S1 Data Quality Summary

J. Zweizig

October 18, 2002

1 Introduction

Most gravitational wave analysis of the LIGO science data assumes that the interferometers were operating under stable conditions throughout the data acquisition period. Although every attempt was made to keep conditions stable, experience tells us that it is inevitable that some data taking periods deviated sufficiently from the optimal (or normal) running conditions that those data should be treated differently in the analysis or even rejected.

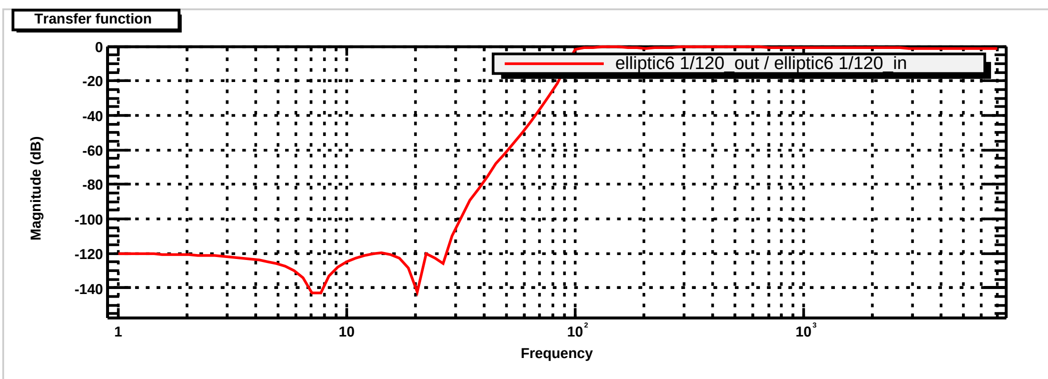
This survey is an attempt to evaluate the state of the interferometers as a function of time by looking at gross measures of noise. It is hoped that the results of this survery will allow the exclusion of periods that may introduce misleading effects into the analysis results. In addition to the description in this report, I will write a series of segments defining data periods for each interferometers during which the interferometer was running well.

2 Data Quality Monitor

The data for this survey were collected by a data quality monitor which was run during the entire S1 run and was also rerun at Caltech to make up for a few booboos.

The data quality monitor produced trends of band limited RMS and of glitch rates. For the rms measurements, the frequency range from ~25Hz - 8kHz was divided into 30 logarithmic bands. This corresponds to about 12 bands per decade or about 20% frequency intervals. The band RMS was calculated by taking a DFT of signal and summing the squares of all coefficients in the band. A Hanning window was applied to the signal before the DFT to prevent prominant signal from spreading into adjacent bins.

The Transient rate measurement was made using the PSLmon Glitch tool. It looks for cases where the signal exceeds a fixed threshold (in sigma) from the signal average. Once found, the glitch is assumed to continue until the signal remains inside the threshold band for $>$10ms. The signals were pre-filtered with a 100Hz or 500Hz high-pass filter and rates were calculated for both 4σ and 6σ thresholds. The transfer function for the 100Hz (6th order elliptic) high-pass filter is shown in the following figure.



3 Results

3.1 Summary plots

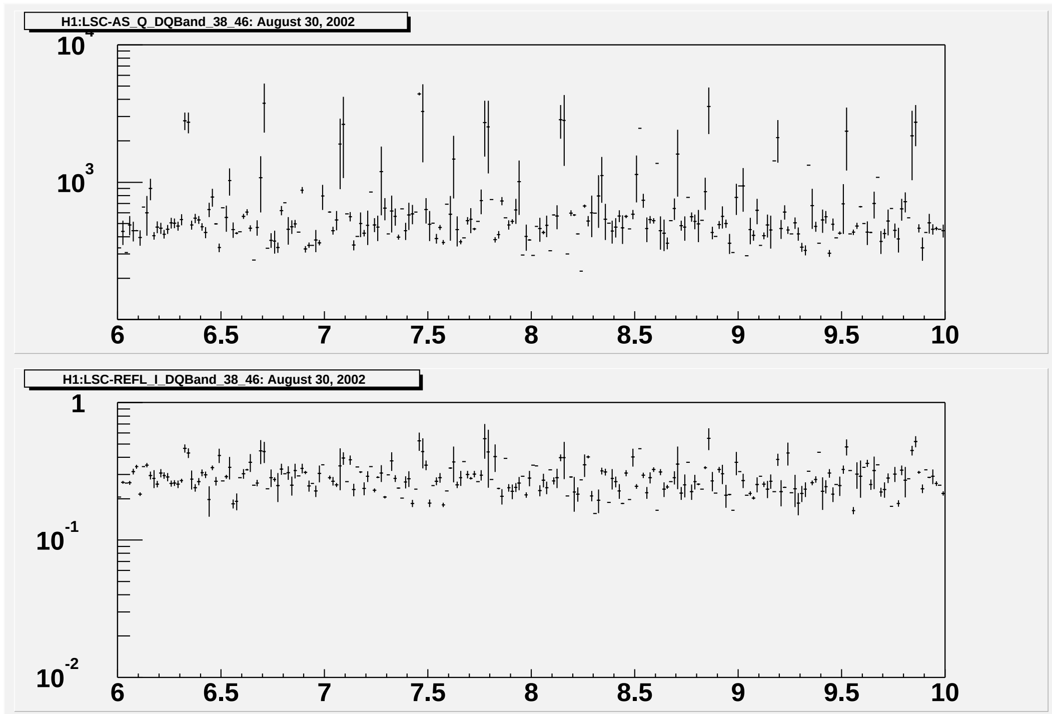
The S1 run summary contains close to 100 pages of trend plots. These have not been included in this report, but may be viewed over the web at `http://www.ligo.caltech.edu/~jzweizig/DataQual/` . Where possible figures are included to illustrate the various effects found in the data.

In general there is a great deal of non-stationarity in the data which varies smoothly or drifts monotonically through a locked segment. In these cases it is difficult to chose a threshold between good and bad or ugly. In the absense of an obvious discriminant, no additional comments will be made, although the individual analysis groups should keep in mind the sometime large variations in noise levels.

3.2 H1

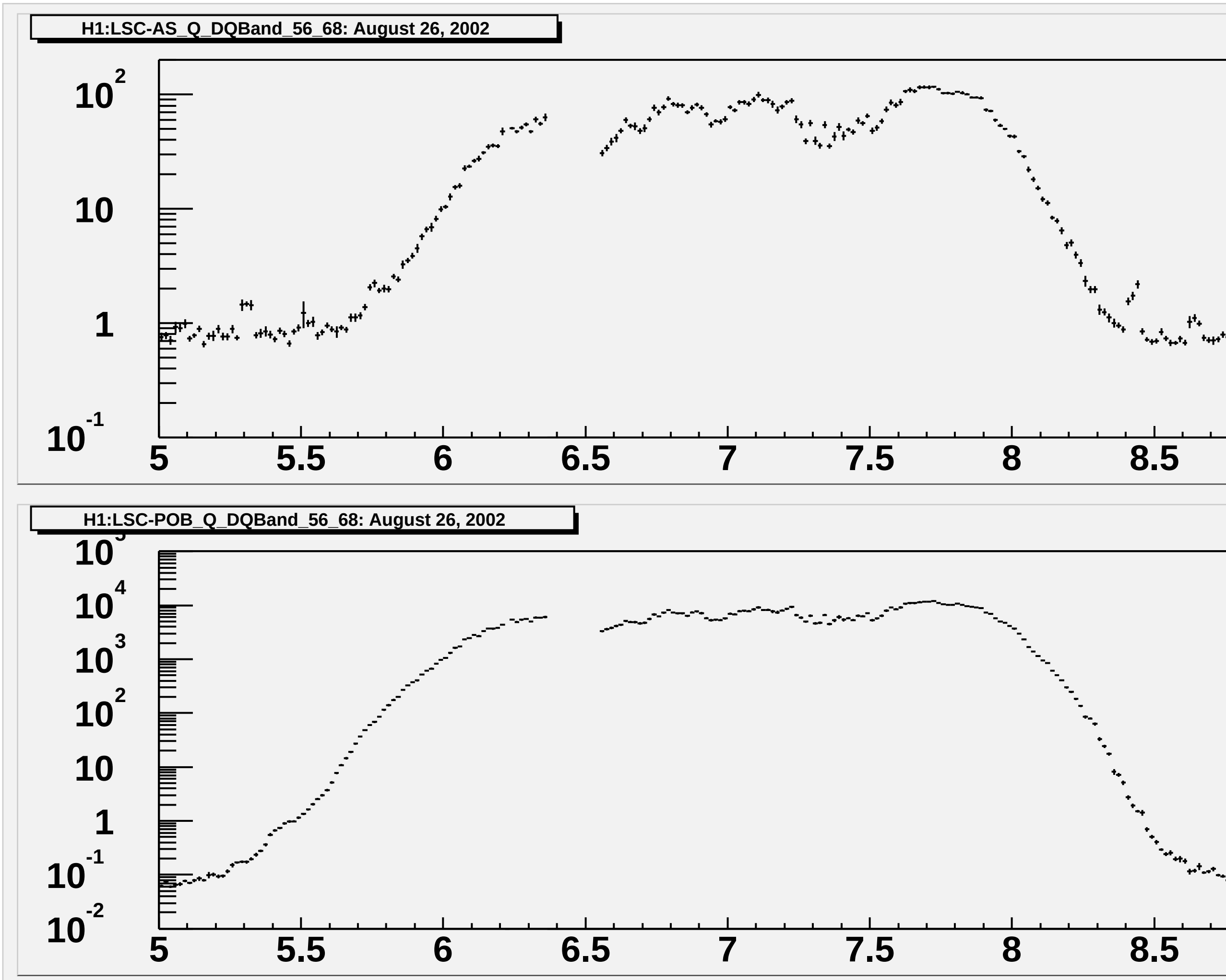
3.2.1 Periodic noise bursts in the 38-56 Hz band

Periodic noise bursts were noted, most prominently in the 38-46Hz and 46-56Hz bands of H1:LSC-AS_Q. These bursts occurred throughout the run with varying amplitude. They were also seen in the same bands of H1:LSC-REFL_I, although with possibly less significance. A 'typical' stretch of 4 hours of data is shown in the following figure with the prominent deviations resulting from these outbursts.



3.2.2 100Hz bulge in H1:LSC-AS_Q and H1:LSC-POB_Q

On August 26, 2002 5:40 UTC, The 56-147Hz bands increased by greater than 2 orders of magnitude for about 3 hours. This effect is also seen in most bands (up to 1kHZ) of the H1:LSC-POB_Q channel. This is shown in the figure below. A shorter but otherwise similar bump is seen at 1:30-2:10 UTC August 27, 2002.



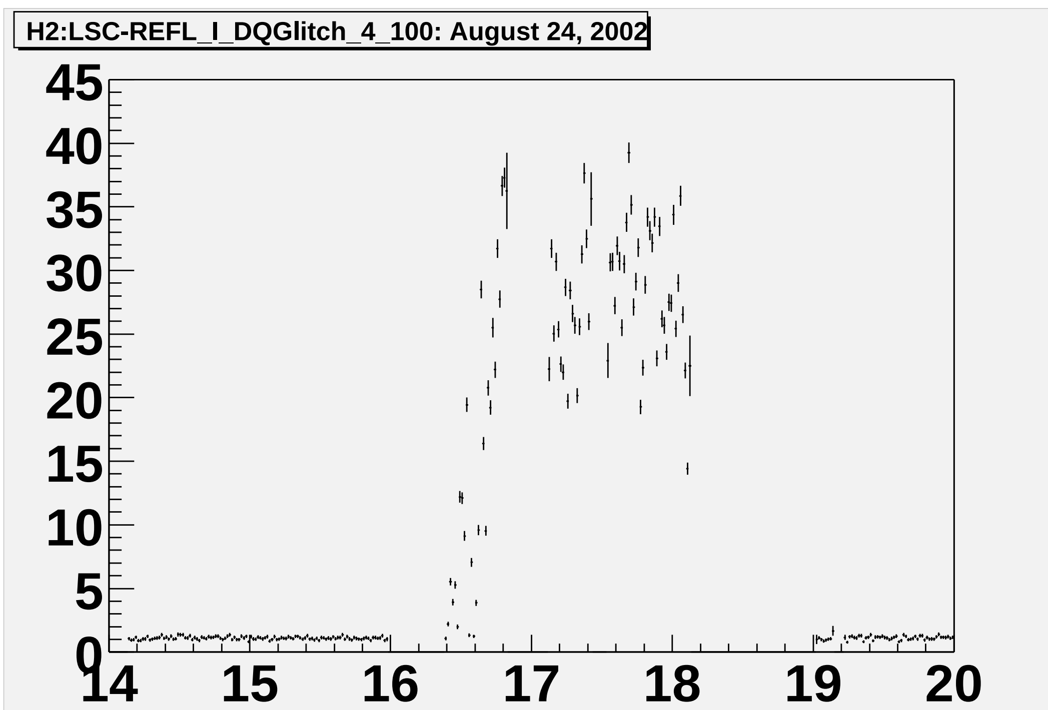
3.3 H2

3.3.1 Anomalous glitch rates

There are occasional H2 lock stretches with anomolously high glitch rates. This is most easily seen in the 4σ H2:LSC-REFL_I glitch rates, although it appears in almost all of the glitch rate plots. The APPROXIMATE time spans are tabulated below:

Period	Start time (UTC)	Start time (GPS)	Duration (s)
1	August 24, 2002 16:20	714241200	6600
2	August 25, 2002 14:10	714319800	1200
3	August 27, 2002 15:30	714497400	1200
4	August 29, 2002 12:20	714691200	1200
5	August 30, 2002 15:20	714756000	3600
6	August 31, 2002 16:50	714847800	4200
7	September 3, 2002 12:40	715092000	600
8	September 4, 2002 14:10	715183800	1500
9	September 5, 2002 09:50	715254600	2400
10	September 5, 2002 15:45	715275900	3900
11	September 5, 2002 19:20	715288800	1800
12	September 6, 2002 22:10	715385400	1500

The figure below shows the glitch rate in H2:LSC-REFL_I during the first of the periods.



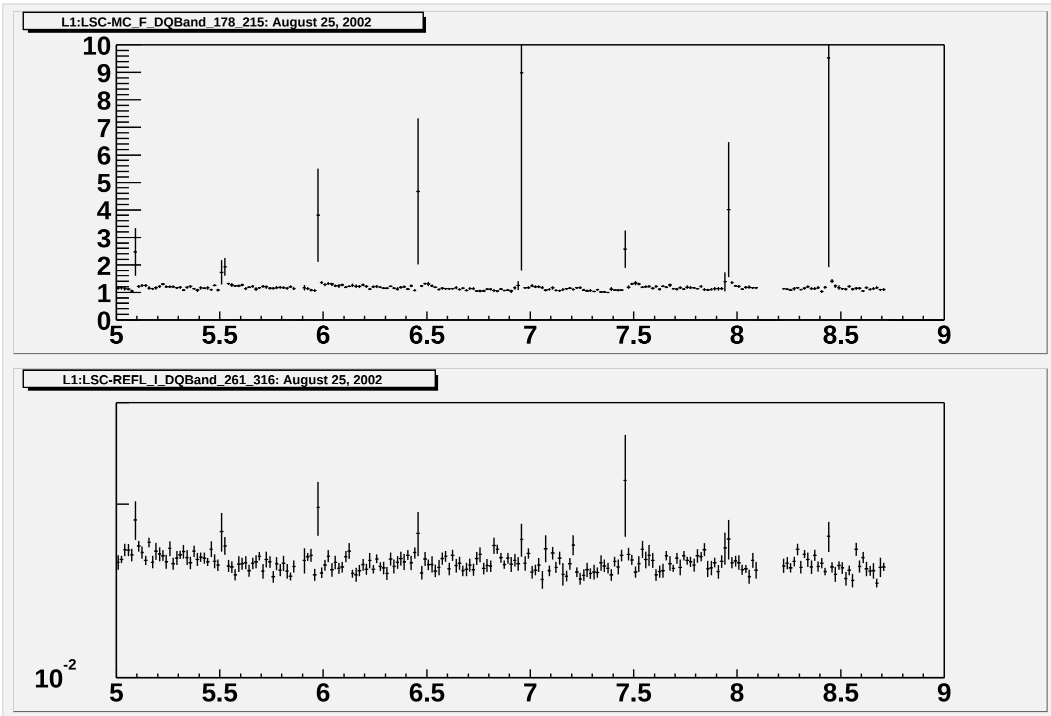
3.4 L1

3.4.1 L1:LSC-MC_F tails off

August 25th 01:05 UTC duration ~1500s.

3.4.2 Periodic glitches in L1:LSC-MC_F and L1:LSC-REFL_I

MC_F, clear repetitive signal in 147-178Hz, 178-215Hz and 215-261Hz bands. Maybe seen in mich ctrl glitch finder.



A similar pattern may be seen in 261-316Hz band of L1:LSC-REFL_I. Although it might be expected that such large transients would be apparent to a glitch algorithm, There is no evidence of increased glitch rates coincident with these transients.