LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
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Proposal for Remote Control of Laser Power into 2km LHO Mode Cleaner

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Distribution of this draft:

LHO Laser Safety Officer

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of the LIGO Project.

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1   ABSTRACT

In the daily operation of commissioning the 2km interferometer at Hanford, it has become apparent that remote readout and control of the laser power incident on the mode cleaner is desirable. This document is intended to propose a method of remote readout and control, identify safety concerns, and suggest reasonable checks to address these safety concerns.

2   KEYWORDS

Laser, Pre-stabilized Laser, Safety, Proposal For...

3   OVERVIEW

Power input into the 2 km interferometer at LHO is controlled by a half-waveplate/polarizer combination on the PSL table, located after the last electro-optic modulator (the power in the modulators is kept high and reduced after them in order to maintain constant thermal loading in the modulators). Currently this is accomplished by operating a picomotor driver hand-paddle at the PSL table, which drives the rotation stage holding the half-waveplate and dictates the power. The DC output of a Newfocus 1811 detector collecting a small fraction of the beam gives an indication of power changes, but it is not calibrated in terms of absolute power incident on the mode cleaner. The readout and control function could be implemented in Epics state notation code, so that the power into the mode cleaner could be read out in a calibrated manner, and adjusted remotely (for example, from the control room). The advantage of remote/computer operation are: elimination of the need to visit the PSL table and speedup up operations; elimination of the current practice of inserting a power meter into the beam to measure absolute power and the obvious disruption it causes to the system; better test repeatability from being able to more easily set the power to a known level.

Figure 1 is a schematic of the method of control envisioned. There are two separate stages of the remote control, i) actuation of the waveplate rotation stage, and ii) measurement of the power after the waveplate.

Actuation of the waveplate rotation stage would be initiated within an Medm screen. Selection of the desired power could occur in a dedicated operator screen via a slider or an expressed numerical field; a numerical field is probably less error-prone, as there is no slider which could be pulled past an intentional value, and will be implemented first. This would result in the setting of an Epics channel on the PSL or IOO IOC (VME cpu), and the sequencer code would then communicate with the New Focus 8732 Picomotor Driver, to rotate the waveplate and set the power.

The measurement of the power after the waveplate will be accomplished via a wedge pickoff optic, already resident on the PSL table. A Newport 818-SL large-area calibrated photodiode would be employed to monitor the power level of the beam, sending this signal through a Melles Griot amplifier to a 3113 ADC channel; the 1.13 cm diameter of the photodiode is large enough that small shifts in the beam position on the diode will not change the photocurrent (a problem with the current 1811 detector). The wedge plate and detector will be calibrated at installation, and this calibration factor will be used to display on the Medm screen the actual power incident on the mode cleaner. The sequencer must monitor this power level and respond accordingly.
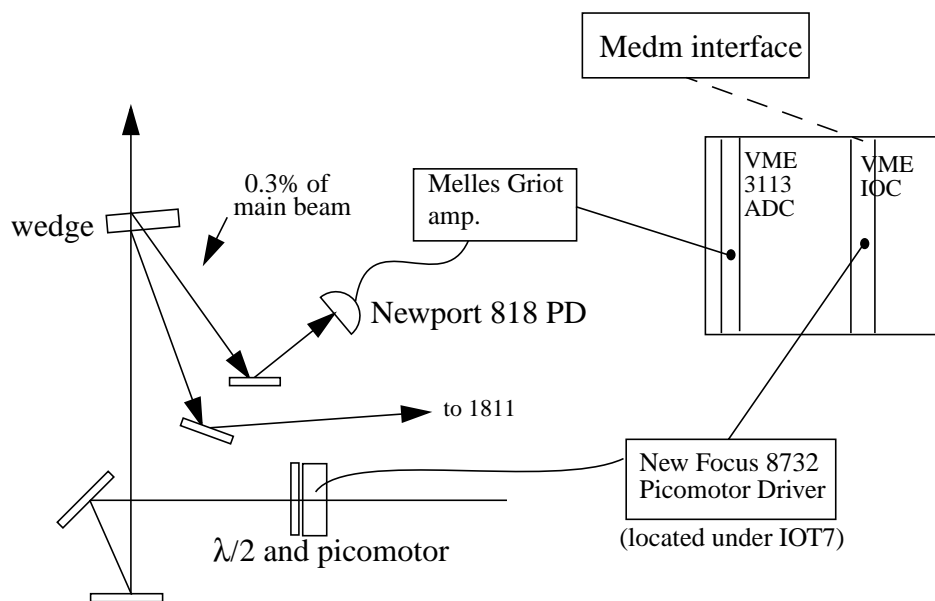
Fig. 1: Schematic of power monitoring of laser, downstream
of half waveplate/picomotor setup.

4   SAFETY MEASURES

In order to address safety concerns related to modifying the laser power input into the mode cleaner remotely, the following checks will be implemented.

• In the Medm screen from which the laser power is manipulated, a popup dialogue box (written in Perl/TCL) will clearly state that prior authorization from the 2km responsible laser operator is required before executing the function. Additionally, the dialogue box will explain that the control room operator must be notified of the change (initially this will be via verbal communication to the operator; later it may be done as part of the Epics alarm handler).

• The requested power in the mode cleaner will be set by a field in the Medm screen. The sequencer code will then instruct the picomotor driver to adjust the waveplate accordingly. As an additional check, the sequencer will keep a Maximum power setting, settable through an additional Epics channel, above which the power cannot be increased, regardless of what is requested in the Medm screen.

• The measured power after the half-wave plate will be monitored at the wedge pickoff, as described above. If the measured power is above threshold, the sequencer will ramp the power back.

• In the event that the remote control needs to be effectively "locked out" at a hardware level, the cable from the picomotor driver (underneath the PSL table) to the picomotor could be disconnected. There will likely be instances when work is underway on the PSL table or downstream of the PSL where such a lockout procedure (i.e. low power with no remote control available) is appropriate (In the unlikely event there are hysteresis effects and the picomotor drifts when

detached, causing an unexpected change in power level, we can monitor this downstream of the wedge and issue an alarm to the operator console).

• The remote modification of the power is intended to be able to be run whereever Medm screens can be invoked, e.g. the LVEA, the control room, mid and end stations. No further security is implemented. We note that if network connections enable Medm screens to be launched from off site, then it is conceivable that if safety notices are ignored, the power into the MC could be modified remotely.

• The SOP relating to the safe operation of the 2km 10-W laser should be modified to include instructions/procedures regarding modifying the laser power input to the mode cleaner.