LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

RECORD OF DECISION/AGREEMENT (RODA)

Document	LIGO-M 070120-02 -Y
Date:	16-Nov-2007
Title:	RODA: Beamplitter Optic Size, Geometry, Wedge Orientation and Suspension Wire Material
To the Attention of:	aligo_sus, aligo_sys
cc:	aligo_coc
From/ signatories:	Name/Title: Dennis Coyne, AdL Chief Engineer — Signature: Dennis Coyne (Digitally signed by Dennis Coyne, DN: cn=Dennis Coyne, c=US, o=Caltech, ou=LIGO, email=coyne@ligo.caltech.edu, Reason: I am approving this document, Date: 2007.11.18 20:49:21 -08'00')
	Name/Title: Peter Fritschel, AdL Chief 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: 2007.11.19 21:00:06 -05'00')
	Name/Title: Norna Robertson, AdL SUS Leader — Signature: Norna A Robertson (Digitally signed by Norna A Robertson, DN: cn=Norna A Robertson, c=US, o=Caltech, ou=LIGO, email=nrroberts@ligo.caltech.edu, Date: 2007.11.19 09:49:05 -08'00')
	Name/Title: Justin Greenhalgh, SUS/UK/RAL Program Manager — Signature: Justin Greenhalgh (Digitally signed by Justin Greenhalgh, DN: CN = Justin Greenhalgh, C = GB, O = CLRC, OU = EID, Date: 2007.11.20 16:27:22 Z)
	Name/Title: GariLynn Billingsley, COC Leader — Signature: GariLynn Billingsley 2007.11.19 10:08:24 -08'00'
	Name/Title: — Signature:
System(s) affected:	☐ Initial LIGO ☑ Advanced LIGO ☐ Other:
Nature/ Scope:	☑ Design Decision ☐ Requirements Decision ☐ Work Scope Decision ☐ Working Agreement between Groups ☐ Other
Subsystem(s) affected	☐ Relevant Subsystem(s)/Component(s): SUS, COC, SYS
Primary Contacts	Group or Affiliation and Contact: Norna Robertson Peter Fritschel
Reference Documents:	See RODA M040006-00 which defines the BS and FM optics to be the same size See RODA M050397-02 for BS and FM size T070153-01, Indirect Length Coupling for the Beamsplitter with Horizontal Wedge

DECISION/AGREEMENT STATEMENT:

N.B.: This RODA supersedes M050397-02 with regard to the beamsplitter comments. A record change to M050397 to release version -03 replacing the paragraph on the beamsplitter and referring to this RODA will be made concurrent with issuing this RODA.

The beamsplitter shall have a symmetrically wedged optic with an azimuthal (clocking) orientation which is nominally horizontally (i.e. wedge does not cause the surface normal vector to have a component in the vertical direction). The wedge angle will be ± 0.45 degrees (0.9 degrees total).

The beamsplitter thickness will be 60 mm at its thickest point (measured parallel to the cylindrical axis). The diameter is 370 mm.

The beamsplitter suspension will use a carbon steel wire to suspend the beamsplitter optic (not fused silica fibers or ribbons).

The beamsplitter penultimate mass shall be metal (not glass).

The beamsplitter shall not have flats on its barrel for mounting ears or prisms for interfacing to the suspension wires. The design of the wire breakoff point and attachment of this breakoff part (e.g. prism) is TBD. The wire breakoff attachment shall not be secured with silicate bonding and will likely use vacseal. Likewise the design of the wire clamp at the penultimate mass is TBD.

BACKGROUND:

The motivation for considering a metal wire suspension for the beamsplitter is reduced cost and complexity as compared to the baseline fused silica fibre, monolithic penultimate and optic assembly. Mark Barton produced thermal noise curves (to be documented in the updated conceptual design document, T040027-01) and Peter Fritschel used these curves to decide that we could use steel wires (i.e. not require a fused silica fibre suspension for the beamsplitter). Currently only vertical coupling noise estimates are in the updated conceptual design document, T040027-01 (next pending release); horizontal coupling noise estimates will be added soon.

The nominal beamsplitter suspension frequencies for a wire suspension are given in T070153-01. (Updated estimates of these frequencies will appear in T040027-01). The length coupling due to optical wedge at these suspension frequencies are also addressed in T070153-01. Length coupling from the suspension modes does not appear to be a problem.

The optical layout with a horizontal wedge angle in the beamsplitter and either small vertical wedge in the ITMs (so as to have the beam height drop to the height of the RM placed on a HAM table set to -325 mm in the global coordinate system) or no vertical wedge in the ITMs appears to fit for both the stable and marginally stable power and signal recycling cavity options. This was verified with Zemax models created by Mike Smith and Dennis Coyne in as yet undocumented studies.