Technical Document **9/26/01** **LIGO-T010105-00-Z**

Description of the LockLoss DMT Monitor

D. Chin (dwchin@umich.edu)
K. Riles (kriles@umich.edu)

University of Michigan Physics Department, Harrison Randall Laboratory
500 E. University Ave., Ann Arbor, MI 48109-1120

1 Function

The LockLoss Data Monitoring Tool (DMT) monitor watches for losses and acquisitions of lock in the interferometer arms. It sends triggers to the MetaDataBase when these events occur. The monitor also serves data in the form of lock history to the DMT Viewer program.

2 Algorithm

LockLoss monitors one channel for each arm of a specified interferometer: XX:ASC-QPDX_DC for the X-arm, and XX:ASC-QPDY_DC for the Y-arm, where the XX in the channel name is to be replaced by H1, H2, or L1 for the Hanford 4K, 2K, and Livingston 4K interferometers, respectively. These 2 kHZ channels correspond to currents measured from photodiodes that see the light transmitted through the ends of the two arms. When an arm is resonant, the light power in the arm increases dramatically, and the relatively small fraction that leaks out the highly reflective end mirrors increases accordingly.

To make the "in lock" definition used here robust against transient resonances but not unduly sensitive to downward in-lock power fluctuations, we require that the mean power detected by the end photodiodes over a one second interval be at least one third of the nominal resonant power for that arm when locked in isolation. The definition used here for both arms being locked is simply that both arms satisfy in the same 1-second interval the conditions for being in lock individually. Note, however, that when an interferometer is operated in recycled mode, the actual power in the arms when they are simultaneously resonant can be hundreds of times larger than the resonant powers of the arms when locked one at a time (because the carrier power is not resonant in the recycling cavity until both arms resonate).

Because conditions have been changing with time during commissioning (*e.g.*,, laser power, photodiode gains), we have found it necessary to change from

time to time the numerical values of the thresholds applied to the QPDX/QPDY channels. For reference, during the August 2001 E5 engineering run, the Hanford 2K X-arm power threshold was set to 25 ADC counts, and the Y-arm threshold to 30 counts. It should be noted that properly normalized, floating point transmitted power channels,, XX:LSC-LA_NPTRT and XX:LSC-LA_NPTRR, do exist and are used by the lock acquisition software. These channels are treated in the data acquisition code as test points, however, making them unavailable to offline analysis and their use in the DMT environment problematic.

3 Triggers

The `LockLoss` monitor sends triggers to the MetaDataBase whenever one or more arms changes its lock state, *i.e* if lock is acquired or lost. The following table lists the presently defined trigger labels, where the meanings are self-evident:

Trigger Name
X_arm_lock_acquired
Y_arm_lock_acquired
Both_arms_lock_acquired
X_arm_lock_lost
Y_arm_lock_lost
Both_arms_lock_lost

Table 1: Trigger set

The trigger record also includes the ID of the interferometer (H1, H2, L1) and a time stamp.

4 DMT Viewer Interface

The `LockLoss` monitor also serves data for display in the DMT Viewer program. At present, the data served are 6-hour histories of livetime fractions computed every minute for each interferometer arm and for simultaneous locked states in both arms. Future enhancements will include histograms of locked time intervals.

5 Implementation

`LockLoss` uses the `OperStateCondList` DMT class[1] to define conditions. For illustration, the configuration file used during the E5 engineering run for the Hanford 2K is shown below:

```
#
# OSC configuration for LockLoss monitor
#

X_arm_locked     meanabove   "H2:ASC-QPDX_DC"     threshold=25
Y_arm_locked     meanabove   "H2:ASC-QPDY_DC"     threshold=30

Both_arms_locked   boolean       "X_arm_locked & Y_arm_locked"

X_arm_lock_acquired  transitup   "X_arm_locked"
X_arm_lock_lost      transitdown "X_arm_locked"

Y_arm_lock_acquired  transitup   "Y_arm_locked"
Y_arm_lock_lost      transitdown "Y_arm_locked"

Both_arms_lock_acquired   transitup   "Both_arms_locked"
Both_arms_lock_lost       transitdown "Both_arms_locked"
```

6 Known Bugs

LockLoss trigger entries in the MetaDataBase through the end of the E5 engineering run have time stamps that are exactly one second later than intended. The bug was corrected in the source code after E5.

References

[1] D. Chin and K. Riles, "Defining and Testing Operational State Conditions in the Data Monitoring Tool", LIGO-T-010104-00-Z (September 2001).