



**Attachment OPS to the
Memorandum of Understanding LIGO-M050370-00
between the Columbia Experimental Gravity Group (GEC0)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
For The Period
August 15, 2008 - August 14, 2009**

This Attachment OPS to the Memorandum of Understanding LIGO-M050370-00 defines the role of the Columbia Experimental Gravity Group (GEC0) as a Member of the LIGO Scientific Collaboration (LSC) in the areas of detector commissioning, detector characterization, and operations support in 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. LSC groups are encouraged to contribute to the commissioning, characterization, and operation of the LIGO detectors, as members of working groups established by the LIGO Laboratory and the LSC.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of GEC0 will participate in the initial LIGO detector research program in the following areas:

a. Detector Commissioning

- GEC0 will continue to participate in calibration studies with special focus on the photon calibrator.
- GEC0 presently has two graduate students working on commissioning at LHO. If future funding allows, a regular GEC0 presence at the observatories is preferred.
- Timing work will continue.

b. Detector Characterization

- Marka will co-coordinate the Timing Stability Working Group (TSWG) that includes LIGO Laboratory (Daniel Sigg and Paul Schwinberg from LHO) and other LSC scientists. TSWG is responsible for the real time diagnostics as well as reports on the achieved timing accuracy. TSWG also works together

with the Calibration group to ensure the accurate phase and timing calibration of the gravitational wave data stream ($h(t)$).

- GECO will continue to enhance timing verification studies in order to ensure that the real time automatic timing diagnostic analysis is - at the very least - enough to support potential discoveries in S6;
- GECO shall set up representative assemblies of the Advanced LIGO timing distribution and diagnostics system towards in-situ tests with Enhanced LIGO;
- GECO shall further develop and test injection techniques to determine accurate timing through direct test mass excitations.
- GECO will maintain its data monitoring tools already in service.
- GECO might implement new ideas (depending on available manpower and LIGO lab priorities) for DMT monitors and related hardware.

c. Detector Operations

- GECO will participate in scientific shifts during science runs as required
- GECO will provide service work for various LIGO committees and review groups.

d. Other Contributions

- GECO will provide assistance if needed for the users of the LIGO-TriNet stations.
- Kalmus will contribute to the work of the LSC Calibration Committee.
- GECO will provide people to do service work for various LIGO committees and review groups.
- Marka will lead and coordinate the timing and timing diagnostic effort for LIGO, enhLIGO and advLIGO.

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.

Not Applicable

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 in coordination with the LIGO Laboratory Commissioning Leader.

2b will be carried out within the Detector Characterization Working Group of the LSC.

2c will be carried out in coordination with the LHO or LLO Site Head.

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



Szabolcs Marka
Principal Investigator(s)
GEC



David Reitze
LSC Spokesperson