Attachment DAT to the Memorandum of Understanding LIGO-M950059-00 between the Experimental Relativity Group of the Louisiana State University (LSUERG) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment DAT to the Memorandum of Understanding LIGO-M950059-00 defines the role of the Experimental Relativity Group of the Louisiana State University (LSUERG) as a Member of the LIGO Scientific Collaboration (LSC). In particular, it addresses data analysis activitites in support of the initial LIGO interferometers. The period of performance for the activities in this Attachment is from August 15, 2008 - August 14, 2009.

1. Collaboration

Together, the LIGO Laboratory and the LIGO Scientific Collaboration (LSC) are responsible for implementing and exploiting the initial LIGO detector through its science data runs. The LSC has organized the data analysis effort into search groups which coordinate analysis, review, and publication on behalf of the collaboration. LSC groups are encouraged to participate in one or more of these groups.
MOU Attachment DAT defines the contributions of each participating group to the data analysis development groups.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of LSUERG will participate in the analysis of initial LIGO data in the following areas:

a. Binary Inspirals

LSC-LSU members active in the CBC group in July 08-July 09: Jacob Slutsky, Jeff Kissel, Sarah Caudill (graduate students) Romain Gouaty (postdoc, until September 19, 2008) Gabriela Gonzalez, Jorge Pullin (faculty), Lisa Giaime, Sam White, Josh Abadie (scientist/engineer).

- CBC Veto Investigations:
  Jacob Slutsky and Gabriela Gonzalez will work on refining veto definitions for the S5 analysis using data quality flags defined by the Detector Characterization Group. They will work in collaboration with other members of the CBC

group on the use of data quality flags for S6, and on automating tools for evaluating their performance. Jacob Slutsky will continue leading the team creating vetoes for the groups searches.

- Follow up of CBC candidates:
  Sarah Caudill, Romain Gouaty, and Gabriela Gonzalez will conclude the follow up of the S5 candidates resulting from the group searches. In collaboration with Cristina Torres and other members of the CBC group they will also work on the automation of the follow up tools and the interpretation of the results preparing for S6 weekly review of searches. Romain Gouaty and Sarah Caudill will co-lead the efforts for the follow up team.
- High Mass CBC searches:
  Sarah Caudill and Romain Gouaty will collaborate with the rest of the CBC group in the search for high mass binary black hole systems; they each will be responsible for analyzing a month of S5 data. Romain and Sarah, in collaboration with Chad Hanna at CIT, and Jorge Pullin, Lisa Giaime, Josh Abadie and Sam White (from the LSU Center for Computation and Technology), will prototype implementation of high mass searches done over the grid, using data stored at CIT and computer clusters at LSU.
- Low mass CBC searches:
  Romain Gouaty will analyze a month of LIGO-Virgo S5 joint run in the search for low mass systems.
- S6 online searches:
  Jeff Kissel and Gabriela Gonzalez will work on the monitoring the output of the online analysis of S6 data, and specifically develop tools to monitor changes in the detector performance that are not flagged by automatic data quality monitors.
- Background estimates in CBC searches:
  Sarah Caudill and Gabriela Gonzalez will work on ways to estimate the background of the CBC searches resulting for coincident candidates, starting from the background for the candidates for each detector. They will also study the effect of artifacts producing single detector loud triggers for a limited amount of a time on the estimate of the background produced using a finite number of time slides. If successful, this work may help to estimate the background at the high significance tail of the distribution, where good candidates are expected to appear, and where time slide estimates are weaker.

b. Bursts

- Scimon injection monitor:
  Myungkee Sung, with help from Warren Johnson, will maintain the near real time burst injection monitor. This monitor produces web pages, with about 1/2-1 hour latency, that show the results of the optimal filter analysis of every burst injection. The new version will use on-line generated “h(t)” He will look for a partner at VIRGO to implement an equivalent system there.
- Real-time Optimal Filter diagnostic tool:
  Myungkee Sung and Warren Johnson will port the Optimal Filter analysis engine to the Livingston GC system for commissioning and scimon diagnostics. A recently written data streaming tool should allow easy interfacing between the data and the program, so the main work should be a good graphical representation of the results. Our first efforts will be real-time strip-charts of the rate

and strength of burst-like events. The target latency, or delay, is 30 seconds, which we suspect is reasonable. We plan to use this tool ourselves as an alert for single-detector "noise storms" and then use the immediacy of that alert to narrow down the number of possible causes. If it proves useful, we will port it to Hanford and offer to port it to VIRGO.
Once this real-time system is proven, we will then propose extending it to perpetual operation, to contribute to the real-time alarm system and the data quality system.

- Optimal Filter Pipeline:
Myungkee Sung and Warren Johnson will continue development of the Optimal Filter Pipeline as a signal detection system, incorporating VIRGO data.
Myungkee Sung and Warren Johnson will continue to contribute to the followup investigations of burst detection candidates.

c. Stochastic

Not Applicable

d. Continuous

Not Applicable

e. Other Contributions

- Luis Lehner and Joel Tohline, in collaboration with Anderson, Hirschman, Neilsen (BYU) and Liebling (LIU) will continue their work towards understanding gravitational waves from (non-vacuum) compact binary systems. We will concentrate on estimating observable differences when varying possible equations of state together with the inclusion of magnetic fields. Our goal will be to understand the relevance of these effects and the possible detection of specific signatures associated with them. Additionally, we will examine the possibility of detecting electromagnetic signals associated with these systems to provide a better understanding of coincidences that might arise between burst or inspiral sources of gravitational waves and, for example, gamma-ray bursts (GRBs).

3. 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. 2, as indicated below.

a. Research accommodations for LSUERG group members while on LIGO research assignment at any LIGO Laboratory site.

Not Applicable

b. Access to LIGO data through established LSC channels in support of this work.

LSU personnel working on data analysis will continue to request grid certificates as needed.
Lisa Giaime, working on the OSG project, will continue requiring a grid-admin certificate.

4. Coordination and Reporting

LSUERG will perform research within the structures established by the LIGO Laboratory and the LSC where appropriate.
In particular, with reference to activities described above:

2a will be carried out within the LSC Inspiral Search Group.

2b will be carried out within the LSC Burst Search Group.

2c will be carried out within the LSC Stochastic Search Group.

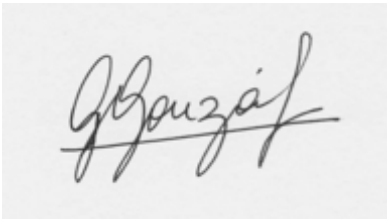
2d will be carried out within the LSC Continuous Waves search Group.

This includes keeping the Group leaders informed of activities and plans, reporting to the group at meetings and telecons, and through technical documents submitted to the LIGO Document Control Center.
In addition, an annual report will be submitted with the update to this Attachment, giving a summary status on research by topic as indicated in Item No. 2, 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.
This Attachment will be updated at least annually with a plan of activities for the succeeding one-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. Computer Code

All computer code delivered to the LSC under this Attachment must be developed in consultation with the LSC Data Analysis Software Working Group (DASWG) and archived, documented and reviewed as determined by that group.

Jay Marx
LIGO Laboratory Director



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