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S4 Data Quality

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Data Quality Preparation

- Many sources
  - » ELOG
  - » CDS/Epics channels (state vector, overflow counts, etc…)
  - » DMT
    - – Science monitor (burstMon, SenseMon, StochMon, PulsarMon)
    - – Generic data watchers (TimeMon, PSLmon, glitchMon,etc)
  - » Offline processing
- Requirements
  - » Low latency
    - – <1hr for “online” analysis
    - – ~1-2 weeks for offline analysis
  - » Ease of use – machine readable
- DQ segment list compilation (currently) done by hand (Keith).
- Automated evaluation/compilation highly desireable (S5?)

Data Quality Segments

- Detector characterization concurrent with science running.
- Data quality segments compiled at the end of each week of running:
  - **v00**: Current science mode segment list
  - **v01**: Week 1 science segments with preliminary data quality.
  - **v02**: Week 1-2 science segments with preliminary data quality.
  - **v03**: Week 1-3 science segments with preliminary data quality
  - **v04:** Week 1-4 science segments with preliminary data quality
  - **v05-vNN:** Further refined data quality flags – full run.
- Segment lists available from: http://gallatin.physics.lsa.umich.edu/~keithr/S4DQ/

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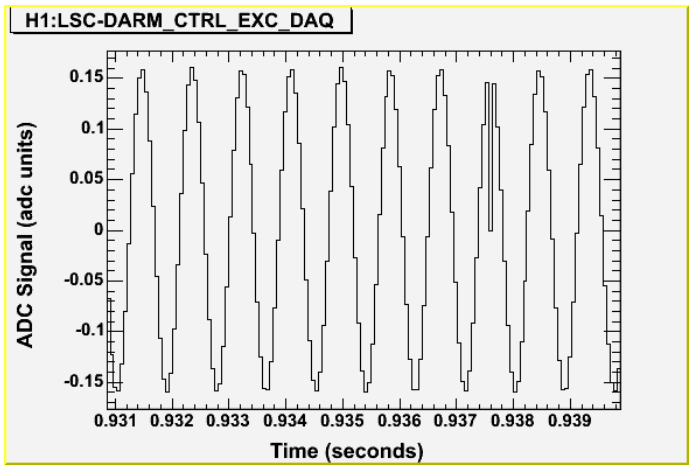
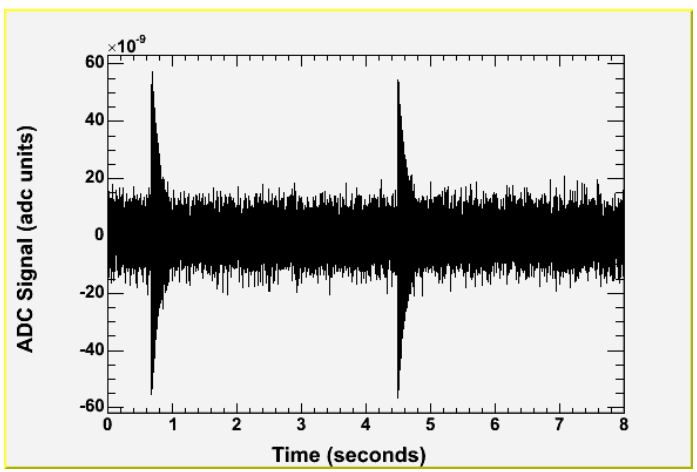
Data Quality Flags

- Recommended data quality flags
  - OUTSIDE_S4
  - OUT_OF_LOCK
  - INJECTION_BURST (INSPIRAL, PULSAR, STOCHASTIC)
  - CALIB_LINE_DROPOUT
  - ADC_OVERFLOW
- To be evaluated.
  - DUST
  - HIGH_MICROSEISM
  - HIGH_PIXEL_FRACTION_1KHZ (2KHZ)
  - 120HZ_UPCONVERSION
  - TCS_SERVO

Calibration Line Dropouts

- Calibration line injection fails occasionally
- Added directly to DARM_CTRL – feeds into GW channel!
- Line dropouts found by line tracking (Gaby et al.).
- Second check by notching calibration lines and looking for glitches (JGZ).
- Dropout classes:
  - » 1 second
  - » Single sample
  - » Others???

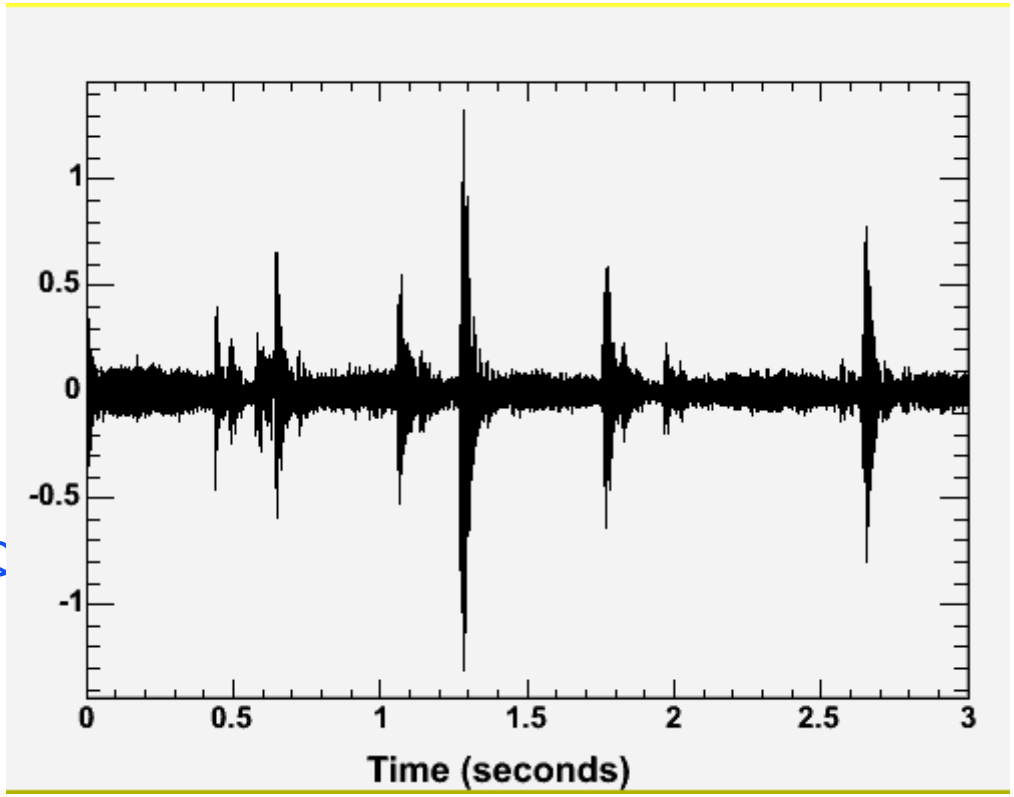




ADC Overflows

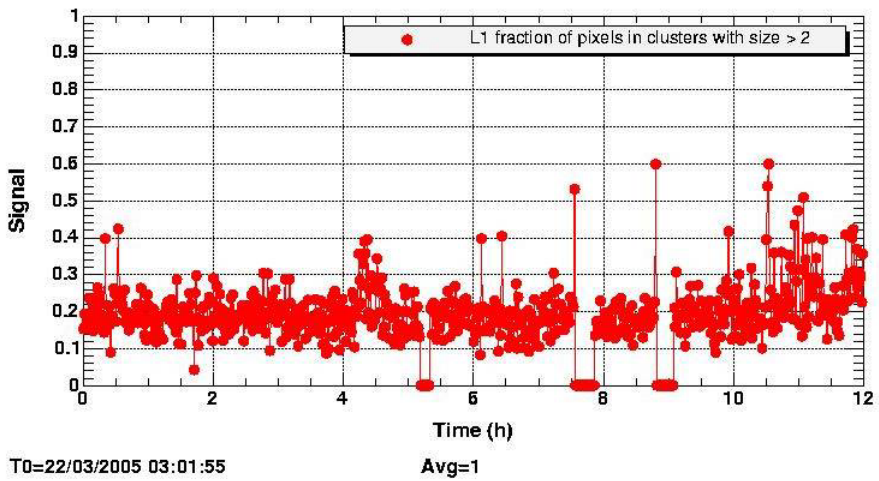
- ADC Overflow counts kept by FE processors
- DQ flags generated from minute trends – 60s Time resolution.
- Channels tested
  - » AS1-4 photodiodes, I and Q
  - » POB1-2 photodiodes I and Q phases
  - » REFL1-2 photodiodes I and Q

H1:LSC-AS_Q with 100Hz hi-pass filtering near AS1_Q saturation event at GPS 793728755

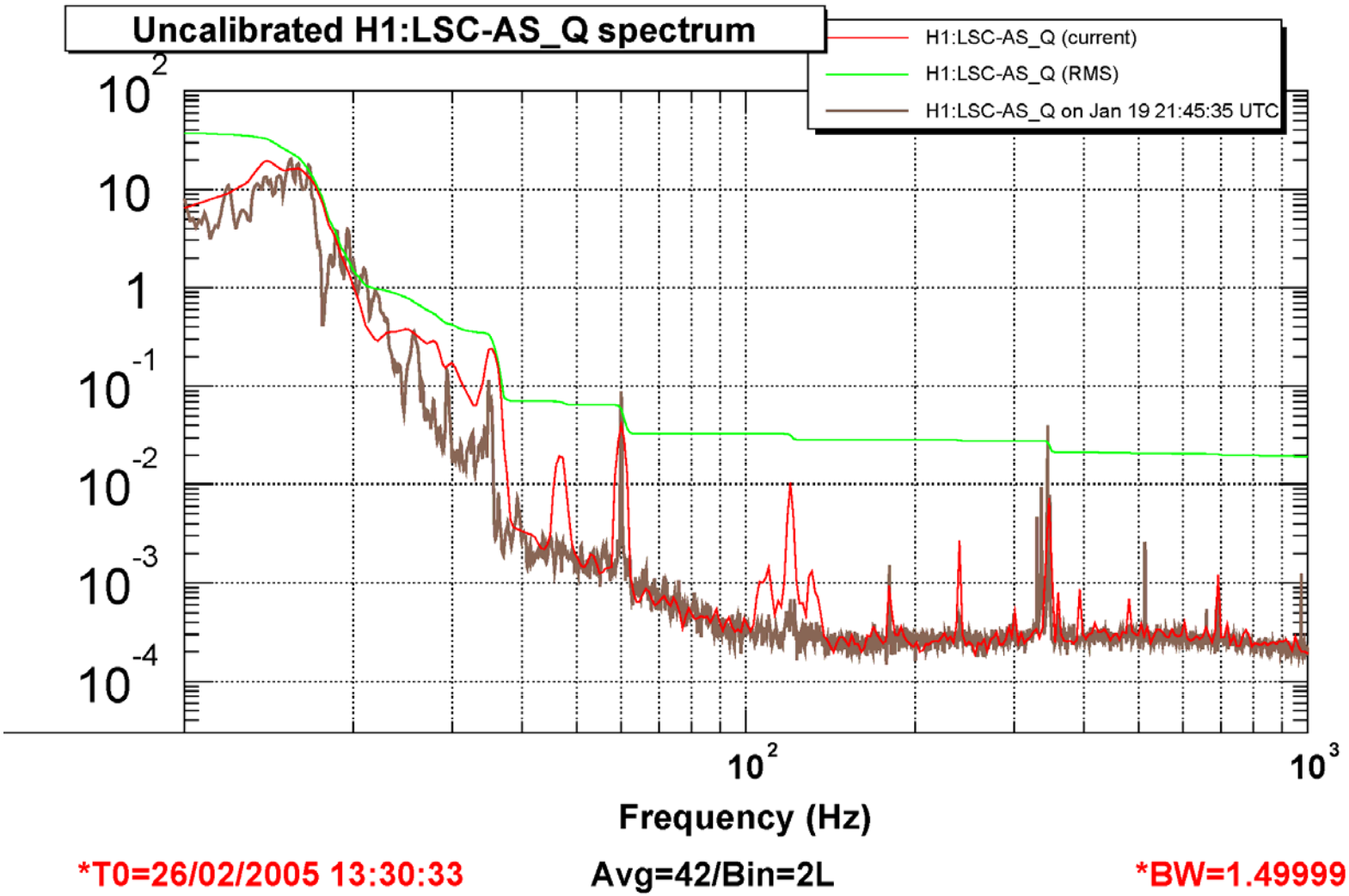


BurstMon Cluster Fraction

- Cluster fraction is a measure of noise gaussianity.
  - » Run with 1kHz & 2kHz bandwidth
  - » gaussian noise pixels distributed uniformly over t-f plane → f_{pixel} ~0.13
  - » Increasing cluster fraction indicates non-gaussian noise.
  - » FOMS indicate it is a good indicator of deteriorating noise.
  - » DQ flags demand $f_{pixel} > 0.5$ for t>5min.
- Safety???



120 Hz Upconversion



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S4 DQ Dead-Times (weeks1-3)

FLAG	H1	H2	L1
Injections	13279 (0.9%)	13604 (0.9%)	12822 (1.0%)
Calib Line Dropouts	168 (<.1%)	360 (<.1%)	283 (<.1%)
ADC Overflow	1080 (<.1%)	3840 (0.3%)	3300 (0.3%)
Dust	50430 (3.4%)		38994 (3.0%)
High μSeism			39315 (3.1%)
Pixel Fraction (1kHz)	23880 (1.6%)	12900 (0.9%)	43800 (3.4%)
Pixel Fraction (2kHz)	17640 (1.2%)	262020 (18%)	342180 (27%)
120Hz Up-Conversion	35554 (2.4%)		
TCS Servo	9362 (0.6%)		
Total Science Data	1484845	1473266	1288070*

*) L1 total time adjusted for OUT_OF_LOCK, OUTSIDE_S4 segments