Attachment OPS to the

Memorandum of Understanding (LIGO-M 050421 -00-M)

between the

Dept.of Chemistry and Physics,Southeastern Louisiana U (DCP/SLU)

and the

Laser Interferometer Gravitational Wave Observatory (LIGO)

August 15, 2006

This Attachment OPS to the Memorandum of Understanding LIGO-M 050421 -00-M defines the role of the Dept.of Chemistry and Physics,Southeastern Louisiana U. 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, 2006 to August 15, 2007.

1. 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 Laboratroy and the LSC.

2. During the period August 15, 2006 to August 15, 2007, the members of DCP/SLU will participate in the initial LIGO detector research program in the following areas:

a) Detector Commissioning

Our activities with the use of e2e simulation are complementary to tasks of various LSC working groups. Instead of building detailed models of particular subsystems, we integrate models of subsystems developed by other working groups so that the overall performance of the LIGO system can be studied. To accomplish this, we (1) build a model of the integrated system, (2) validate the simulation environmental framework of the model and (3) calculate the performance and feedback the result to improve the design.

Our group focuses our research on the input optics subsystem, especially the Input Mode Clear (IMC). We integrate the seismic isolation and suspension subsystem that holds the IMC mirrors, inject measured ground motion time series as input to our seismic isolation model, control IMC optics using realistic length /alignment control models, and simulate the frequency noise and beam pointing of the beam coming out from IMC. By combing our simulation with simulation of the Core Optics Component system developed by the LIGO Lab simulation group, we quantitatively characterize the effect of IMC on the interferometer sensitivity.

In the last LSC period, we went through the above path (1) through (3) for the Initial LIGO system. We compared the results of simulation with various measurements made at LLO to validate/modify our models. Through this study, we learnt how the seismic motions affect the beam coming out from IMC. These results were presented at appropriate meetings.

In this LSC period, our focus is mainly on simulation of the advanced LIGO (AdvLIGO) IO subsystems so that we understand the behavior of IMC quantitatively and provide necessary information to the AdvLIGO design teams. To this end, we will (a) construct necessary e2e codes and (b) perform numerical studies using the constructed e2e codes and characterize the detector's performance. Below, the former is described under a) Commissioning and the letter under b) Detector Characterization.

We will replace the current seismic isolation system and the suspension systems by proper models developed by Suspensions and Seismic Isolation working group. For the suspension system, we use the mathematica model developed by Mark Barton at Glasgow. There are two candidate designs for the horizontal access module (HAM) seismic isolation system; one uses active controls and the other uses passive controls (HAM-SAS). We have already been provided with a state-space model for the HAM-SAS design, and expect to be provided with a state-space model for the active control design soon. We will work with the HAM-SAS group to study the effect of back reaction from the suspension system to the HAM system. The simulation setup can be used for trade-off study of the two HAM schemes, when necessary, not just by comparing them in the transfer functions but comparing the simulation at the level of the interferometer performance. These mechanical models are subject to design changes, but at least one set of working models will be completed to perform the simulations described below under b).

Another important improvement necessary is the addition of the radiation pressure effect. This effect exists and can be measured in the Initial LIGO IMC. We will incorporate the radiation pressure model developed by the Simulation group at Caltech LIGO with the existing IMC model that we developed in the last LSC period.

b) Detector Characterization

Using the modified e2e model mentioned above, the performance of AdvLIGO IMC will be studied in details. The detector's sensitivity limitation due to (1) the frequency noise induced by the IMC's length fluctuation and (2) beam pointing due the HAM table motion will be analyzed. As the local and global controls of the triple pendulum on AdvLIGO HAM table is developed, we will install the identical control systems in the simulation, and the realistic performance of the Advanced LIGO IMC will be predicted.

c) Detector Operations

Not Applicable

d) 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 **DCP/SLU** group members while on LIGO research assignment at any LIGO Laboratory site,
b) Access to LIGO data through established LSC channels in support of this work.

c) Not Applicable

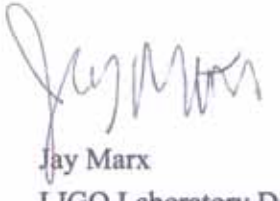
4. Coordination and Reporting -

DCP/SLU 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 in coordination with the LIGO Laboratory Commissioning Leader, Item 2b) will be carried out within the Detector Characterization Working Group of the LSC, and Item 2c) will be carried out in coordination with the LHO {or LLO} Site Head. 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.

Approved:



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