

**Attachment Number A to the
Memorandum of Understanding (LIGO-M970063-00-M)
between the
Northwestern University Theoretical Relativity Group (NUTRG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
February 15, 1998**

This Attachment to the Memorandum of Understanding LIGO-L970063-00-M covers the role of NUTRG as a Charter Member of the LIGO Scientific Collaboration (LSC) and a member of the LIGO I Development Group (L1DG). The period of performance for the activities in this Attachment is from February 15, 1998 to August 15, 1998. This period may be modified by agreement to a revision of this Attachment.

1. LIGO Scientific Collaboration - The LIGO Scientific Collaboration will be organized as a separate organization from the LIGO Laboratory. It will include scientists from the LIGO Laboratory, and those from collaborating institutions, and will have 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 will commence on March 1, 1997 and will end following the first full meeting of the Collaboration at which the Collaboration Council will assume its role. We expect that this transition will occur within six months. Membership in the Collaboration during this charter period will be initiated by proposal to the LIGO Laboratory Directorate.

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 Northwestern University Theoretical Relativity Group (NUTRG) and the LIGO Laboratory concerning the activities noted below, under provision 8, of NUTRG as a Collaborating Institution in the LIGO Scientific Collaboration (LSC) and in the LIGO I Development Group (L1DG).

4. LIGO I Development Group - The LIGO I Development Group will be the scientific collaboration for implementing and exploiting the initial LIGO detector and physics through the initial science data run. Only groups who establish a specific Attachment approved by the LIGO Laboratory, which defines a sufficient contribution and participation in LIGO I development, implementation or data analysis will be part of this initial LIGO data run and science. Participation in future data runs and science that follow LIGO I will be possible for other groups, with guidelines to be determined by the LIGO Scientific Collaboration. It is anticipated that LIGO I data will only be made available through formal collaboration within the LIGO I Development Group during the first two years following its collection.

The general guideline for institutional membership in the LIGO I Development Group is that the contribution per collaborator of any new group to the design, construction, and implementation of the initial LIGO detector and to the first data run be comparable to that of the LIGO Laboratory scientists.

5. Report of Progress - NUTRG will provide a summary report of progress, monthly, by e-mail to the Collaboration Council and to the LIGO Laboratory Director. NUTRG will submit a complete report on its activities every six months, supply an updated List of Collaborators, and a plan of activities for the next six months. This report should be submitted one month before the updated attachment will take effect.
6. Term of Membership - Membership will be renewed every six months upon evidence of satisfactory performance of agreed upon duties.
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. During the period February 15, 1998 - August 15, 1998, NUTRG will consist of three post-docs, Soumya Mohanty, Soma Mukherjee, and Joseph Romano, and one faculty member, Prof. Sam Finn, for a total of four personnel.

Proposed Work Statement:

a.) LIGO End-To-End Modeling: Mohanty and Finn will continue to participate in the LIGO end-to-end modeling effort led by H. Yamamoto, with particular responsibility for modeling and implementing the SEI/SUS modules. Particular targets depend on the evolving priorities of the E2E group.

b.) Data Diagnostics: Mukherjee and Finn will participate in LIGO on-line/quick-look data diagnostics development effort, currently led by Mark Coles. The NU Theoretical Relativity Group has particular responsibility for developing graphical monitors and tools for studying the evolving amplitude, phase and frequency of spectral line features (e.g., power line features and violin mode resonances) in the data stream as well as graphical monitors and tools for studying the data stream using time-frequency methods (e.g., short time Fourier transforms or wavelets). Simultaneously, the NU Relativity Group will investigate statistical

tools for characterizing detector non-Gaussian and non-Stationary noise.

c.) Stochastic Signal Detection Algorithms: Romano and Finn will continue to investigate the differences between cross-correlation and maximum likelihood statistical methods for detecting a stochastic gravitational-wave signal using multiple gravitational-wave detectors. During the six month period covered by this MOU they will determine the relative power of the cross-correlation and maximum likelihood tests by determining false-dismissal vs. false-alarm rates for different strength stochastic signals.

d.) Multi-detector receiver data analysis: Finn will complete and submit for publication his work on multi-detector receiver data analysis for deterministic sources.

e.) LIGO Data Analysis and Data Diagnostics System Planning: Finn will continue to participate in the design and planning of the LIGO Data Analysis System; in addition, Finn will participate in the design of data diagnostics for use both at the 40m and in LIGO 1.

Approved:

Barry Barish
Barry Barish
LIGO Laboratory Director

Lee Samuel Finn
Lee Samuel Finn
NUTRG Principal Investigator

March 12, 1998
Date

3/13/98
Date