Attachment Number A to the Memorandum of Understanding (LIGO-M020265-00-M) between the Balearic Islands University Relativity Group (UIBRG) and the Laser Interferometer Gravitational-Wave Observatory (LIGO) Laboratory February 15, 2003

This Attachment A to the Memorandum of Understanding LIGO-M020265-00-M covers the role of the Balearic Islands University Relativity Group (UIBRG) as a 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, 2003 to August 15, 2003. 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 Balearic Islands University Relativity Group (UIBRG) and the LIGO Laboratory concerning the activities of UIBRG 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 and No. 9.

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 – UIBRG 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. 9 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 UIBRG members are included in the Attachment Z to the Memorandum of Understanding LIGO-M03tbd-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. During the period February 15, 2003 to August 15, 2003, the agreed upon research plan and commitments for UIBRG will be as follows:

   a) Detector Characterization:

   Sintes will continue leading the GEO detector characterization efforts and serve as liaison between GEO and LIGO/LSC on detector characterization matters.

Sintes will follow the development of automated tools for data/detector characterization analysis. She is particularly interested in the problem of monitoring lines that can degrade searches for astrophysical sources. She will continue the analysis of S1 and S2 data.

b) Periodic Sources Upper Limit Group:

Sintes is a member of the PSUL group, and, therefore, will participate in that group's activities on analyzing LIGO and GEO data. She will also represent the group at the Recontres de Moriond.

Sintes will be focused on the development of the *Hough Hierarchical Pulsar Algorithm.* She has already coded all the main routines necessary to generate Hough transform maps from non-demodulated SFT data and demodulated data (DeFT, output of the F-statistics). Documentation needs to be updated in the LAL `houghpulsar` package.

Together with the AEI group, we plan to revise the existing 'driver-code' by B. Allen and M.A. Papa and set up new codes for both Hough flavors. We need to study and understand the statistics of the Hough maps before designing a production code. For that, we plan to use 'test' codes and perform many simulations. The different cases we need to study are: only signal, only Gaussian noise, and noise plus signal. Since the parameter space is so large, we need to understand which are the relevant ones (the sky location, integration time-scales, initial SNR, etc). Some issues need to be addressed as well, i.e., how are the peaks being selected in the first step and how this choice affects the statistics of the Hough map. We also need to characterize the code performance for different kinds of parameters.

As soon as the Hough statistics are understood, we will be in a position to perform first analysis using LIGO-GEO data. Big or full sky-area searches could be done using the non-demodulated version of the Hough, while small area (almost target) searches using demodulated data.

Our goal is to use these codes for the analysis of S2 data, in particular, using non-demodulated SFT data. We also need to learn which data conditioning will be required, and if the Hough transform is robust to the presence of line noise.

I do not expect to have a production code (using demodulated data) ready in the next 6 months, since many other questions need to be addressed, e.g., grid in parameter space for the coherent step, in particular, understand the sky patch size, and design how to move from one to another.

c) Astrophysical Source Identification and Signatures (ASIS) working group:

UIBRG group is also interested in the problem of detection and parameter estimation of gravitational waves from compact binary systems.

d) Grid computing:

Sintes plans to learn about and get involved in grid computing with LIGO data.

10. During the period February 15, 2003 to August 15, 2003, the LIGO Laboratory will provide, as requested and necessary, LIGO data of relevance to the research topics in Item No. 9.

11. The research effort pursuant to this Attachment A will be coordinated by Alicia M. Sintes Olives and Albert Lazzarini on behalf of UIBRG and the LIGO Laboratory, respectively.

12. 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. 9, as indicated below.

    a) Accommodations for UIBRG investigators while on LIGO research assignment at Caltech, and /or LIGO sites.

    b) Provide funding for visits at Caltech, and/or LIGO sites, as agreed on a case-by-case basis.

Approved:

Barry Barish
LIGO Laboratory Director

26 Nov 03
Date

Alicia M. Sintes Olives
Principal Investigator
Relativity Group
Balearic Islands University

15 Dec 03
Date

Albert Lazzarini
LIGO Laboratory Data and
Computing Group Leader

15 Nov 2003
Date