LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Installation Plan: eLigo 35-W laser for the H1 interferometer

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Distribution of this document:
LIGO Science Collaboration

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1 Introduction

This document outlines the installation plan for the eLigo 35-W laser for the H1 interferometer.

1.1 Relevant documents

1. *Advanced LIGO PSL Hazard Analysis*, LIGO-T070145-02-D
2. *Standard Operating Procedure: Advanced LIGO 35-W Nd:YAG Laser for the H1 Interferometer*, LIGO-M070393-00-D (awaiting final approval)
3. *Advanced LIGO Pre-stabilised Laser Safety Plan*, LIGO-T070010-05-D
4. *eLigo and AdvLigo PSL Pump Diode room Design Requirements and Conceptual Design*, LIGO-T070105-00-W
5. *Preliminary Design – AdvLIGO PSL Laser Diode Room*, LIGO-T070195-04-W

2 Installation plan

The installation of the laser is scheduled to begin on March 24, 2008.

2.1 Participants

1. Christian Veltkamp, LZH
2. Sascha Wagner, LZH
3. Mike Fyffe, LLO
4. Antonio Lucianetti, LLO
5. Peter King, CIT
6. Anamaria Effler, LHO
7. Rick Savage, LHO

2.2 Work plan

A rough outline of the planned work is:

1. Unpack shipment from LZH – Laser, Control Box, Diode Box, etc.
2. Lay fibers and cables in trays
3. Install Diode Box in Laser Diode Enclosure
4. Configure PSL computer
5. Configure EtherCat network
6. Install Control Box in LVEA
7. Connect fiber optics at Laser Diode Enclosure
8. Test optical fibers

9. Connect fiber optics at Laser Head
10. Test 35-W laser for shipping damage
11. Remove 10-W laser from PSL table
12. Install 35-W laser
13. Test laser safety/access controls, laser kill button, laser shutter, laser interlock circuit, etc. with laser in place (before energizing)
14. Characterize 35-W laser

Low-power operation (500 mW to 10W via beamsplitters in place of steering mirror)

15. Configure 35-W laser diagnostics signals and shutter/shutdown control (close and off only)
16. Modematch to PMC and FSS
17. Commission FSS loop
18. Commission PMC loop
19. Test and characterize modecleaner servo/VCO operation
20. Install AdvLigo EOM (with VolkerQ from UofF)
21. Test modecleaner locking/servo
22. Commission ISS loop

High power operation (to 35 W via replacement steering mirror)

23. Adjust light levels and gains for FSS, PMC, ISS, and MC loops
24. Test PMC performance
25. Test EOM performance

2.3 Preparation

1. Laser Diode Enclosure construction – complete
2. Laser safety/access controls – ongoing, est. completion 3/7/08
3. Pipe bridge installation – complete
4. Portable HEPA fabrication - complete
5. Cable tray installation – ongoing, est. completion 3/14/08
6. Chiller line installation – begin 3/7/08, est. complete 3/12/08
7. Chiller installation and testing – begin 3/12/08
8. Laser Diode Room diagnostics installation (dust, temperature, humidity) – week of 3/10/08
9. Laser Diode Room characterization – begin week of 3/10/08

10. 35-W laser SOP – under review
11. Laser safety/access authorization for visitors – 3/24/08
12. LHO work permit for 35-W laser installation – week of 3/17/08

3 Safety controls testing

3.1 Laser Kill Circuit

A new laser kill button will be added at the entrance to the Laser Diode Enclosure. The performance of this button and the rest of the laser kill circuitry will be tested to ensure that the power to the InnoLight Mephisto power supply (for the NPRO master oscillator) and the Diode Box are disabled when one of the buttons is depressed..

3.1.1 Description of tests performed and results:

The circuit was tested by Cyrus Reed and Richard McCarthy (LIGO- T080076-00-C) to ensure the existing Laser Kill circuit shuts down power to the new diode power and no problems arise on the existing system. This also tests that the new button at the Diode room shuts down all LVEA laser power supplies.

First all buttons were tested verifying power at the interface box was killed when each button was pressed. These included Control Room, LVEA entrance, Diode Room 4k PSL, 2k PSL.

We then verified that 120V at the lasers was disconnected when a kill button was pushed. A Fluke 87 True RMS meter was used. The 120V was removed and restored at the Diode Room, 4k PSL, 2k PSL, X-arm TCS, Y-armTCS, Unable to verify an assembly area circuit due to circuit being off at the circuit breaker therefore no 120V was present.

System test was successful and completed 21March 2008.

Richard McCarthy

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3.2 Access controls

A forced door condition at the entrance to the Laser Diode Enclosure, the PSL Table Enclosure, IOT1 or one of the H1 ISC tables will result in the shutdown of both the Innolight Mephisto power supply and the laser diodes within the Laser Diode box. This is realized via the interlock circuit of the 35-W laser. This will be tested by forcing doors and verifying system performance.

3.2.1 Desription of tests performed and results:

The response of the 35-W laser system to a *Forced Door* condition for both the Laser Diode Enclosure and in the Laser Table Enclosure was tested by R. Savage, C. Veltkamp, S. Wagner, and P. King on March 25, 2007.

For the Laser Diode Enclosure, one person remained inside the Laser Diode Enclosure while the other person logged out of the access control system, leaving it in the *Active* state. The person inside the Laser Diode Enclosure then opened the door, thus causing a *Forced Door* condition. The response of the Beckhoff Control Box was verified via telephone communication with someone stationed in the LVEA next to the control box. Both the Innolight Mephisto power supply and the 35-W laser transitioned to the interlock open state in which no laser light is emitted from either the Diode Box or the Laser Head.

For the Laser Table Enclosure, a similar test was performed by simply opening one of the table doors with the access control system in the *Active* state. Again, the access control system transitioned to the *Forced Door* condition and both the Innolight Mephisto power supply and the Bechoff Control Box responded by transitioning to the interlock open state in which no laser light es emitted from either rthe Diode Box or the Laser Head. This test was repeated by forcing the door in ISCT1 with similar results.

Rick Savage

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