



S2 Data Quality Investigation

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Data Quality Investigation

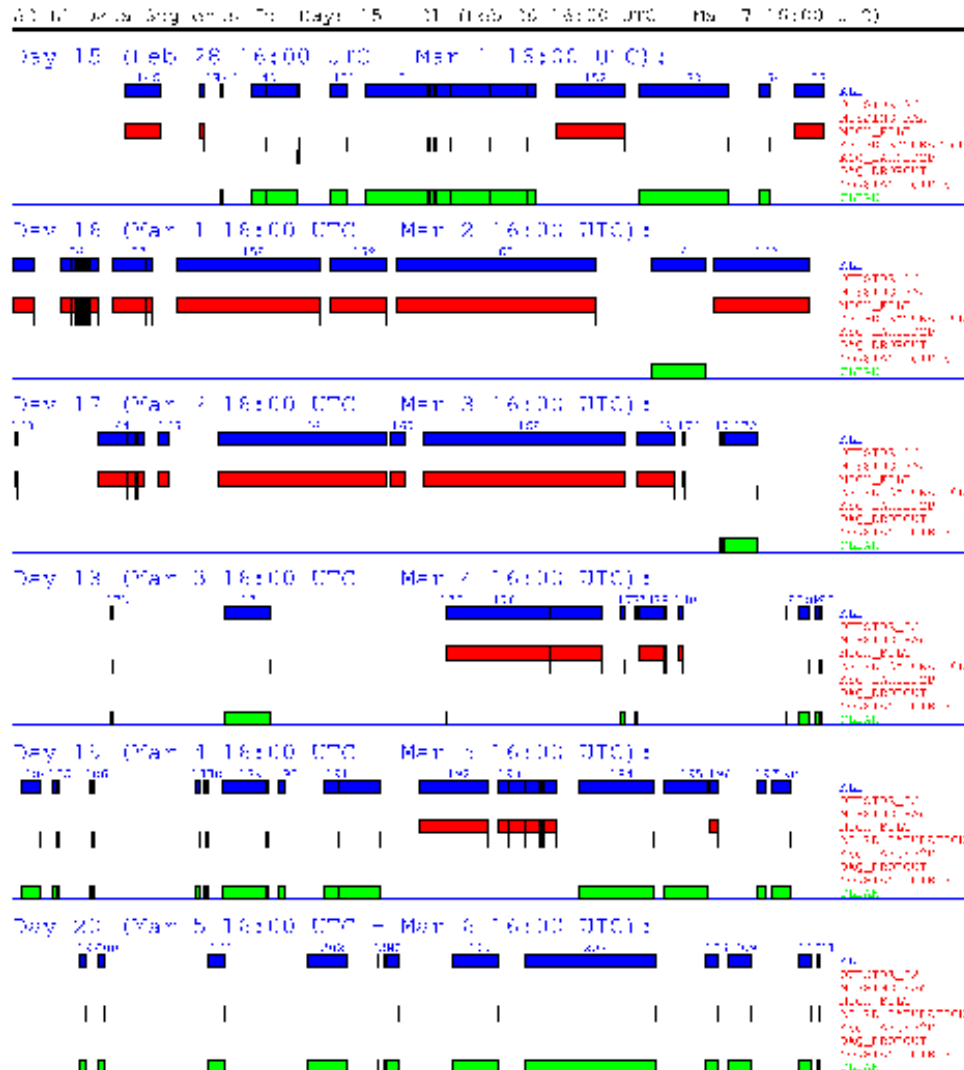
Goals:

- Tabulate known problem
- Publish useful data segments with full info
- Analysis groups to decide what is appropriate for their analysis pipelines

Data Quality Segment List

- Official segment lists are maintained by Keith Riles & Peter Shawhan and are available via:
<http://tenaya.physics.lsa.umich.edu/~keithr/S2DQ/S2seglists.html>
- List of all locked segments generated/verified by Peter Shawhan.
- Segments are given a permanent ID - split if bad or non-existent data found in part of a segment.
- Error bit-mask associated with each (sub)segment – indicates which errors occurred in the segment.
- Graphical segment status.

Segment Summary (Sample)



Tests Underway

We are studying the following potential problems:

1. DAQ Errors / Missing data
2. Control parameter changes
3. ADC Saturation
4. Peak-peak Outliers (from minute trends)
5. Calibration validity
6. Excessive noise in AsQ bands

DAQ Errors / Missing Data

- Used BitTest triggers to find data with >32 successive 0 samples in AS_Q
 - » Two 1 second drop-outs in H2:LSC-AS_Q
 - » One 33-second and one 6-second drop-out in L1.

Control Parameter Changes

- Rana (LLO & LHO), Betsy (LHO) and Gaby (LLO) reviewed the control parameter values and E-log throughout S2.
- Non-standard values of several parameters were found from time to time including:
 - » Filters not set.
 - » MICH_GAIN, PRC_GAIN
- Most problems don't invalidate data although noise level or calibration may change in some cases.

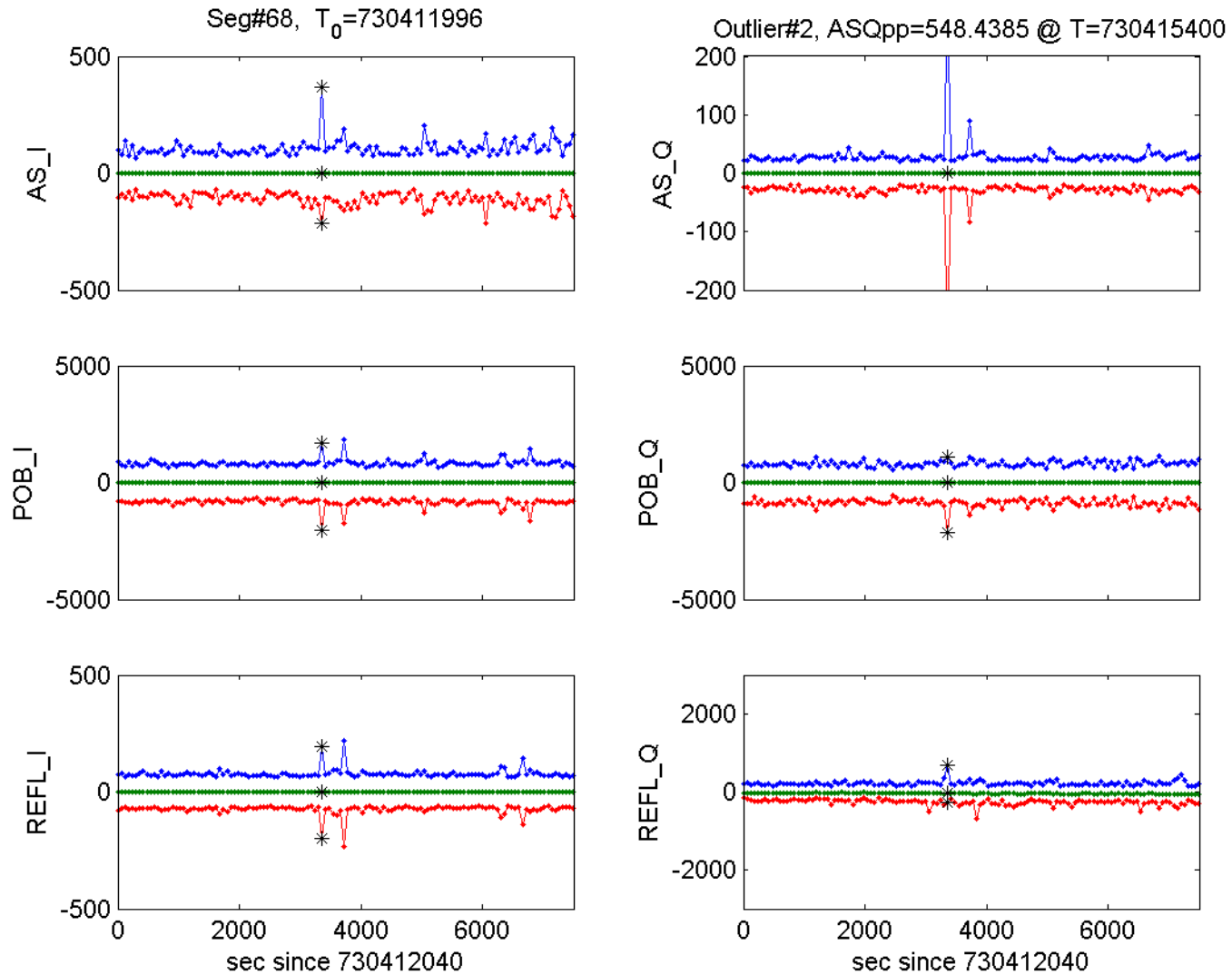
ADC Saturation

- Digital IFO signals may saturate if
 1. RF signal exceeds amplifier range
 2. Demodulated signals exceed ADC range
- AS, REFL and POB ADC values reconstructed from raw data and searched for either
 1. Signal values exceeds $\pm(2^{16}-1)$, or
 2. Signal value repeated > 4 times in successive samples
- Majority of times flagged due to
 - » Loss of lock
 - » Accidental triggers (5 repetitions occur at a level of $\sim 1/\text{hr}$)
- Saturation flagged in L1, H1 segment lists. H2 has segment-dependent saturation rates. Under investigation.

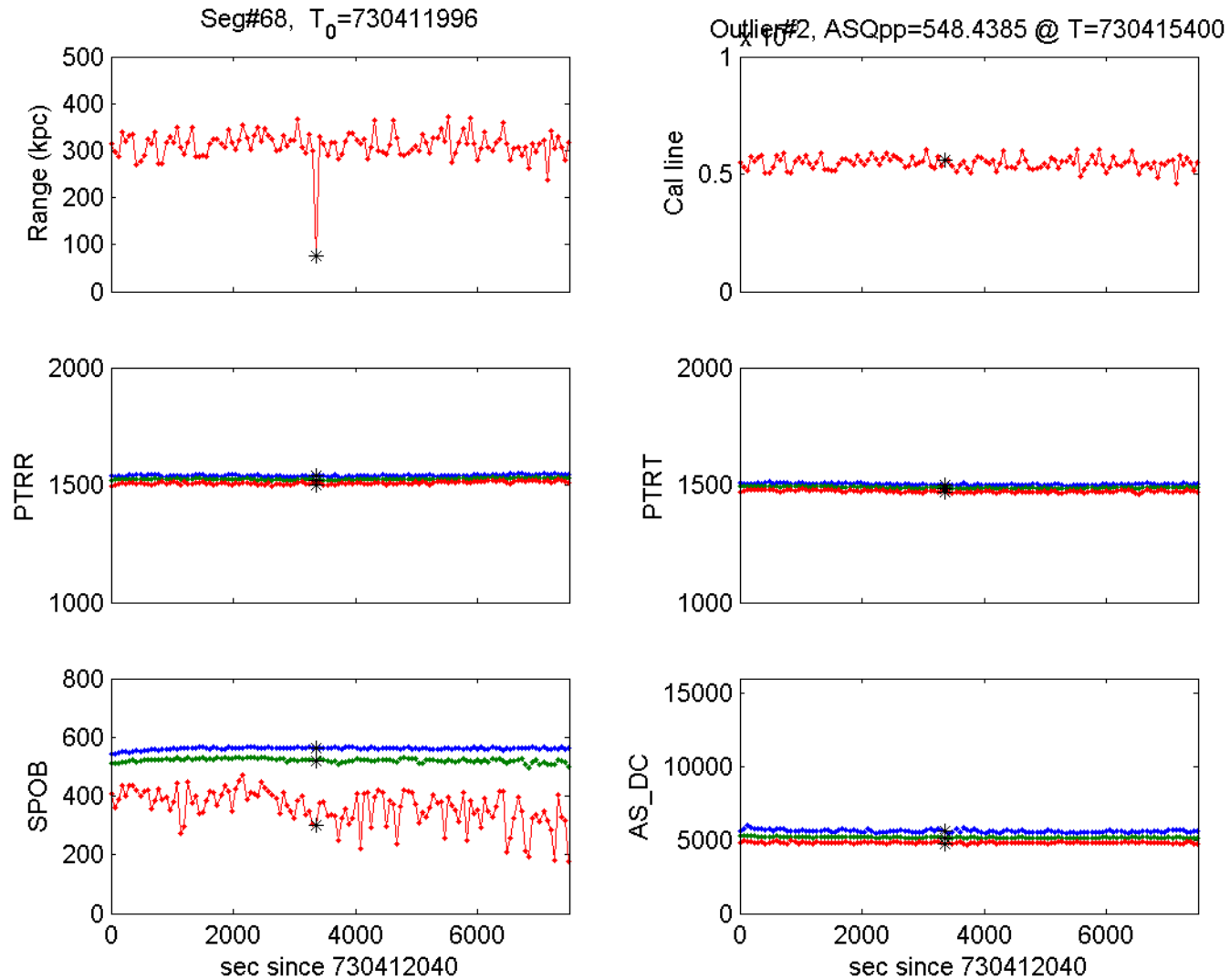
Peak-to-Peak Outliers

- Gaby scanned IFO channel (AS, REFL & POB) minute trends for outliers in max-min values
- Produced graphs of 102 outliers (>140cts) in H1 and 89 outliers (>70cts) in L1. All graphs are available online at:
<http://www.phys.lsu.edu/faculty/gonzalez/S2trends/>
- Outliers further classified by whether they are
 - » Clustered: one of several in consecutive minutes
 - » Correlated: Outlier seen in other IFO channels in addition to AsQ
 - » AsQ Only: no other evidence seen.

Outlier 2 IFO Channel Trends



Outlier 2 Power Channel Trends



Calibration Validity

- Gaby checked all SenseMon trends for valid calibration constants.
- Segments where calibration is not valid are generally due to:
 - » Missing calibration lines ($\alpha=0$)
 - » Calibration not stable near 35Hz ($\alpha\beta < 0.6$ in L1)
- Flagged segments totaled ~0.4% of H1 data, ~2.4% of L1 data.

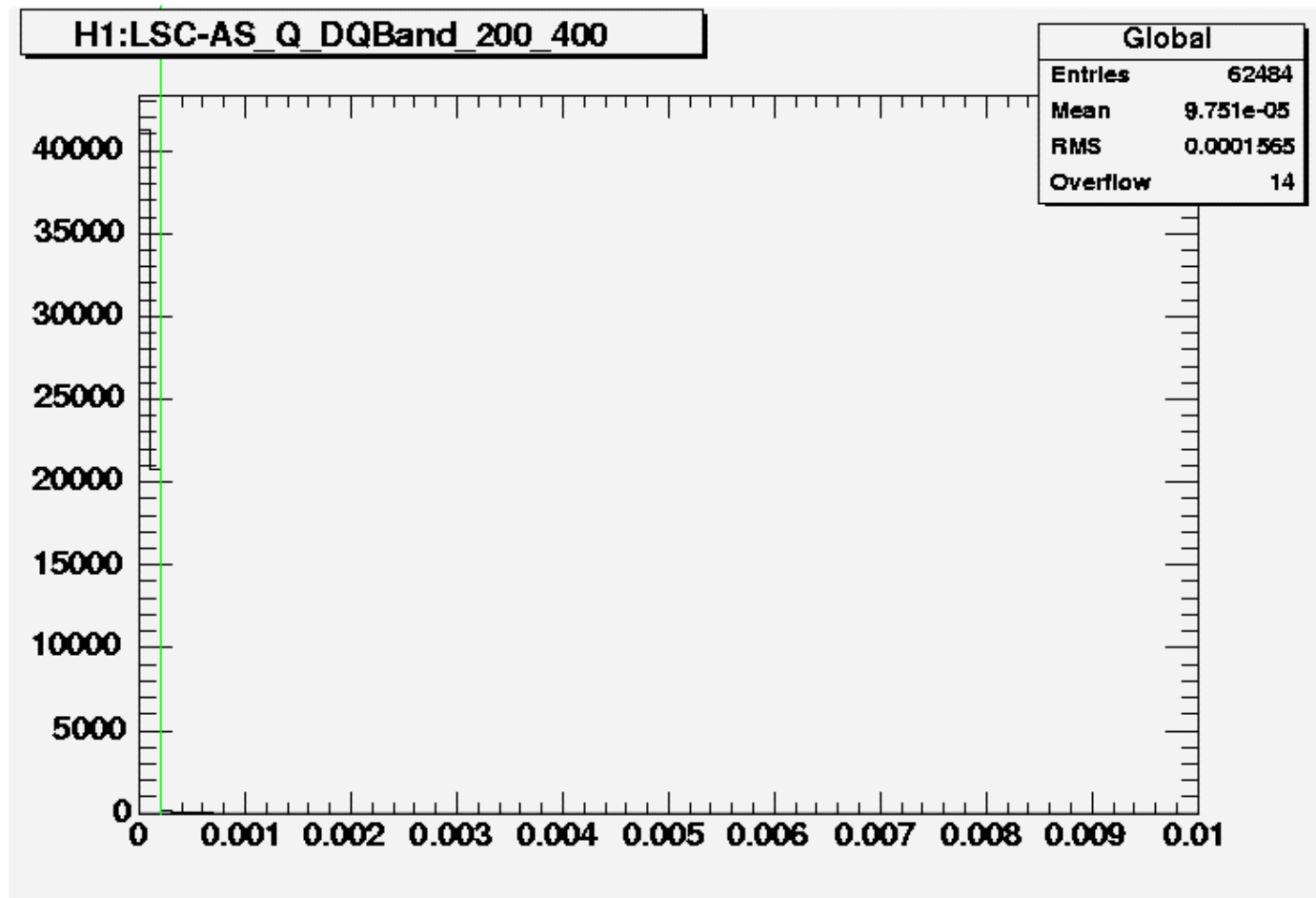
Excess Noise in AsQ

- RMS noise level monitored in wide bands by Data Quality Monitor (DataQual).
- PDFs of average and maximum values for entire run may be found in:
 - » http://blue.ligo-wa.caltech.edu/gds/monitor_reports/DataQual/60dayssummary
 - » http://london.ligo-la.caltech.edu/gds/monitor_reports/DataQual/60dayssummary
- Preliminary selections made on all H1 bands by comparing maximum 4s RMS to a threshold
- Low frequency bands seen to be correlated with windy conditions during data taking, but predominantly uncorrelated with glitches or noise in other bands.

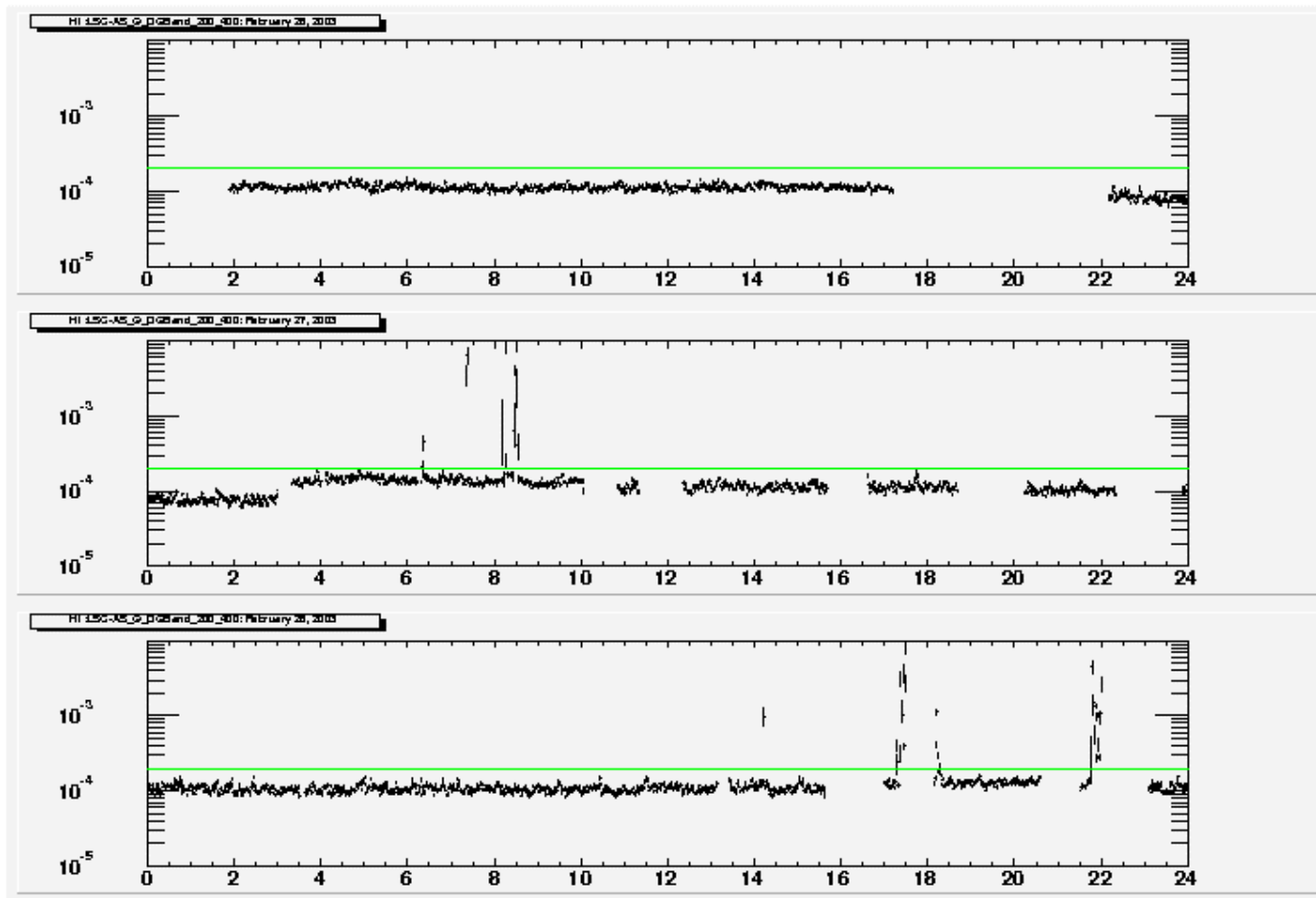
Excess noise in AsQ(cont'd)

- Excess noise in higher frequency bands (100-200, 200-400, 400-1kHz, 1k-7kHz) correlated with (glitches seen by DataQual glitch tool) and between bands.
- Sources include
 - » Broad-band noise episodes
 - » Violin spontaneous ring-ups
 - » ADCU reboots (should be vetoed independently)

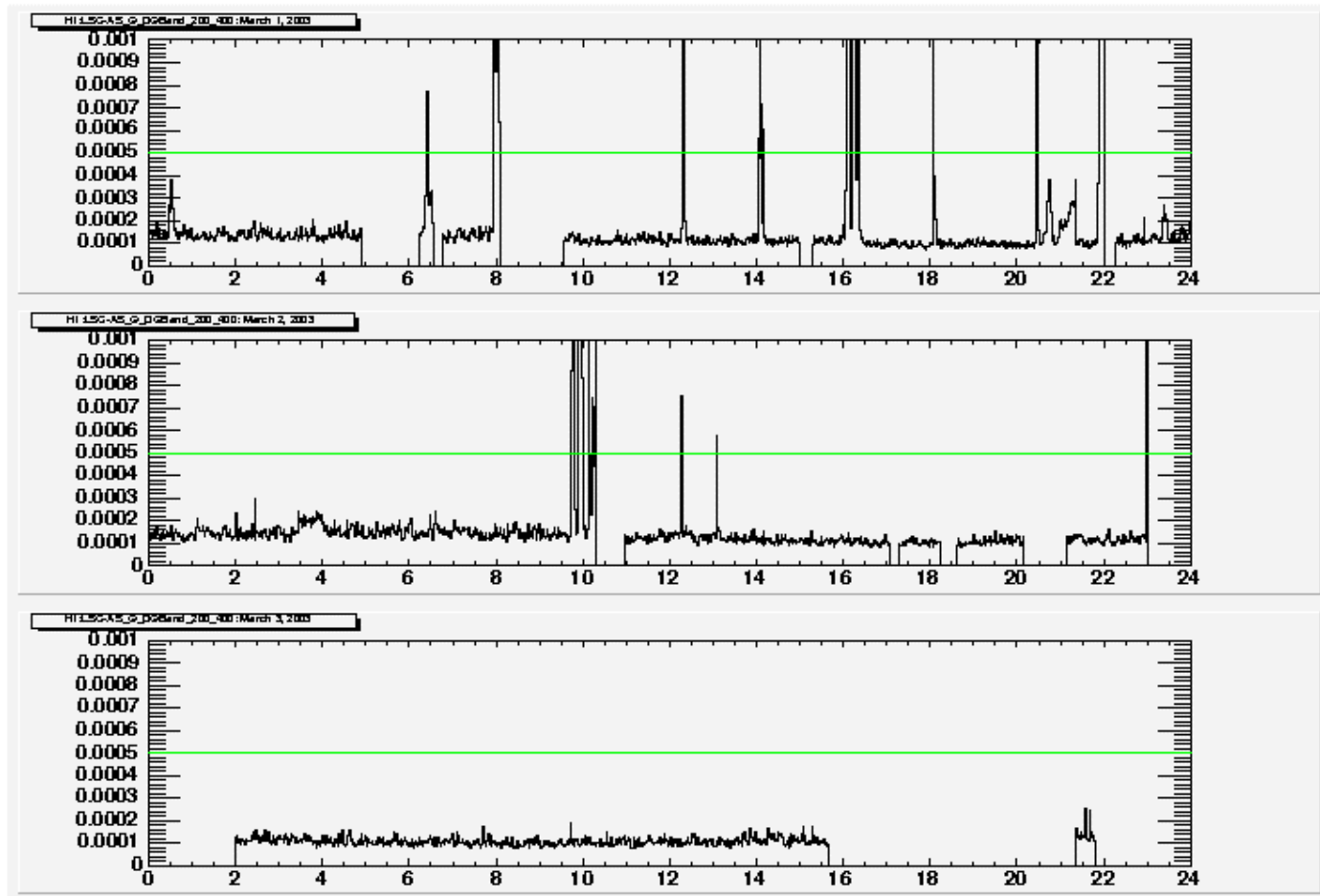
Sample Average Histogram



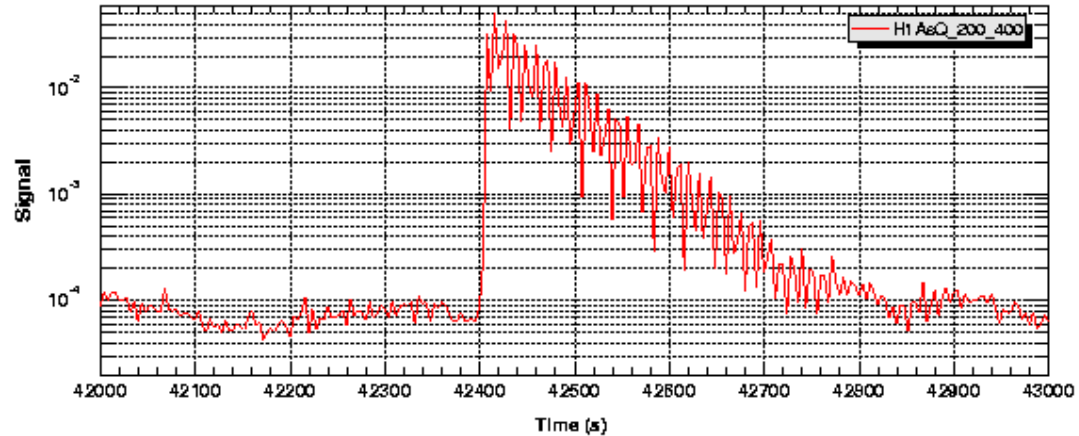
Average RMS in 200-400Hz Band



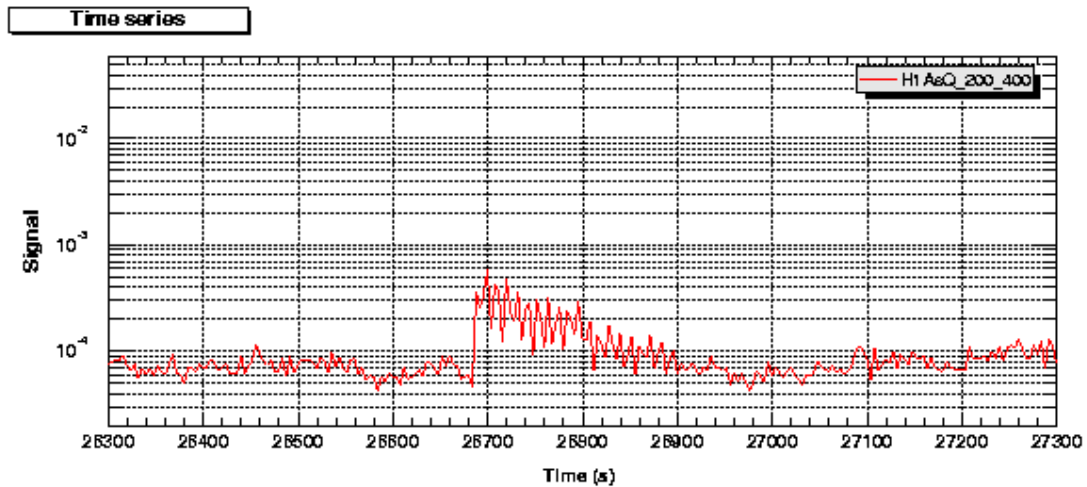
Maximum 4s RMS in 200-400Hz



Violin Ring-ups?

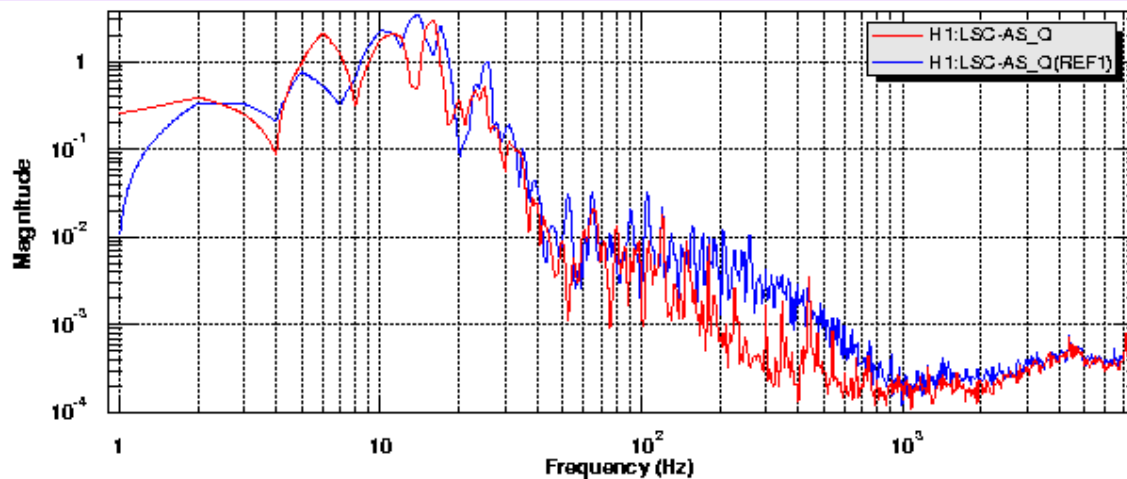


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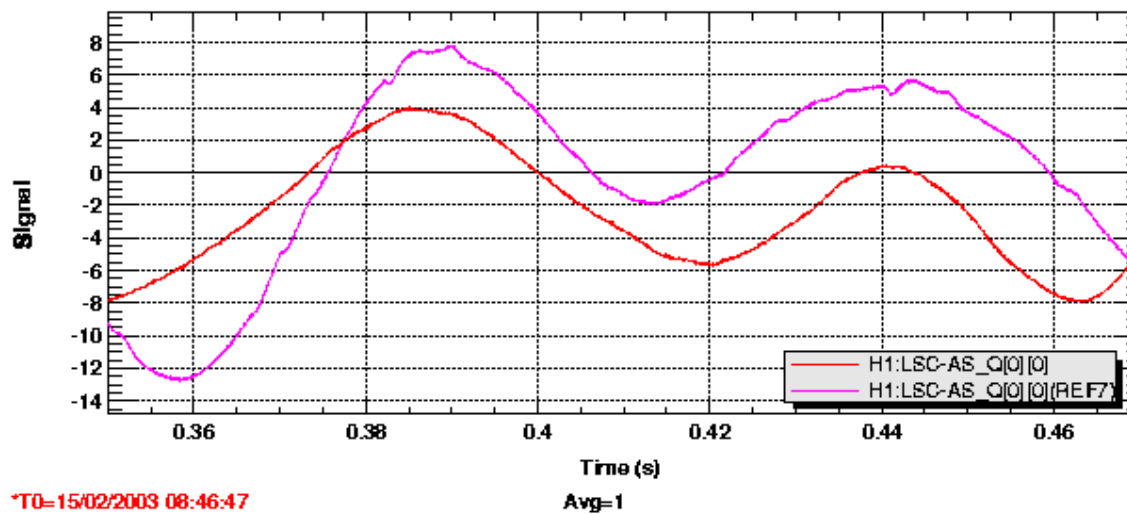


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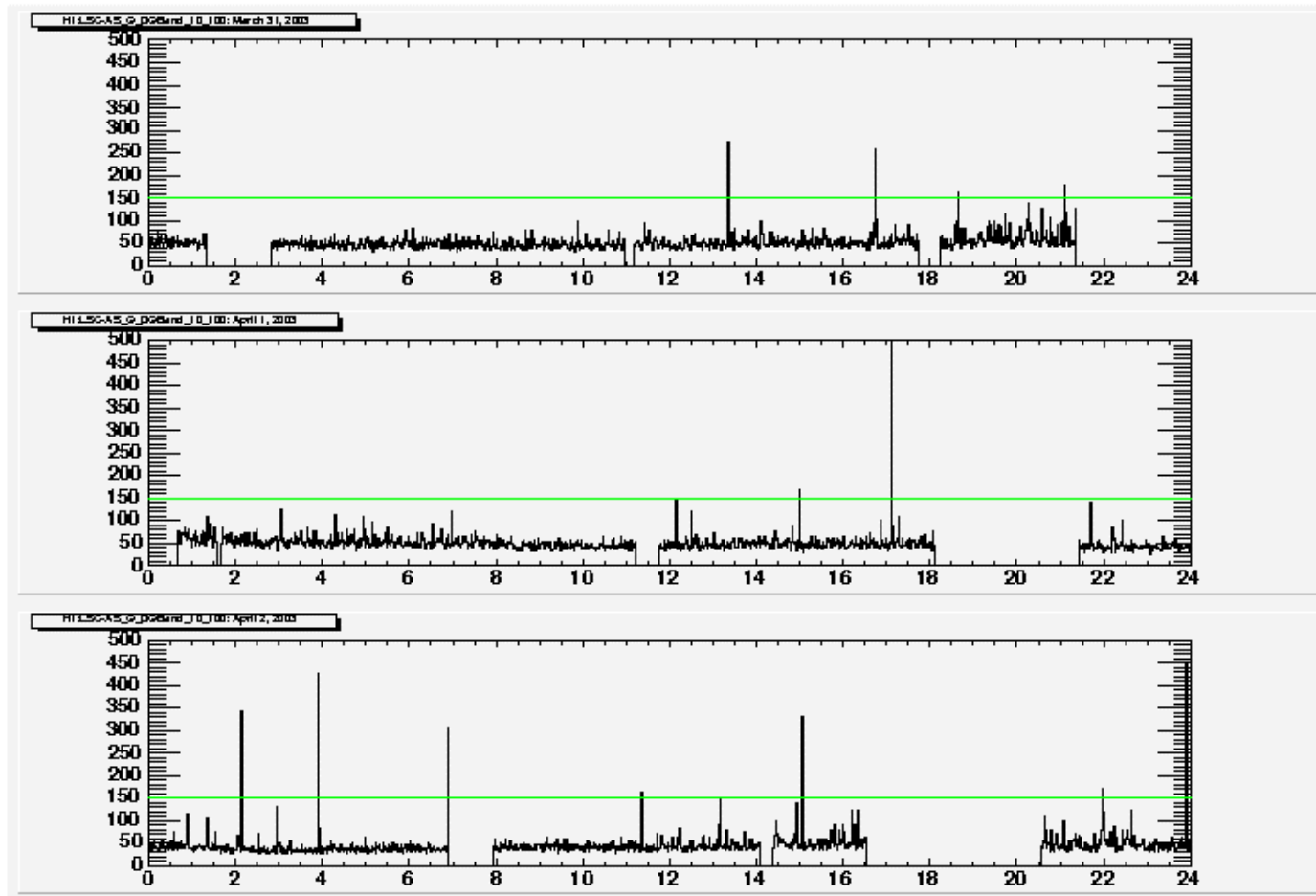
H1 Broadband Noise Syndrome



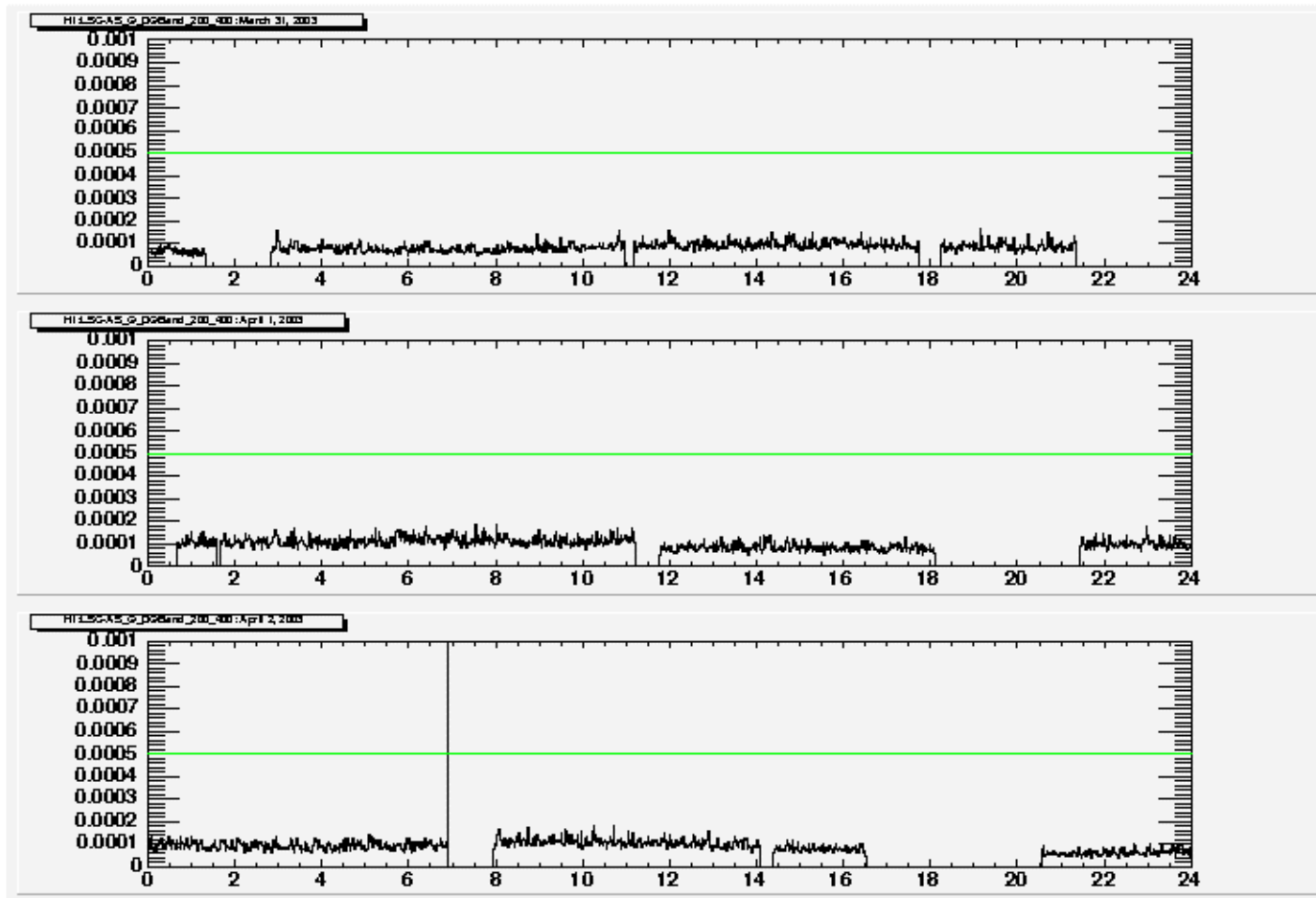
Time series



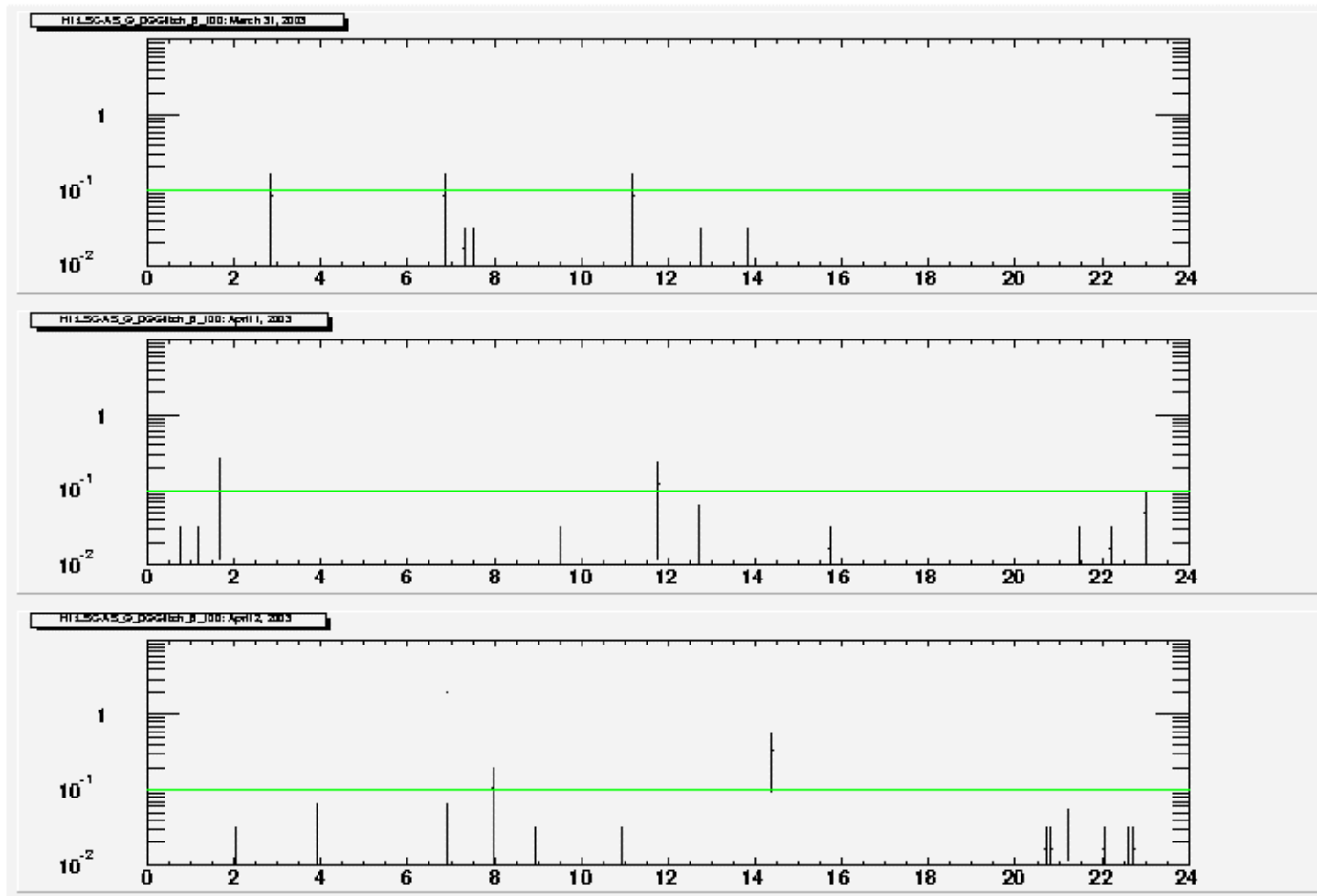
10-100Hz Noise Spikes



200-400Hz Noise Trends



6 σ Glitch Rate Trend



Questions For Burst Analysis

- Cutting calibration, controls, saturation segments should be safe. Are they necessary?
- Cutting p-p outliers and enormous noise excess in 10-100Hz band is probably safe (thresholds \gg expected GW strain). Can we afford not to cut them (would a discovery be believable if there was a coincident l.f. noise excess?)
- Are cuts based on AS_Q RMS alone safe? Under what circumstances can segments be cut based on these data?