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E12 Report from the Burst Group

Burst Analysis Group

and the

Glitch Investigation Team

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Tools and Methods

BurstMon: Control-Room Figures of Merit

- Using injected signals (sine-gaussians Q=9 F=100, 235, 555 Hz)
  - » Minimum detectable signal amplitude for 1% black pixel probability and 1 Hz false rate
  - » The ratio hrss_min/noise is a measure of how glitches affect the burst search
  - » for gaussian data, expect ratio~4
- Fraction of pixels in clusters of size > N
  - » large fraction is associated to strong glitches that will affect the burst search.
  - » for gaussian data: N=2, fraction=0.13 N=4, fraction=0.05
- Variability
  - » ratio of "instantaneous" (fraction of a second) to average (minutes) noise RMS.
  - » for “good” data, expect v=1
- Properties of loudest trigger in each minute
  - » Time, Frequency, SNR
  - » could be used for “quick” diagnostics and veto studies of loudest glitches

For trend plots and histograms over E12 at L1, H1, H2, see:

http://emvogil-3.mit.edu/~cadonati/E12/BurstMon/BurstMon.html

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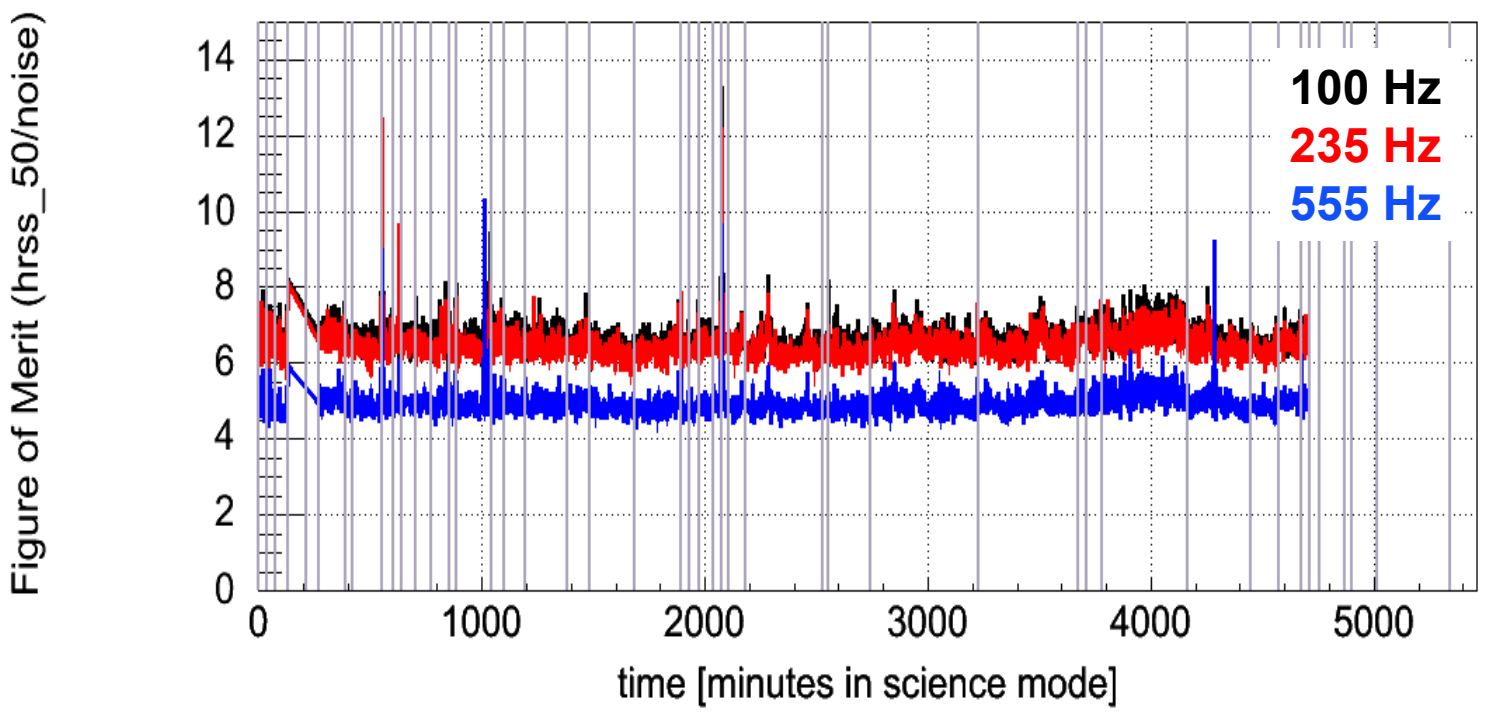
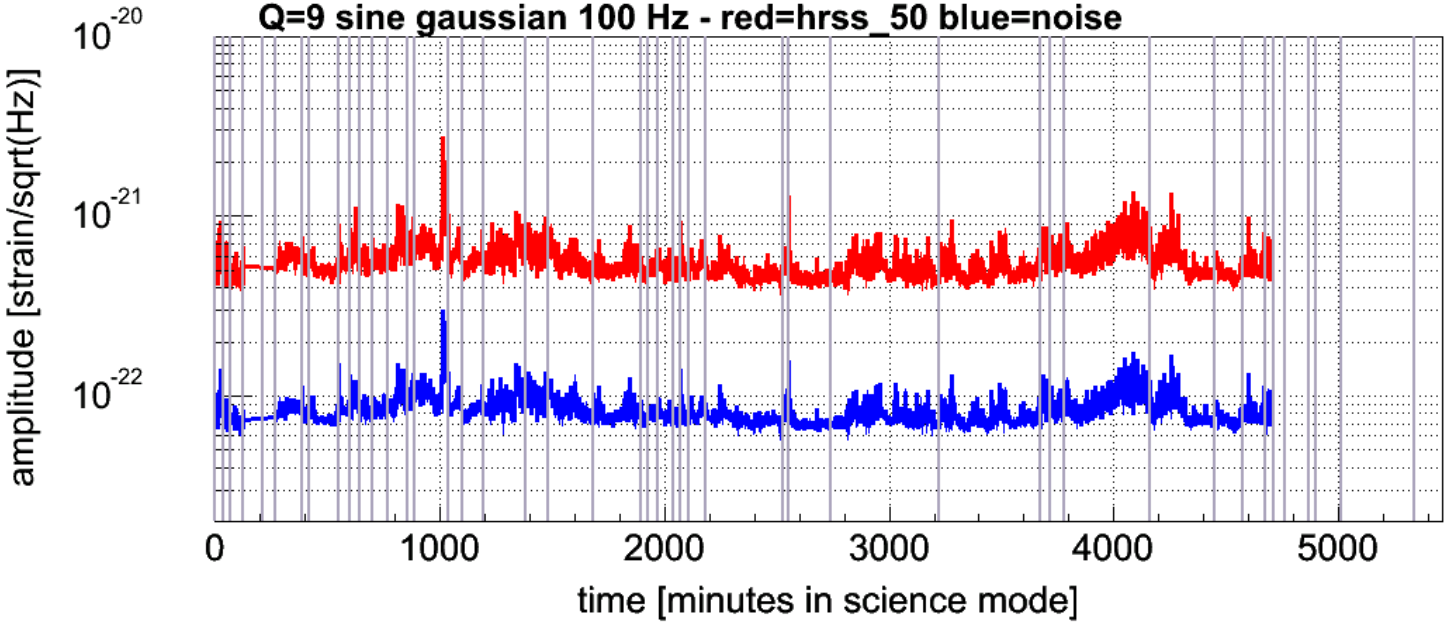
L1 during E12 science segments longer than 1800 sec





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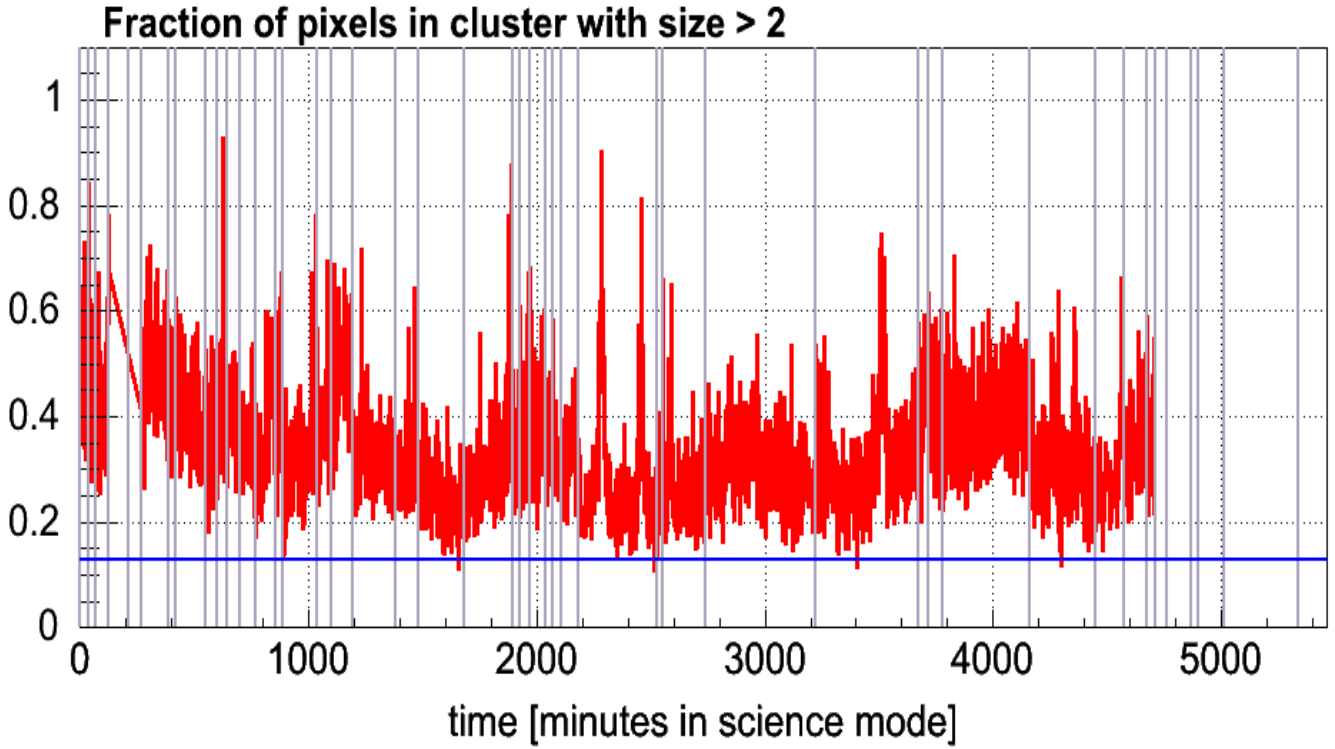
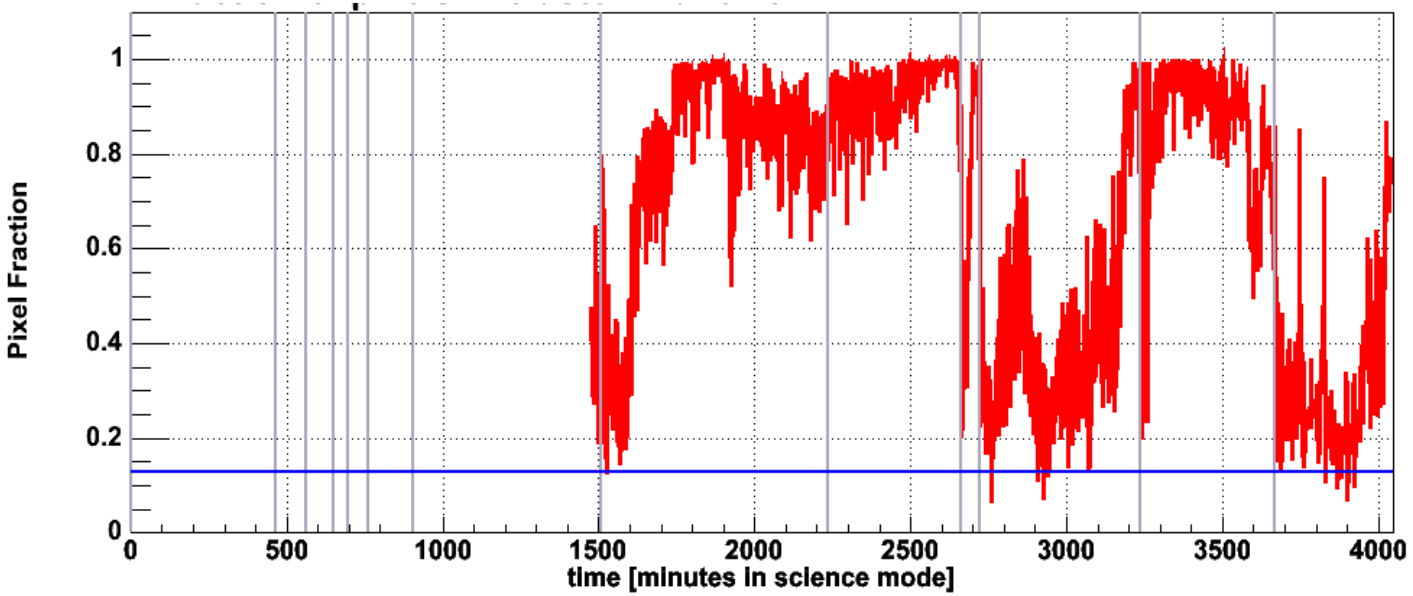
L1 during E12 science segments longer than 1800 sec



H1 during E12 science segments longer than 1800 sec – starting Friday 8 UTC



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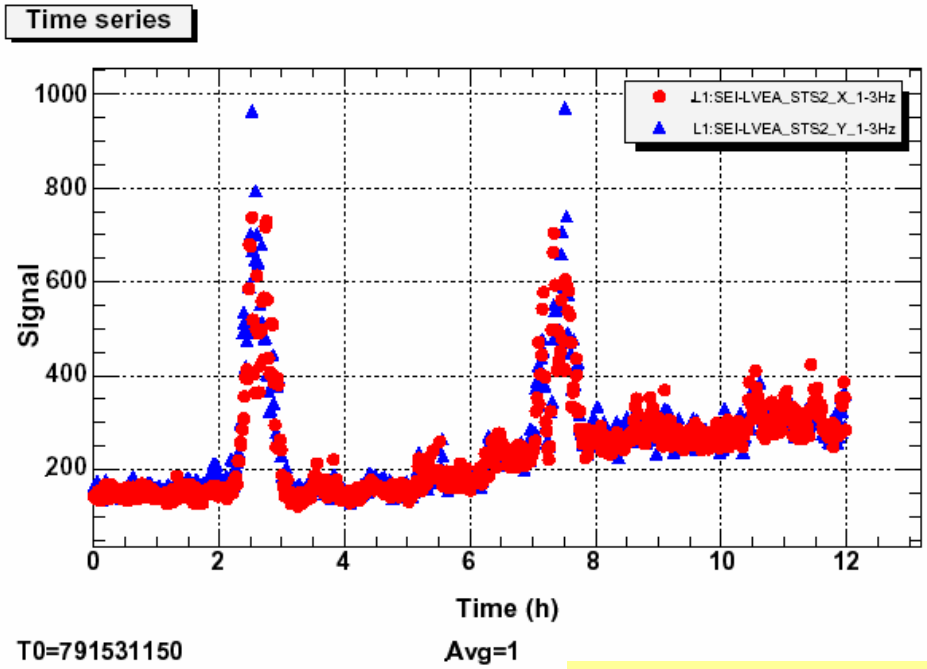
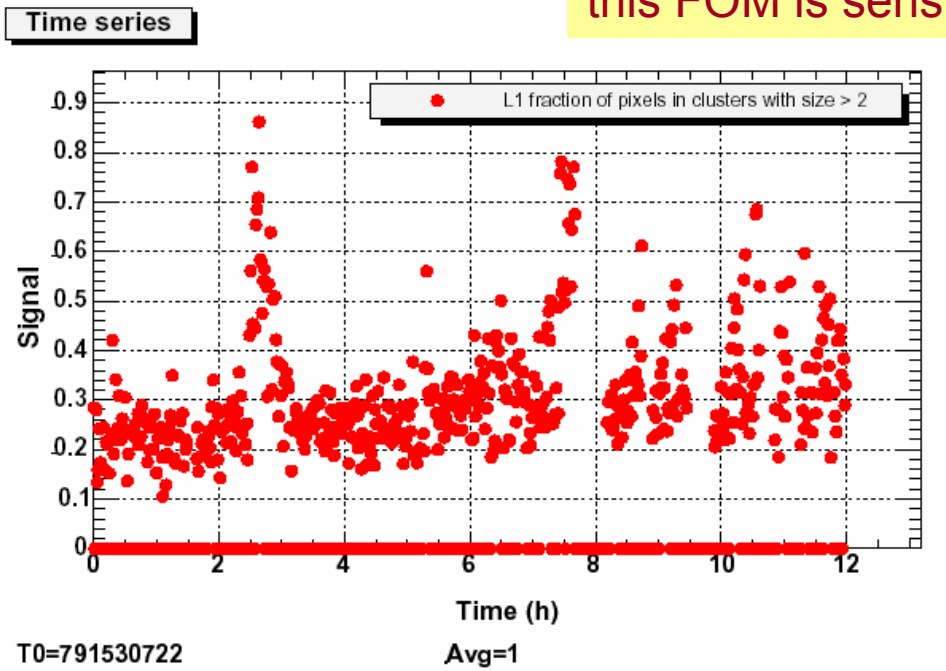
LVEA seismometers (STS2_X and Y)



Friday morning at L1

this FOM is sensitive to trains!



fraction of pixels in clusters with size >2

Trigger Analysis

- Excess Power (http://www.lsc-group.phys.uwm.edu/~kipp/E12)
  - » on AS_Q, up to 1 kHz
- KleineWelle (http://lancelot.mit.edu/~lindy/e12/report)
  - » on AS_Q, AS_I, AS_AC, MICH_CTRL, PRC_CTRL, POB_Q, REFL_Q, WFS1_QP, WFS2_QP, up to 1 kHz
- WaveBurst (http://tier2.phys.ufl.edu/~klimenko/waveburst/E11/datasets)
  - » on AS_Q, up to 2 kHz

For diagnostic plots and veto studies over E12 at L1, H1, H2, see:

http://emvogil-3.mit.edu/~cadonati/E12/TriggerAnalysisReport.html

Results

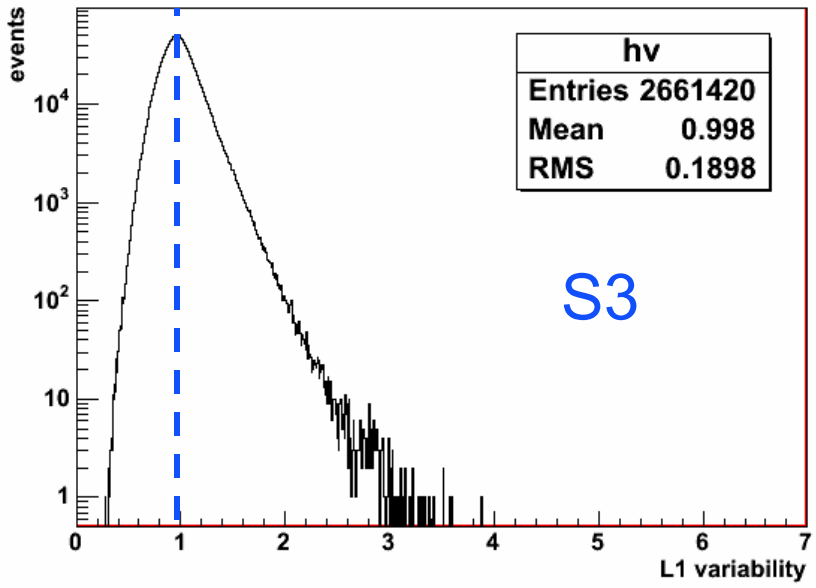
L1

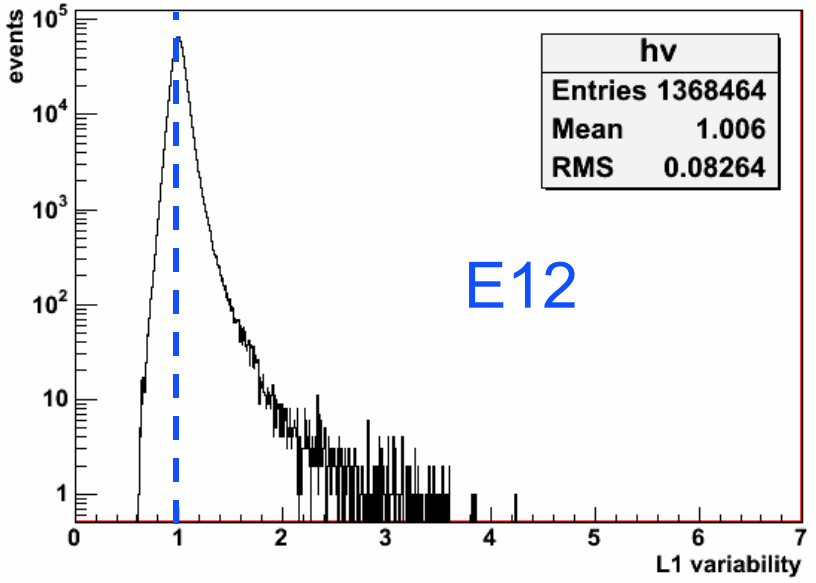
Detectable burst amplitude: 4-6 10^{-22} strain/sqrt(Hz)

Ratio FOM: 6-7 at 100, 235 Hz 5 at 555 Hz – stable during E12

pixel fraction FOM, N=2: ~0.4 (0.13 for gaussian noise)

Variability: significant improvement from S3 but still detector shows a lot of noise non-stationarity.





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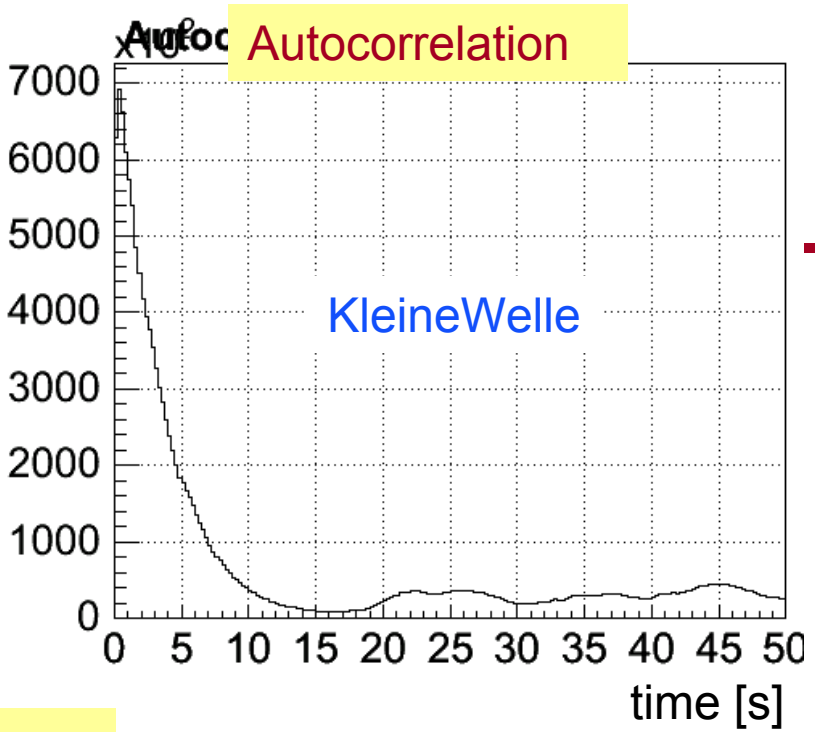
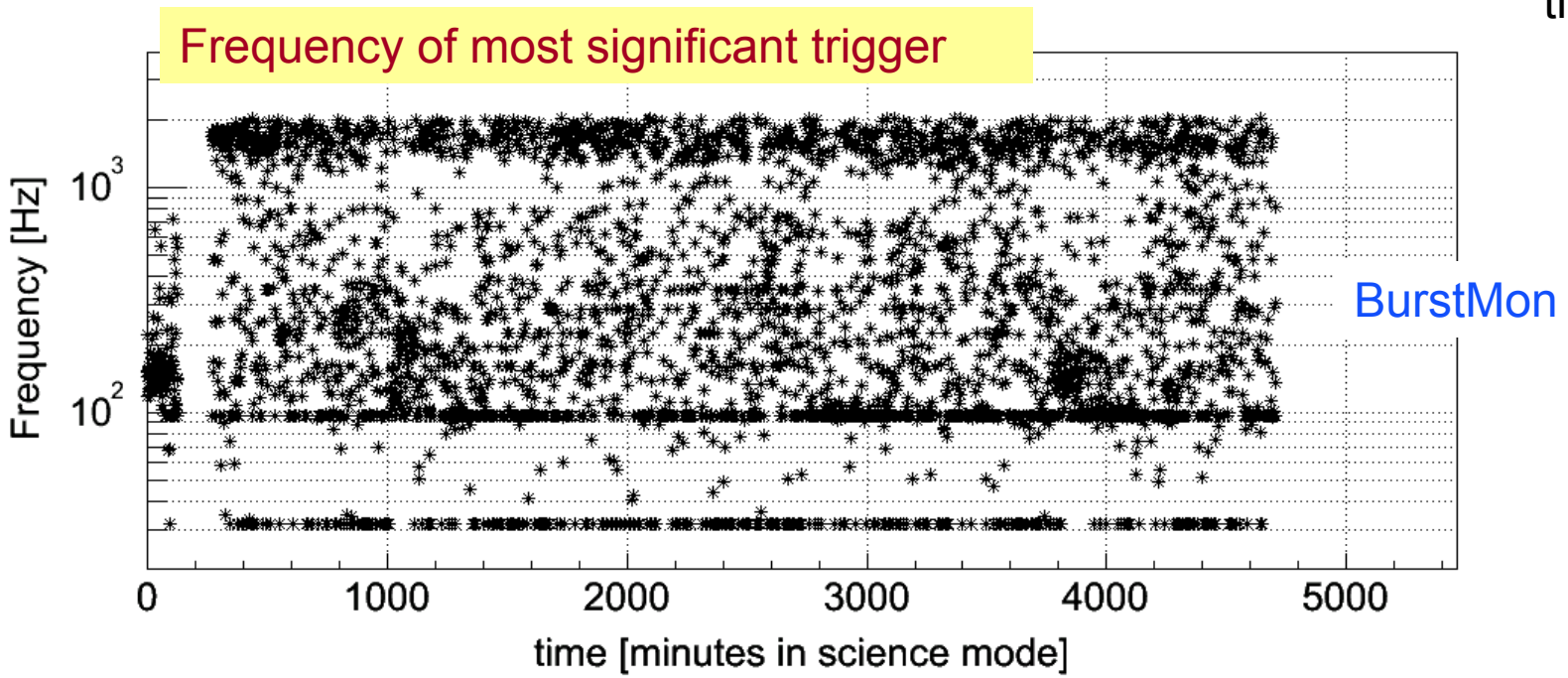
L1

autocorrelation scale=10 s
bumps at ~20, 40 sec
0.1 Hz noise?

Dominant trigger frequency:
90-100 Hz. Also, high frequency phase noise



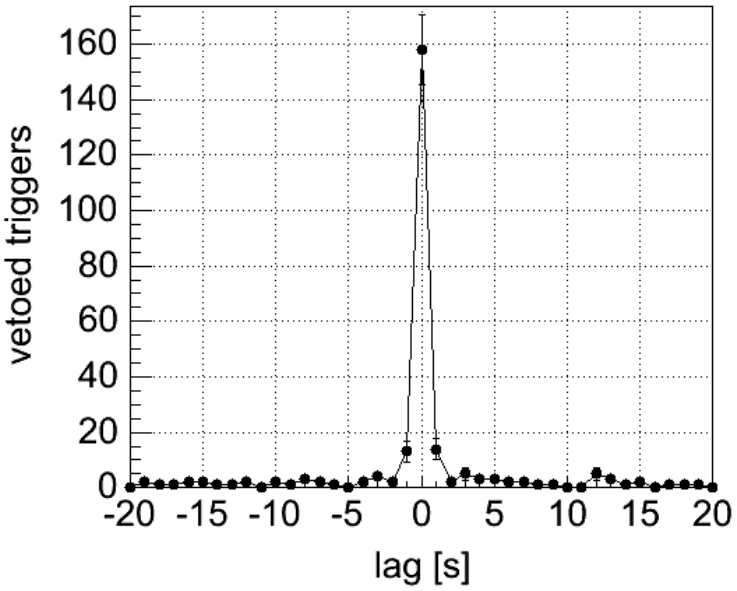


Early Veto Candidates

KleineWelle triggers with Significance>100 (non-gaussian tail in event histogram

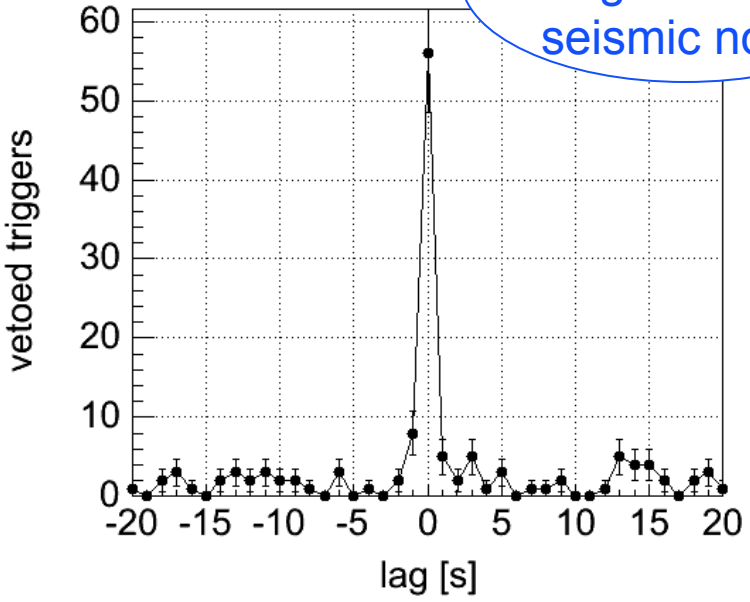
➔ all tested channels exhibit correlations. PRC_CTRL has ~30% veto efficiency

PRC_CTRL



WFS1_QP

glitches in high 1-3 Hz seismic noise



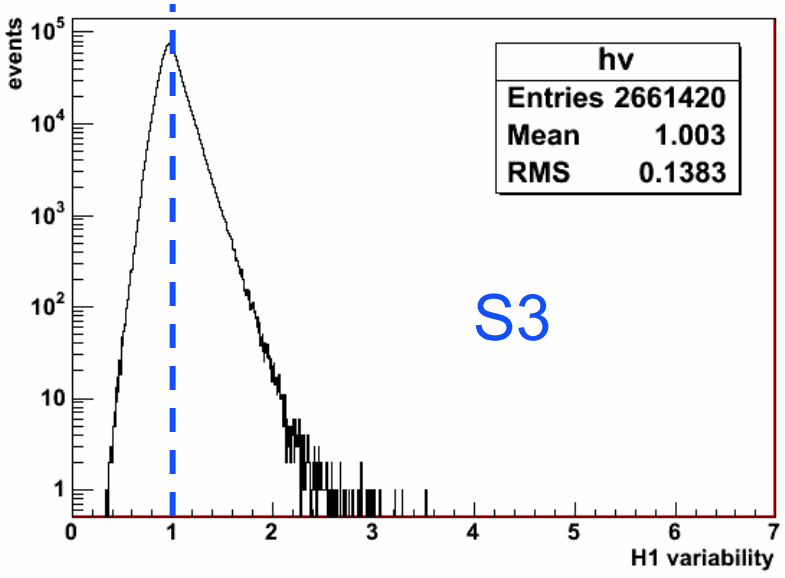
H1

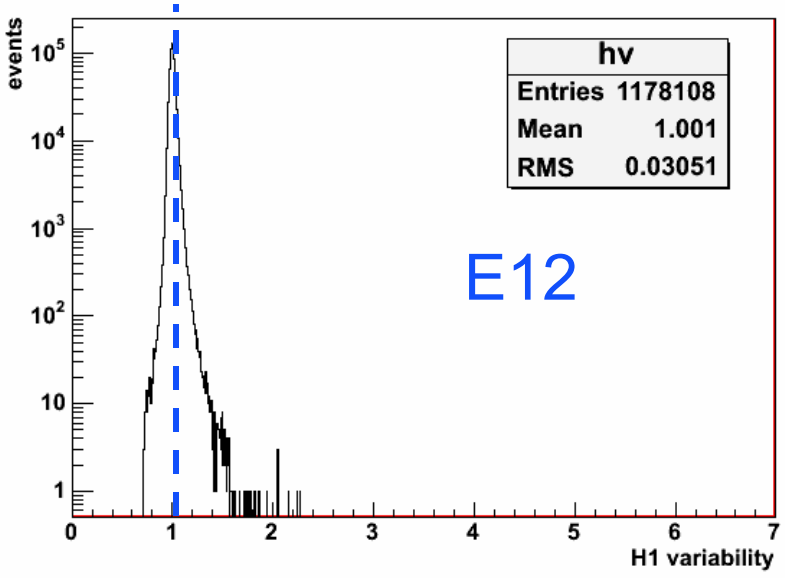
Detectable burst amplitude: 4-6 10^{-22} strain/sqrt(Hz)

Ratio FOM: 6-12 at 100, 235 Hz 4-6 at 555 Hz – large excursions

pixel fraction FOM, N=2: often ~1 (glitches!!!!)

Variability: significant improvement from S3 (similar to E11)





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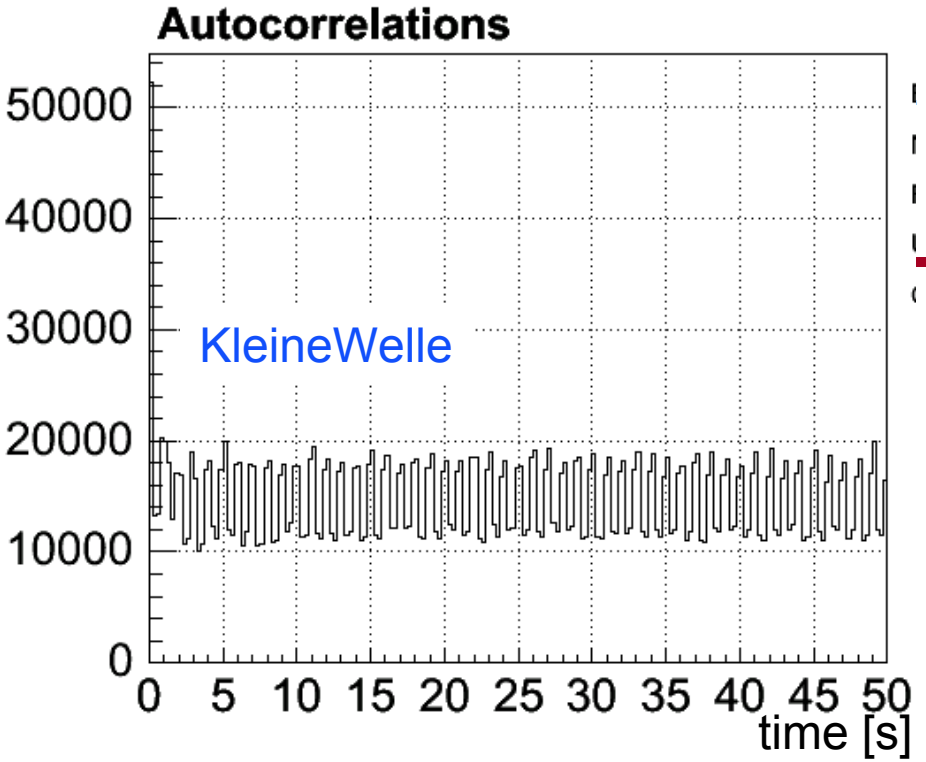
start analysis: Feb 4, 8 UTC

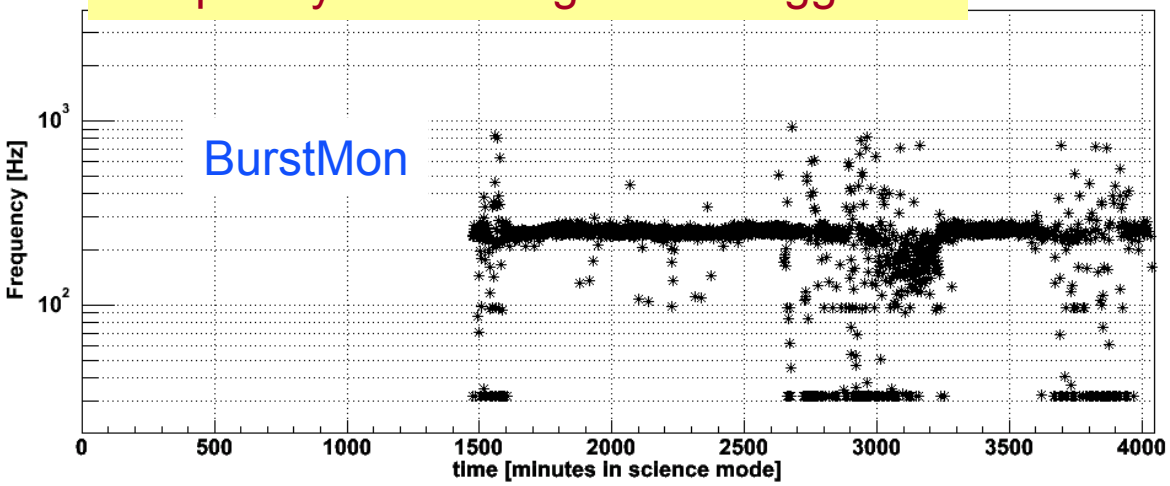
H1

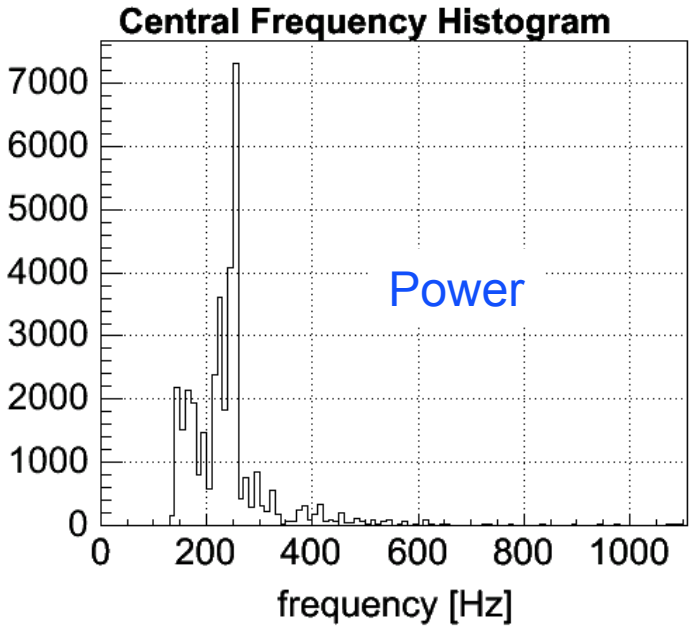
autocorrelation scale=1 s
(note: both H1 and H2 are required to be in science mode)

Dominant trigger frequency: 250 Hz
(known resonance in the TCS)



Frequency of most significant trigger





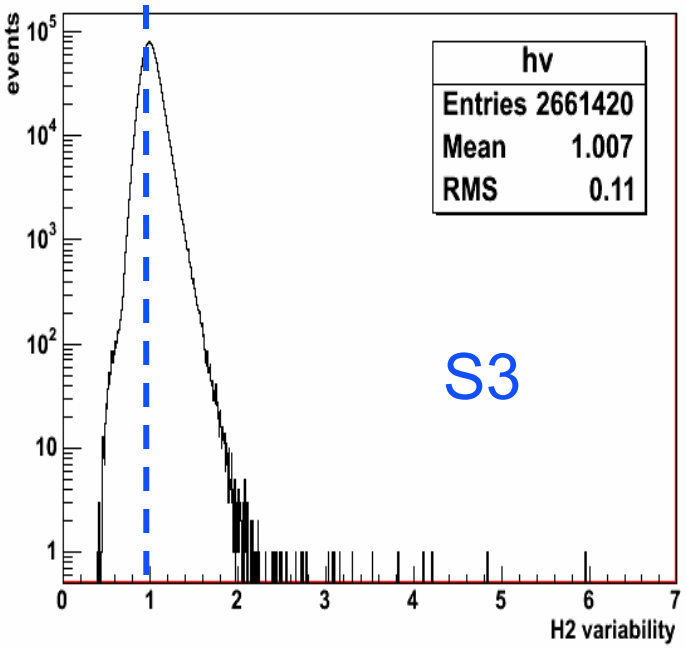
H2

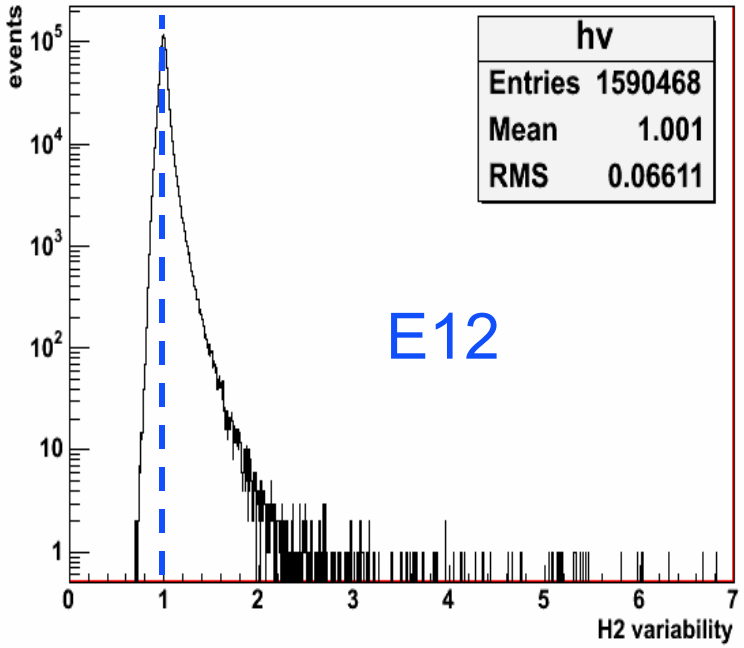
Detectable burst amplitude: 6-10 10^{-22} strain/sqrt(Hz)

Ratio FOM: 6 at 100, 235 Hz 4.5 at 555 Hz – stable

pixel fraction FOM, N=2: large excursions 0.2-0.8

Variability: significant improvement from S3 (similar to E11)



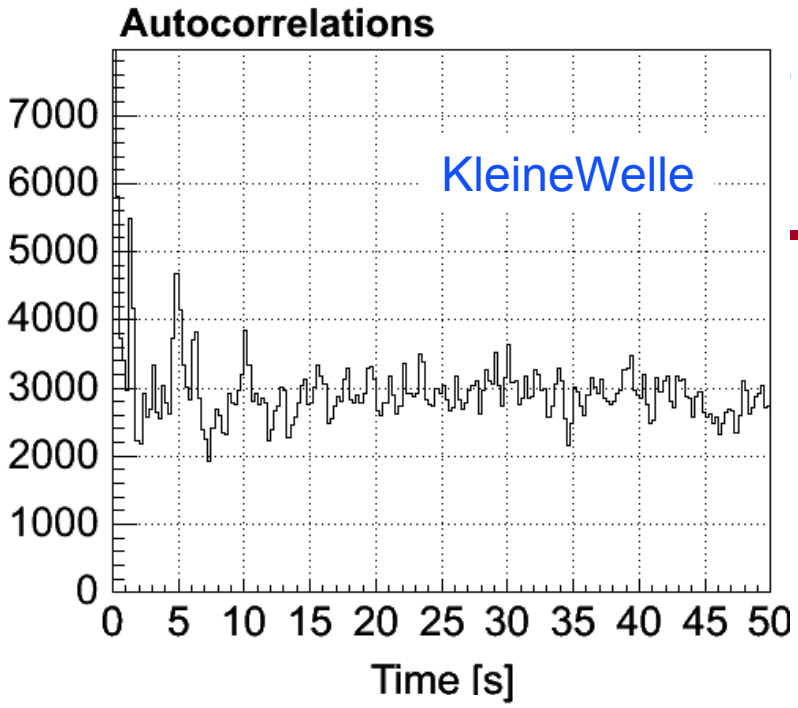


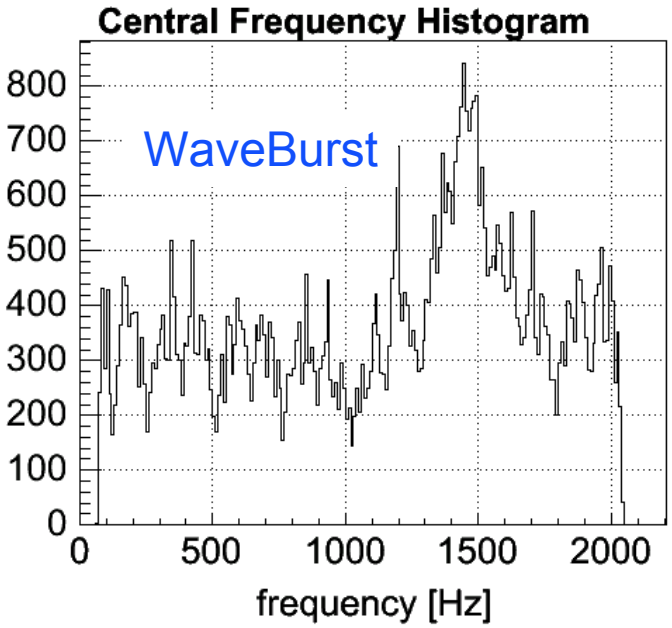
start analysis: Feb 4, 8 UTC

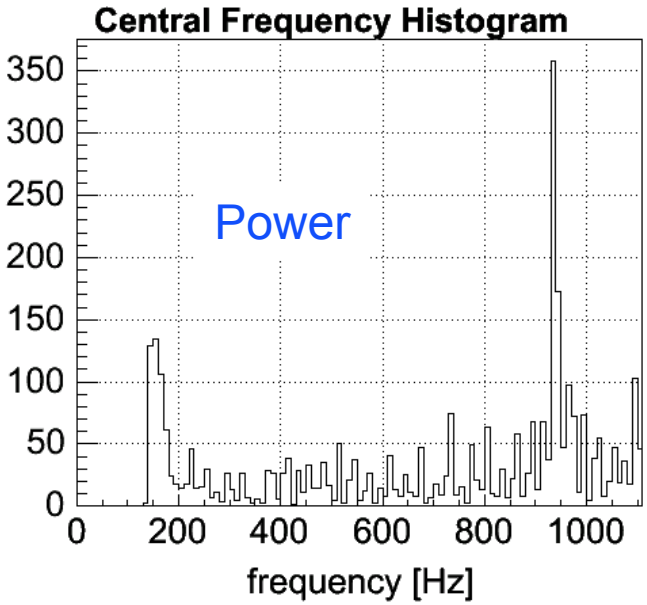
H2

autocorrelation scale=2 and 5 s
(note: both H1 and H2 are required to be in science mode)

Dominant trigger frequency: 950 Hz







Conclusion

- The BurstMon ratio FOM quantifies how the sensitivity of the burst pipeline is affected by glitches
  - » FOMs relatively stable at L1, excursions at H2
- Variability improved since S3
- Transients at L1 associated to seismic noise (1-3Hz) and to phase noise in the 1.5-2kHz range
- Features at H1 have the largest impact on the burst analysis:
  - » large excursions of all figures of merit during E12
  - » 1 sec periodicity
  - » 250 Hz