E2 Correlations

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- 3-15-01
- LSC Detector Characterization
- LIGO-G010104-00-Z

E2 Correlations

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Goal is to quantify correlations between various interferometer control and environmental channels

Interferometer noise from the E2 run was approximately five orders of magnitude larger than the desired noise level – correlations provides some information.

Ready to roll with E3 and beyond.

E2: Other systems were behaving relatively well

- See where environmental noise was corrupting operation of “well behaved” systems
- Such as mode cleaner, the pre-mode cleaner, the pre-stabilized laser, …

A detailed description of the DMT code used for this study can be found:

A. Ottewill, http://blue.ligo-wa.caltech.edu/gds/dmt/Monitors/DEnvCorr

B. Allen, W. Hua and A. Ottewill, gr-qc/9909083

All of the results of the E2 correlation study can be found at

http://physics.carleton.edu/Faculty/res67/E2corr.htm

Data and channels analyzed
Correlations at various times

Written report

Attempted to see if we could observe some indication for the loss of interferometer lock. Hence we examined two types of data;

(1) one set was in the middle of a long (1000s) section of locked interferometer operation

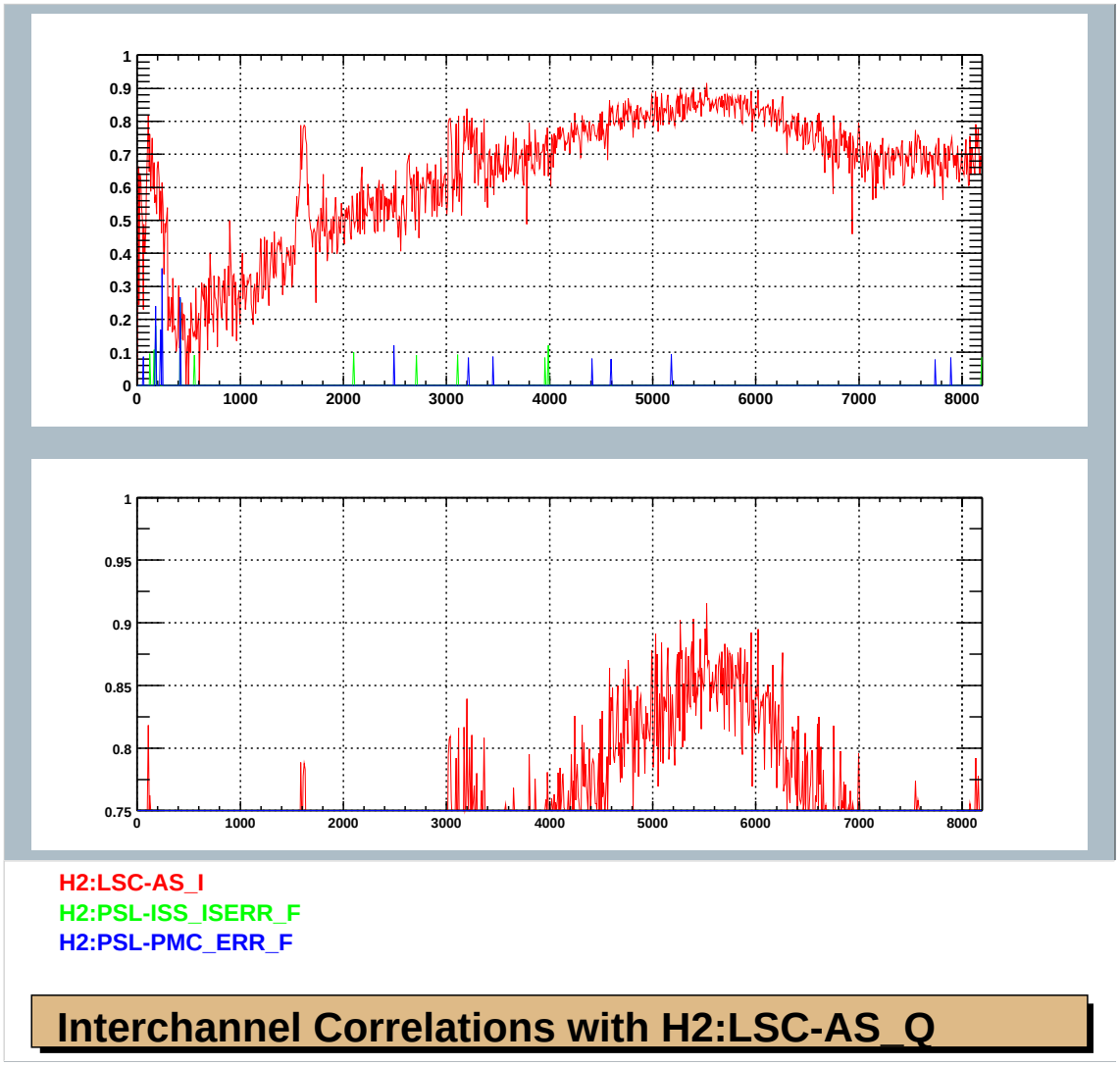
(2) while the other set was within a minute of lock loss.

We did not find indication of loss-lock in correlation results.

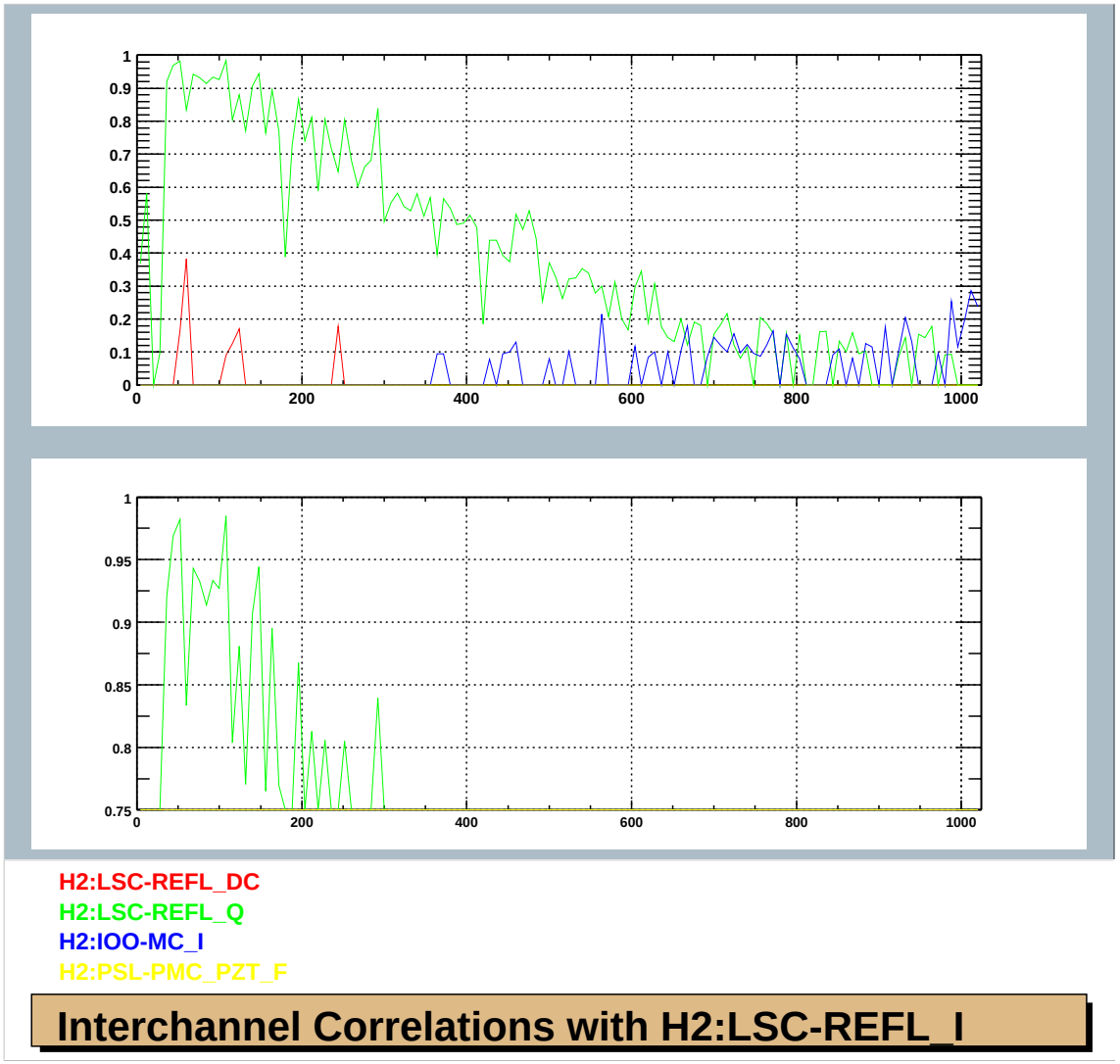
E2 run the digital phase adjustment mixed I and Q phases at the level of 15 to 20%.

Considering the overall quality of the data, it was decided that there was not a lot to be gained by correcting the phase.

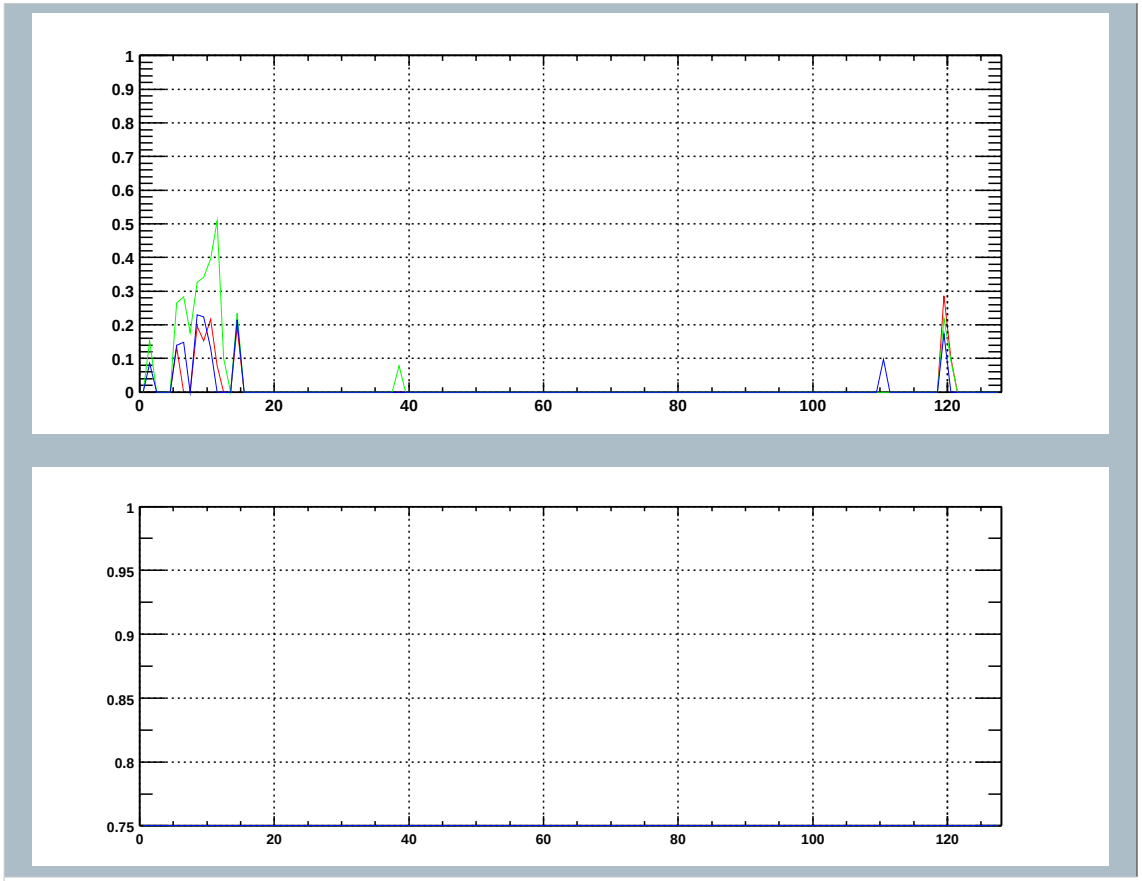
Correlations from this phase error can be seen



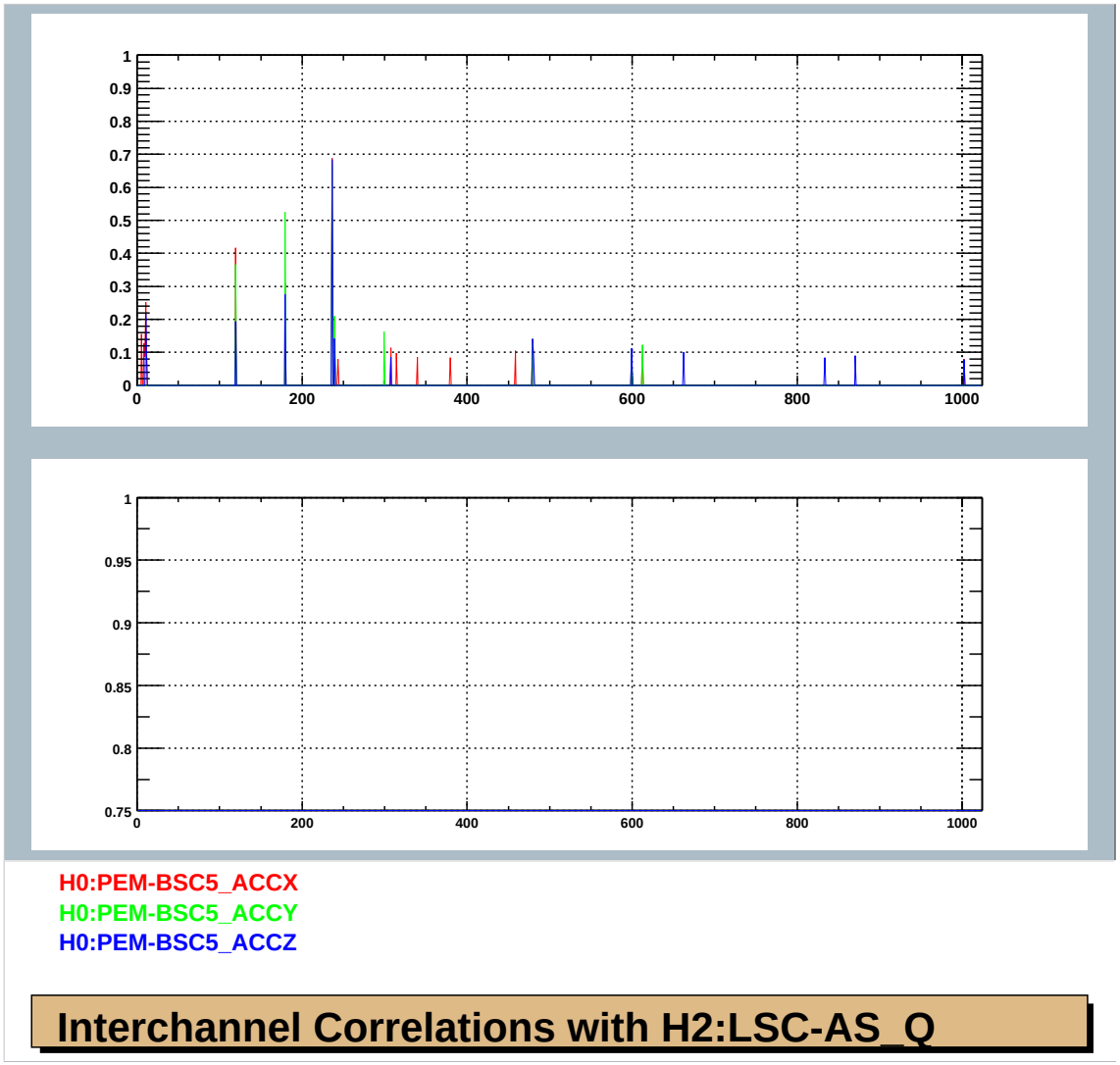
The correlation between H2:LSC-AS_Q and H2:LSC-AS_I



Correlation between H2:LSC-REFL_I and H2:LSC-REFL_Q



Typical correlation between H2:LSC-AS_Q and some seismometers



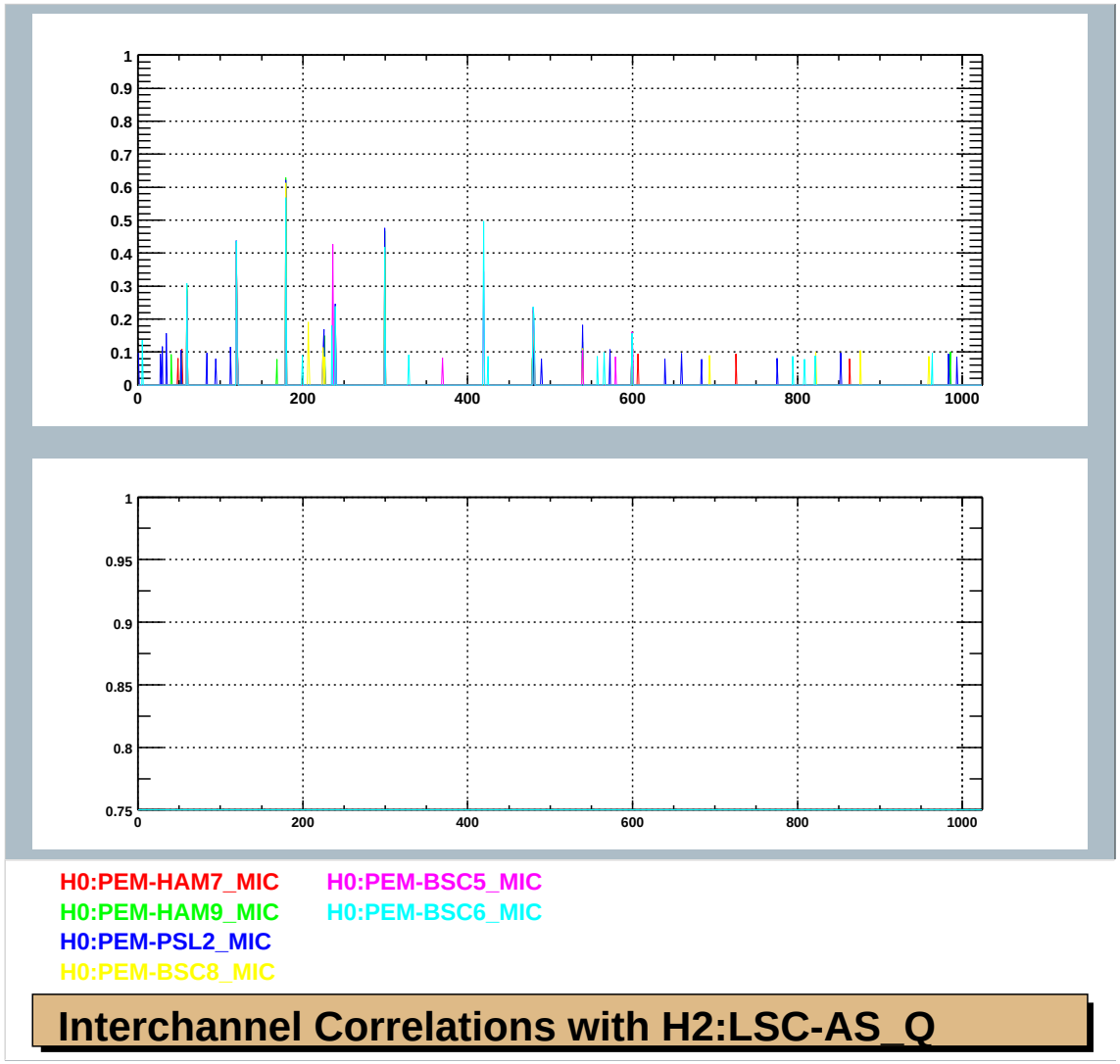
Typical correlation if H2:LSC-AS_Q with accelerometers
Mostly 60Hz and harmonics.

With respect to H2:LSC-AS_Q

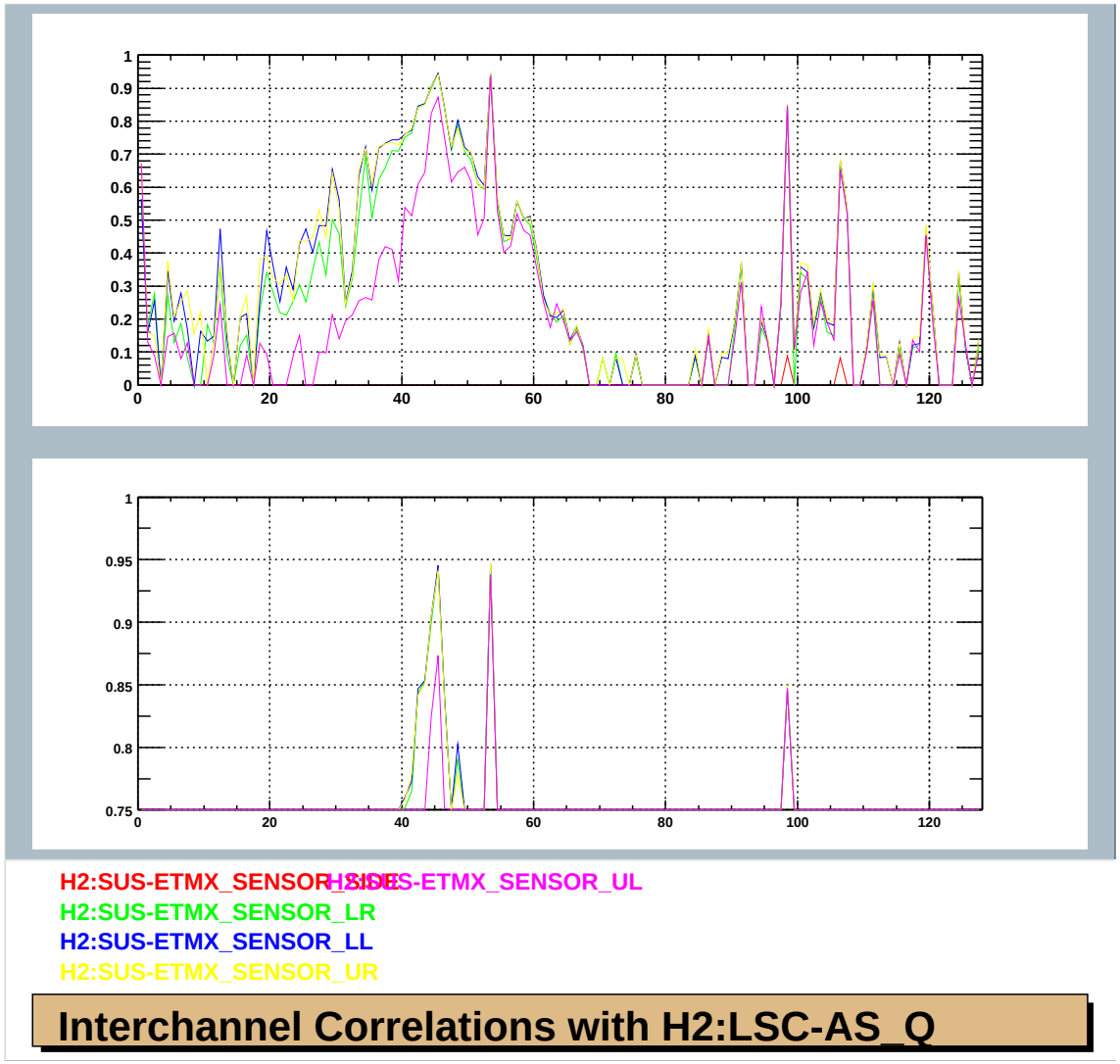
The tilt meter correlations did not show much of interest.

Voltage monitors correlations displayed 60 Hz and harmonics.

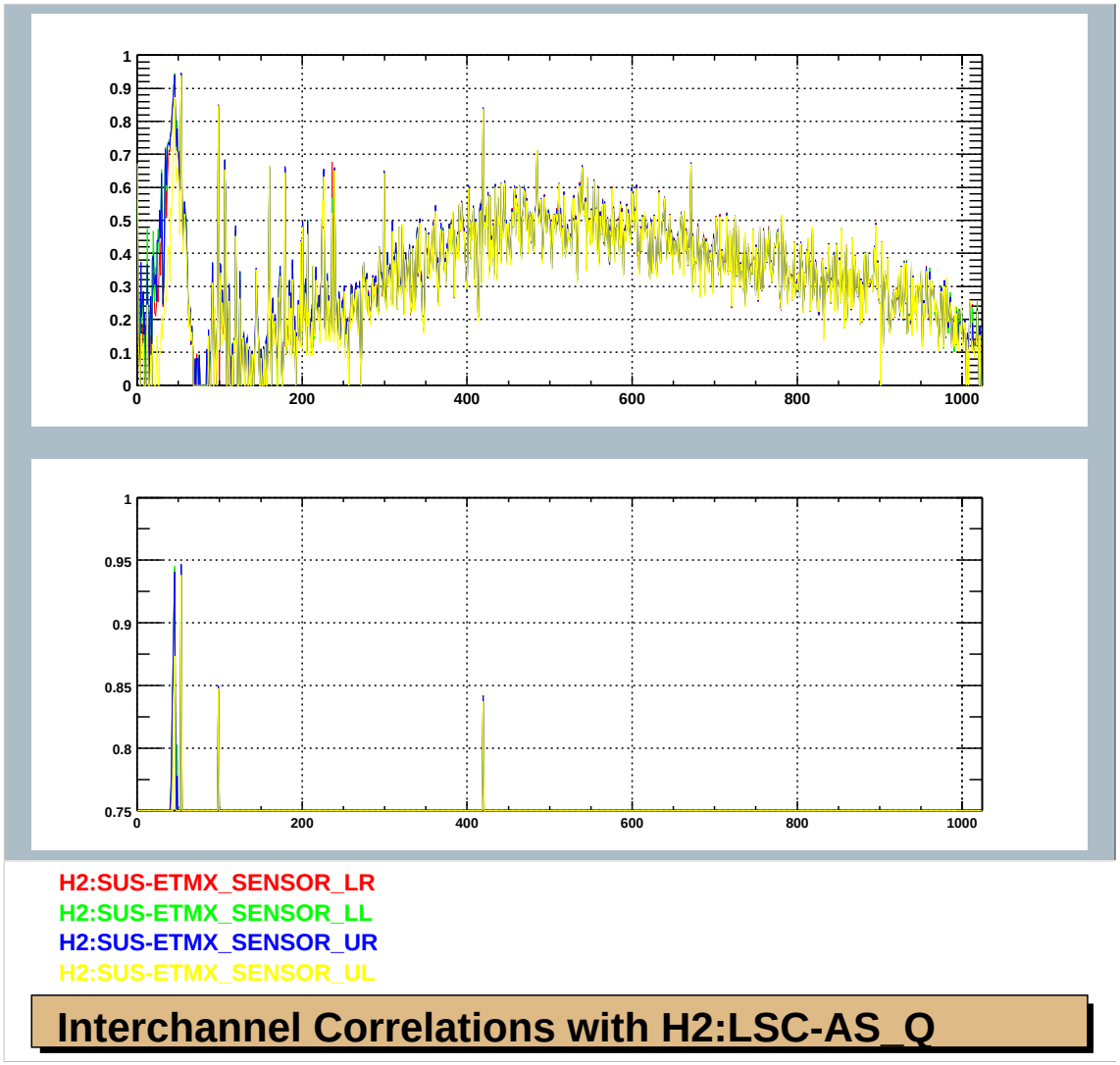
The microphones did register correlated signals; many of these spikes are at 60 Hz or harmonics.



Correlations between H2:LSC-AS_Q and microphones
Note 60Hz and harmonics



Low frequency correlations between H2:LSC-AS_Q and suspension channels

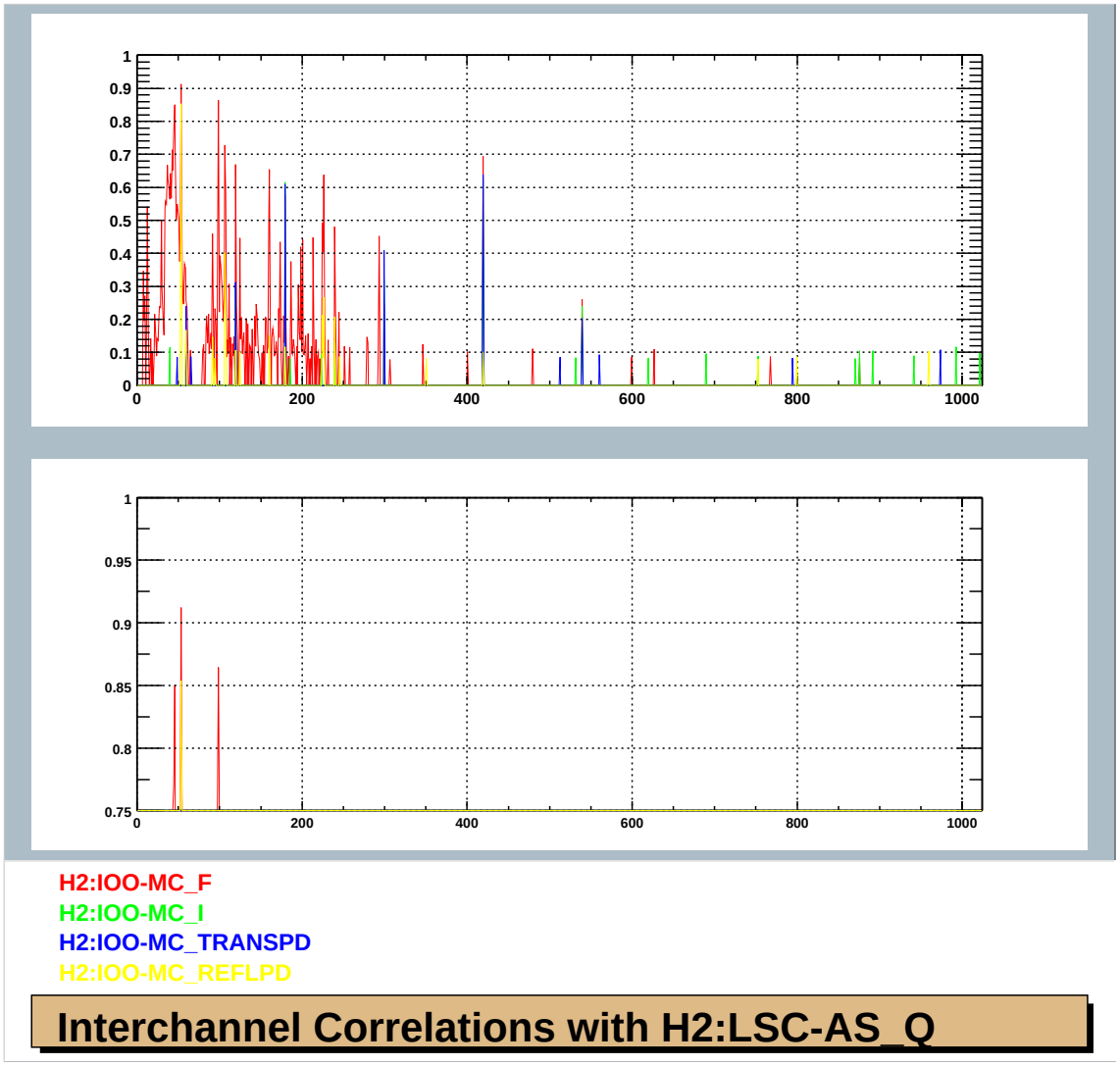


High frequency correlations between H2:LSC-AS_Q and suspension channels.

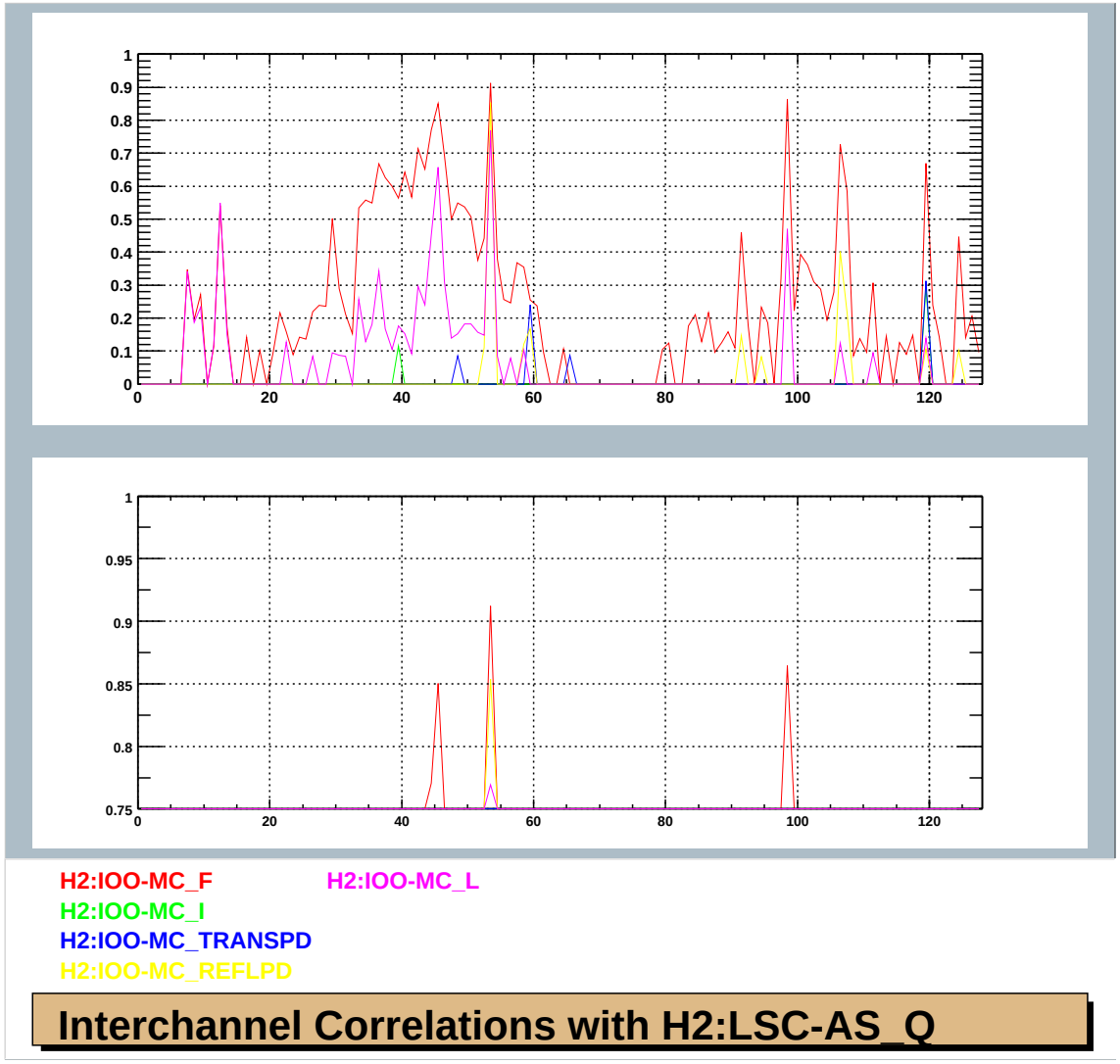
Mode Cleaner

- The mode cleaner is a source of many correlations with the interferometer output.

- Numerous correlations between H2:LSC-AS_Q and H2:IOO-MC_F from 0 - 300 Hz.



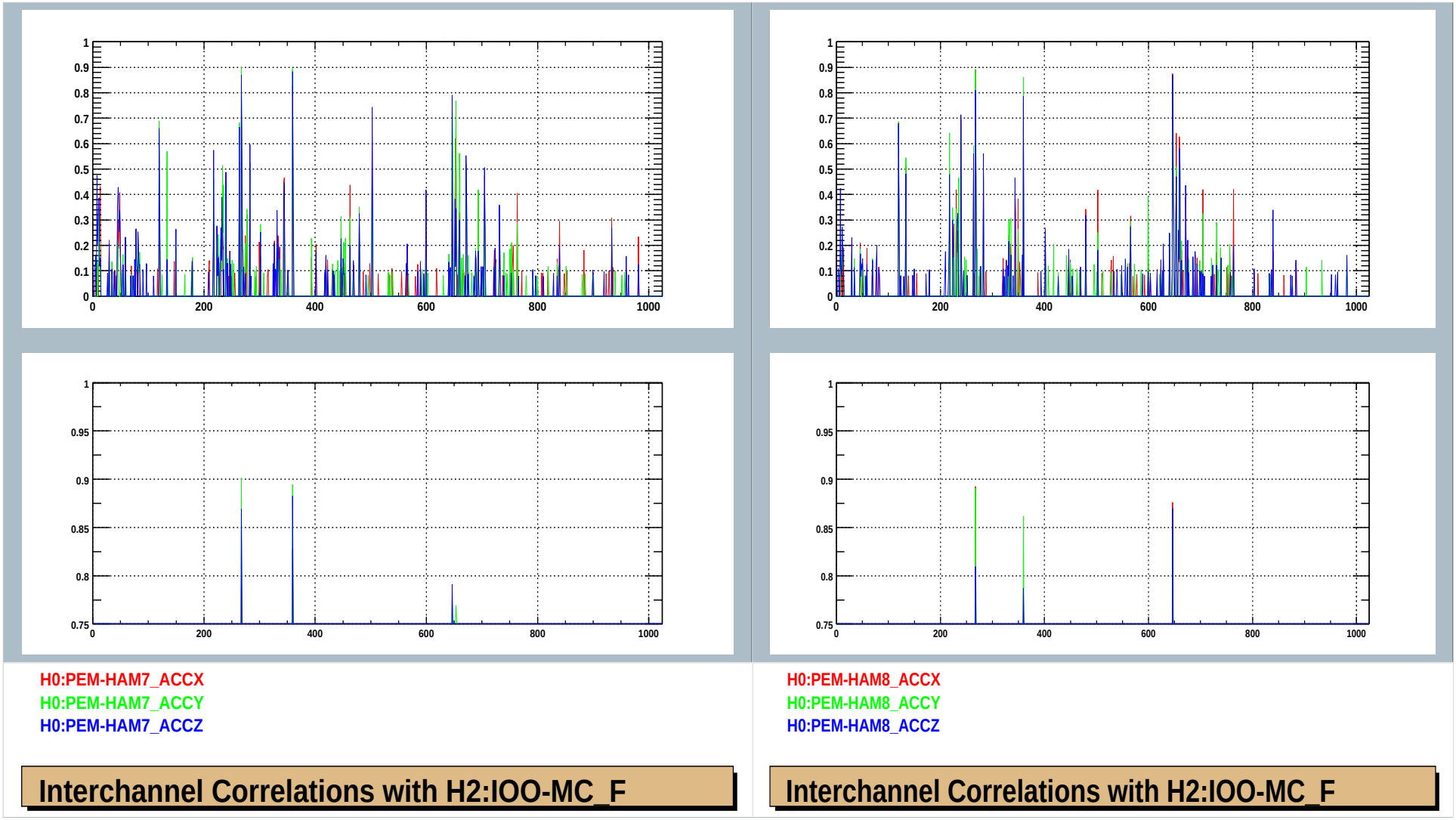
High frequency correlations between H2:LSC-AS_Q and mode cleaner channels.



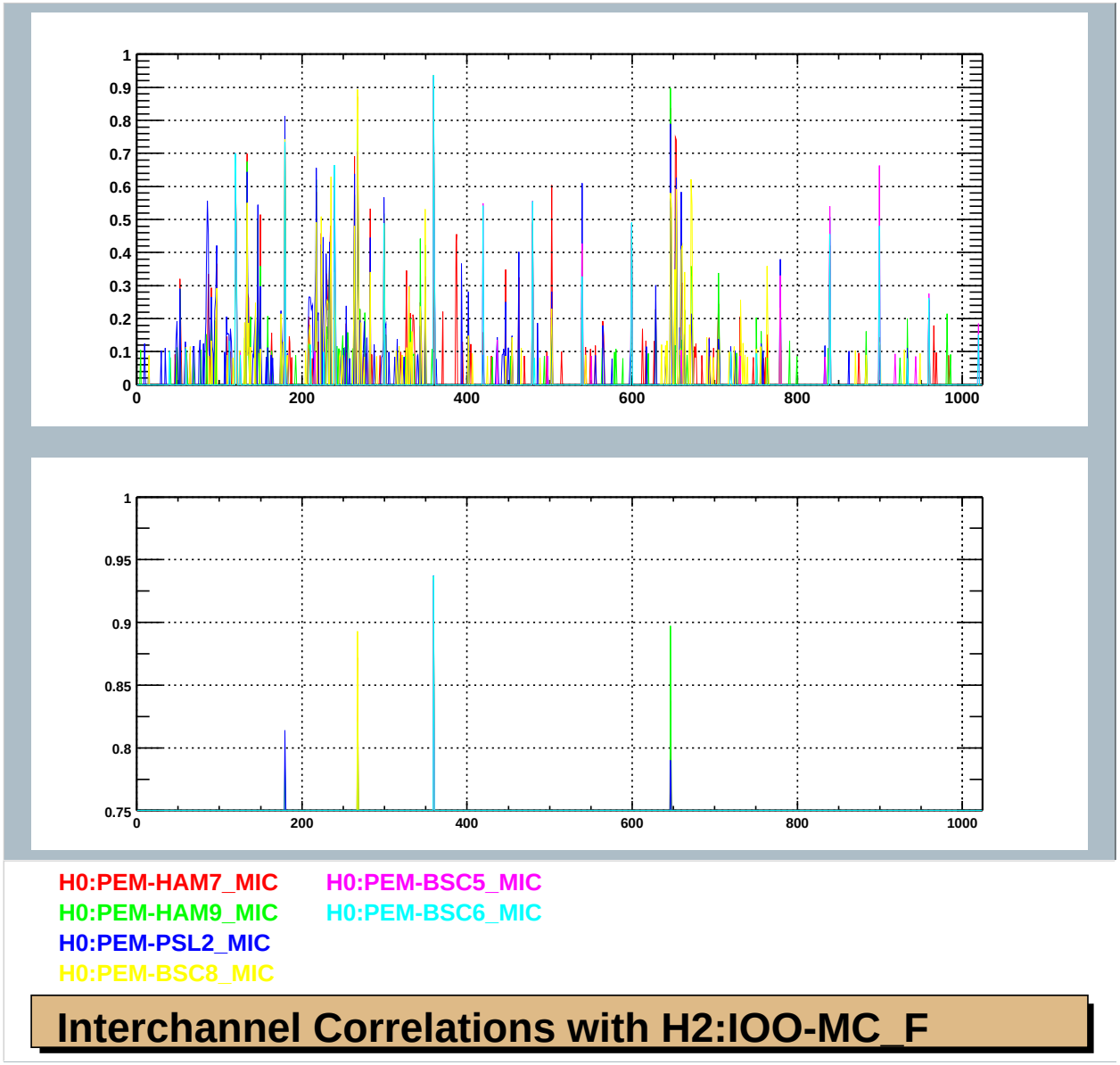
Correlation of interferometer output H2:LSC-AS_Q with Mode Cleaner channels

The mode cleaner signal H2:IOO-MC_F was correlated with some control signals and environmental channels.

There are numerous correlations to be seem with the accelerometers and microphones



Correlations between mode cleaner mixer output H2:IOO-MC_ I and the HAM7 and 8accelerometers



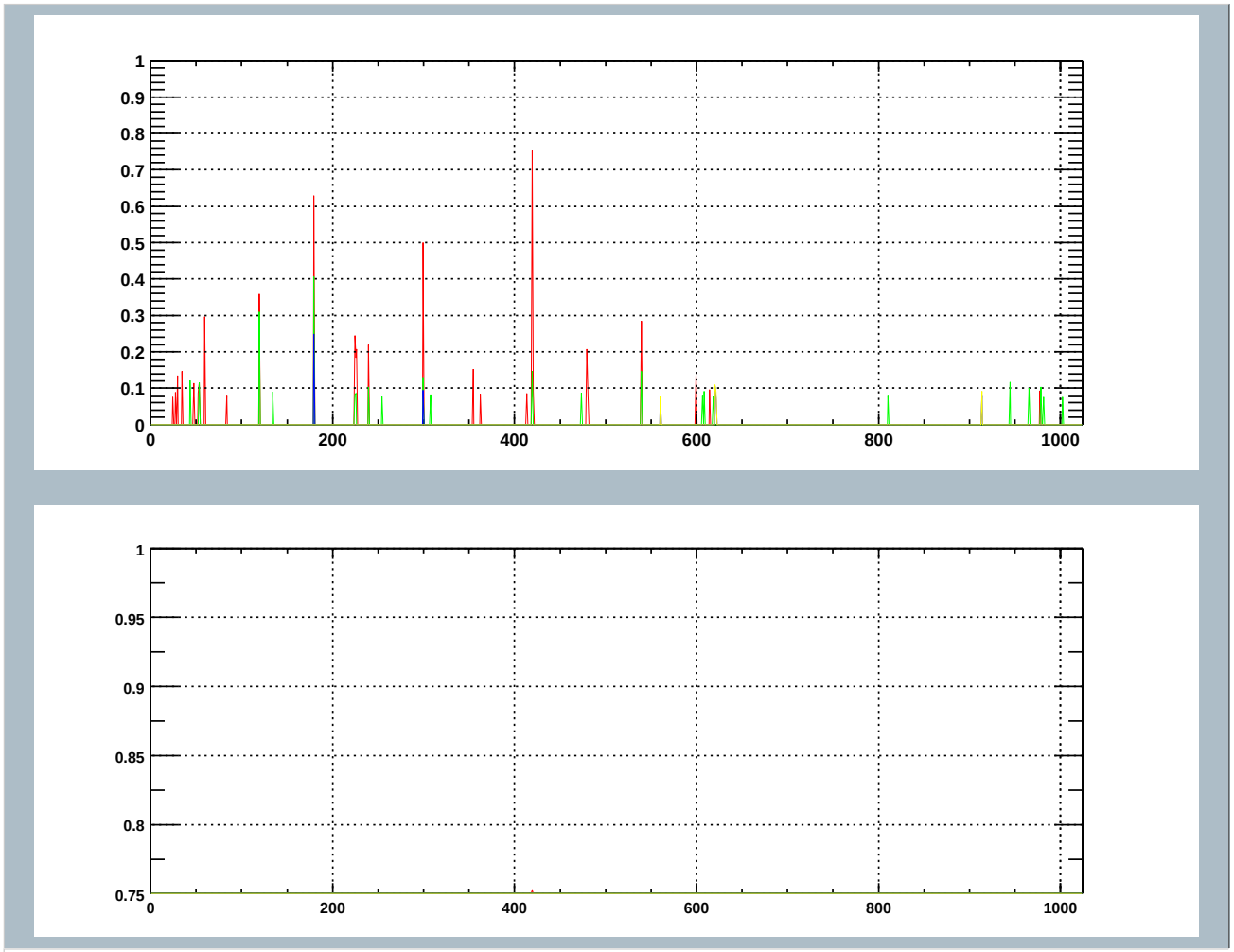
Correlations between mode cleaner mixer output H2:IOO-MC_F and various microphones.

Pre-Mode Cleaner

- Correlations between the pre-mode cleaner signal, H2:PSL-PMC_ERR_F and the interferometer output H2:LSC-AS_Q were mainly observed at 60 Hz and harmonics

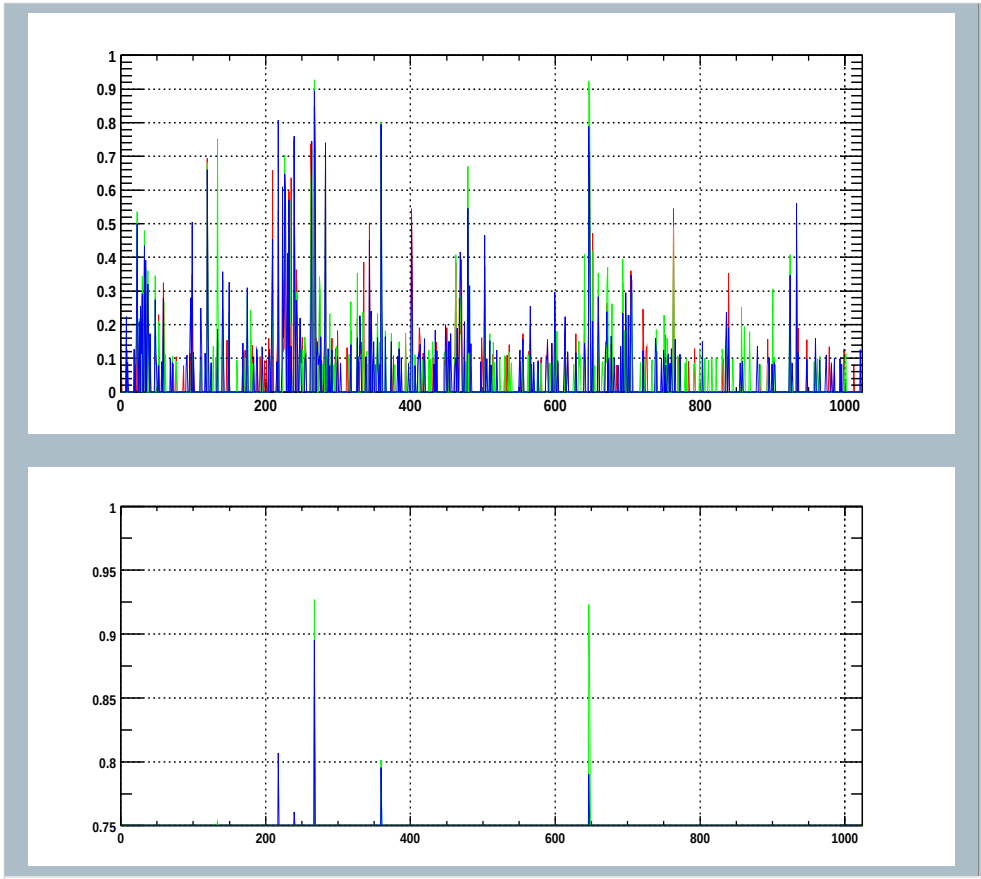
- Numerous correlation between

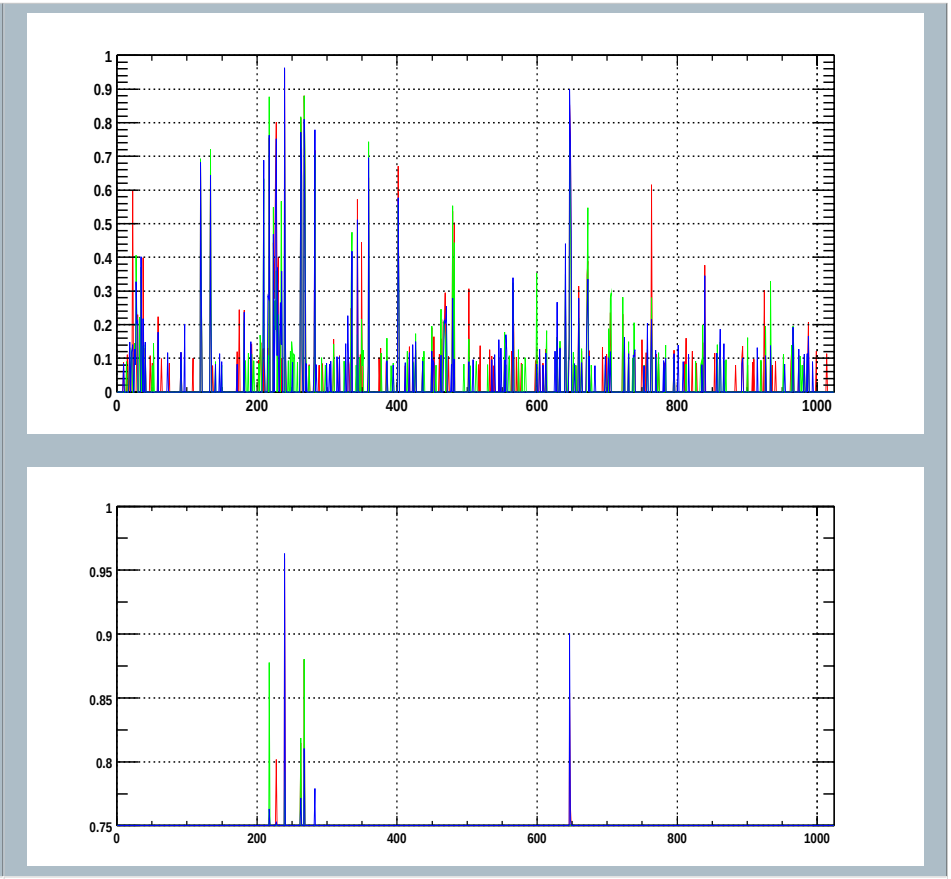
  H2:PSL-PMC_ERR_F and accelerometers and microphones



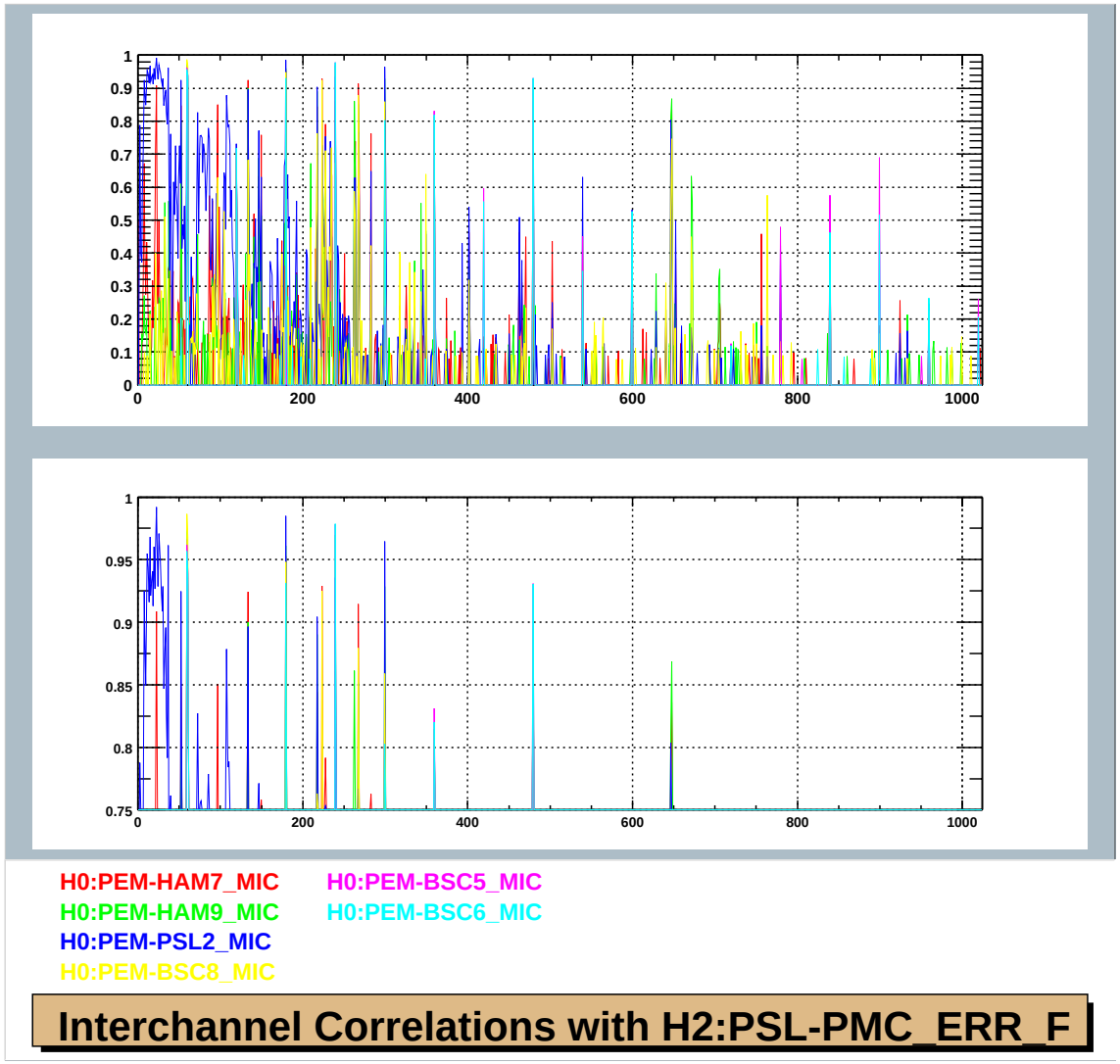
Interchannel Correlations with H2:LSC-AS_Q

The pre-mode cleaner signal H2:PSL-PMC_ERR_F was correlated with the interferometer output H2:LSC-AS_Q





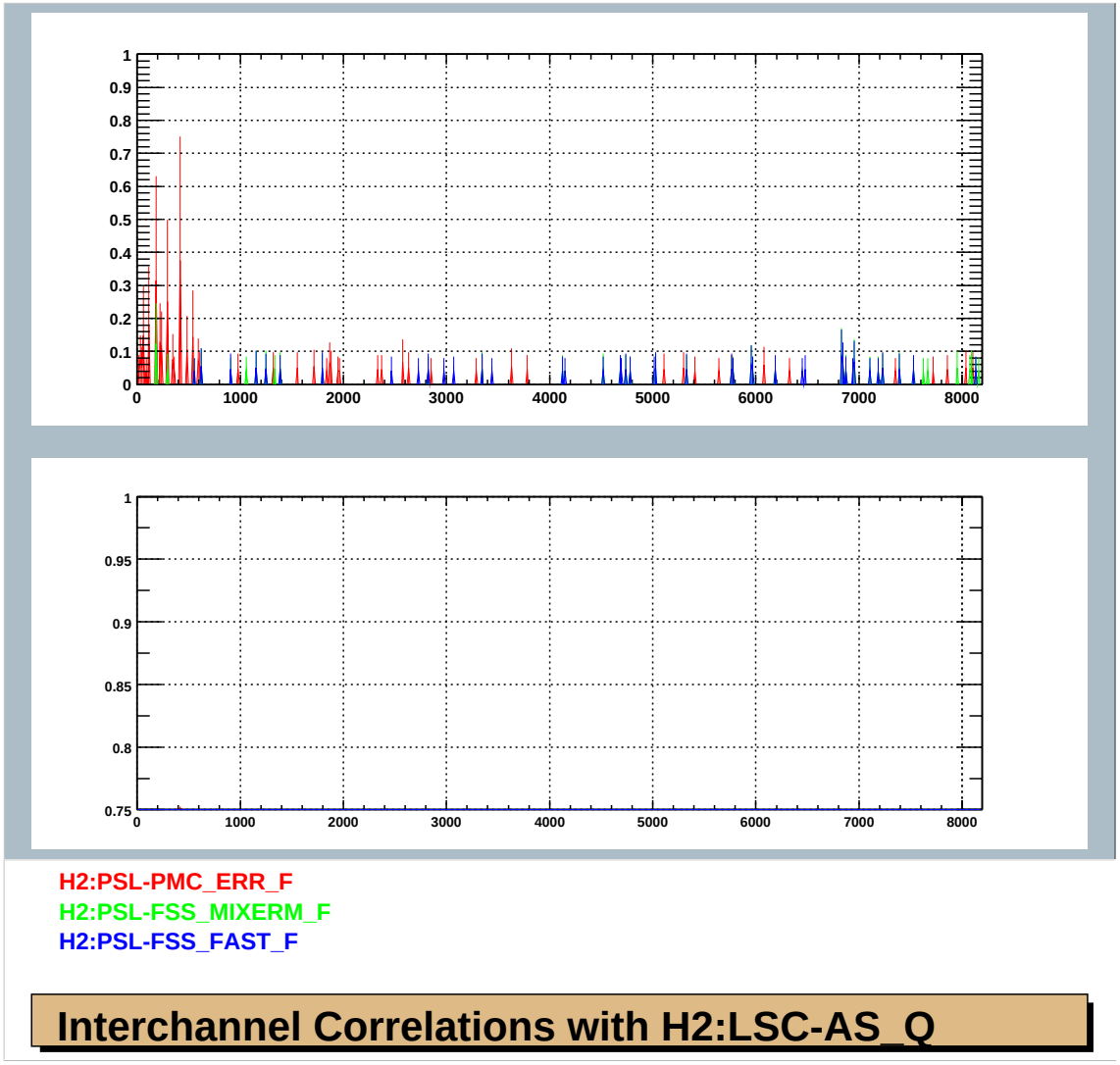
The pre-mode cleaner channel H2:PSL-PMC_ERR_F was found to be highly correlated with the HAM7 and 8 accelerometers.



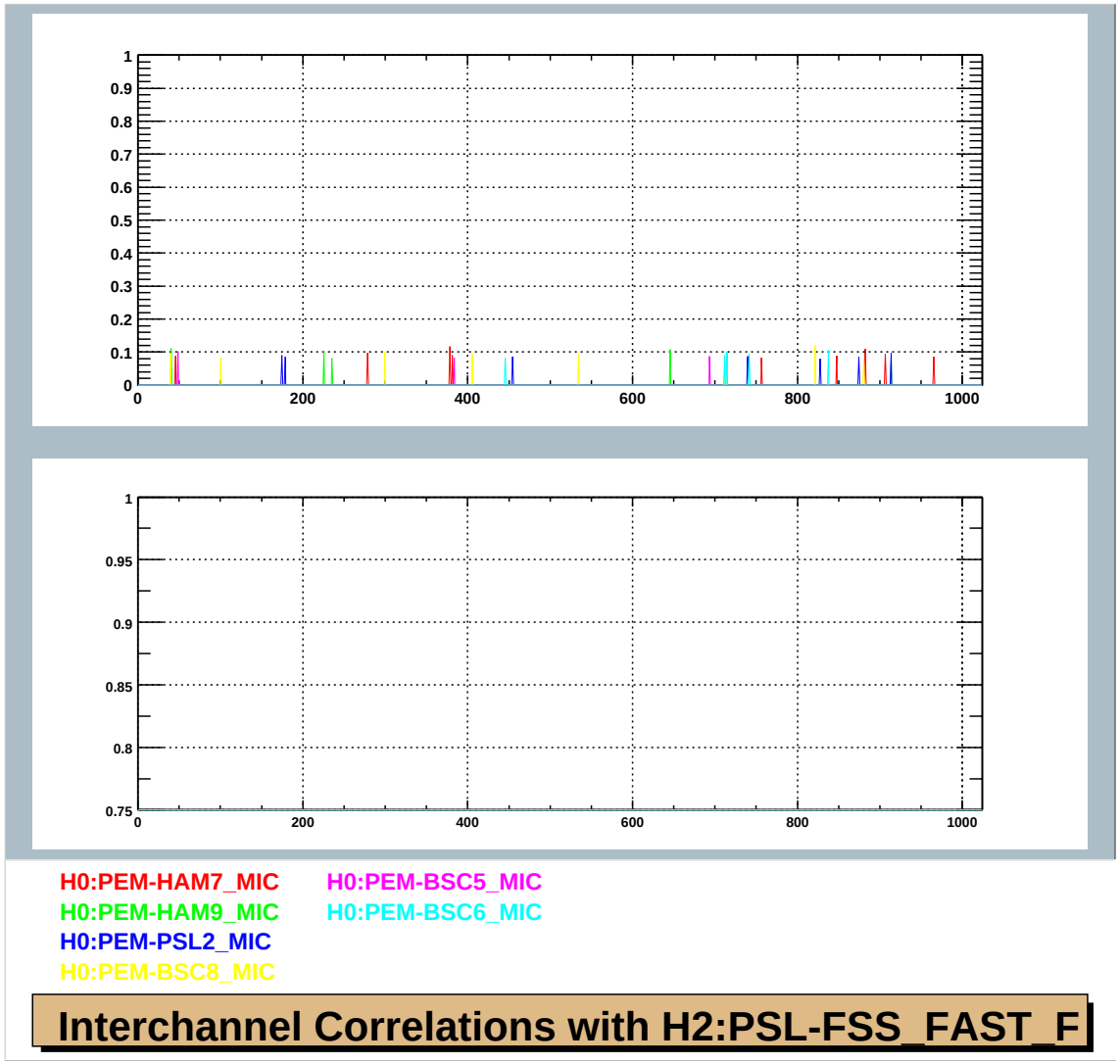
The pre-mode cleaner signal H2:PSL-PMC_ERR_F with observed correlations with numerous microphone channels.

Frequency control feedback to laser

- H2:PSL-FSS_FAST_F
- Insignificant correlations observed with microphones or accelerometers



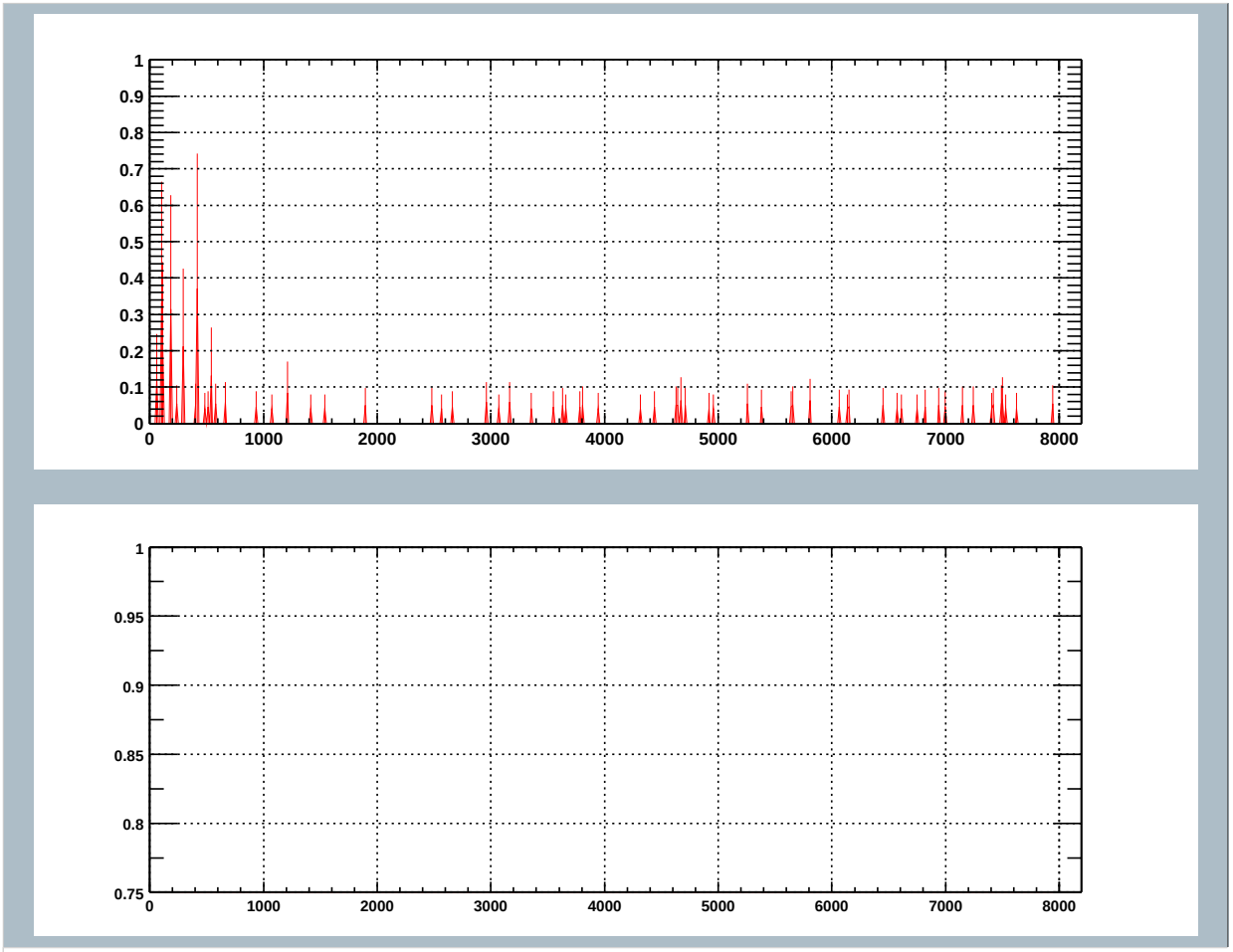
The laser's fast frequency control signal, H2:PSL-FSS_FAST_F, was only observed to have small correlations with the interferometer output, H2:LSC-AS_Q. These appeared at relatively high frequencies.



Correlations between laser fast frequency control signal, H2:PSL-FSS_FAST_F, and various microphones.

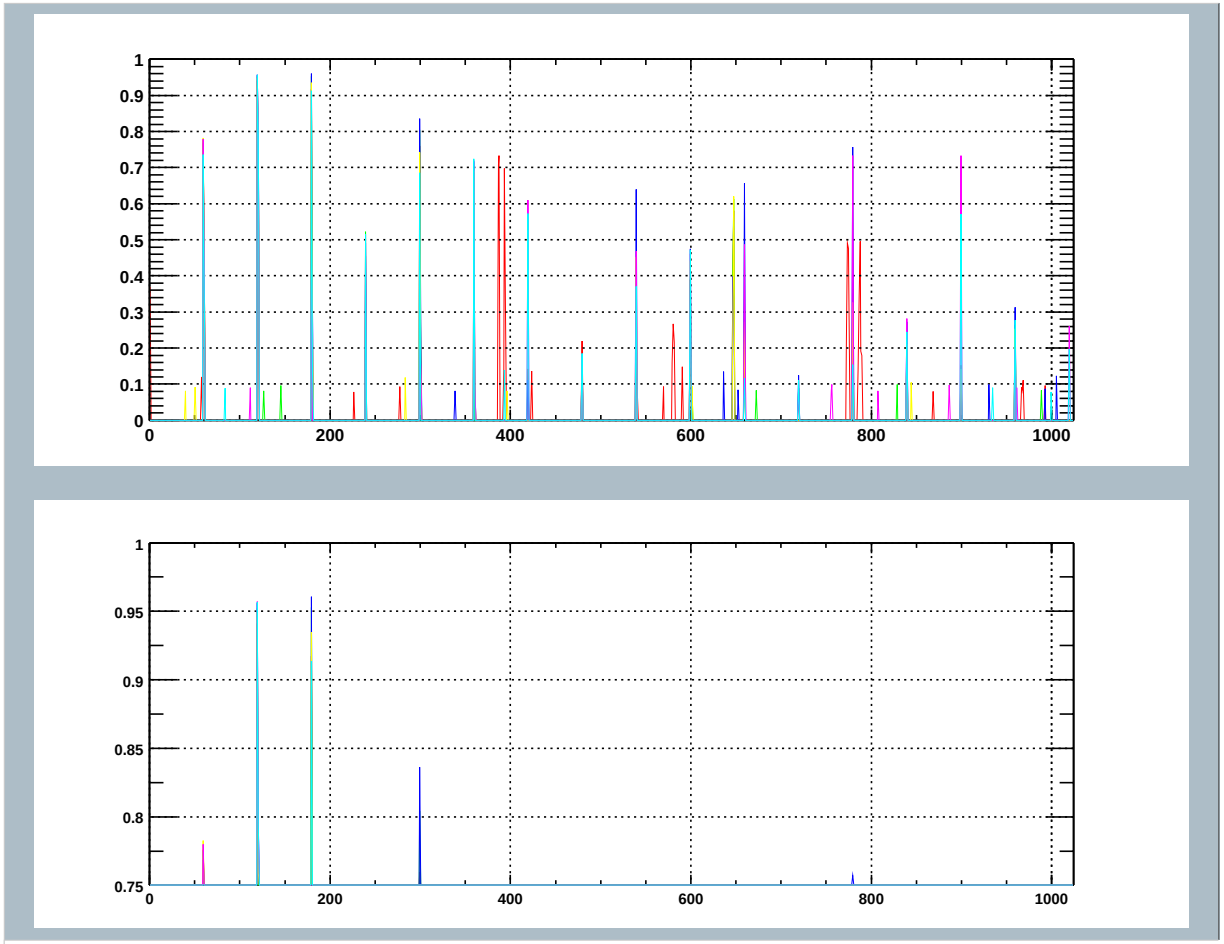
Intensity Stabilization for PSL

- H2:PSL-ISS_ISERR_F



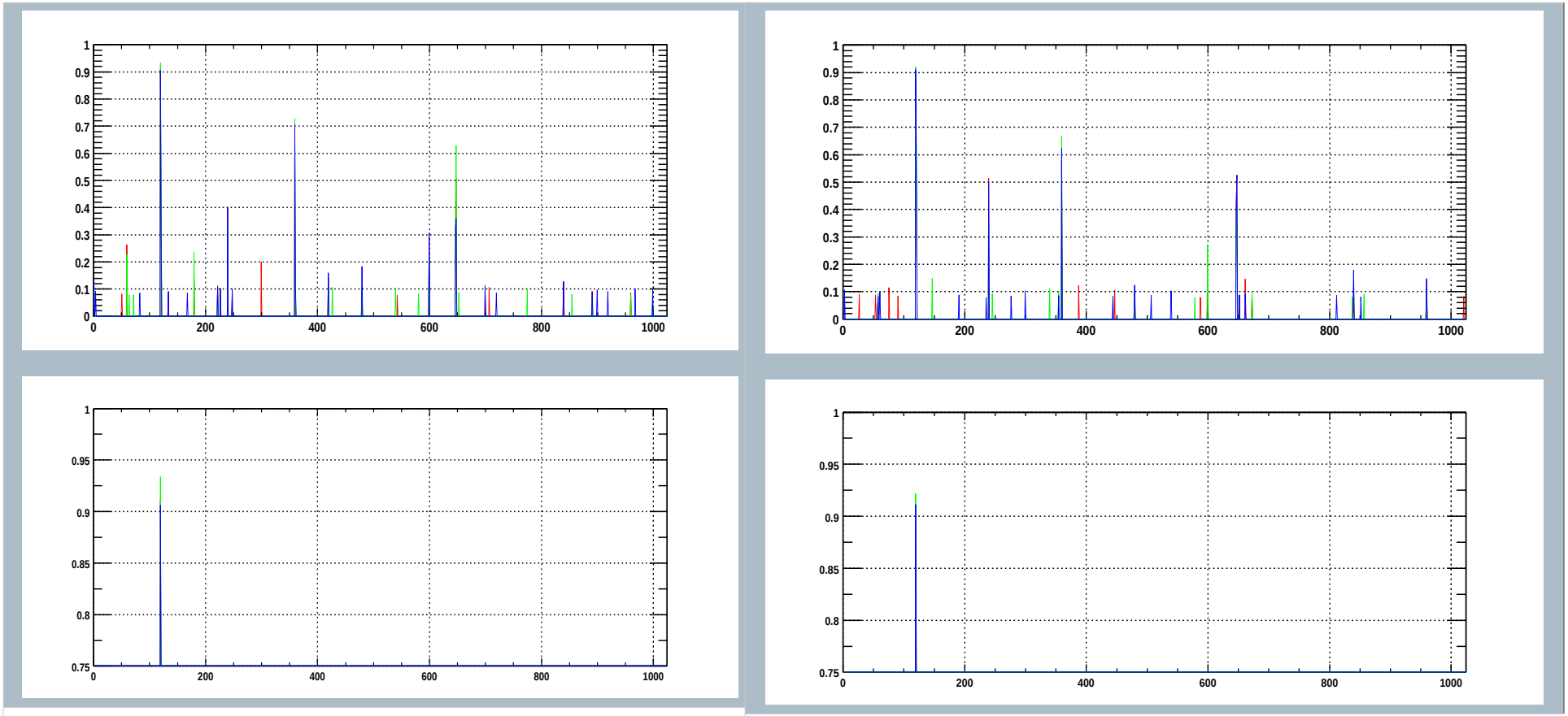
Interchannel Correlations with H2:LSC-AS_Q

Correlations between H2:LSC-AS_Q and H2:PSL-ISS_ISERR_F. Low frequency correlations coincide with 60 Hz and harmonics.



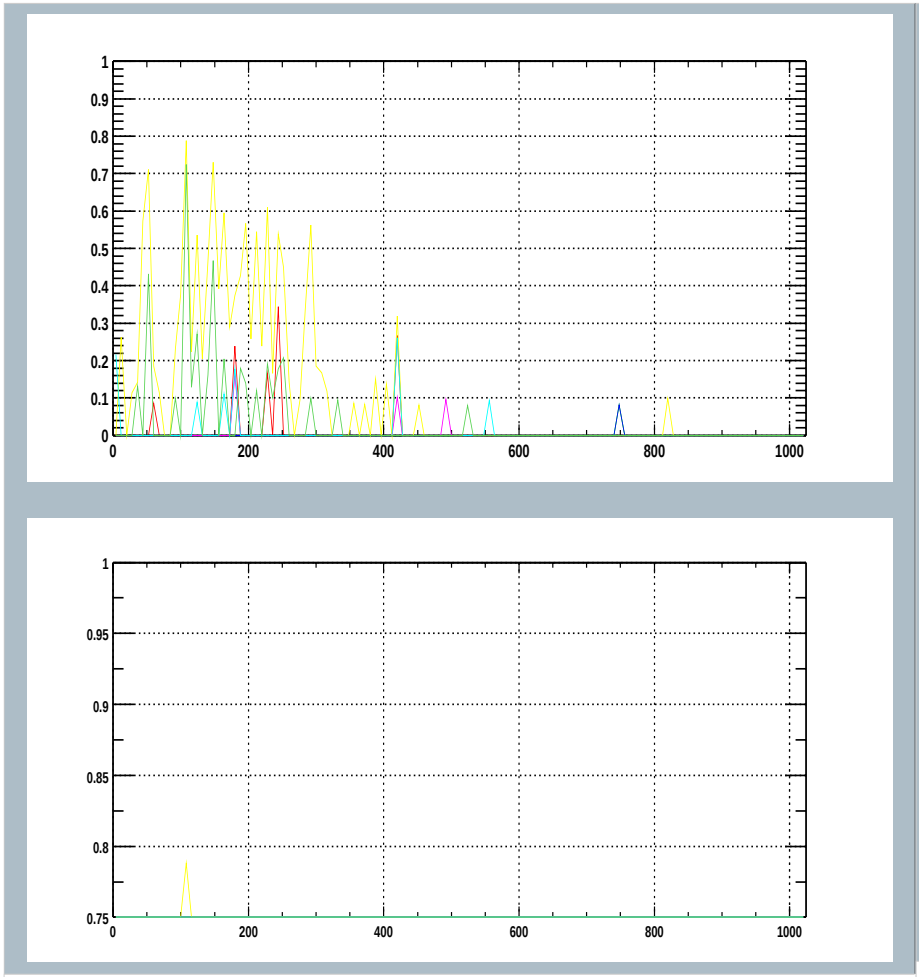
Interchannel Correlations with H2:PSL-ISS_ISERR_F

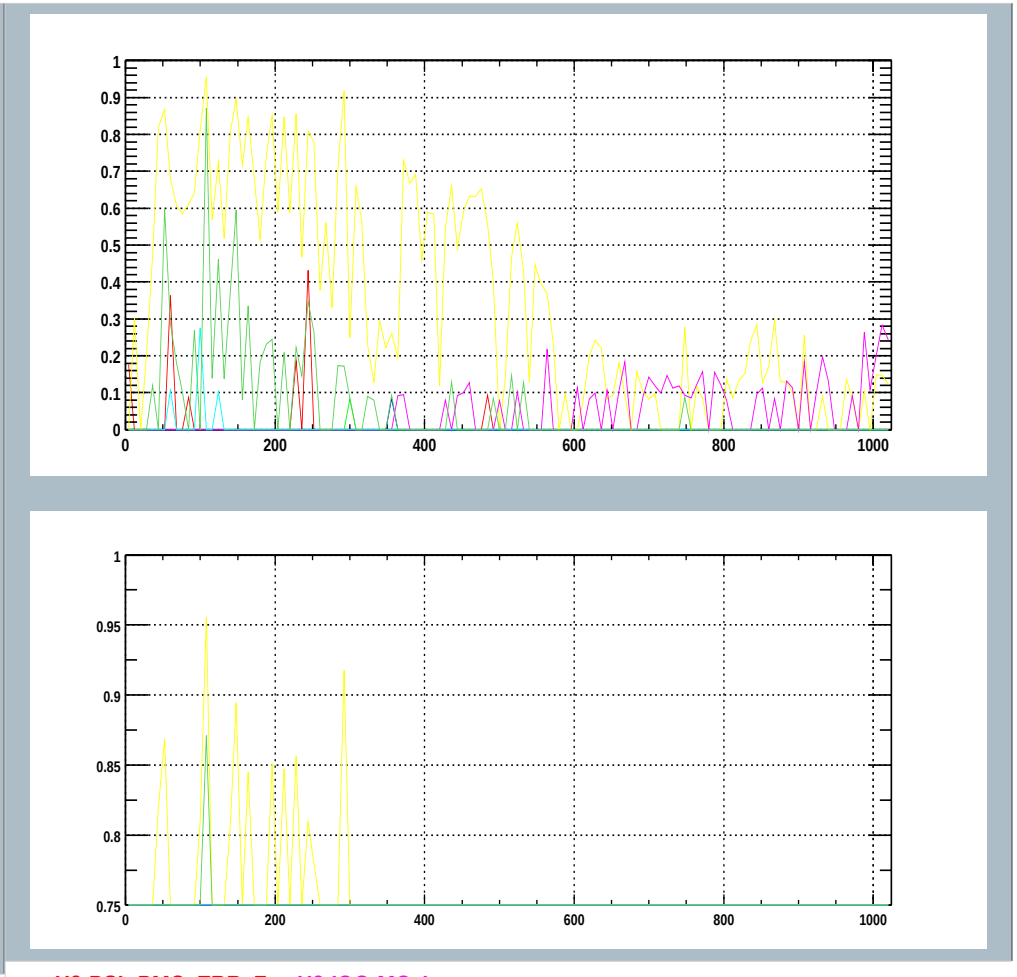
Correlation of intensity stabilization servo error signal H2:PSL-ISS_ISERR_F and various microphones. Note 60Hz and harmonics.



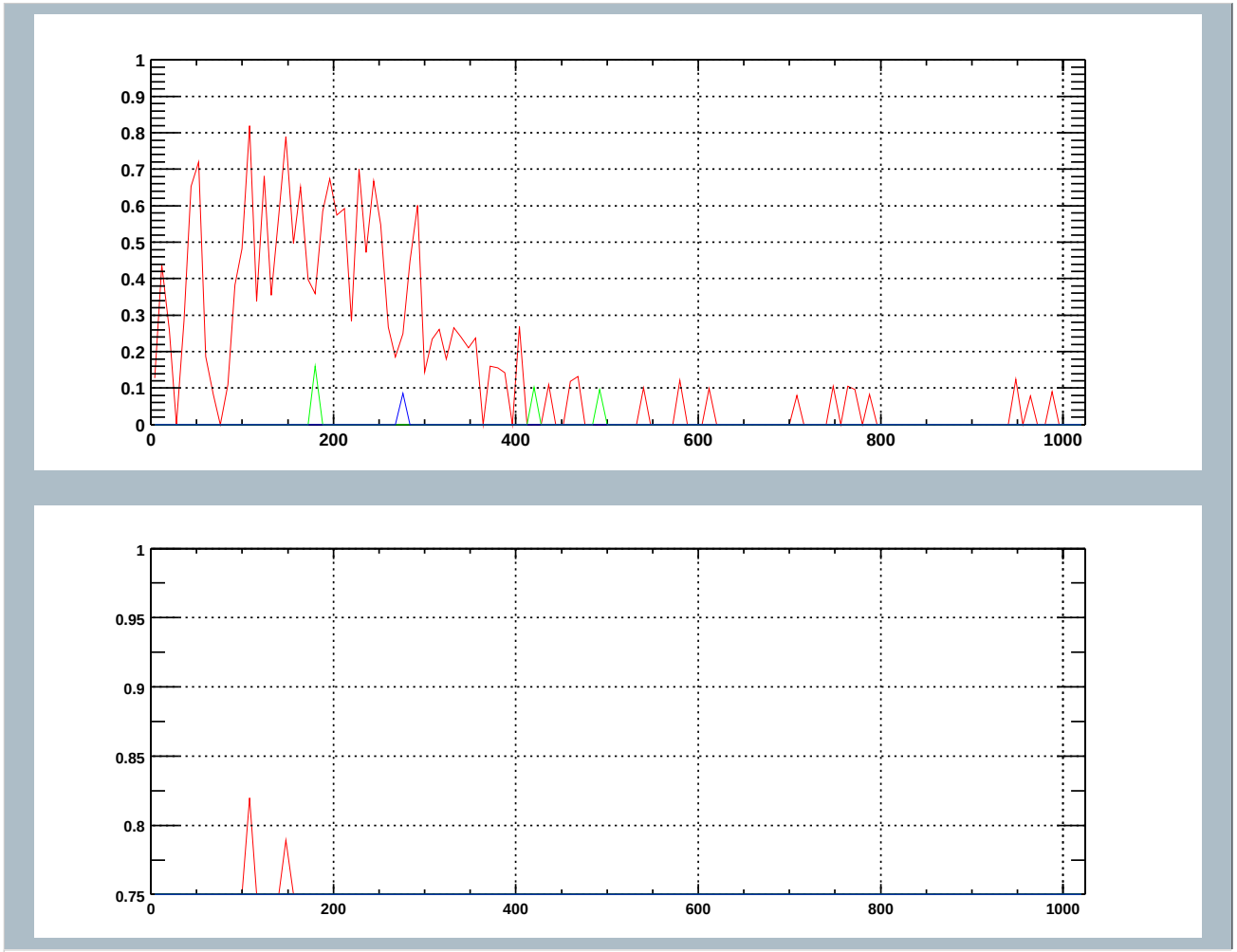
Correlation of intensity stabilization servo error signal H2:PSL-ISSER_F and HAM7-8 accelerometers.

H2:LSC-DARM_CTRL
H2:LSC-CARM_CTRL





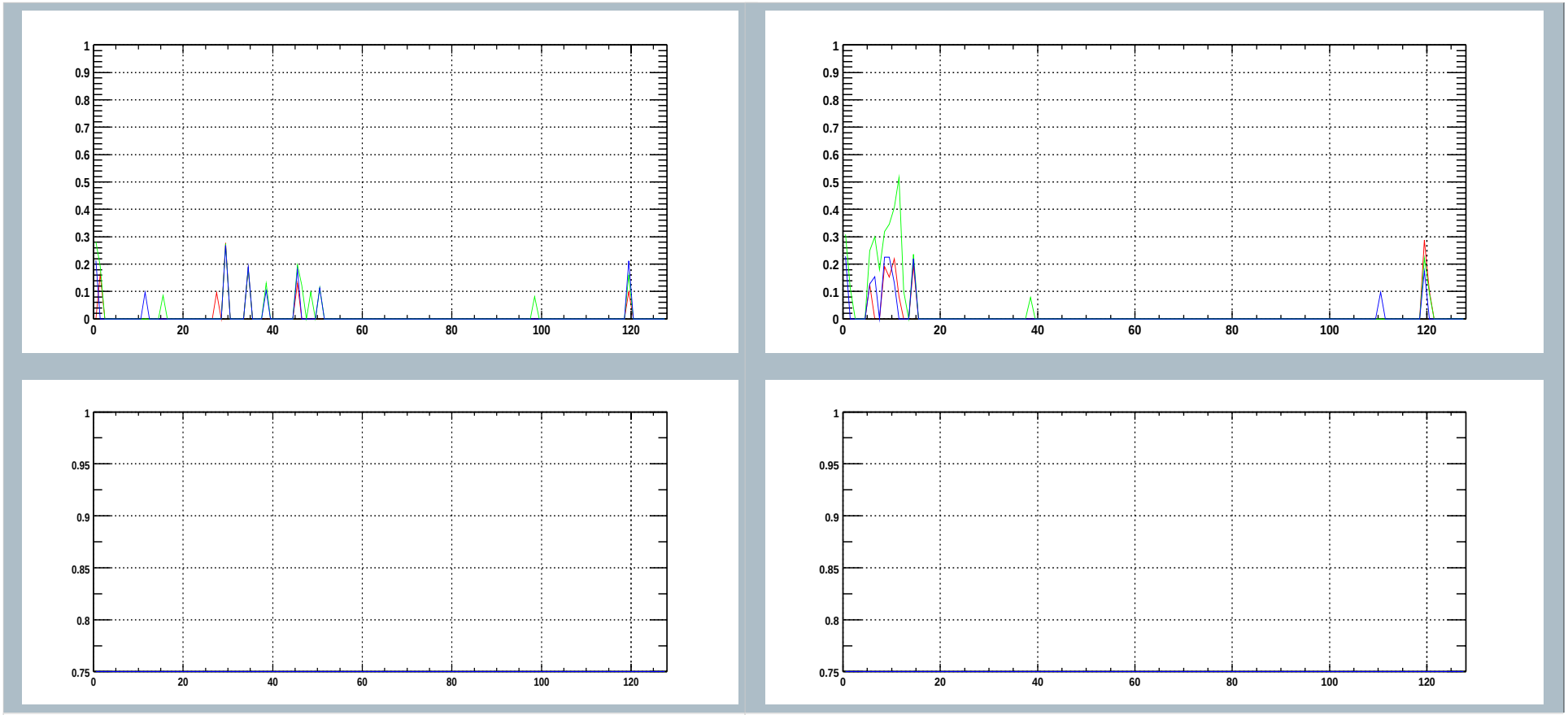
The interferometer arm control signal H2:LSC-C(D)ARM_CTRL are correlated with various control signals.



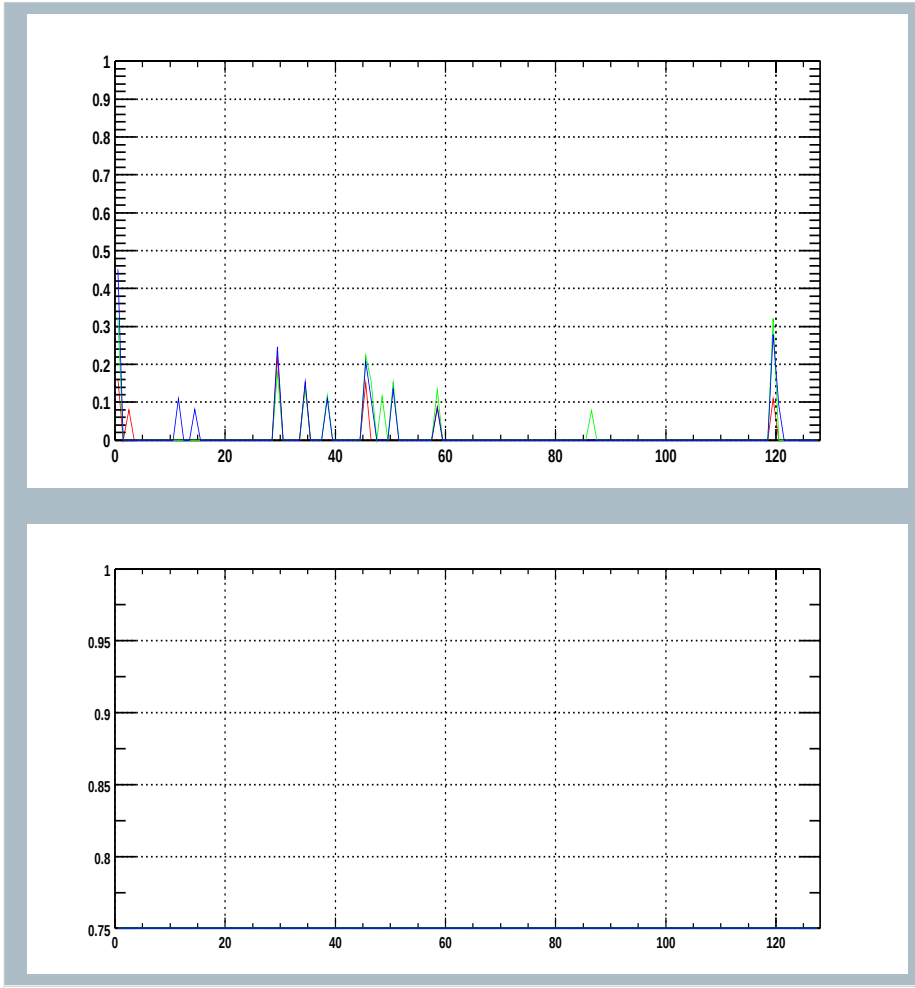
H2:LSC-CARM_CTRL
H2:IOO-MC_I
H2:PSL-PMC_PZT_F

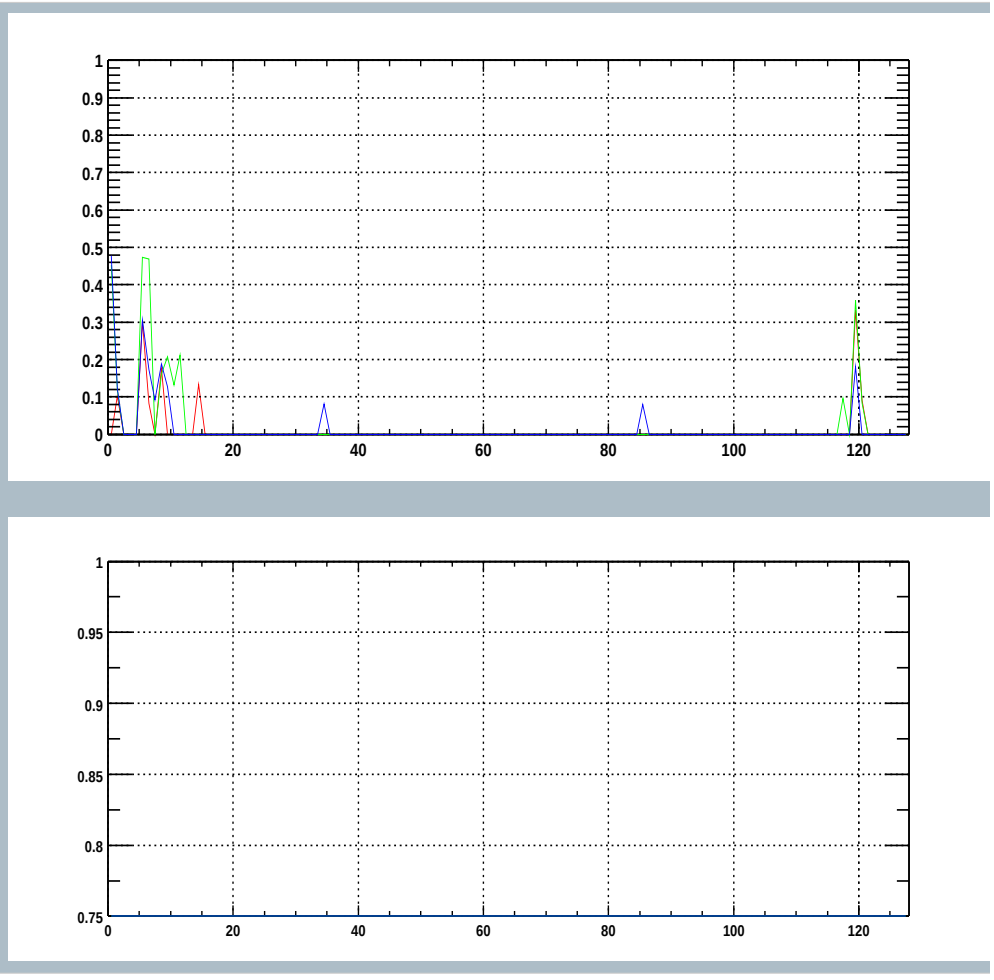
Interchannel Correlations with H2:LSC-DARM_CTRL

Correlation of the two interferometer arm control signals, H2:LSC_DARM_CTRL and H2:LSC_CARM_CTRL.



Correlation of interferometer arm control signal H2:LSC-DARM_CTRL and seismometers.

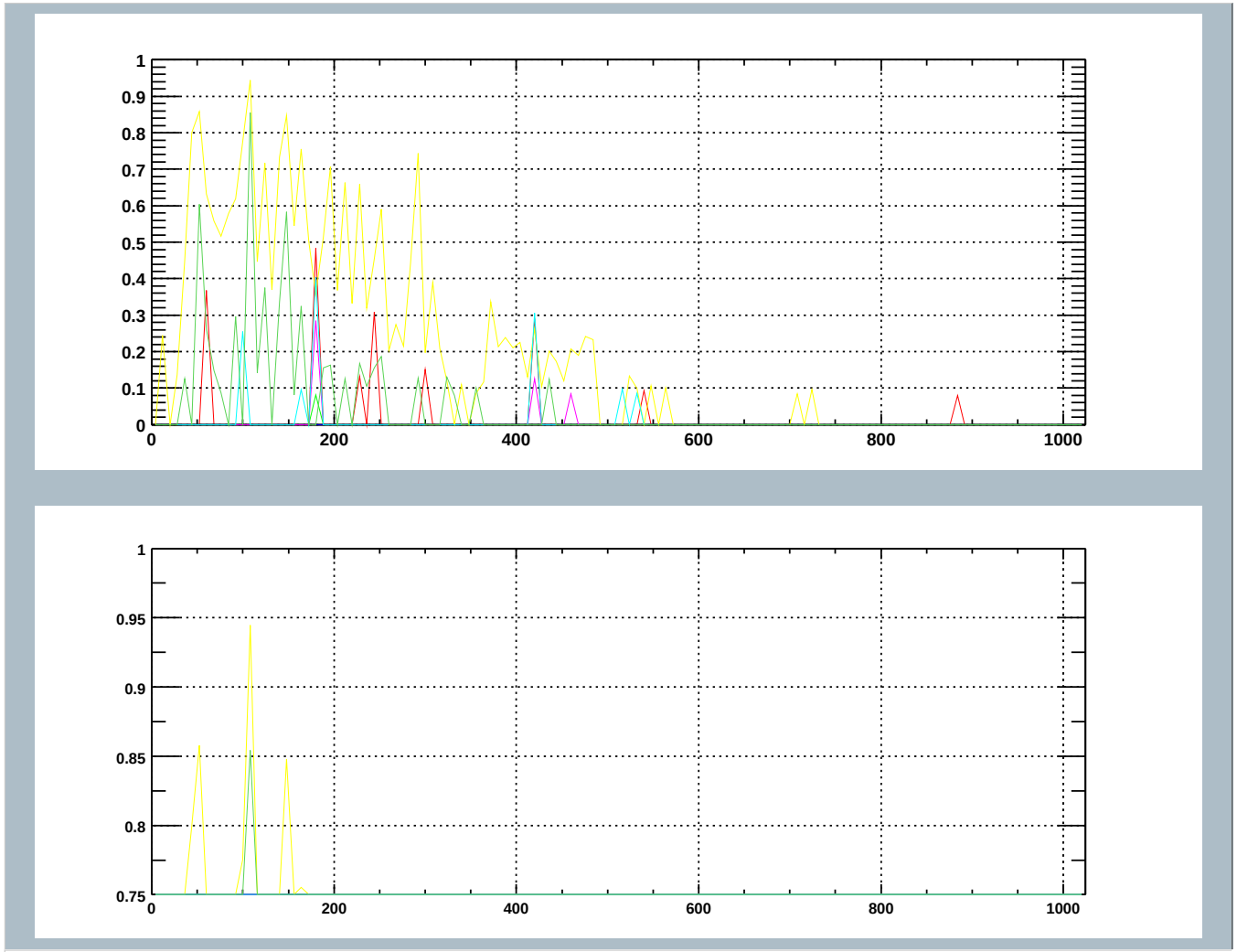




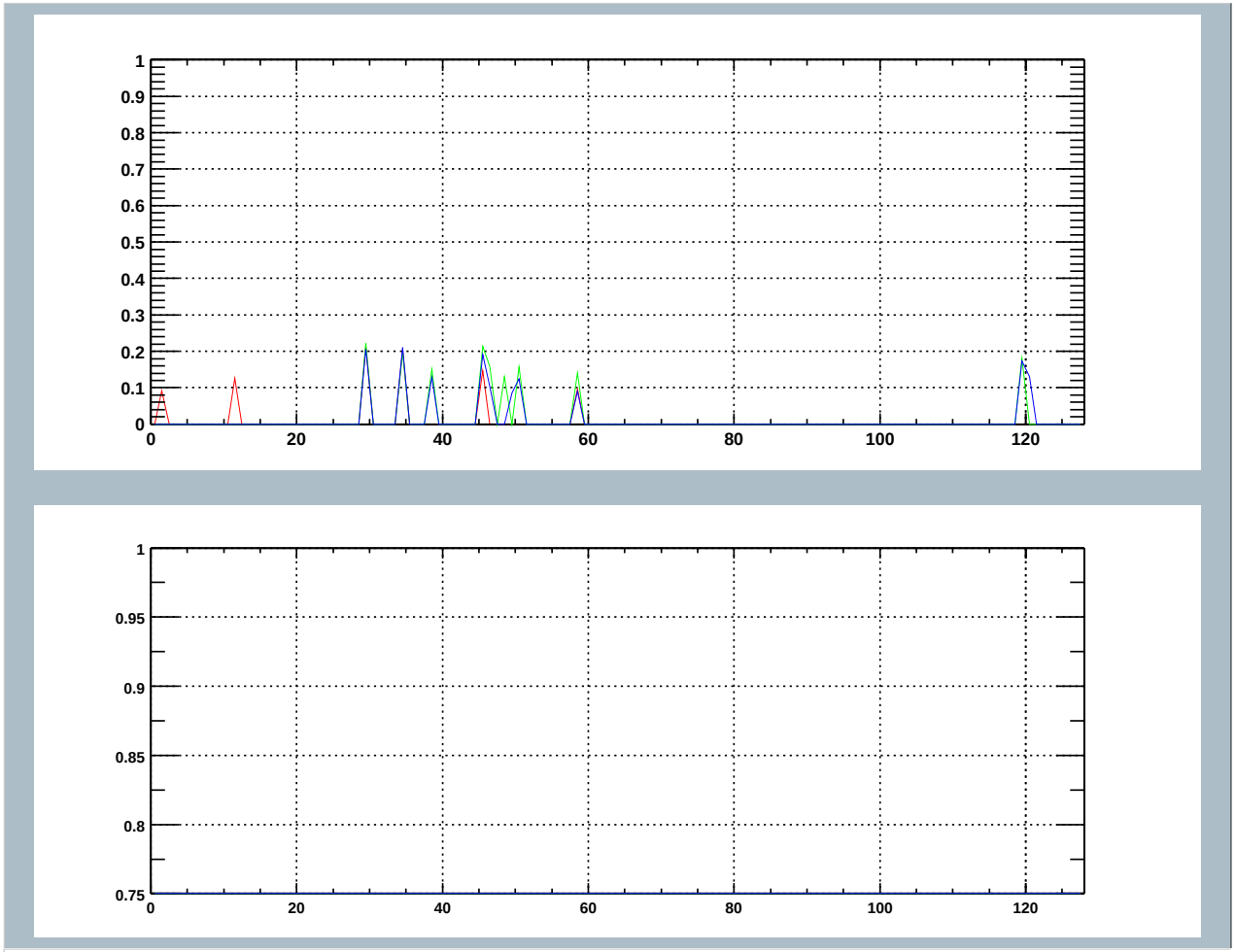
Interferometer arm control signal H2:LSC-CARM_CTRL with seismometers.

H2:LSC-MICH_CTRL

- The Michelson interferometer control signal was correlated with various other control signals
- Main correlation is from the mode cleaner.



The Michelson interferometer control signal H2:LSC-MICH_CTRL with various control signals.



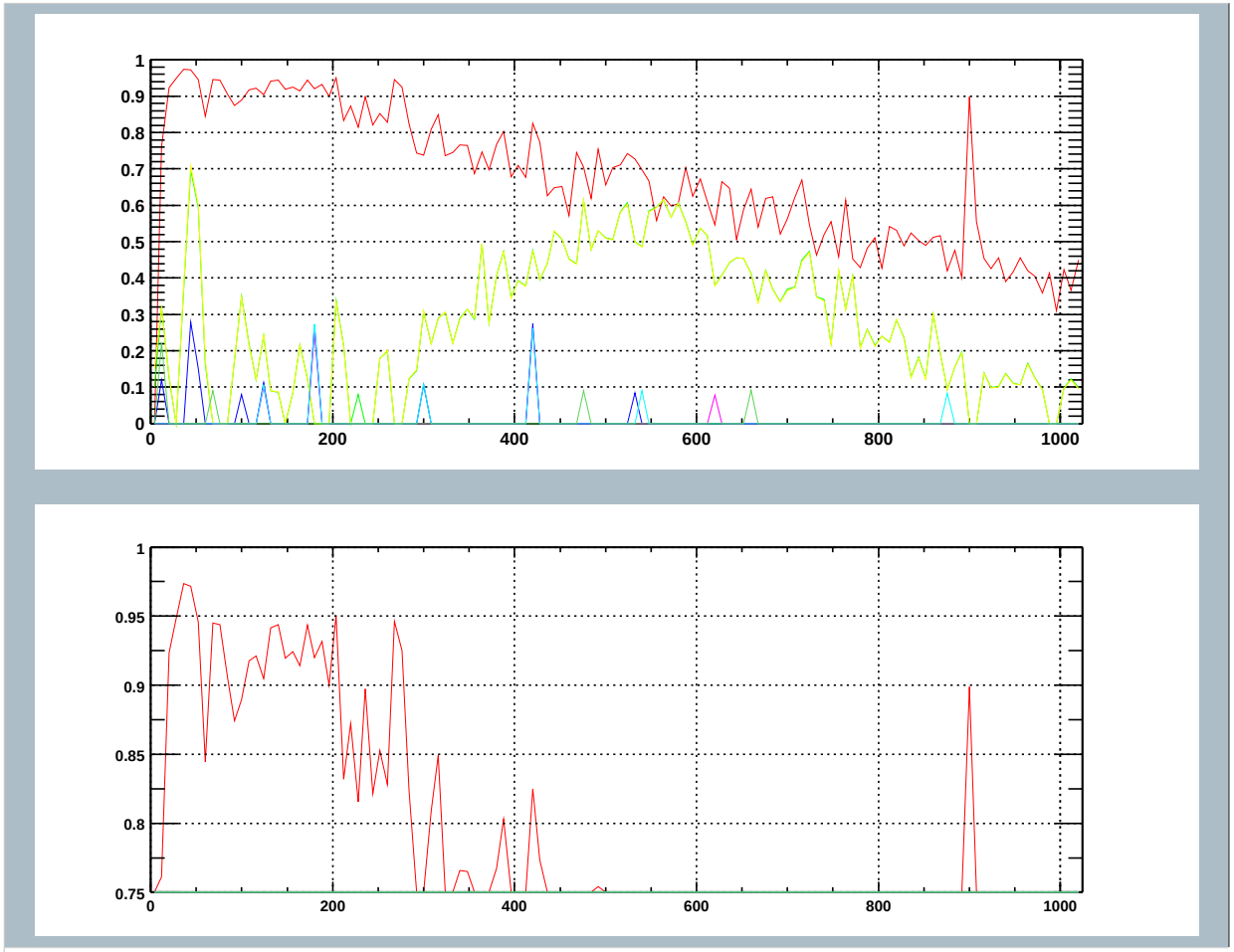
Michelson interferometer control signal H2:LSC-MICH_CTRL correlated with some seismometers.

H2:LSC-REFL_I
H2:LSC-REFL_Q

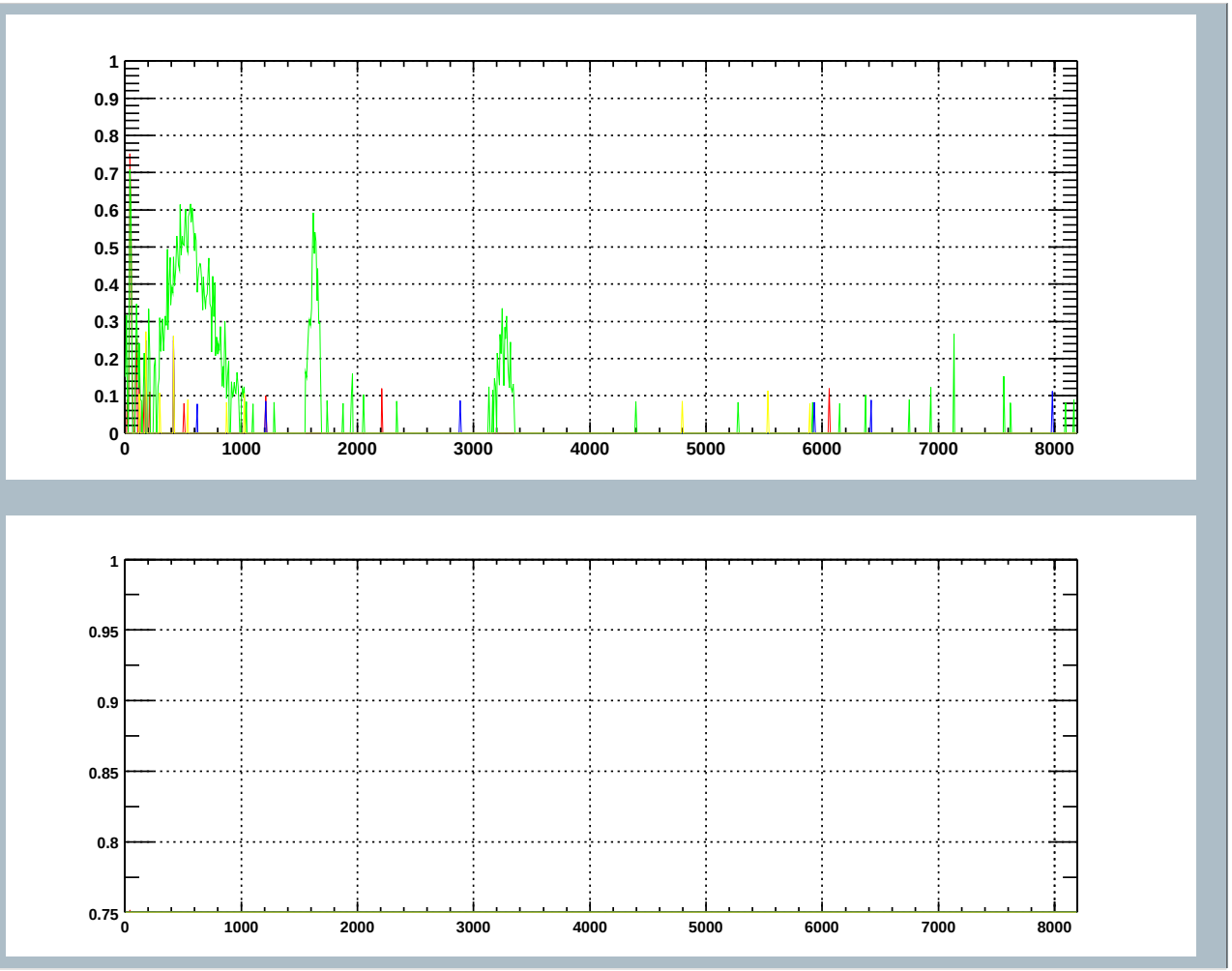
- Broad correlation between H2:LSC-REFL_I and H2:LSC-AS_Q below 1 kHz

- Correlations of H2:LSC-REFL_I and H2:LSC-AS_Q observed at various ranges of frequencies, below 1 kHz, .at 1.6 kHz, and 3.3 kHz.

- Consistent with results of the line noise group



Correlation between H2:LSC-REFL_I and H2:LSC-AS_Q is strong below 1 kHz.



H2:IOO-MC_F
H2:LSC-REFL_I
H2:PSL-ISS_ISERR_F
H2:PSL-PMC_ERR_F

Interchannel Correlations with H2:LSC-AS_Q

Correlations between H2:LSC-REFL_I and H2:LSC-AS_Q.}