

**THIS GROUP DID NOT SUBMIT AN MOU IN THE NEW
TEMPLATE FORMAT. THIS WILL BE REQUESTED FROM THE
PI BEFORE THIS MOU IS SIGNED. THE ATTACHMENTS
DESCRIBING THE PROPOSED WORK TO BE DONE ARE
AVAILABLE AND ARE INCLUDED IN THIS FILE**

Attachment DAT to the
Memorandum of Understanding (LIGO- M950059-00-M)
between the
Experimental Relativity Group of the Louisiana State University (LSUERG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
August 15, 2005

This Attachment DAT to the Memorandum of Understanding LIGO-M950059-00-M defines the role of the Louisiana State University Experimental Relativity Group (LSUERG) as a Member of the LIGO Scientific Collaboration (LSC), in particular, its activities in data analysis in support of the initial LIGO interferometers. The period of performance for the activities in this Attachment is from August 15, 2005 to August 15, 2006.

1. Together, the LIGO Laboratory and the LIGO Scientific Collaboration 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 the analyses, perform detailed reviews, and prepare publications on behalf of the collaboration. LSC groups are encouraged to participate in one or more of these groups. MOU Attachments define the contributions of each participating group to the data analysis groups.
2. During the period August 15, 2005 to August 15, 2006, the members of LSUERG Group will participate in the analysis of initial LIGO data in the following areas:
 - a) Source Analysis

Jorge Pullin, Manuel Tiglio and Luis Lehner will work on the development of a three dimensional multipatch code for the evolution of the Einstein equations in situations of interest to black hole waveforms.

Joel Tohline will continue to simulate dynamically evolving astrophysical fluid systems and binary systems that are likely sources of gravitational radiation. In collaboration with Luis Lehner, he will continue the extension of the Newtonian and post-Newtonian treatment of such systems to include fully relativistic hydrodynamical models. Tohline will continue to participate as an active internal reviewer of LSC papers that focus on a search for burst sources; he will also continue to serve as a contact point at LSU for high-bandwidth network connections between LLO and Caltech. Jorge Pullin, Manuel Tiglio and Luis Lehner will continue work on various aspects of numerical relativity. Tiglio, in collaboration with Dorband, Schnetter and Diener will continue the development of a three dimensional multipatch code for the evolution of the Einstein equations in situations of interest to black hole waveforms. Lehner will continue development of an adaptive mesh code for neutron stars and fluids with Tohline and others. Pullin and Anderson will

concentrate on evolutions using unstructured meshes and finite elements.

Alexander Dietz, Ed Seidel and Gabrielle Allen will continue working on making LSU computing resources available to the LSC through grid computing technology.

b) Search Groups

Gabriela Gonzalez will continue to act as co-chair of the inspiral search group.

Chad Hanna and Andres Rodriguez will finish the S3/S4 search of primordial black holes, and work on the analysis of S5 searching for the same sources.

Andres Rodriguez will work on the implementation of the new signal-based veto in S4 and S5 searches.

Chad Hanna will continue the investigation on a new technique for future MACHO searches which will optimize the matched filtering engine by a new Hierarchical search method. This will decrease the time required to analyze large parameter space regions and reduce the amount of data written to disks and memory required (all of which are limiting our current computational power.) Additionally it may lower the false alarm rate by 1-2 orders of magnitude. The initial plan is described here

<http://www.lsc-group.phys.uwm.edu/cgi-bin/enote.pl?nb=iags4macho&action=view&page=3>

Gabriela Gonzalez and Jacob Slutsky will work on veto strategies for the various inspiral searches.

Warren Johnson and Myungkee Sung will continue to work with the LSC Burst analysis group. They have concluded that they can be most productive by emphasizing the direct application of the methods of classical signal processing to burst analysis.

They are in the middle of a program to use "optimal linear filters" for a bank of burst-like signals, as an alternative to the "ETG-plus-postprocessing" model. Their filter bank includes most of the signal waveforms used in the burst group MDCs, and more can be added at little cost. They are part way through implementing this analysis for the S3 data, but now propose to switch to the S4 data: because the noise is much lower, and because the preprocessing is much better (the S4 data have already been transformed to the physical variable, strain, thanks to the work of Xavi Siemens at UWM.). They will be regularly present intermediate results to the burst-analysis group. Their goal is to have a first version of this analysis by the spring '06 LSC meeting.

Warren Johnson, Damon Nettles, Jon Hanson, and Phillip Miller will continue to run the ALLEGRO detector in coincidence with LIGO during Science Runs, provide data quality information, and participate in the data analysis of ALLEGRO and LLO data for stochastic sources.

A burst analysis, combining the ALLEGRO data from S4 with LIGO data, will be proposed to the burst analysis group.

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

4. Coordination and Reporting – LSUERG Group will perform this research within the structures established by the LIGO Laboratory and the LSC where appropriate. In particular activities described in Item 2a) will be carried out within the LSC Inspiral Search Group, Item 2b) will be carried out within the LSC Burst Search Group, and Item 2c) will be carried out within the LSC Stochastic Search Group. Coordination will include 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 on-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. 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.

6. The research effort pursuant to this Attachment A will be coordinated by Joseph A. Giaime (LSUERG Group), Albert Lazzarini (LIGO Laboratory), Peter Shawhan (LSC Burst Search Group Leader), Patrick Brady (LSC Inspiral Search Group Leaders) and

Approved:

Barry Barish
LIGO Laboratory Director

Joseph A. Giaime
LSUERG Principal Investigator

Peter Saulson
LSC Spokesperson

Peter Shawhan
LSC Burst Search Group Leader

Albert Lazzarini
LIGO Laboratory Data and Computing
Group Leader

**Attachment OPT to the
Memorandum of Understanding (LIGO-M950059-00-M)
between the
Experimental Relativity Group of the Louisiana State University (LSUERG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
August 15, 2005**

This Attachment OPT to the Memorandum of Understanding LIGO-M950059-00-M defines the role of the Louisiana State University Experimental Relativity Group (LSUERG) as a Member of the LIGO Scientific Collaboration (LSC) and a member of the Optics Development Group (ODG). The period of performance for the activities in this Attachment is from August 15, 2005 to August 15, 2006.

1. Optics Development Group – The Optics Development Group (ODG) is the scientific collaboration for defining and developing improvements in optics for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers. MOU Attachments define the roles and responsibilities of groups in this development group.
2. During the period August 15, 2005 to August 15, 2006, the members of LSUERG Group will participate in ODG in the following areas:

a) Seismic Isolation and Suspension:

Joe Giaime and Shyang Wen will work to enhance performance of the external hydraulic actuator seismic isolation system (HEPI) at LLO, using signal paths that connect it with the main length and angle control systems to reallocate control authority. Also, enhancements that employ resonant gain at suspension resonances will be tried. Gabriela González will continue to help the LLO staff in the commissioning of the ASC (Alignment Sensing and Control) wavefront sensor and optical lever control systems.

b) Detector Characterization

Myungkee Sung will produce time-dependent calibration factors for the final version of the S4 calibration. He also intends to produce the same coefficients on-line (or within a day) during the upcoming S5 run. Gabriela Gonzalez, in collaboration with Mike Landry and Brian O'Reilly, is producing the models to generate the reference functions for the final S4 calibration. She is also working on the documentation of the S4 calibration.

Gabriela Gonzalez and Myungkee Sung will produce data quality flags associated with calibration and loop gain fluctuations for S5.

Gabriela Gonzalez and Jacob Slutsky will work on veto strategies for the various inspiral

searches, developing new detector diagnostic triggers as needed for these vetoes.

c) Engineering Run and Science Runs

González will keep lock statistics for the science runs. González will work on calibration runs of the LLO detector during S4 and S5 (there are usually three calibration runs, before the run, in the middle of the run and after the end of the run). Gabriela González and Joe Giaime will act as contact persons to fill the shifts required of LSU.

d) Chief Scientist at LIGO Livingston Joseph Giaime will continue as the Chief Scientist at LIGO Livingston.

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,
 - b) Access to LIGO data in support through established LSC channels in support of this work.
4. Coordination and Reporting – LSUERG Group will perform this research within the structures established by the LIGO Laboratory and the LSC where appropriate. In particular activities described in Item 2 will be carried out within the Optics Development Working Group of the LSC. Coordination will include 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 on-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. The research effort pursuant to this Attachment A will be coordinated by Joseph A. Giaime (LSUERG Group) and the leader(s) of the ODG .

Approved:

Barry Barish
LIGO Laboratory Director

Joseph A. Giaime
LSUERG Principal Investigator

Peter Saulson
LSC Spokesperson

David Reitze
ODG Leader

**Attachment SUS to the
Memorandum of Understanding (LIGO-M950059-00-M)
between the
Experimental Relativity Group of the Louisiana State University (LSUERG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
August 15, 2005**

This Attachment SUS to the Memorandum of Understanding LIGO-M950059-00-M defines the role of the Louisiana State University Experimental Relativity Group (LSUERG) as a Member of the LIGO Scientific Collaboration (LSC) and a member of the Isolation/Suspension/Thermal Noise Development Group (ISTNDG). The period of performance for the activities in this Attachment is from August 15, 2005 to August 15, 2006.

1. Isolation/Suspension/Thermal Noise Development Group - The Isolation/Suspension/Thermal Noise Development Group (ISTNDG) is the scientific collaboration for defining and developing future isolation and suspension improvements for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers. MOU Attachments define the roles and responsibilities of groups in this development group.
2. During the period August 15, 2005 to August 15, 2006, the members of LSUERG members will participate as follows:

Giaime will serve as chair of the Suspensions and Isolation Working Group, organizing regular phone meetings and sessions at the LIGO Science Collaboration Meetings.

Joe Giaime will serve as lead scientist of the Advanced LIGO seismic isolation team. This involves coordination of LSC work at LLO, Caltech, Stanford, MIT, JILA, and LSU, as well as AdLIGO proposal preparation duties, procurement, planning, and instrument design and testing. LSU will provide lock/unlock mechanisms and electronics for the LASTI advanced LIGO seismic isolation prototype. Also, LSU will participate in the R&D for the advanced LIGO technology demonstrator system at Stanford and the Adv LIGO seismic prototypes for LASTI. This includes the design, construction and commissioning phases.
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,
 - b) Access to LIGO data in support through established LSC channels in support of this

work.

4. Coordination and Reporting – LSUERG Group will perform this research within the structures established by the LIGO Laboratory and the LSC where appropriate. In particular activities described in Item 2 will be carried out within Isolation/Suspension/Thermal Noise Development Group of the LSC. Coordination will include 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 on-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. The research effort pursuant to this Attachment B will be coordinated by Joseph A. Giaime (LSUERG Group) and the leader(s) of the ISTNDG.

Approved:

Barry Barish
LIGO Laboratory Director

Joseph A. Giaime
LSUERG Principal Investigator

Peter Saulson
LSC Spokesperson

Joseph Giaime
ISTNDG Leader

**Attachment Number Z to the
Memorandum of Understanding (LIGO-M950059-00-M)
between the
Experimental Relativity Group of the Louisiana State University (LSUERG)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO) Laboratory
August 15, 2005**

This Attachment to the Memorandum of Understanding LIGO-M950059-00-M lists the coordinates of the members of LSUERG who will participate in the LIGO Scientific Collaboration (LSC) as members of LIGO Development Groups. The period of performance for the activities in this Attachment is from August 15, 2005 to August 15, 2006. This period may be modified by agreement to a revision of this Attachment.

Name	Address	E-Mail	Phone Nos.	Begin Date	End Date
Giaime, Joseph 100% LIGO I 60% AdLIGO 40% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	jgiaime@ligo.phys. lsu.edu	225-578-5794 225-686-3169 (LLO) Fax225-578-5855	Aug 15, 2005	Aug 15, 2006
González, Gabriela 100% LIGO I 100% AdLIGO 0% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	gonzalez@lsu.edu	225-578-0468 Fax225-578-5855	Aug 15, 2005	Aug 15, 2006
Allen, Gabrielle 10% LIGO I 5% AdLIGO 5% Faculty	Department of Computer Science, Louisiana State University, Baton Rouge, LA 70803	gallen@cct.lsu.edu	225 284 6605	Aug 15, 2005	Aug 15, 2006
Hamilton, William 10% LIGO I 5% AdLIGO 5% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	hamilton@dave. phys.lsu.edu	225-578-5847 Sec 225-578-5860 Lab 225-578-5845 Cpt Fax:225-578-5855 225-578-2261 Dpt	Aug 15, 2005	Aug 15, 2006

Johnson, Warren 67% LIGO I 33% AdLIGO 34% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	johnson@dave. phys.lsu.edu	225-578-5847 Sec 225-578-5860 Lab 225-578-5845 Cpt Fax:225-578-5855 225-578-2261 Dpt	Aug 15, 2005	Aug 15, 2006
Lehner, Luis 10% LIGO I 10% AdLIGO 0 Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	lehner@lsu.edu	225.578.0016	Aug 15, 2005	Aug 15, 2006
Pullin, Jorge 10% LIGO I 10% AdLIGO 0% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	pullin@phys.lsu.edu	225 578-0464	Aug 15, 2005	Aug 15, 2006
Seidel, Edward 10% LIGO I 10% AdLIGO 0% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	eseidel@cct.lsu.edu	225 578 4012	Aug 15, 2005	Aug 15, 2006
Tiglio, Manuel 25% LIGO I 25% AdLIGO 0% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	tiglio@phys.lsu.edu	225 578-7636	Aug 15, 2005	Aug 15, 2006
Tohline, Joel 50% LIGO I 25% AdLIGO 25% Faculty	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	tohline@lsu.edu	225-578-6851 Ofc Fax:225-578-5855 225-578-2261 Dpt	Aug 15, 2005	Aug 15, 2006
Alexander Dietz LIGO I 100% Postdoc	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	dietz@phys.lsu.edu	225-578-8186	Aug 15, 2005	Aug 15, 2006

Myungkee Sung LIGO I 100%	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	sung@baton.phys.lsu. edu	225.578.8318	Aug 15, 2005	Aug 15, 2006
Zhang, Peter LIGO I 10% Postdoc	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	zhang@dave.phys.lsu .edu	225.578. 2796	Aug 15, 2005	Aug 15, 2006
Amin, Rupal 100% LIGO I 67% AdLIGO 33% Graduate Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	amin@ligo- la.caltech.edu	225 686-3119	Aug 15, 2005	Aug 15, 2006
Hanna, Chad LIGO I 100% Graduate Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	channa@phys.lsu.edu	225-578-0945	Aug 15, 2005	Aug 15, 2006
Kopparapu, RaviKumar LIGO I 50% Graduate Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	kumar@phys.lsu.edu	225-578-1829	Aug 15, 2005	Aug 15, 2006
Rodriguez, Andres LIGO I 100% Graduate Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	andres@phys.lsu.edu	225-578-7637	Aug 15, 2005	Aug 15, 2006
Slutsky, Jacob LIGO I 100% Graduate Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	jslutsky@phys.lsu.ed u	225-578-2261	Aug 15, 2005	Aug 15, 2006

Wen, Shyang 100% LIGO I 75% AdLIGO 25% Grad Student	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	swen@phys.lsu.edu	225 686-3115	Aug 15, 2005	Aug 15, 2006
Nettles, Damon LIGO 1 50% AdLIGO 0% Operator	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	nettles@phgrav.phys. lsu.edu	225 578-5860	Aug 15, 2005	Aug 15, 2006
Hanson, Jon LIGO 1 50% AdLIGO 0% Undergrad	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	hanson@phgrav.phys. lsu.edu	225 578-5860	Aug 15, 2005	Aug 15, 2006
Miller, Phillip LIGO 1 50% AdLIGO 0% Undergrad	Department of Physics and Astronomy, Louisiana State University, Baton Rouge, LA 70803	pmille8@yahoo.com	225 578-5860	Aug 15, 2005	Aug 15, 2006

Scientific Collaboration Council Delegates: Gabriela González, Joe Giaime, Warren Johnson

Approved

Barry Barish
LIGO Laboratory Director

Joseph A. Giaime
LSUERG Principal Investigator

Peter Saulson
LSC Spokesperson