This Attachment DAT to the Memorandum of Understanding LIGO-M070065-00 defines the role of the Montana Graviational Wave Astronomy Group (MtGWA) as a Member of the LIGO Scientific Collaboration (LSC). In particular, it addresses data analysis activities 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 MtGWA will participate in the analysis of initial LIGO data in the following areas:

a. Binary Inspirals

- **S5 Ringdown Search**: Cornish and full time graduate student Paul Baker, in collaboration with members of the UWM group, will update the S4 ringdown search to run under ihope and provide instructions on how to run the pipeline on S5. The Montana group will run the ringdown search on several months of S5 data and coordinate with other groups that volunteer to analyse additional months. In addition to modernizing the code, several deficiencies in the S4 algorithm will be corrected. These include the problem of spurious overlaps between high/low frequency injections with low/high frequency templates, dynamic generation of properly spaced template banks (as per the inspiral searches), and implementation of the full 3-dimensional template metric for
setting coincidence windows.

- **Inspiral-Merger-Ringdown:** Cornish and Baker will participate in the IMR development activities. Our first task will be to investigate ways to combine triggers from the inspiral and ringdown searches applied to numerical relativity and effective one body MDCs. Our eventual goal is to tie this work in with the coherent waveform reconstruction techniques Cornish and Littenberg are studying in connection with the cWB algorithm in the Burst group.

- **Parameter Estimation:** Cornish will coordinate with the other groups working on MCMC follow-ups and Bayesian model selection to incorporate elements of our MCMC based parameter estimation and model evidence algorithms into the detection candidate follow-up pipeline.

  All of these activities will be closely coordinated with the Compact Binary Coalescence working group.

b. **Bursts**

- **Simulations:** Cornish and full time graduate student Tyson Littenberg will incorporate the Ott-Burrows acoustic supernovae MDC generation facilities into the standard software and hardware injection software.

- **Understand Astrophysics of potential sources:** Cornish and Littenberg will continue to develop and implement a general method for optimizing coherent Wave Burst searches for specific astrophysical models. The Ott-Burrows acoustic waveforms will be used as an initial test case. The goal is to increase the detection range and to allow specific models to be more tightly constrained (for example in the event of no detectable GW counterpart to a galactic supernovae event).

- **Assessment of Event Candidates and Position Reconstruction:** Cornish and Littenberg will develop and implement a MCMC follow up for event candidates that provides posterior distributions for the waveform reconstructions and sky positions (in other words, “error bars” on the waveform reconstructions and sky positions). This work is a simple extension of the full network MCMC tools developed by the CBC group (the inspiral waveform generators are replaced by general purpose waveform generators that use wavelet coefficients or cubic spline control points as parameters).

c. **Stochastic**

   _Not Applicable_

d. **Continuous**

   _Not Applicable_

e. **Other Contributions**

   _Not Applicable_
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 MtGWA 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.

   Not Applicable

4. Coordination and Reporting

MtGWA 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.
Attachment Z to the 
Memorandum of Understanding LIGO-M070065-00 
between the Montana Graviational Wave Astronomy Group (MtGWA) 
and the 
Laser Interferometer Gravitational Wave Observatory (LIGO) 
For The Period 
August 15, 2008 - August 14, 2009

This Attachment Z to the Memorandum of Understanding LIGO-M070065-00 lists the members of Montana Graviational Wave Astronomy Group (MtGWA) participating in LIGO Scientific Collaboration (LSC) development group activities in support of the initial LIGO interferometers. The period of performance for these activities is from August 15, 2008 - August 14, 2009.

Faculty:

The Faculty category includes all “faculty rank” LSC members. This includes professorial appointments, research faculty appointments, teaching faculty appointments, lecturer and reader appointments, and similar appointments, and visiting appointments in all these categories.

Name: Cornish, Neil
Phone: 1 406 994 7986
Fax: 1 406 994 4452
Email: @LIGO.Org: neil.cornish@LIGO.Org
Forwarding: cornish@physics.montana.edu

Postal Address: Montana State University
Department of Physics
City: Bozeman
State: MT
Postal Code: 59717
Country: USA

Technical Staff:

The Technical Staff category includes all non-PI LSC members with scientist, engineer, computer systems administrator or programmer, technician, and similar appointments, and visiting appointments in all these categories.

Postdoctoral Scholars: 

Graduate Students:
Undergraduate Students:

Administrative Staff:

The Administrative Staff category allows the listing of administrative aides and other staff members who perform essential support services in or for LSC member groups, but are not involved in the LIGO Scientific Collaborations engineering or scientific work. Personnel who are involved in the LSC's scientific or engineering work, including computer system administration and programming, should be listed under other categories. Personnel listed as Administrative Staff may be designated as a point of contact or proxy, but do not appear as authors on LSC publications, do not count toward a group's council delegate allocation, may not serve as council delegates, and do not increase a group's shift obligation.

FTE Commitment:

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Category</th>
<th>Member</th>
<th>Research</th>
<th>LIGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baker, Paul</td>
<td>graduate</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Conover, Cathy</td>
<td>administrative</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>3</td>
<td>Cornish, Neil</td>
<td>faculty</td>
<td>100%</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Littenberg, Tyson</td>
<td>graduate</td>
<td>100%</td>
<td>100%</td>
<td>60%</td>
</tr>
</tbody>
</table>
FTE Commitment:
# Name Category Member Research LIGO
Total FTE: 2.10

Roles:
Principal Investigators: Cornish, Neil
Membership Point-Of-Contact: Cornish, Neil
Group PIO/Press Coordinator: Conover, Cathy
Proxies:

Author Eligible Council Delegates
Cornish, Neil Cornish, Neil
Baker, Paul
Littenberg, Tyson

Approvals:

Jay Marx
LIGO Laboratory Director

Neil John Cornish
Principal Investigator(s)
MtGWA

David Reitze
LSC Spokesperson

MtGWA Attachment Z Generated: August 13, 2008 Page 3 of 3