Attachment ACF to the Memorandum of Understanding LIGO-M050421-00 between the Department of Chemistry and Physics at Southeastern Louisiana University (DCP-SLU) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2007 - August 14, 2008

This Attachment ACF to the Memorandum of Understanding LIGO-M050421-00 defines the role of the Department of Chemistry and Physics at Southeastern Louisiana University (DCP-SLU) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Advanced Detector Configurations Development Group (ADCDG). The period of performance for the activities described in this Attachment is from August 15, 2007 - August 14, 2008.

1. Collaboration

The Advanced Detector Configurations Development Group (ADCDG) is the scientific collaboration for defining and developing entirely new advanced interferometers. It is expected that this development group will pursue research in dual recycling, resonant sideband extraction, Sagnac interferometers, systems with non-transmitting optics, and other advanced configurations.
MOU Attachment ACF defines the role and responsibilities of workgroups participating in this development group.

2. Participation

During the period August 15, 2007 - August 14, 2008, the members of DCP-SLU will participate in the ADCDG in the following areas:

a. Interferometer Configurations

Not Applicable

b. Squeezed Light Generation

Not Applicable

c. Other Contributions

During the period August 15, 2007 to August 15, 2008, the members of DCP/SLU Group will participate in the initial LIGO detector research program in the following

areas:

We develop time-domain models of LIGO subsystems using the LIGO end-to-end (e2e) simulation package, and perform numerical studies to assess the performance of the subsystems and understand the underlying physics. Generally speaking, our activities are complementary to other LSC working groups; we integrate component models developed by other groups into end-to-end models, and study the performance of the integrated system. We validate our models by feeding experimental data recorded with the LIGO data acquisition system (DAQ) as input, and comparing the result of simulations with the corresponding DAQ signal.

In the last LSC period, we constructed e2e models of the Advanced LIGO HAM seismic isolation and triple suspension, using components models developed by the Suspension and Seismic Isolation Working Group (SWG). In addition, using the constructed models, we started to construct an e2e model of the Advanced LIGO Input Mode Cleaner (IMC). To validate the IMC model, we built an equivalent e2e model for the initial LIGO IMC and compared results of the simulation with measurement made at the LIGO Livingston observatory via the DAQ system. Consequently, the simulation and measurement showed good agreement in the IMC's transmitted beam's length and pointing fluctuation.

In this LSC period, we will continue our efforts as follows.

(1) Construction of component models
The e2e model of HAM seismic isolation that we constructed in the last LSC period was based on the state space model of the passive HAM scheme developed by V. Boschi et al of the SWG. In this period, we will construct an equivalent e2e model using the state space model of the single stage HAM seismic isolation developed by B. Lantz et al of the SWG. The resultant single-stage HAM seismic isolation e2e model will be combined with the triple suspension e2e model that we developed in the last LSC period using the state-space model developed by M. Barton of the SWG. We will also construct an advanced version of the triple suspension e2e model with the violin dynamics included, using the most recent release of the M. Barton's model. We will provide realistic ground motion as input to the seismic isolation model, and assess the resultant HAM table motions and the optics motions.

(2) Development of Advanced LIGO Input Mode Cleaner model and numerical study
We will continue the development of Advanced LIGO IMC model. In the last LSC period, we constructed the e2e model of the length/frequency control servo, and succeeded in locking the IMC with realistic translational ground noise fed to the base of the HAM isolation model. In this period, we will include rotational degrees of freedom by adding the alignment sensing control servo (the wave front sensing). The resultant model will be used to study the frequency fluctuation and beam-pointing fluctuation of the IMC due to seismic disturbance. The effect of radiation pressure and the violin mode dynamics will also be studied. Through these numerical analyses, the Advanced LIGO detector's sensitivity limitation due to the IMC performance will be assessed. We will stay in close collaboration with the numerical simulation group at Caltech LIGO Lab for these analyses.

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.

   Not Applicable

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

   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 2 will be carried out within the Advanced Detector Configurations Development Group of the LSC.
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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