

**Attachment OPT to the
Memorandum of Understanding (LIGO- M050297-00-M)
between the
Stanford Advanced Gravitational Wave Interferometry (SAGWI) Group
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
August 15, 2005**

This Attachment OPT to the Memorandum of Understanding LIGO-M050297-00-M 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 (ODG). The period of performance for the activities in this Attachment is from August 15, 2005 to August 15, 2006.

1. Optics Development Group – The Optics Development Group (ODG) is the scientific collaboration for defining and developing improvements in optics for use in advanced subsystems for the initial LIGO interferometers or in entirely new advanced interferometers. MOU Attachments define the roles and responsibilities of groups in this development group.
2. During the period August 15, 2005 to August 15, 2006, the members of SAGWI Group will participate in OPT (Optics Development Group) in the following areas:

Development of optical materials

(V. Kondilenko, A. Alexandrovski, R. Route, 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 recent 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. The focus will be to identify post-growth processing conditions that reduce optical absorption losses from as-grown levels of 40-60 ppm/cm to the range of 10 ppm/cm. This will be done on sapphire windows 37 mm dia. by 25 mm high, using an existing rf-induction-heated (~ 1800 °C) high-vacuum furnace and a new tungsten-mesh-heated vacuum furnace with larger capacity that was purchased with other sources of funding. The study will elucidate the effects of high-temperature, high-vacuum heat-treatment on absorption losses in Crystal Systems, Inc. (CSI) sapphire, aiming to determine if the levels of 12.5 ppm/cm achieved previously on smaller size optics can be demonstrated on larger size optics. To do this, we will focus on investigating the kinetics of the process to predict if large-size sapphire boules could 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 coated fused silica optics in a collaborative study with LIGO aimed at optimizing coating deposition, heat-treatment parameters and associated cleaning and handling procedures.
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,
 - b) Access to LIGO data through established LSC channels in support of this work.
4. Coordination and Reporting – SAGWI Group 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 Optics Development Working Group of the LSC. 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.

Approved:

Barry Barish
LIGO Laboratory Director

Robert L. Byer
SAGWI Principal Investigator

Peter Saulson
LSC Spokesperson

David Reitze
ODG Leader