

Advanced LIGO UK
Project management meeting number 28
Telecon, April 6th 2006

Stuart Aston, Caroline Cantley, Justin Greenhalgh, Nick Lockerbie, Ian Wilmot

1 Participants

Justin Greenhalgh (chair)
Stuart Aston (SMA)
Deepali Lodhia (DL)
Joe O'Dell (JO)
Ken Strain (KAS)
Alberto Vecchio (AV)
Ian Wilmot (IW)

2 Comments on minutes from last meeting

There were no comments on the minutes of the previous meeting.

3 Actions from previous meeting

These are noted under item 13 below.

4 UK/US interactions

4.1 Controls prototype design

RJSG, IW and JO would be travelling to LASTI during the week following the meeting to participate in installation tests on the controls prototype.

4.2 SUS and design meeting telecon issues

The topics of recent discussion had been

- Requirements for force and force noise on OSEMs
- Wiring of reaction chain (problems caused by stiffness of the wires; on investigation we realised that we do not need to shield the wires to the UIM and PM OSEMs because they do not have sensors except on the noise prototype)
- The indium-bonded hook idea to modify the way we interface the ears to the test masses (a novel approach with some potential but too late for advanced LIGO)
- Earthquake stop design (an approach had been suggested; discussed below)
- Bench test structure

The LSC had superseded several of the SUS meetings and design telecons during the period.

4.3 RODAs and MoU

After many iterations the UK/US MoU had been cleared by all parties for signature; the mechanics of getting the document signed were now in hand.

For RODAs, see:

http://www.ligo.caltech.edu/~coyne/AL/project_management/RODA/RODA_status.htm

RJSG had a drafted M060043 with the following text, and forwarded it to Dennis Coyne for processing:

“For the ETM and ITM we will not fit sensors to the OSEMs for global control. These OSEMs are the ones on the penultimate and upper intermediate masses.

In the case of the noise prototype only, the sensors will be included. However, the pigtailed leading to them will not be shielded.”

4.4 Recent Weekly LIGO reports

Reports are to be found at <http://www.ligo.caltech.edu/~weekly/>.

Nothing not covered elsewhere. It was decided to remove this item from future agendas.

4.5 Reviews

4.5.1 Noise prototype PDR

The following dates had been provisionally agreed between RJSG and Dennis Coyne:

Documents to reviewers by Friday June 16th
 Reviewers send us questions by Friday June 30th
 We respond on ~Friday July 7th.

4.5.2 RRR

In order to verify the state of our readiness a “review readiness review” had been held on March 15th. It had been a very useful meeting and Notes had been written up by RJSG at

http://www.eng-external.rl.ac.uk/advligo/papers_public/M060041_RRR_notes/M060041-00-K.pdf

The compliance matrix had been revised and was to be found at

http://www.eng-external.rl.ac.uk/advligo/papers_public/E050317_compliance_matrix/E050317-00-K.doc.

4.5.3 NSF review

LIGO in the US were to undergo a routine but key review in May to allow the release of full construction funding. RJSG and KAS would be attending. It was expected that a statement would be required in some form from the UK, and so slides should be prepared in the following areas which would illustrate the congruency between UK and US views of the work:

- UK Schedule (at the level presented to the OsC)
- Concise info on budget, WA level and usage, spend profile, earned value, etc.
- Organisation chart.

ACTION 28.01 RJSG to prepare slides for potential use at NSF review and circulate to US team.

4.6 LSC meeting

The LSC meeting had been held at Hanford on March 20-22, with a suspensions workshop on 22nd and 23rd March. RJSG, AV, CAC, SMA, DL and IW had attended from the UK.

Highlights included:

- Interesting talk from Doug Cook on cleanliness

- Agreement at the workshop that Rana and Jay would finalise the OSEM force and force noise requirements.
- Very useful discussions on 23rd March (RJSG recorded thanks to Janeen Romie for excellent organisation) including a review of the document summarising UK responses to the DRD and ICD documents. That document had been updated with actions arising and was to be found at

http://www.eng-external.rl.ac.uk/advligo/papers_public/M050438%20comments%20on%20ICD%20DRD%20from%20UK/M050438-01-K.pdf

- Useful report from Steve Penn on measurements of noise in wires. We would need to ensure that our account of the drum-end vs wire-clamp decision at PDR #3 included reference to the relevance or otherwise of this work. G060144.
- A very useful report from Brian Lantz on the ETF tests.
- Dennis Coyne's latest optical layouts had included some provision for a "damping stay" on the structure.
- Janeen Romie had produced notes from the workshop which could be found on the "SUS" web pages at:

http://www.ligo.caltech.edu/%7Ectorrie/SUS_MEETING/daylinks/Workshop%20Notes%20March%202006.doc

4.7 Vacuum bake-out discussions

RJSG reported that there had been an extended email exchange on the subject of vacuum bake-out and cleanliness. There had been no obvious conclusions but we should stand by for possible adjusted recommendations on vacuum cleaning procedures (eg storage of solvents).

4.8 Visits and trips etc.

Iain Martin had visited RAL from 13th March for two weeks and had a very productive visit working on the bench test structure.

Several members of the team had travelled to the LSC.

It was planned that several team members would travel to LASTI in April to witness setting-up of the controls prototype in the LASTI chamber.

KAS and RJSG were planning to be at MIT for the NSF review.

5 OsC issues

The OsC meeting had gone well. Actions were

- Continue to report on opportunities for use of WA
- Report on activities at Cardiff
- Complete MoU
- Include reports on the following:
 - Outcome of NSF review
 - Update on LIGO risk management and the "staffing" risk
 - Update on resonant frequency and outcome of PDR #3
 - Update on violin mode damping
 - Comment on vulnerability to single-source supply problems
 - Report on activities at Cardiff.

The OsC had emphasised in its formal report that it was it as essential to avoid any further delay to PDR #3.

6 Finance

Nothing to report.

7 Changes

7.1 OSEM force requirements change

In finalising the figures for noise a final change had been made, the impact of which was

- The OSEMs at the PU would no longer require dual windings
- The OSEMs at the UIM would still require the longer windings (was it planned to equip all OSEMs this way)
- The magnets at the PU would still need to be the 6mm by 2mm size and paired to avoid stray pickup.

7.2 Violin mode dampers

Nothing new to report. A modification to the ICDs would be required.

7.3 Extra damping on structure

Following work at the ETF a suggestion had been made that an additional strut be attached to the structure to damp the motion. Since it was not yet clear that we would be able meet the frequency requirements without adding a stiffening brace, no concrete decisions could be made yet.

There were no other significant changes noted.

8 Earthquake stop design process

RJSG briefly outlined the plan for the earthquake stop design and invited comments. From the point of view of assembly procedures etc, JO was working on a design based on the agreements reached during the suspensions workshop as regards required movements of masses for fibre welding etc. On the dynamics/structural side, RJSG had made a simple FE model using springs, dampers, and masses which could be used to explore the effect of a particular time-series ground motion on the motion of the test mass and the force in the stops. This would be used with a time-series to be supplied by Dennis Coyne to check the effect of stop elasticity. Once a reasonable solution had been found, the elasticity of the stops would then be designed to suit. Tests might be needed to verify that the proposed level of impact stress (with a suitable safety margin) would do no harm to the masses.

It was agreed that this was a sensible strategy for arriving at a final design at minimum cost.

9 Web sites etc

http://www.eng-external.rl.ac.uk/advligo/papers_public/ALUK_Homepage.htm.

Most recent updates:

- RAL March 2006; ALUK Feb 2006 to include new Glasgow address.
- Glasgow: Feb 2006.

- Birmingham updated during December 2005.

10 Activity/plans and document summaries

10.1 Glasgow

10.1.1 Activities in previous month

- Preliminary quotes for the blanks (without flats and polishing) are being considered to optimise material choice for the reaction and penultimate masses. Indium bonded stand-off prisms are being considered as an alternative to silicate bonded prisms. This requires less of a flat surface and doesn't need to be superflat.
- Orders will be placed for the ribbon fabrication pieces within the next few weeks. An alternative manufacturing process involving drawing of a 10:1 aspect ratio rod is being considered by one of the vendors.
- Polishing issues have been resolved with the vendors and mechanical polishing is considered as the best way forward for the ear manufacture. Flame polishing / annealing is being kept as a back-up. Orders for the refined ears will be placed within the next few weeks.
- The development of the CO₂ laser ribbon fabrication and welding machine is continuing and progress is on track with schedule. The basic design is complete. Parts to remove any problems with back-reflection leading to laser power fluctuations have been specified and will be ordered within the next few weeks if required.
- The batch of 50 welding horns has been received. Welding tests to directly simulate ribbon tab to ear welding as per the designed configuration will continue following our EGO machine build in May.
- Following cancellation of our orders by one of the vendors alternative requests for quotation for small and large disks for bonding tests have been received and orders will be placed as soon as possible for these items.
- Progress on procurement of all silica parts must continue to be carefully monitored to ensure that it remains on-track with the schedule.

10.1.2 Plans for coming month

- The optimum material for penultimate and reaction masses with respect to performance, cost and availability will be selected within the next few weeks. Mass design details will be finalised and formal quotes for the final polished articles will be requested.
- Complete final FE analysis using finalised refined ear design. Firm up on quotes and place orders for a further 20 off test refined ears.
- Optimise performance of CO₂ machine with respect to ribbon pulling and welding for Advanced LIGO application.
- Continue welding development with welding horns commencing June.
- Place (for second time) orders for disks for bonding of ears and smaller 15mm test disks for bond strength measurements.
- Place orders for 50 off inspection polish finish ribbon fabrication pieces. Continue current tests using fine ground finish pieces.
- Continue to closely monitor progress on procurement of silica machined parts.

10.1.3 New and modified documents

- G060049-00-K
“Update on development of Advanced LIGO quad noise prototype”
LSC presentation
C. A. Cantley
March 2006
- G060055-00-D
“Advanced LIGO SUS controls prototype ETM suspension update”
LSC presentation
C. Torrie, C. A. Cantely
March 2006

10.1.4 Progress against schedule

- Progress is currently on track with the schedule.

10.2 RAL

10.2.1 Activities in the previous month

- After the last PMC RJSG looked at the earned value analysis in more detail and concluded that effort was not as tight as was first feared hence we have been ramping backing off our other project commitments over the month. This is only just coming to fruition however and over the last month ~50% of IW time and 50% JOD time has been LIGO.
- Iain Martin visited from Glasgow with the Larson Davis and sufficient understanding to take some modal measurements of the structure. We are awaiting his report; initial results did not deliver any obvious reason why the FEA and measured performance of the controls prototype do not match.
- RJG and IW attended the LSC, and the workshop following, useful progress was made on the assembly procedure and the most important areas of work that remain.
- We have all the custom hardware for the marionette. We are awaiting some fasteners etc. to enable us to assemble everything.
- Using an un-split lower structure is looking increasingly unlikely with Glasgow’s revised welding procedure. Our efforts are now being put into optimizing the split design.
- TMH has been looking at FEA packages and how their results vary and why. A very telling pair of analyses covered the same structure, one with ANSYS workbench and all the parts “glued” together, the second using ANSYS classic and all the parts merged before meshing. The ANSYS classic result was significantly different from the Workbench result – which is not what one might expect.
- Work continuing on raising natural frequencies of both structures.
- JOD has been looking at earthquake stops from the point of view of assembly tasks after much information was found at the LSC. A viable scheme is presently being written up with the intent of circulating it in a couple of weeks.
- RJSG has been looking at the earthquake stops from the point of view of the dynamic structural behaviour in an earthquake. The results of this work will need to be incorporated into JO’s work in due course.

10.2.2 Plans for the coming month

- Finnish assembly of the marionette

- Work with the Marionette calculating the fits required or adjustment ranges necessary.
- Complete wire and clamp tests. (this is now possible since we have the video extensometer, it has been on hold for some time pending this)
- Complete upper structure drawings
- Try and draw useful conclusions from the work of Iain Martin.
- We have been in discussions with both Glasgow and Stanford on the future of the Controls structure. Hopefully the structure will arrive at RAL in the next couple of weeks, and can be investigated in more detail.
- Use the experiences with assembling the marionette to further many documents and drawings toward review.
- Refine the lower structure in an attempt to improve its performance by using less material, and install accurate representations of the earthquake stops.
- Continue work on the earthquake stop dynamic theory.

10.2.3 New and modified documents

Document	Status
M050465 (private) Impact of PDR delay	Contact RJSG to see this document
M060008 (private) OSC March 2006	Contact RJSG to see this document
G060016 (private) OSC March 2006	Contact RJSG to see this document
M060020 (private) PAG Feb 2006	Contact RJSG to see this document
M060036 PMC March 2006	Complete; not on DCC
M060041 RRR notes	Version 01 on RAL ALUK site
T050255 wire bending and blade torsion	Complete; not on DCC
M060043 RODA on sensors	Being processed in US
T060053 Earthquake stop dynamics	In draft, contact RJSG if interested
G060107 Structures (LSC workshop)	Complete
G060109 Ring heaters (LSC workshop)	Complete
G060047 Blades and D distances (LSC)	Complete
T060059 (Hayler) FEA of Structures	Submitted to DCC
M060047 (this document) PMC March 2006	In draft
Older Documents	
M060007 PMC Jan 2005	Complete; not on DCC
Document considering the effect of an angled wire on a blade's stiffness (T040215)	on DCC
Blade process paper, Updated (T040108)	Updated. Need to put version 02 onto DCC
E050317 Compliance matrix	still in draft, version 01 now on RAL ALUK website.
T050253 Blade moment and lateral stiffness	Complete, On the DCC
M050458 PMC Nov 2005	Complete; not on DCC
M050452 PMC Dec 2005	Complete; not on DCC
Blade specification(E050226-00-K)	Ready for review, not on the DCC
Blade clamp specification (E050225-00-K)	Ready for review, not on the DCC
Changes from controls to noise prototype T050104	Under review, not on the DCC
Proposed adjustments in noise prototype T050103	Under review, not on the DCC
Top mass GA and PDS (T050188)	Ready for review, not on the DCC

Tablecloth GA and PDS (T050190)	Ready for review, not on the DCC
Two documents on wire testing (T050194, T050198)	Ready for review, not on the DCC
Chain separation document (T050077)	on DCC
Aluminium alloys for ALUK (T050171)	on DCC
M050438 comments on ICD from ALUK	Version 00 Submitted but not visible on the DCC; version 01 on RAL ALUK web site.

The table of documents as presented at the meeting was missing several new documents. ACTION 28.02 RJSG and IW to insert several new documents into document table above before publishing minutes. (Outcome of the action is in the table above)

10.2.4 Progress against schedule

Now the review has moved the schedule should be re-written and progress will be reported along with a new schedule next time.

ACTION 27.01 IW to produce a new RAL schedule.

10.3 Birmingham and Strathclyde

There had been no opportunity to obtain input from Strathclyde before the PMC, so the following report covers Birmingham only.

10.3.1 Activities over the previous month

- Travel:-
 - AV, SMA and DL attended LSC meeting at LHO (19th - 22nd March)
 - SMA and DL attended Suspensions workshop (22nd - 23rd March)
- Mechanical:-
 - Take delivery of blade stripping tool for OSEM coil windings
 - Gaining experience using this tool (consider reliability of the process)
 - Continuation of manufacturing study to obtain competitive quotes from external contractors and consider how to optimally manage the production task

OSEM Prototype Assembly

- Cleaning and assembly of a batch of OSEMs (5)
 - Characterization of these prototype devices using Automated Test Equipment (ATE) identified an issue with the flexi-circuits which we need to discuss with the supplier
 - OSEM assembly support provided by workshop staff (Anthony Page) who is documenting the assembly (and coil winding) process
 - Continue to generate fixtures and tooling required for OSEM assembly tasks
- Electronics:-

OSEM Electronics

- Participate in “Electronics Requirements” discussion held at the LSC meeting
 - Request the US (Rana) to provide electronics noise requirements in an applicable form (i.e. current noise spectra)
- Continue to monitor developments with the US investigation into OSEM emitter failures (headed by Ben Abbott)
- Continuation of satellite box design (soon to begin PCB layout)
- Coil driver design is ongoing (should quickly mature following LSC discussion).

ESD Electronics

The following report was provided by Nick Lockerbie but was not available for discussion during the meeting:

I have been working recently on the instrumentation amplifier front-end for the ES Driver channels, and can report that at 1 Hz the prototype achieved ~ 30 nV/rt-Hz, whilst at 10 Hz it was ~ 18 nV/rt-Hz. A surface-mount version is now under construction, which should improve on these figures.

I have also completed the water-cooled heatsinks work, and can report that at the very low water flow-rate of 0.5 litres/minute the three heatsinks each display a cooling capacity of 0.25 degrees Celsius per watt.

10.3.2 Plans for the coming period

- Complete OSEM part drawings (adhering to the LIGO drawing requirements document)
- Sign-off OSEM drawings and submit to the DCC
- Update SUS-US / SUS-UK ICD (SMA to update and forward to Dennis Coyne)
- Conduct thermal tests on the OSEM head power dissipated when in-vacuum
- Investigate alternative wire striping techniques (talk to Dave Smith (UoB), Bob Taylor (CIT)). The Birmingham group’s findings had been that the original type of wire, HML, can be stripped by either the solvent-based or blade-based technique. The (newly-recommended) quadruply-insulated type, QML, had given problems with the (also recommended) blade-based stripper. It was agreed to be important to try to establish which types of wire had been used in the controls prototype, how they had been stripped, and which had failed there.
- Investigate flexi-circuit production issue with supplier
- Continue manufacturing study
- Consider possible April visit to LASTI (MIT) to observe / assist with quad & electronics installation and testing
- Place external contracts for OSEM mechanical parts fabrication
- Begin generating input for “Noise Prototype OSEM Assembly Specification” document

10.3.3 New and modified documents

LIGO-G060116-00-K, Stuart Aston, 21/03/2006, Noise Prototype OSEM Development
 LIGO-G060165-00-K, Stuart Aston, 27/03/2006, UoB Contribution to Advanced LIGO

10.3.4 Progress against schedule

With reference to the Birmingham schedule 08/02/06. Progress to date as per schedule.

11 Visits etc and absences planned for the coming months

	Mar	April	May	June
General	LSC w/b Mar 20			June 16th deadline for PDR docs
RJSG	LSC	LASTI visit April 9th to 13th.	May 28 to June 2 – NSF review	May 28 to June 2 – NSF review ?EPAC 26-30 June
AV	LSC 16-26.	Italy over Easter		
CAC	LSC	LASTI visit		
KAS	Germany next 2 weeks	Germany last 2 weeks		
TMH				
JO		LASTI visit		
IW	LSC	LASTI visit followed by 1 week leave		
SMA	LSC, then leave etc --> 3 April	?LASTI, perhaps for ESD shielding tests.		

12 AOB

There were two items of other business:

12.1 Noise prototype assembly location

IW observed that it would be important to clarify which parts of the noise prototype assembly would take place where. The current understanding was as follows:

- Assembly of “dirty” mechanical parts at RAL
- Trial of ribbon pulling and welding, with partial structure, Glasgow
- Cleaning of parts and tooling, Caltech
- Pre-assembly of masses etc – not clear (LASTI or Caltech?)
- Assembly of suspension into upper and lower parts with metal dummy masses installed – not clear (LASTI or Caltech?)
- Installation of non-metal masses, ribbon pulling and welding, LASTI (needs space for optics table 1.5 by 2.5 m)

12.2 Envelope for Beam splitter and folding mirror structures

Calum Torrie had pointed out to IW that discussions were currently ongoing about usage of space in the vicinity of the BS and FM structures and so it would be prudent to sketch out

the required volume for the support structures as currently understood in order to avoid difficulties later.

13 Summary of actions

13.1 Complete or superseded by events:

ACTION 27.02 CAC to notify Carol Wilkinson of the outcome of discussion with JHR about PDR # 6. Discussed with JHR who has agreed to action. Discharged.

13.2 Outstanding

ACTION 25.04 RJSG to contact Linda Turner to ask her to re-publicise any “M” documents that had been made hidden unnecessarily. Not done; planned to do during LSC. Not done. Action stands.

ACTION 27.01 IW to produce a new RAL schedule. Not done. Action stands.

ACTION 27.03 CAC will contact Phil during the LSC and attempt to get direct communication between him and Geppo on the subject of tapers. Not done – action stands.

13.3 New

ACTION 28.01 RJSG to prepare slides for potential use at NSF and circulate to US team.

ACTION 28.02 RJSG and IW to insert several new documents into document table above before publishing minutes.

14 Next meetings

Friday 12th May, 2pm, telecom.

Justin Greenhalgh with progress reports from the other authors.
11th April 2006