



**Attachment DAT to the
Memorandum of Understanding LIGO-M050370-00
between the Columbia Experimental Gravity Group (GECO)
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-M050370-00 defines the role of the Columbia Experimental Gravity Group (GECO) 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 GECO will participate in the analysis of initial LIGO data in the following areas:

a. Binary Inspirals

Not Applicable

b. Bursts

GECO will continue to concentrate on and spearhead scientifically intriguing data analysis. In particular, we will put emphasis on astrophysical triggered searches. GECO will keep an eye on astrophysical triggers and start a specialized offline search for exceptionally close-by or remarkably energetic cosmic events. Depending on the nature of the astrophysical event we will use existing analysis methods or will develop specialized new approaches where absolutely necessary.

Feasible Contributions:

- **Untriggered Searches**

- Graduate Student Project: We will make advances towards the search for GW burst trains emitted during parabolic and eccentric encounters of black hole binary systems. The most recent detection rate estimates for eccentric orbit binary black holes based on Advanced LIGO design sensitivity goals are promising: 1-1000 events/year. Development of the data analysis, publication of the expected sensitivities for future detectors, and establishing the recovery accuracy of physics observables will be done first. Searches for such GW signal types during S6 is a good idea, as there is some chance for discovery. Collaboration will be done with Bence Kocsis (currently Harvard-cfA, soon at IAS, Princeton) and colleagues.
- Undergraduate project: Evaluate the realistic reach of future detectors for simulated supernova waveforms in extrapolated detector noise. Both detection and parameter extraction capabilities shall be mapped. In collaboration with A. Burrows, Princeton. Progress shall depend on student availability during the school year.

- **Triggered Searches**

- Multiple GECO contributors: Ensure the readiness of fully reviewed and approved analysis infrastructure and paper skeletons to enable fast response to possible exceptional triggers during S6 from GRBs, SGRs, supernovae, and other sources addressable through infrastructures that have already produced one or more science publications.
- Graduate Student project: Search for GW signatures associated with bursts of (at least) SGR1806-20 and SGR1900+14 soft gamma repeaters (SGRs) in S6 data. Our present upper limits are already within the theoretically predicted range of some SGR models. The increased sensitivity of the Enhanced and Advanced LIGO-Virgo detector network shall allow us to take advantage of improved data analysis approaches producing interesting scientific results. The traditional per flare search will also be expanded to search for the cumulative GW signatures of many flares together. In collaboration with Peter Kalmus (expected to leave for Caltech).
- Graduate Student project: We will make progress towards the search for GW events that are coincident in time and direction with events detected by high-energy neutrino observatories. Our recent simulations show that false alarm rates of the combined LIGO-Virgo-IceCube detector network are suppressed by several orders of magnitude when compared to a single detector, thereby improving the sensitivity to detect GW/neutrino events arriving from common astrophysical sources. Theoretical motivations also make this search a high priority. The student will develop the GW data analysis part of the project and execute the full search in collaboration with our Virgo, IceCube and ANTARES colleagues.
- Graduate Student project: Jameson Rollins will continue to spearhead the search for the gravitational wave signatures associated with the best characterized optical supernovae triggers.

- **Online Searches**

- Contribution to infrastructure for rapid online analysis for undirected and directed burst events with Omega Pipeline
- Enable rapid S6 publication
- Contribute to real time phase/timing calibration

- **Looc-Up**
 - Continue to contribute to automatization of the pipeline and science operations
- **Simulations**
 - Create simulated noise repository for future detectors
- **Infrastructure**
 - Omega and Flare development support
- **Service**
 - Co-coordinate ExtTrig team
 - Maintain Omega, Flare and XPipeline project management systems (wikis, code repository, etc.)
- **Other**
 - Quite possibly as time and talent allows

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 GECO 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.

(This includes data and computing infrastructure.)

4. Coordination and Reporting

GECO 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.



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LIGO Laboratory Director



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