# Attachment Number A to the

# Memorandum of Understanding (LIGO-M960071-00-M)

# between the

# University of Florida Laser Interferometric Gravitational Wave Group (UFLIGO)

# and the

# Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory

# August 15, 2003

This Attachment to the Memorandum of Understanding LIGO-M960071-00-M covers the role of the University of Florida Laser Interferometric Gravitational Wave Group (UFLIGO) 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, 2003 to February 15, 2004. 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 University of Florida Laser Interferometric Gravitational Wave Group (UFLIGO) and the LIGO Laboratory concerning the activities of UFLIGO as a Collaborating Institution in the LIGO Scientific Collaboration (LSC) and in the LIGO I Development Group (L1DG), and as indicated in Items No. 8, 9 and 10.

4. LIGO I Development Group - The LIGO I Development Group is 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 - UFLIGO 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 Nos. 8, 9 and 10, 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.

6. Term of Membership - The Membership will be renewed every six months upon evidence of satisfactory performance of agreed upon duties.

   The coordinates of UFLIGO members are included in the Attachment Z to the Memorandum of Understanding LIGO-M960071-00-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. LAL Software Conventions - It is necessary that any delivered code conforms to the LAL style as laid out in the LAL specification T990030. This includes: 1) coding style, headers, etc.; 2) use of function calls, etc.; 3) organization of software in the directory structures indicated in the document; 4) inclusion of test codes and validation tests to enable users to verify successful installation of implementation; and 5) documentation and users manuals (html or pdf) to enable users to understand and adopt code.

9. LSC Service Functions - Participation in LIGO I brings with it responsibility for service functions to support the overall effort in achieving high detector sensitivity and high data quality. In particular, each LIGO I group is expected to assist in the staffing of scientific monitoring shifts during organized data runs (8hr shifts are assumed). The staffing of these shifts is notable for both its importance and the travel burden it places on scientists. This burden makes an equitable shift allocation mechanism necessary.

A nominal guideline is that each LIGO I group should staff a fraction of the shifts comparable to its FTE fraction devoted to LIGO I activities. The current count of FTE in the Collaboration is XX (not including GEO FTE). The (name of group) has ZZ FTE's associated with LIGO I and is expected to staff x.x% of the scientific monitoring shifts during this MOU period.

Each LIGO I group will assign a representative who will be responsible for interaction with the designated LSC Shift Organizer (currently Keith Riles of Michigan Univ.) with respect to the group's Service Function commitments.

Groups making extensive contributions to the LSC in other service efforts that involve a substantial travel burden may request a reduction in their nominal share of shift staffing. Those efforts can include:

1) Commissioning and instrument improvement

2) Participation in on-site detector characterization investigations

3) Development/operation of analysis software/hardware infrastructure and validation of analysis software that requires travel away from the home institution.

10. During the period August 15, 2003 to **February 15, 2004**, UFLIGO will perform as follows:

On-site Observatory Support

a) Contribution in support of the commissioning effort at the two LIGO sites will continue. Two UF scientists, Rupal Amin and Ken Franzen, are based at the LIGO Livingston Observatory and are primarily responsible for this activity. In addition, UFLIGO will continue to support LIGO Engineering and Science runs through staffing during shifts.

b) UFLIGO will develop an auto-alignment system for the LLO interferometer including the modecleaner.

c) UFLIGO will develop new wide aperture Faraday isolators for retro-fitting into the three LIGO interferometers.

d) UFLIGO will continue in the commissioning of the wavefront sensors for the LIGO Livingston interferometer.

Detector Characterization

e) UFLIGO will complete the analysis of violin modes in S2 data to infer thermal noise levels in the LIGO interferometers.

f) UFLIGO will continue characterization of interferometer arm cavities, specifically i) measure the Fabry-Perot arm cavity lengths in all interferometers with a precision of 80

micros, and ii) measure the arm cavity g-factors and infer the mirror radii of curvature of the input and end test masses for the LIGO interferometers

g) UFLIGO will continue to use the e2e code to understand asymmetries in the ETM coatings on the LLO detectors.

LIGO I Data Analysis

h) UFLIGO will continue its effort in the burst analysis: Produce preliminary results for the burst analysis of the S2 data using the WaveMon algorithm. The includes i) production of the burst triggers, ii) simulation study of sine-gaussian injections, iii) determination of the pipeline detection efficiency for black hole mergers, iv) processing of the burst triggers, determination of the background and setting upper limit on rates, and v) preliminary result on BH-BH rates.

i) UFLIGO will participate in the inclusion of GEO 600 data in the stochastic analysis, including evaluation of overlapping windows, and filtering, for the S2 data, and preparation of results for consideration with a view to publish. Participate in making available calibration data for pre-S2 stochastic signal injections for confirmation of our analysis procedures. Participate in evaluation of extensive Monte Carlo simulations (previously not possible with our DSO) of stochastic signals within our data analysis pipeline.

j) UFLIGO will continue support of the wavelet tool for LIGO LDAS.

k) UFLIGO will continue support and operation of the LineMonitor and WaveMon DMTs.

LSC Service Functions

l) The UFLIGO team agrees to **staff 4.9%** of the science monitoring shifts in support of the engineering and scientific running of LIGO detectors.

David Reitze will be responsible for the coordination with the designated LSC Shift Organizer with respect to the UFLIGO's Service Function commitments.

11. During the period August 15, 2003 to February 15, 2004, the LIGO Laboratory will share, as requested and appropriate, LIGO data of relevance to the research focus in Item No. 10 above.

12. The research effort pursuant to this Attachment A will be coordinated by G. Mitselmakher, Albert Lazzarini and Keith Riles on behalf of UFLIGO, LIGO Laboratory and LSC, respectively.

13. 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. 10, as indicated below.

a) LIGO research effort at the University of Florida is supported in part with the LIGO Laboratory funds under the Caltech Purchase Order for IO operations.

b) Provide accommodations for UFLIGO investigators while on LIGO research assignment at Caltech, and/or LIGO sites.

Approved

Barry Barish
LIGO Laboratory Director
11-Jan-04
Date

Guenakh Mitselmakher
UFLIGO Principal Investigator
2/8/2004
Date

Albert Lazzarini
LIGO Laboratory Data and
Computing Leader
18 Dec 2003
Date

Keith Riles
LSC Shift Organizer
Date 12-29-03