

**Attachment Number D 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**  
**August 15, 1998**

This Attachment to the Memorandum of Understanding LIGO-M970084-00-M covers the role of the Moscow State University Relativity Group (MSURG) as a member of the LIGO Scientific Collaboration (LSC) and as a member of the Advanced Detector Configurations Development Group (ADCDG). The period of performance for the activities in this Attachment is from August 15, 1998 to February 15, 1999. This period may be modified by agreement to a revision of this Attachment.

1. LIGO Scientific Collaboration - The LIGO Scientific Collaboration (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 semi-annual 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 and approved, as appropriate, through the Collaboration Council. 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 Advanced Detector Configurations Development Group (ADCDG), and as noted in Item No. 8 below.
4. Advanced Detector Configurations Development Group - The Advanced Detector Configurations Development Group (ADCDG) is the scientific collaboration for defining and developing entirely new advanced interferometers. It is expected that this development group will

pursue research in dual recycling, resonant sideband extraction, Sagnac interferometers, systems with non-transmitting optics and other advanced configurations. 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 (Attachment Z), 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 commitments in Item No. 8 below.

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

7. In order to preserve the intellectual property rights of MSURG and Caltech, the MSURG Principal Investigator will inform Caltech at once of any inventions coming from joint actions which might lead to intellectual property rights.
8. During the period August 15, 1998 to February 15, 1999, Vladimir Braginsky, Mikhail Gorodetsky and Farid Khalili will continue work on development of readout systems for advance detectors. Possible methods for quantum measurement, which will allow crossing of the standard quantum limit of detector sensitivity, will be investigated. The research will be performed in collaboration with Kip Thorne of Caltech and his associates.
9. During the period August 15, 1998 to February 15, 1999, the LIGO Laboratory will share as requested and appropriate the LIGO data of relevance to the research focus in Item No. 8 above.
10. The research effort pursuant to this Attachment D 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.
  - a) Provide accommodations for investigators in Item No. 8 above while on research assignment on LIGO at Caltech.

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

Approved:

*Barry Barish*

Barry Barish  
LIGO Laboratory Director

*8/9/99*

Date

*Vladimir Braginsky*

Vladimir Braginsky  
MSURG Principal Investigator

*20/9/99*

Date