Revised LASTI Plan Summer 2007-2009

Report of the LASTI Technical Advisory Committee (TAC)

Members of the committee: Rich Abbott, Dennis Coyne, Riccardo DeSalvo, Brian Lantz, Fred Raab, Norna Robertson (chair) and Alan Weinstein

DCC number T070031-00-R

16th February 2007

1. Introduction.

It is timely to revisit the LASTI long term research plan which has not been updated for several years. To this end David Ottaway the LASTI leader prepared a report entitled "Proposed LASTI research Summer 2007-2009" T070011-00-R which was reviewed at a telecon held on Tuesday 30th January 2007. The review started with a presentation from Dave, included in Appendix A. This presentation included information on the old plan, a summary of the current experiments at LASTI, a summary of the proposed and a table showing the effects of the changes from the old to the new plan on each of the subsystems.

2. General Observations

In general the revised plan was well received. It was recognised that circumstances have changed since the old plan was put together.

The replan involves removing from the list of goals from the old plan items 7 and 9 "qualify for low displacement noise with sensitive interferometer system" and "integrate/test Adv LIGO 180 W PSL and modecleaner". The reasoning behind removing the first of these is clearly explained in the replan document, including the point that dedicated small-scaled experiments can address the expected limiting noise sources more easily. Regarding the second item, the PSL will now be set up and tested either at Caltech or LLO, and the expense associated with upgrading safety controls and infrastructure at LASTI seems unwarranted. At LASTI a single cavity-locking test between a triple and a quad, both mounted on isolation stages, should give a significant amount of the information which a full test would have given.
Other items in the old plan have either been completed (1 and 2), are underway, or are proposed to be carried out either in the near term or as part of this revised longer term plan, with some modification. In summary the proposed plan includes 11 items as listed below.

1) DC readout system test including Output modecleaner (OMC) tests
2) Characterise test mass mechanical modes (using quad noise prototype)
3) Test of damping mechanical modes using the electrostatic drive
4) Active damping of violin modes (using quad noise prototype)

5) Non-Gaussian noise in loaded silicate bonds and in fibres.
6) Test of thermal compensation system (TCS)
7) Installation and test of HAM ISI
8) Installation and test of recycling mirror (RM) suspension
9) More rigorous quad acquisition studies
10) BSC ISI Loading experiments
11) CDS testing

3. Comments
(numbers refers to item above)

4) It was noted by the UK team that the timing of this item (spring 2008) appeared reasonable in terms of availability of violin mode sensors from the UK.
6) The aim is to perform a realistic test of as much of the Advanced LIGO TCS as possible. It will also be advantageous to assess the heating effect on the actual quad structure.
7) This will only be performed if HAM SAS is not chosen. It will have HEPI under it (only place to do this test). Retires risk to schedule in integration testing.
8) This is a heavier, and more challenging assembly and installation than an input modecleaner (IMC) which has already tested in controls prototype form and is no longer to be suspended on silica fibres. An IMC (reworked from a controls prototype) could also be tested at a later date beyond the period of this plan - useful for assembly and installation experience.

Comment on dropping PSL +MC tests
Sidles-Sigg instability doesn't appear to be a problem for the Adv LIGO MC – not a huge change from LIGO 1. More of a problem for enhanced LIGO.

4. Questions and Actions

4.1 OMC testing.
Why should this work be done at LASTI? Does not need a HAM isolation system. Most of the OMC team are at CIT. The electronics infrastructure will exist at CIT for OMC development. Perhaps best done in air on an optics table either in the LASTI high bay or in other venues, e.g. 40m Lab?

4.2 Noise ptype quad (ETM/ITM) stand-alone testing was not mentioned . Need to perform suspension dynamics survey and demonstration of modal damping from the upper stage.

4.3 TM mechanical modes & ES damping of TM modes: Are the modes measured with a linear cavity formed with a triple?

4.4 CDS Infrastructure testing. Can we focus efforts at LASTI & 40m & Enhanced Ligo so that they are complimentary and not entirely redundant?

4.5 BSC-ISI Loading Experiments: Testing an ITM/FM assembly on the BSC ISI might be possible. One is being made in UK, ready in fall. It could be cleaned here. Include, if/when available, installation & testing of such an assembly. Also note that effect of vertical position of CG of load is an important factor to investigate.

4.6 Details of shorter term plan at LASTI need fleshing out. Note that for SUS this is being addressed at present at SUS telecons.

4.7 Triple pendulum suspension coil driver force and noise requirements and OSEM count are needed by the UK as well as required delivery schedule given this revised plan.

4.8 Additional description of the intended TCS test(s) is required to scope the effort.

4.9 Relation of proposed changes to perceived risk and mitigation strategies: The plan should be compared to schedules to see how it addresses risks, in particular the most risky items, and close loop on this.

4.10 A detailed schedule should be put together. Overlapping timeframes – vacuum and manpower - need to be looked at.

4.11 Affects on Enhanced and Advanced LIGO schedules with the proposed changes should be looked at.

4.12 Check overlap of ISI installation at LASTI and the observatories at the same time for Enhanced LIGO.

4.13 Longer term program needs to be developed to train staff, practice installation (etc) for reduction of commissioning time.

5. Other general remarks

5.1 Separation of one of the HAM chambers from the rest of the LASTI installation.
This was noted in the Aug 06 LASTI TAC report and as we observed at that time it would greatly increase the flexibility of scheduling different experiments at the LASTI facility. We strongly encourage that this is seriously considered.

5.2 Technical staff at LASTI
LASTI requires a high level of cleanliness. Technical staff are at present doing duty keeping the facilities clean as well as their other duties. Could some solution be found to have cleaning done by dedicated cleaning staff to remove this burden from the technical staff?

5.3 Scattering measurements.
A possible future addition to the LASTI scope is in the area of tests relating to scattering and its amelioration. For example if it is decided that an air shower attached to the BSC chamber should be included in the Adv LIGO design then this should be tested for

usability and effectiveness at LASTI. Development and testing of a scatterometer is another possibility to be considered.

APPENDIX A

LASTI Planning

David Ottaway

Jan 2007

LASTI Old Plan

- Develop & test EPI for LLO seismic remediation (Completed)
- Qualification test of early pre-prototype triple pendulum (Completed)
- Integrate/test active HAM SEI pathfinder (Delayed)
- Integrate/test active BSC SEI pathfinder (Underway)
- Integrate/test Quad and Triple suspensions (Due to start)
- Integrate/test sapphire & fused silica core optics (Sapphire deleted)
- Qualify for low displacement noise with sensitive interferometer system
- Integrate and test full scale adaptive thermal compensation
- Integrate/test AdLIGO 180 Watt PSL & Mode Cleaner

Review of the Status of Current Experiments at LASTI

- **BSC Internal Seismic Isolation (ISI) System**
- HAM SAS Seismic Isolation System
- Quantum Optics and Radiation Pressure Tests
- Control Prototype Tests
- **Quad Pendulum Cavity Locking Tests**

Suggested Program for LASTI

- Output Modecleaner Bench Tests
- Complete characterization of noise prototype TM mechanical modes
- **Testing of damping of mechanical modes using ES drive and others**
- **Testing of active violin mode active damping strategies**
- Non –Gaussian noise in violin mode studies – bond studies
- Complete end to end test of Adv LIGO TCS system including SEI/SUS thermal interactions
- Installation and Test of a HAM Single Stage Seismic Isolation Platform
- **Installation and Test of a Recycling Mirror Triple Suspension**
- **More rigorous quad lock acquisitions studies**
- **BSC ISI Loading Experiments**
- **Beta Testing of CDS Advanced LIGO Controls Infrastructure**

Effects on Subsystems

Sub System	Effect	Comment
SEI	Positive	More time to fully characterize the seismic platform without artificially loading it
SUS	Neutral Positive	Will not test the mode cleaner noise prototype but will test the recycling mirror prototype
AOS	Extremely Positive	Full end to end test of the system
PSL	Negative	Test of 180 Watt laser will not occur at LASTI. The one benefit is that the 180 Watt laser will spend more time at Caltech where the US head of PSL (Peter King) resides
IO	Negative	Full test of modecleaner removed from scope plus test of mode cleaner noise prototype suspension delayed until 2009
CDS	Positive	A greater range of CDS deliverables are tested
COC	Neutral	Different COC optics are tested
SYS	Positive	More time dedicated to lock acquisition studies and parametric instability mitigation.