Barry Barish  
 Barry Barish  
 LIGO Principal Investigator

James B. Faller  
 James B. Faller  
 LFI Principal Investigator

Aug 2, 1995  
 Date

Oct 6, 1995  
 Date