LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

RECORD OF DECISION/AGREEMENT (RODA)

Document	LIGO-M070025-00-Y
Date:	February 2, 2007
Title:	RODA: Decision to adopt Hartmann sensors over WLISMI sensors for Advanced LIGO TCS
To the Attention of:	
cc:	
From/ signatories:	Name/Title: Phil Willems — Signature: Phil Willems (Digitally signed by Phil Willems DN: cn=Phil Willems, c=US, email=willems@ligo.caltech.edu Date: 2007.02.02 10:28:56 -08'00') Name/Title: Peter Fritschel/SYS Scientist — Signature: Peter Fritschel (Digitally signed by Peter Fritschel DN: cn=Peter Fritschel, c=US, o=M.I.T., email=pf@ligo.mit.edu Reason: I am approving this document Date: 2007.02.02 14:14:27 -05'00') Name/Title: — Signature:
System(s) affected:	☐ Initial LIGO ☑ Advanced LIGO ☑ Other: Enhanced LIGO
Nature/ Scope:	☑ Design Decision ☐ Requirements Decision ☐ Work Scope Decision ☐ Working Agreement between Groups ☐ Other
Subsystem(s) affected	☐ Relevant Subsystem(s)/Component(s): AOS, SYS
Primary Contacts	Group or Affiliation and Contact
Reference Documents:	

DECISION/AGREEMENT STATEMENT:

The Advanced LIGO Thermal Compensation System (TCS) will use Hartmann sensors for all dedicated thermal aberration sensors. The alternative WLISMI technology will not be used by TCS.

The Advanced LIGO Thermal Compensation System (TCS) will use dedicated on-axis sensors to monitor the thermal aberrations in the test masses and beamsplitter and verify the quality of thermal compensation. Two promising technologies have been developed for this purpose; these were identified in the TCS Conceptual Design Document LIGO-T060083-00-D as the Hartmann sensor, developed by the University of Adelaide, and the White-Light In-Situ Measurement Interferometer (WLISMI), developed by the Institute for Applied Physics at Nizhny Novgorod, Russia. Both have demonstrated sufficient sensitivity and spatial resolution for Advanced LIGO. However, the WLISMI has two significant disadvantages compared to the Hartmann sensor.

First, the WLISMI is significantly more complex than the Hartmann sensor. This was the point of view of the TCS Design Requirements and Conceptual Design Review committee.

Second, the optimal operation of the WLISMI interferes two wavefronts differentially affected by the thermal aberrations to make its measurement. Ideally, these would reflect from the ITM HR face and the outer face of the compensation plate (CP), between which most of the significant thermal aberrations lie. However, the Advanced LIGO optical layout generally requires core optics to be wedged to prevent parasitic etalons from forming. These wedge angles are typically of order 1° so that the ghost beams from the AR surfaces can be safely dumped. This requires the two faces of the CP to have a significant angle from normal to the main IFO beam. This angle is nominally equal to the wedge of the ITM in the current design. This angle by design prevents the reflection from the AR surface of the CP from exiting the IFO through a pickoff at the BS AR face, where the TCS sensor probe beam is injected and returns after reflection from the ITM HR face. Thus, one of the wavefronts ideally used by the WLISMI is not available. The only practical technique is to compare the wavefronts reflected off different regions of the ITM HR face. This significantly muddles interpretation of the sensor data and requires larger pickoff telescopes to get the same coverage as a Hartmann sensor, which uses reflection off the ITM HR face only and so does not have this problem.