

# Report of the 40m TAC 17<sup>th</sup> April 2008.

## LIGO-T080100-00-R

Valera Frolov for the 40m lab TAC

*April 22, 2008*

### Attending

Rana Adhikari, Stefan Ballmer, Dennis Coyne, Matt Evans, Tobin Fricke, Peter Fritschel, Valera Frolov, Hartmut Grote, John Miller, Osamu Miyakawa, Daniel Sigg, Dave Tanner, Steve Vass, Rob Ward, Alan Weinstein, David Yeaton-Massey

### Documents

The presentation and the technical note describing the proposed 40m interferometer upgrade T080074 are posted on 40m wiki:

[http://lhocds.ligo-wa.caltech.edu:8000/40m/TAC\\_Meeting-Apr\\_08](http://lhocds.ligo-wa.caltech.edu:8000/40m/TAC_Meeting-Apr_08).

### Minutes

Rana lead a presentation covering the status of DRFPMI locking and DC readout, the alternative locking studies, and the proposed upgrade of the 40m interferometer.

Rob presented the status of the DC readout. The measurements in PRFPMI configuration with DC readout (enhanced LIGO) are complete. The laser and oscillator noise coupling have been measured. The locking of the DRFPMI configuration (advanced LIGO) is in progress. The lock is acquired with a large CARM offset using arm transmitted signals and as the arm cavities are brought to resonance the control is handed off to the RF signals. The daytime locking is totally impossible due to nearby construction of Annenberg IST center.

John presented the long term plan for lock acquisition studies including sending the light down the end station via fiber and injecting into the ETMs (fiber has to be stabilized), injecting the light into the pick-off ports, suspension point interferometer, and dichroic coatings. The main theme for lock acquisition studies is to lock the arms independently with a large CARM offset without interfering with the DRMI signals. Then bring the CARM offset to zero and handoff to the nominal control scheme. According to Lisa Barsotti modeling the third harmonic demodulated signal on the reflected port generates linear error signals for the three DRMI degrees of freedom and depends only weakly on the CARM offset through the range of interest. The 3f locking of DRMI will be attempted in the near term.

Daniel: Based on H1-H2 laser frequency noise measurement using optical fiber one may need a reference cavity at the end station.

Rana: According to the clock community experience the rms of 1Hz can be achieved at low frequencies using an optical fiber of 1 km scale.

Dave: What is the requirement for the frequency noise for lock acquisition.

Rana: ~1 nm.

Hartmut: do short dof's lock deterministic.

Rana: statistical locking for now.

Rana presented the proposed upgrade of the 40m lab. The upgrade reflects the change in the advanced LIGO design of the interferometer sensing and control. Namely the arm cavity finesse will be reduced from 1200 to 450, the RF modulation frequencies will change from 33 and 166 MHz to 9 and 45 MHz (the Mach Zuckerman modulation scheme will be replaced with the inline scheme), the CDS will be based on advanced LIGO architecture. To accommodate the modulation frequency changes the recycling cavities and the mode cleaner will have to be made longer. This will require folding the optical path for SRC and PRC and extension of the vacuum tube for the mode cleaner. The folding mirrors for the recycling cavities will be based on the ANU tip-tilt mirrors but will not have actuators and active damping – only the passive Eddie current damping will be used. The lighter masses of the input optics for the arm cavities will be used (SOS instead of MOS). Rana and Co. have been exploring a new technique of adaptive noise cancelation. Matt has recently demonstrated this technique on the 40m lab mode cleaner. This technique will be studied further to subtract the auxiliary channels from DARM.

The upgrade is scheduled to start in the fall of 2008. Rob's PhD work on DC readout with existing 40m DRFPMI should be finished by September.

Dennis: Do you need the superpolished mirrors

Rana: We are assuming the 80 ppm losses so we don't need to superpolish

Rob: We can make the ifo overcoupled with finesse of 450

Dennis: Are there other designs efforts

Rana: Longer mode cleaner

Peter: Any spare substrates for ETMs

Rana: Maybe one spare

Rana: Should we coat for green light or change later

Hartmut: If dichroic coating is needed for advanced LIGO

Peter: How does transmission vs wavelength look for existing ETM

Rana: We have looked at initial LIGO coating. The biggest worry is the AR side.

Dennis: Coating was guaranteed at 1064 nm. We should ask REO if they can meet the spec.

Peter: Optimized advanced LIGO coating turns ETM into high reflector for green.

Peter: Is there budget for the CDS upgrade?

Dennis, Alan, Rana: Yes.

Peter: What about manpower?

Rana: Two incoming postdocs, two existing grad students + 1-2 new grad students.

Peter: I would prefer to see more work on the budget rather than on the upgrade document.  
Dennis: Enter dialog with vendors.

### **TAC Recommendation**

TAC endorses the 40m lab upgrade proposal. The 40m lab team should work on producing the specifications for hardware and the budget.