

**Attachment Number A to the  
Memorandum of Understanding (LIGO-M950061-00-M)  
between the  
University of Wisconsin - Milwaukee Relativity Group (UWMRG)  
and the  
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory  
August 15, 1997**

This Attachment to the Memorandum of Understanding LIGO-L950061-00-M covers the role of UWMRG 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 August 15, 1997 to February 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 University of Wisconsin - Milwaukee Relativity Group (UWMRG) and the LIGO Laboratory concerning the activities noted below, under provision 8, of UWMRG 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 - UWMRG will provide a summary report of progress, monthly, by e-mail to the Collaboration Council and to the LIGO Laboratory Director. UWMRG 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 August 15, 1997 - February 15, 1998, the members of the UWMRG who will work in the LIGO I Development Group are: Bruce Allen, Joe Romano (postdoc at Milwaukee, working until Sept 1.), R. Balasubramanian (postdoc at Milwaukee, starting work Sept 1.), and Adrian Ottewill (Mathematical Physics Professor, University College, Dublin, Ireland).

The work of the group will be in the area of data analysis code and algorithms. It will develop and implement techniques to use in searching for binary inspiral events and for stochastic background sources. It will also develop and implement vetoing techniques that can distinguish non-Gaussian detector noise events from known types of signals, and will categorize these non-Gaussian events. The work plan for the next six months is:

- a. Perform benchmarking studies for LIGO data. This will be done by porting/optimizing the GRASP multifilter code to different parallel platforms, and running it on real data, then extrapolating the performance to the initial LIGO parameters.
- b. Maintaining and distributing the GRASP package, and the November 94 40 meter data set. This includes maintaining compatibility with the FRAME format libraries, and cooperating

with other groups and researchers to enlarge the capabilities of GRASP.

c. Study the placement of templates in parameter space by injecting simulated chirp signals, to see if the theoretically-determined template patterns still work properly with actual IFO data. If this work is successful it should lead to a publication setting upper limits on binary-inspiral event rates during 45 hours of November 1994 data.

d. Study the effects of quantization errors/quantization noise to determine if the number of bits and sampling rates being used by LIGO place intrinsic limits on the sensitivity of searches.

e. Participate in the ongoing efforts to take/analyze 40-meter data, develop/implement the frame format using this experience, and continue the development of real-time diagnostic tools for use in the 40 meter lab.

f. Continue to develop the stochastic-background detection code so that we can achieve the theoretically expected SNR on real IFO data.

g. Assist in the development of the software calibration loop (to replace the existing HP analyzer calibration technique in the 40-meter lab).

h. Begin a study of wavelet techniques that might be applied to binary inspiral analysis. Gilbert Walter ( Mathematics Professor at UW- Milwaukee) is an expert on these techniques and will be assisting the UWMRG.

i. Seek NSF funding for hiring a second full-time postdoc and computer equipment monies to help in carrying out data analysis work, and to work on LIGO data analysis full-time during half of each academic year.

j. Assist in writing and implementing a proposal to do science data runs on the 40 meter prototype.

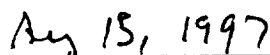
k. Assist in the formulation and drafting of standards for the LIGO Data Analysis System.

l. Assist in the writing of a white paper and proposal on the LIGO Data Analysis System.

Approved:



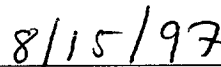
Barry Barish  
LIGO Laboratory Director



Date



Bruce Allen  
UWMRG Principal Investigator



Date