



**Attachment OPT to the  
Memorandum of Understanding LIGO-M050280-00  
between the Australian Consortium for Interferometric Gravitational  
Astronomy (ACIGA)  
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-M050280-00 defines the role of the Australian Consortium for Interferometric Gravitational Astronomy (ACIGA) 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 ACIGA will participate in ODG in the following areas:

a. Optics Characterization

*Not Applicable*

b. Other Contributions

HOPF (UWA, UA)

Experimentally at Gingin HOPF, we will work to extend our recent observations of the 3-mode parametric interactions responsible for parametric instability. This involves four new experimental approaches.

**a)** We will develop the optical systems to allow injection of high order modes into our 80m cavity so that we can test the possibility of optical feedback for parametric instability control.

**b)** We will use injection of high order modes in the south arm to test our ability to

both enhance and suppress instability by feedback the high order modes.

**c)** In parallel we shall instrument one 80m arm with a high finesse optical cavity suspended with an advanced vibration isolation system, with view to being able to create parametric instability, study its onset, and then test suppression schemes. We are currently awaiting the delivery of the high power laser that is necessary to create instability.

**d)** Benchtop configuration for parametric control. We have designed a small scale system capable of creating three mode parametric instability. It uses an intra-cavity membrane and should be able to achieve parametric instability in the hundreds kHz range with only a few milliwatts of power. We will set up this system, test the membrane acoustic resonators, and control schemes. Study and analysis of parametric instability in Advanced LIGO. We will continue to develop the most realistic and precise possible acousto-optic model of Advance LIGO to obtain the best possible estimate of the magnitude of the parametric instability problem. We note that all estimates to date predict instability, but that limitation in the modeling, especially for the case of asymmetric interferometer means that the precise magnitude of the problem is still uncertain. In parallel with this we will continue to model acoustic damping schemes for parametric instability control, with particular emphasis on the noise cost of such schemes.

We will continue to participate in LSC Optics Working Group teleconferences, and to work closely with the Gingin Advisory Committee chaired by Phil Willems.

#### Hartmann Sensor (UA)

1. Identify Hartmann light sources for AdvLIGO.
2. Temperature stabilize the Hartmann sensor to improve long term stability and accuracy. And, assuming funding is available (after 1 January 2009):
3. Begin development of hardware and software for Hartmann profilometer.
4. Begin assembly of Hartmann sensors for AdvLIGO.
5. Continue improvement of Hartmann sensor control software.

#### Tip/Tilt mirrors(ANU)

1. Prepare and complete Final Design Document Review for Tip/tilt mirror and assuming funding is available
2. commence the production of tip/tilt mirrors for AdvLIGO

#### Lock Acquisition Interferometer (ANU)

1. Work with LIGO team to select technique (Suspension platform interferometer; Digital interferometer (DI); or low finesse Fabry-Perot)
2. Prepare and complete Conceptual Design Document Review for chosen technique
3. Demonstrate DI on a suspended mirror prototype interferometer
4. Demonstrate chosen method on a suspended mirror prototype interferometer.

### 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 ACIGA group members while on LIGO research assignment at any LIGO Laboratory site.

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

*Not Applicable*

#### **4. Coordination and Reporting**

ACIGA 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.

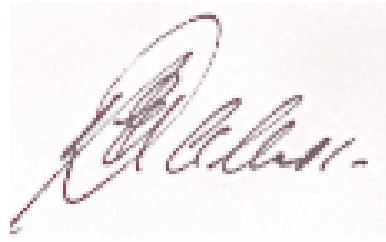
This Attachment will be updated at least annually with a plan of activities for the succeeding one-year period. These documents will be due one month before the close of the period of performance under this Attachment.

#### **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**



David Ernest McClelland  
**Principal Investigator(s)**  
**ACIGA**



David Reitze  
**LSC Spokesperson**