

**Attachment Number B to the
Memorandum of Understanding (LIGO-M970084-00-M)
between the
Moscow State University Relativity Group (MSURG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
February 15, 1999**

This Attachment to the Memorandum of Understanding LIGO-M970084-00-M covers the role of the Moscow State University Relativity Group (MSURG) 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, 1999 to August 15, 1999. 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 Moscow State University Relativity Group (MSURG) and the LIGO Laboratory concerning the activities of MSURG as a Collaborating Institution in the LIGO Scientific Collaboration (LSC) and in the Isolation/Suspension/Thermal Noise Development Group (ISTNDG), and as noted 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 ini-

tial 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 - MSURG 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. Report distribution should be to the Collaboration Council and to the LIGO Laboratory Director.
6. Term of Membership - The Membership will be renewed every six months upon evidence of satisfactory performance of agreed upon duties.

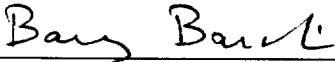
The coordinates of MSURG members are included in the Attachment Z to the Memorandum of Understanding LIGO-M970084-00-M.

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 Moscow State University Relativity Group (MSURG) has the following goals for making contributions to the enhanced and advanced stages of LIGO and will pursue these during the period February 15, 1999 to August 15, 1999:
 - a) To find and develop new technologies to suppress excess thermal noise in the suspension by increasing the quality factors of important modes of the suspension (in particular to obtain $Q_{\text{pendulum}} > 3 \times 10^8$).
 - b.) To develop apparatus and techniques for reducing recoil losses in suspension Q measurements, and use to test high Q suspensions.
 - c.) To detect and to analyze the sources of excess noise (noise of nonthermal origin) in the suspension.
 - d.) MSURG expects to get a set of numbers for the excess noise in the violin modes and to get the first numbers for Q_{pend} in a new version of an all fused silica suspension.
 - e.) To investigate the noise produced by the electrostatic actuators (additional mechanical losses produced by the electric field applied on the mirrors and the random forces produced by the electric field of the actuator and random electric charges on the mirror's surface).

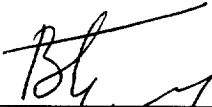
- f.) To propose and to analyze alternative designs of the readout system aiming to reduce pump power and to beat the Standard Quantum Limit (SQL).
9. During the period February 15, 1999 to August 15, 1999, the LIGO Laboratory will share, as requested and appropriate, the LIGO data of relevance to the research topics in Item No. 8 above.
10. The research effort pursuant to this Attachment B will be coordinated by V. Braginsky and Syd Meshkov on behalf of MSURG and 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.

Funding contribution for MSURG's effort in support of LIGO is provided under a subcontract between the Caltech and US Civilian Research and Development Foundation (USRDF). The funding authority is the Cooperative Agreement between the National Science Foundation (NSF) and Caltech No. PHY-9800097.

Approved:



Barry Barish
LIGO Laboratory Director



Vladimir Braginsky
MSURG Principal Investigator

July 14, 1999

Date

July, 14, 1999

Date