Attachment ACF to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment ACF to the Memorandum of Understanding LIGO-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) 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, 2008 - August 14, 2009.

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, 2008 - August 14, 2009, the members of SAGWI will participate in the ADCDG in the following areas:

a. Interferometer Configurations

Attachment ACF – Advanced Detector Configurations Development Group
Robert L. Byer - SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009, the members of SAGWI Group will participate in the ACF (Advanced Detector Configurations Development Group) in the following areas:

Advanced Configurations

(R. Byer, M. Fejer, P. Beyersdorf, K-X. Sun)

a) *Study all-reflective topologies and gratings for application to future ground-based detectors;*

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out in the areas of all-reflective topologies and gratings for application to future ground-based detectors.

a') *Study squeezed noise in various interferometer configurations using a custom test-bed developed at San Jose State University;*

The squeezed noise test-bed that has been developed was intended as a platform for investigating the frequency dependent behavior of "squeezed" light propagating through various interferometer configurations. Lack of funding, however, has forced the group at San Jose State University to focus on projects that require fewer capital resources (i.e. further develop and support the MELODY code base), and further work using the test-bed has been suspended.

b) *Investigate the relationship between transverse displacement noise of gratings and the phase noise it produces for various interferometer configurations;*

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work carried out on investigating the relationship between transverse displacement noise of gratings and the phase noise it produces for various interferometer configurations.

c) *Use the quantum-noise test-bed to simulate the effects of shot noise and radiation pressure noise on suspended mass interferometers in the regime where both effects are of comparable magnitude.*

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the development of the quantum-noise test-bed to simulate the effects of shot noise and radiation pressure noise on suspended mass interferometers in the regime where both effects are of comparable magnitude.

d) *Continue measuring the thermal distortion of mode-cleaners with high circulating powers;*

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the measurement of thermal distortion in mode-cleaners with high circulating powers.

e) Support and make updates to Melody; and

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out in support of Melody.

We had planned to transfer the responsibility of maintaining and continuing the development of MELODY from Amber Bullington, who will graduate soon, to Peter Beyersdorf at San Jose State University. However, Peter Beyersdorf has been unable to develop NSF support for the development of the quantum-noise test-bed, or for continuing the support of MELODY. This is regrettable because a new capability was to be added to Melody to simulate thermal loading of a grating beam-splitter for all-reflective configurations.

f) Continue collaborations with Lawrence Livermore National Laboratory, which routinely fabricates low-loss gratings of a size suitable for applications in future LIGO detectors, relying on other sources for funding.

Using other resources, work at Stanford will focus on characterizing the LLNL gratings and understanding the limitations of their fabrication process, relying on other sources of funding.

b. Squeezed Light Generation

Not Applicable

c. 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 SAGWI 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

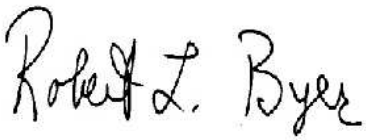
4. Coordination and Reporting

SAGWI 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.

Jay Marx
LIGO Laboratory Director



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment LAS to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment LAS to the Memorandum of Understanding LIGO-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Lasers Development Group (LDG). The period of performance for the activities in this Attachment is from August 15, 2008 - August 14, 2009.

1. Collaboration

The Lasers Development Group (LDG) is the scientific collaboration for defining and developing future high power lasers for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers.
MOU Attachment LAS defines the roles and responsibilities of groups in this development group.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of SAGWI will participate in in LDG in the following areas:

a. Laser Development

Attachment LAS – Lasers and Detectors Development Group
Robert L. Byer - SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009, the members of SAGWI Group will participate in the LAS (Lasers and Detectors Development Group) in the following areas:

Power-scaling of MOPA laser systems
(R. Byer, K. Urbanek, P. Lu)

a) Development of a 100-W Nd:YAG zig-zag slab MOPA system;

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the development of zig-zag slab amplifiers as laser engines for application to future ground-based detectors.

Development of fiber laser systems
(R.L. Byer, K. Urbanek)

b) Scale fiber MOPA to 180 W;

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the development of fiber laser amplifier systems as laser engines for application to future ground-based detectors.

c) Characterize fiber MOPA output;

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on characterization of fiber laser amplifier systems as laser engines for application to future ground-based detectors.

d) Investigate phosphate fibers for possible applications in Advanced LIGO;

Using ARO (Army Research Office) support, we will complete work to build a 25-W single frequency fiber MOPA using highly-doped double-clad phosphate fiber. We will investigate which cooling geometry is most suitable for these fibers which operate under high thermal loading conditions. We will characterize the system to determine if these fibers can be used for creating compact pre-amplifiers and/or scaled to over 100 W for use as power amplifiers.

Development of high-power photodiodes
(J. Harris, M. Fejer, K.X. Sun, B. Lantz)

e) Continue the photodiode development for length sensing and wave-front sensing; and

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the development of custom back-illuminated photodiodes with minimal I-layer impurity concentrations and minimal parallel capacitance for rf length sensing and wave-front sensing.

f) Continue the development of photodiodes for wave-front sensing.

Pending a change in NSF funding for Stanford's program in support of LIGO, no further work will be carried out on the development of commercial front-illuminated photodiode chips that are packaged with attention to minimizing parallel capacitance for rf wavefront sensing.

b. 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 SAGWI 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

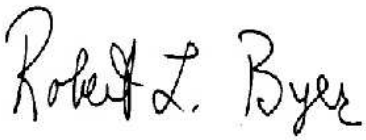
4. Coordination and Reporting

SAGWI will perform 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 Lasers Development Working 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.

Jay Marx
LIGO Laboratory Director



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment OPS to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) 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-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) 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 SAGWI will participate in the initial LIGO detector research program in the following areas:

a. Detector Commissioning

Not Applicable

b. Detector Characterization

Not Applicable

c. Detector Operations

Attachment OPS – LIGO Detector Commissioning and Operations
Robert L. Byer, SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009, the members of SAGWI Group will participate in the initial LIGO Detector Commissioning and Operations program in the following areas:

a) HEPI Support

Brian Lantz will work with LIGO to support the Hydraulic External Pre-Isolator (HEPI) that has been installed at LASTI and the LIGO Livingston Observatory (LLO) to ameliorate the consequences of ground motion if and as needed.

b) Pre-modecleaners for LIGO

Students and staff at Stanford will do their best to work with LIGO scientist Rick Savage in further testing and construction of existing pre-modecleaners for LIGO at Hanford Observatory if and as needed.

c) Scientific Monitors

Stanford will continue to provide scientific monitors for the science runs, according to the relevant rules of the LIGO Scientific Collaboration.

d) Committee Support

Members of SAGWI will continue to serve on various committees for LIGO and the LSC:

Brian Lantz: member of LASTI technical advisory committee, member of LSC publications and presentations committee and Cognizant Scientist for the Isolation and Controls Subsystem (ICS)

Marty Fejer: member of the Next Generation Coating Research Whitepaper development group

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 SAGWI 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

SAGWI 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.

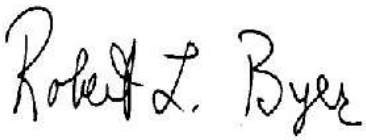
2c will be carried out in coordination with the LHO or LLO Site Head.

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



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment OPT to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment OPT to the Memorandum of Understanding LIGO-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Optics Development Group (LDG). The period of performance for the activities in this Attachment is from August 15, 2008 - August 14, 2009.

1. Collaboration

The Optics Development Group (ODG) is the scientific collaboration for defining and developing instruments in optics for use in advanced subsystems for the initial LIGO interferometers, or in entirely new advanced interferometers.
MOU Attachment OPT defines the roles and responsibilities of groups in this development group.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of SAGWI will participate in ODG in the following areas:

a. Optics Characterization

Attachment OPT – Optics Development Group
Robert L. Byer, SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009, the members of SAGWI Group will participate in OPT (Optics Development Group) in the following areas:

Development of optical materials
(A. Markosyan, A. Alexandrovski, R. Route, and M. Fejer)

a) *Continue vacuum heat-treatment processing and photo-thermal common-path interferometry (PCI) measurements of absorption losses in sapphire optical elements;*

With the adoption of fused silica for the Advanced LIGO test mass material, the need for near-term study of large size sapphire optics has diminished. However, for future gravitational wave detectors, it remains desirable to continue heat-treatment studies on sapphire at a low level of effort. Our emphasis will be on the identification of post-growth processing conditions that reduce optical absorption losses from as-grown levels of 40-60 ppm/cm, as is typical of Crystal Systems HEM-grown sapphire, to the range of 10 ppm/cm that we have seen experimentally. We will focus on investigating the kinetics of the process to determine whether or not LIGO-scale sapphire boules can be vacuum heat-treated at high temperatures in reasonable amounts of time. We will also study the homogeneity of the heat-treated samples.

b) *Continue the measurement of optical absorption losses in multi-layer, high-reflection coatings on fused silica optics in a collaborative study with LIGO aimed at optimizing coating deposition, heat-treatment parameters and associated cleaning and handling procedures; and*

Marty Fejer will continue to work with Andri Grettarson, Eric Gustafson, Greg Harry, Steve Penn, and Sheila Rowen on a coherent plan of research aimed at the development of the next generation of optical coatings for gravitational wave detectors beyond Advanced LIGO. We will work to bring into the program, colleagues from Stanford and elsewhere with expertise in using microscopic probe techniques such as NMR spectroscopy to better understand macroscopic material properties.

The PCI technique will be used to carry out absorption studies on multi-layer optical coatings on fused silica substrates. These studies will continue to be carried out in collaboration with LIGO, LSC and VIRGO colleagues through a systematic comparison of multi-layer antireflection coatings composed of Ta_2O_5, HfO_2, SiO_2, and TiO_2. The PCI will also be used to evaluate cleaning procedures and protective coatings such as "First Contact" for their impact on thermalized optical coating losses.

The development of UV charge management technology
(K.X. Sun, M. Fejer, N. Leindecker)

c) *Continue investigations on the AC charge management technique and evaluate the effects of UV illumination on LIGO coatings.*

We will continue to focus in two areas: a determination of the operating lifetime and reliability of the commercial 257 nm UV LEDs now under study at Stanford, and an understanding of the effects of UV illumination on the HR coatings in terms of both buildup of residual vacuum system contamination and actual damage to the coatings themselves.

b. 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 SAGWI 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

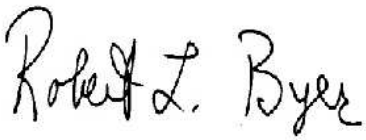
4. Coordination and Reporting

SAGWI will perform 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 Optics Development Working 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.

Jay Marx
LIGO Laboratory Director



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment OUT to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment OUT to the Memorandum of Understanding LIGO-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) as a Member of the LIGO Scientific Collaboration (LSC) in support of Education and Outreach to the broader community. The period of performance for the activities in this Attachment is from August 15, 2008 - August 14, 2009.

1. Education and Outreach

As a frontier physics effort, LIGO offers a unique opportunity to inspire interest in science among students and to educate the broader community. The LIGO Laboratory supports a broad program of education and outreach to take advantage of these opportunities.
Activities to attract and educate visitors take place at both Observatories, as well as the development of educational materials for use there and elsewhere.
The LIGO Laboratory is building a Science Education Center at the Livingston Observatory, and is participating with local partners to make it a vehicle for science education throughout the region.
LSC groups are invited to participate in these activities, and to suggest others, with the goal of leveraging activities to make a greater impact.
This MOU Attachments defines the role and responsibilities of groups in this development group.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of SAGWI will participate in in LDG in the following areas:

a. Educational Materials Developed

Not Applicable

b. Other Contributions

Attachment OUT – Education and Outreach
Robert L. Byer, SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009 the members of the SAGWI Group will participate in Education and Outreach in the following areas:

   a) *Summer students*

   The SAGWI group will continue to take on summer students working on various projects relating to LIGO research areas at Stanford.

   b) *Other activities*

   The SAGWI group will participate in other outreach activities such as Stanford Community Day and take opportunities to give talks and interviews on LIGO as they arise.

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 SAGWI 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

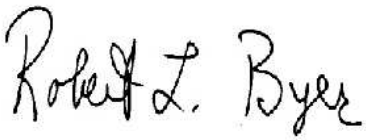
4. Coordination and Reporting

SAGWI will perform 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 with the LIGO Observatories Educational and Outreach Leaders.
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



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment SUS to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) and the Laser Interferometer Gravitational Wave Observatory (LIGO)

For The Period

August 15, 2008 - August 14, 2009

This Attachment SUS to the Memorandum of Understanding LIGO-M050297-00 defines the role of the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) as a Member of the LIGO Scientific Collaboration (LSC), and a member of the Isolation/Suspension/Thermal Noise Development Group (ISTNDG). The period of performance for the activities in this Attachment is from August 15, 2008 - August 14, 2009.

1. Collaboration

The Isolation/Suspension/Thermal Noise Development Group (ISTNDG) is the scientific collaboration for defining and developing instruments in optics for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers. MOU Attachment SUS defines the roles and responsibilities of workgroups in this development group.

2. Participation

During the period August 15, 2008 - August 14, 2009, the members of SAGWI will participate in in ISTNDG in the following areas:

a. Coating Losses

Attachment SUS – Isolation, Controls and Thermal Noise Development Group
Robert L. Byer, SAGWI Principal Investigator

2. During the period August 15, 2008 to August 15, 2009, the members of SAGWI Group will participate in the SUS (Isolation, Controls ans Thermal Noise Development Group) in the following areas:

Materials and Thermal Noise
(M. Fejer, R. Route, A. Markosyan, K. Vijayraghavan)

a) Factors that control excess mechanical losses in dielectric mirror coatings;

Reduction of the mechanical loss associated with coatings applied to substrates and associated thermal noise remains an important research area for Advanced LIGO and is vital for the success of any future detectors with sensitivities better than Advanced LIGO.

We will work with Glasgow on the use of thin silicon cantilevers for analyzing the dielectric mirror coating mechanical losses in deposited dielectric thin films.

In collaboration with Glasgow, MIT, Syracuse and Hobart and William Smith Colleges, we will continue our studies of coated substrate materials to investigate and reduce the mechanical losses of coatings. A main goal will be to develop an atomistic mechanical loss model based on the bond structure of fused silica with the intent of applying it to the high index, generally more lossy material, Ta_2O_5 , to see if its mechanical loss can be reduced.

b) Participation as required in modeling efforts on the effects of inhomogeneous mechanical losses on the expected thermal noise from a finite sized test masses such as silicon;

c) Fabrication of silicon cantilevers for mechanical dissipation studies of optical thin films;

This work will be carried out in collaboration with Glasgow as needed

d) Mechanical dissipation on single layers of coating materials

e) Continued optical and Q measurements on crystalline materials; and

Contingent on measurements currently underway at Glasgow, we will fabricate additional thick cantilevers for the measurement of bulk-dominated loss effects, if requested. The quality of the silicon nitride masking layer and the cleanliness of surfaces in the case of silicon fusion bonding, respectively, will be improved as needed.

f) Conductive coatings for charge mitigation.

With the goal of producing a thin, electrically conducting layer on the surface of fused silica masses, we will continue our studies on the in-diffusion of alkali-ions from molten nitrate salt baths into small fused silica samples. We will monitor for any changes in surface optical absorption at 1064 nm. So far, we have achieved reductions in surface resistances from ~100 TΩ down to 2 TΩ with immersion for 100 minutes in a 300 C bath. Assuming this trend continues, we will determine how much farther the surface resistances can be lowered. If we can achieve sufficiently low values to be of interest for LIGO test mass charge mitigation, we will collaborate with colleagues at Glasgow, MIT, Syracuse and Hobart and William Smith Colleges to investigate changes in mechanical losses that may be caused by the ionic in-diffusion process.

Active Alignment, Isolation, and Control
(D. DeBra, B. Lantz, G Allen, D. Clark,)

g) *Carry out further design, development and characterization of the seismic isolation systems at the ETF, at LASTI, and for Advanced LIGO in general;*

h) *Work with SUS and SEI colleagues on issues of integration of suspension and isolation systems, and on issues of integration with other subsystems;*

This will include collaborating on tests of the ETM/ITM noise prototype in conjunction with the BSC active isolation platform at LASTI.

i) *Continue to develop methods and transfer knowledge to speed up the implementation of control application at LASTI, and for Advanced LIGO;*

j) *Support the installation and testing of the BSC isolation and alignment system currently being installed at LASTI;.*

k) *Use the ETF Tech. Demo. to develop Sys-ID and Control tools for the HAM installation in Enhanced LIGO;*

l) *Support the commissioning of the Enhanced LIGO HAM systems at the observatories;*

m) *Continuing testing the new vertical seismometer;*

We will be working to improve the performance, and concentrate on improved sensing technology and evaluate various techniques to reduce the impact of temperature variations on performance.

n) *Participate in upcoming SUS and SEI design reviews and other reviews and planning meetings associated with the Advanced LIGO activities;*

o) *Continue the development of the Seismic Platform Interferometer for use amongst the platforms in the LVEA. Our focus at this time is to get low cost, reliable performance, and good noise performance in the 10 mHz to 100 mHz band;*

p) *Continue the testing of the Nanometrics Trillium 240 as a replacement for the STS-2 for Advanced LIGO;*

q) *Continue the development of the high-strength replacement flexures for the GS-13 for Advanced LIGO; and*

r) *Develop passive dampers for the beam-direction oscillations of the suspension.*

All of the above will be carried out in collaboration with colleagues in the LSC including the LIGO lab and the GEO group.

b. Suspension Design for Advanced LIGO

Not Applicable

c. 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 SAGWI 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

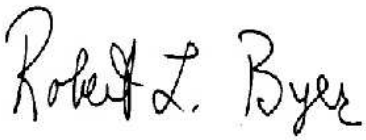
4. Coordination and Reporting

SAGWI will perform research within the structures established by the LIGO Laboratory and the LSC where appropriate. n particular, activities described in Item 2 will be carried out within the Isolation/Suspension/Thermal Noise 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.

Jay Marx
LIGO Laboratory Director



Robert L. Byer
Principal Investigator(s)
SAGWI

David Reitze
LSC Spokesperson

Attachment Z to the Memorandum of Understanding LIGO-M050297-00 between the Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) 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-M050297-00 lists the members of Stanford Advanced Gravitational Wave Interferometry Group (SAGWI) participating in LIGO Scientific Collaboration (LSC) development group activitites in support of the initial LIGO interferometers. The period of performance for these activities is from August 15, 2008 - August 14, 2009.

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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:

#	Name	Category	Member	Research	LIGO
1	Alexandrovski, Alex	faculty	100%	10%	25%
2	Allen, Graham	graduate	100%	50%	100%
3	Bullington, Amber	graduate	100%	50%	100%
4	Byer, Robert L	faculty	100%	25%	25%
5	Clark, Daniel	graduate	100%	50%	100%
6	DeBra, Dan	faculty	100%	15%	100%
7	Fejer, Martin	faculty	100%	25%	25%
8	Hennessy, Michael	technical	100%	100%	10%
9	Lantz, Brian	technical	100%	100%	100%
10	Leindecker, Nick	graduate	100%	50%	100%
11	Lu, Patrick	graduate	100%	50%	50%
12	Markosyan, Ashot	technical	100%	100%	50%
13	Route, Roger	technical	100%	100%	15%
14	Sun, Ke Xun	technical	100%	100%	10%
15	Urbanek, Karel	technical	100%	100%	50%
				Total FTE:	8.60

Roles:

Principal Investigators: Byer, Robert L

Membership Point-Of-Contact: Byer, Robert L

Group PIO/Press Coordinator:

Proxies: Route, Roger

Author Eligible	Council Delegates
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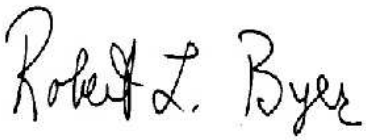
DeBra, Dan	Route, Roger
Lantz, Brian	
Markosyan, Ashot	
Urbanek, Karel	
Allen, Graham	
Bullington, Amber	
Clark, Daniel	
Lu, Patrick	

Approvals:

Jay Marx
LIGO Laboratory Director



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