

Glitch classes seen in aLIGO so far (through end of O1)

LIGO Detector Characterization Group
Maintained by Josh Smith
DCC# LIGO-G1500642

This document:

- A. lists the major glitch classes that have been seen in aLIGO so far,
- B. shows a few representative images,
- C. says which detectors have which glitches, and
- D. provides links to alog pages and wikis for more information

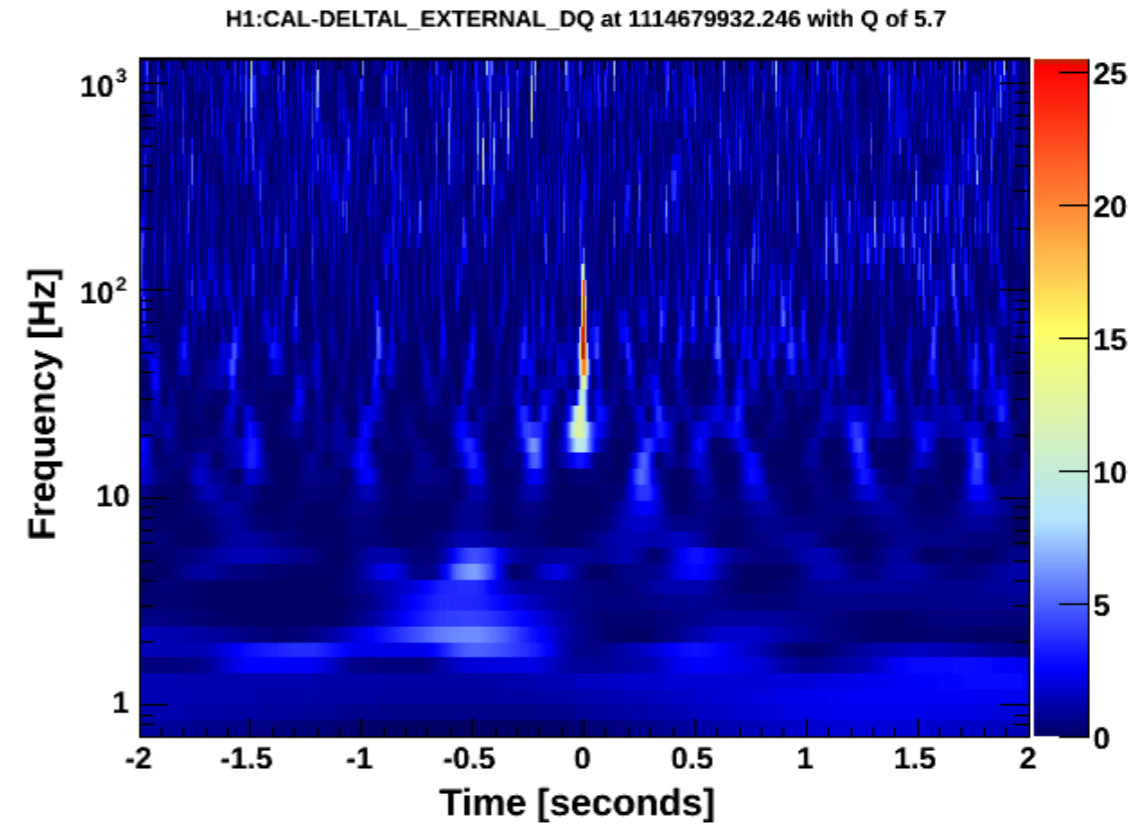
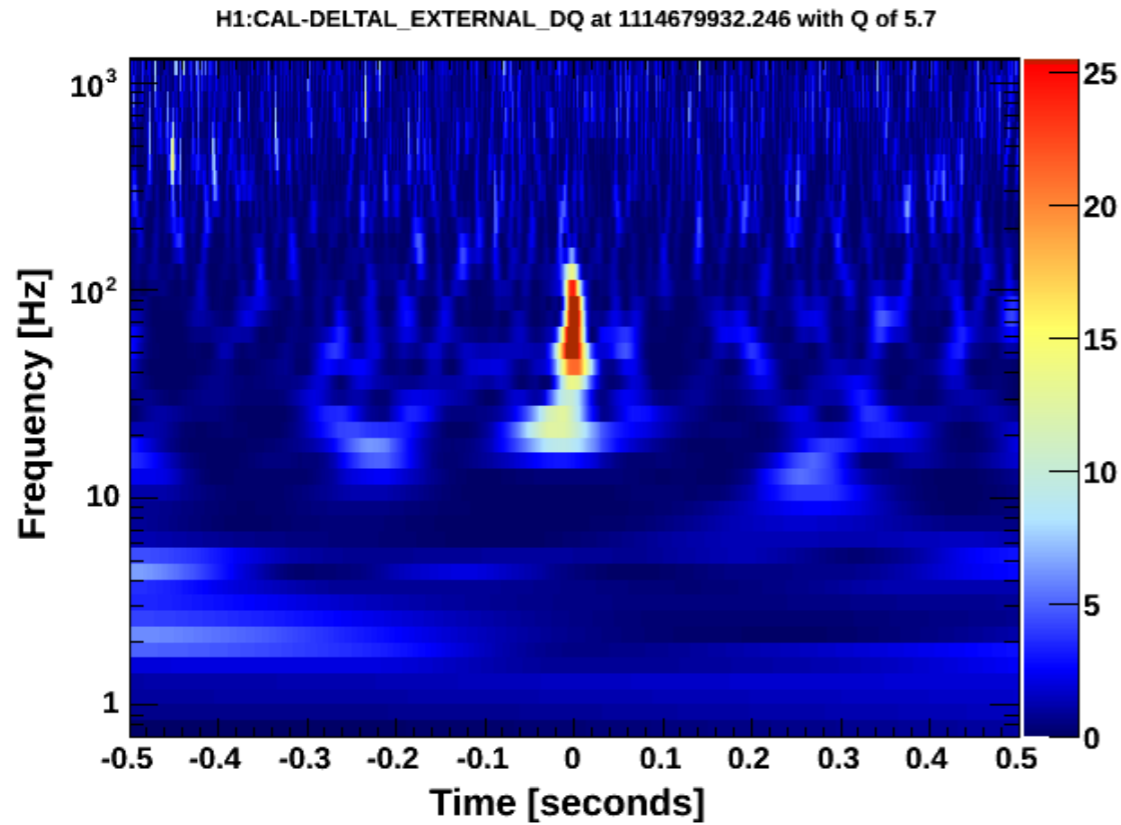
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[**NF**] = not fixed, [**PF**] = partially fixed, [**F**] = fixed

1. Blip glitches

H1 Examples: <https://ldas-jobs.ligo-wa.caltech.edu/~areeda/blip-omega.tar>



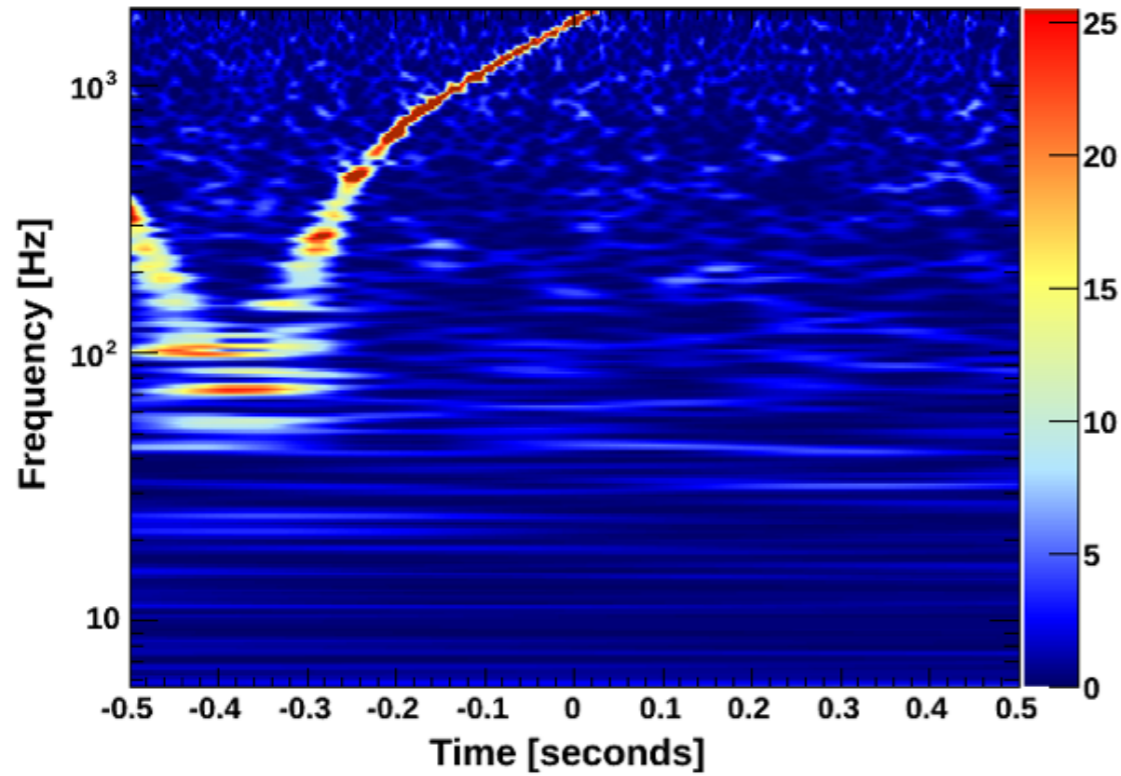
Blip glitches documentation

- Brief description: Class of common glitches in both detectors, with no known cause currently. The only weak lead is that saturated hardware injections cause glitches that look very similar, so perhaps these are saturations in the actuation chain that happen under normal conditions.
- Relevant alogs:
 - LLO:
 - LHO: saturated injections look like blips?
- Other documentation: Some blip times and scans [link](#)

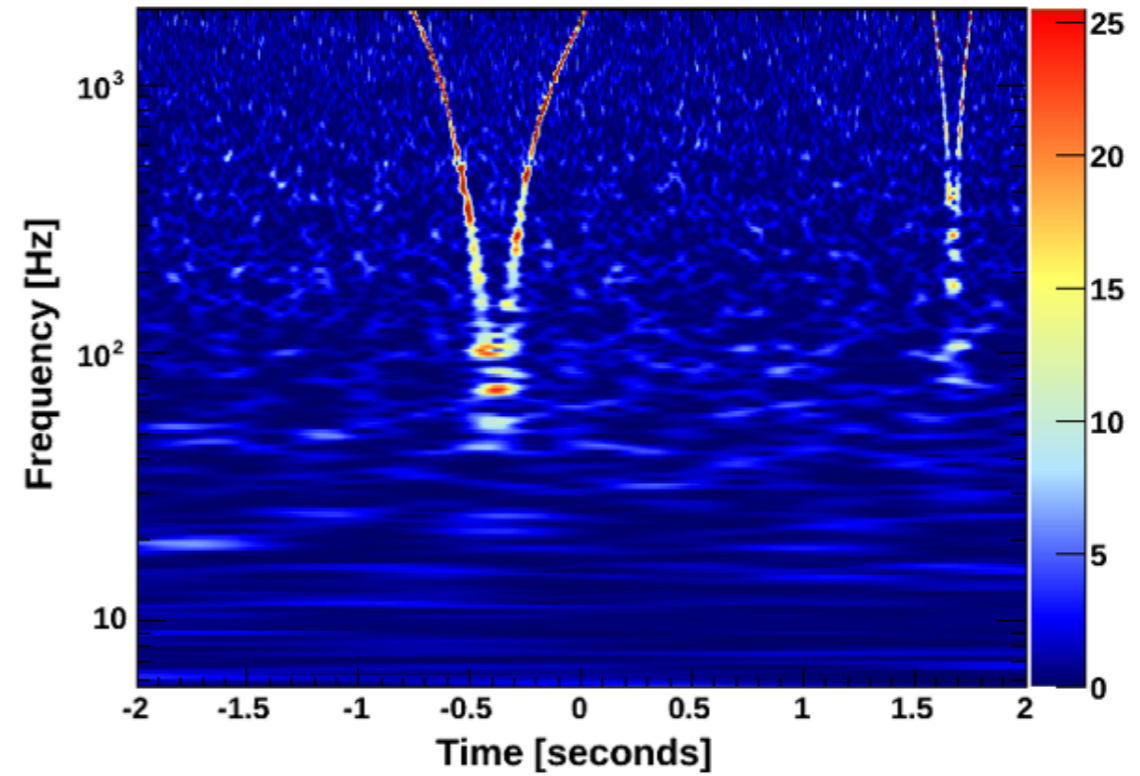
2. RF Beats

Examples: <https://ldas-jobs.ligo.caltech.edu/~areeda/josh-20150828.tgz>

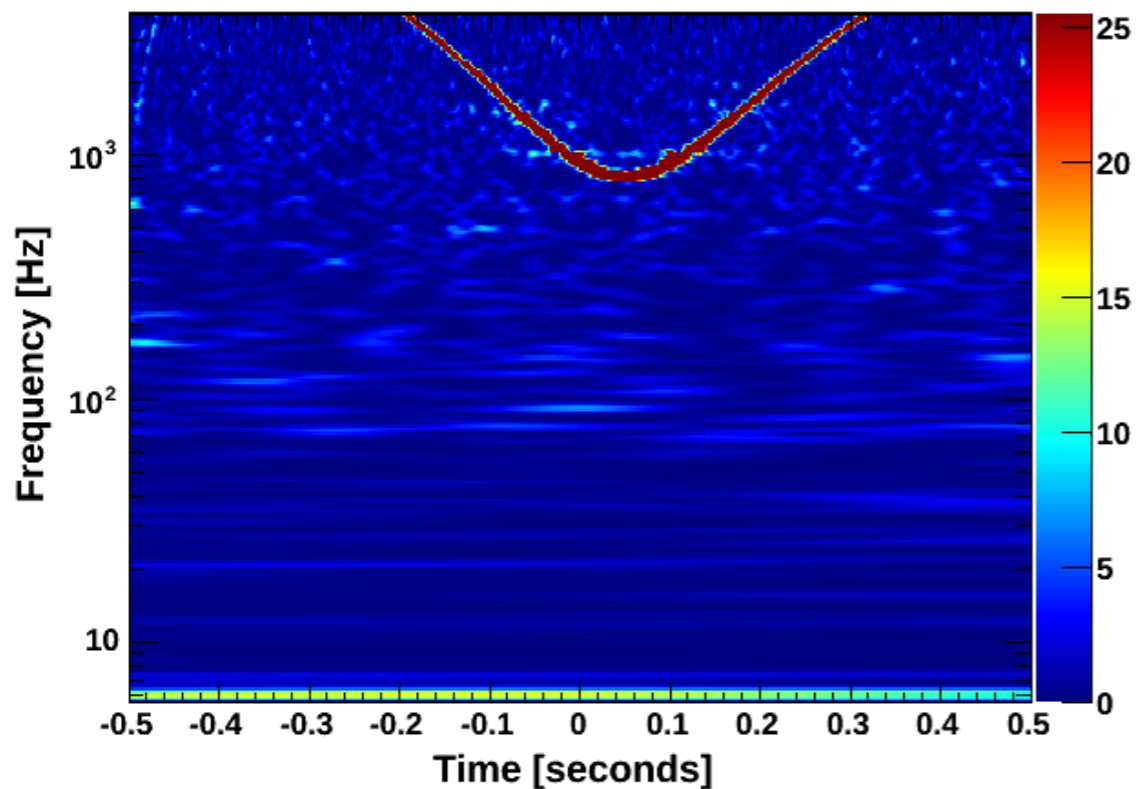
L1:OAF-CAL_DARM_DQ at 1112518287.605 with Q of 45.3



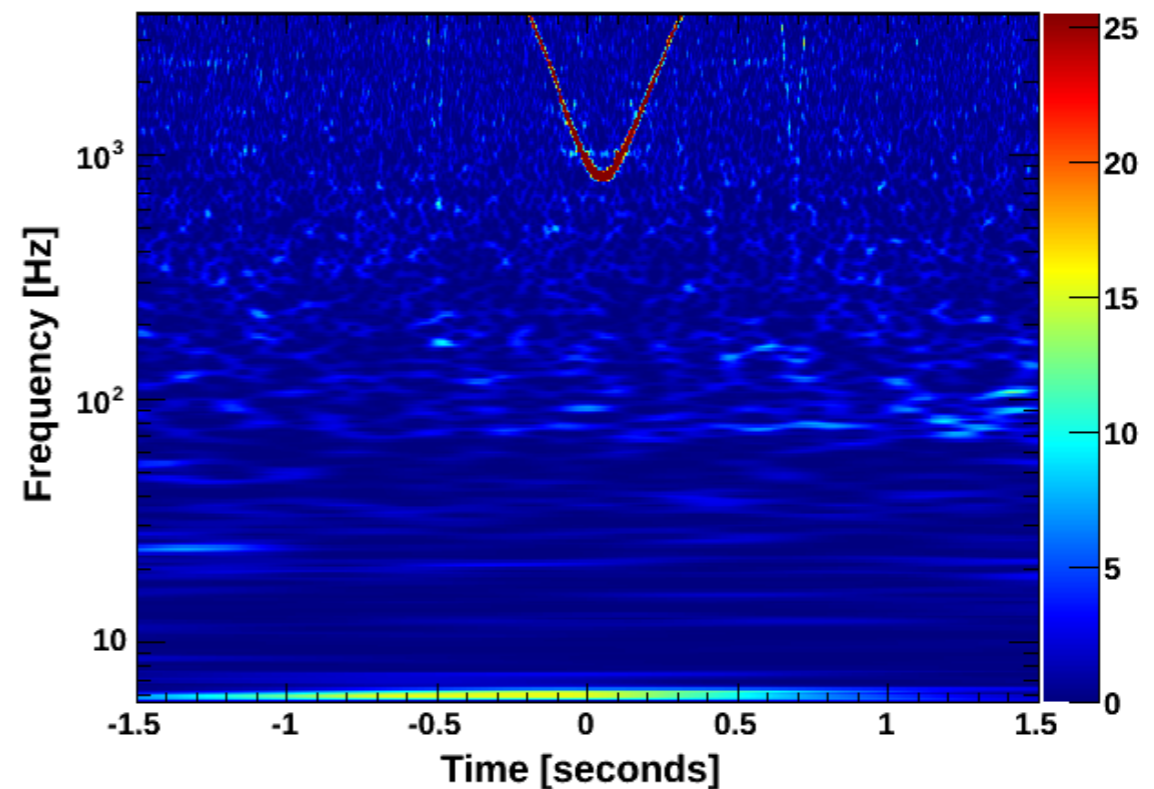
L1:OAF-CAL_DARM_DQ at 1112518287.605 with Q of 45.3



L1:LSC-DARM_IN1_DQ at 1118036740.090 with Q of 45.3



L1:LSC-DARM_IN1_DQ at 1118036740.090 with Q of 45.3

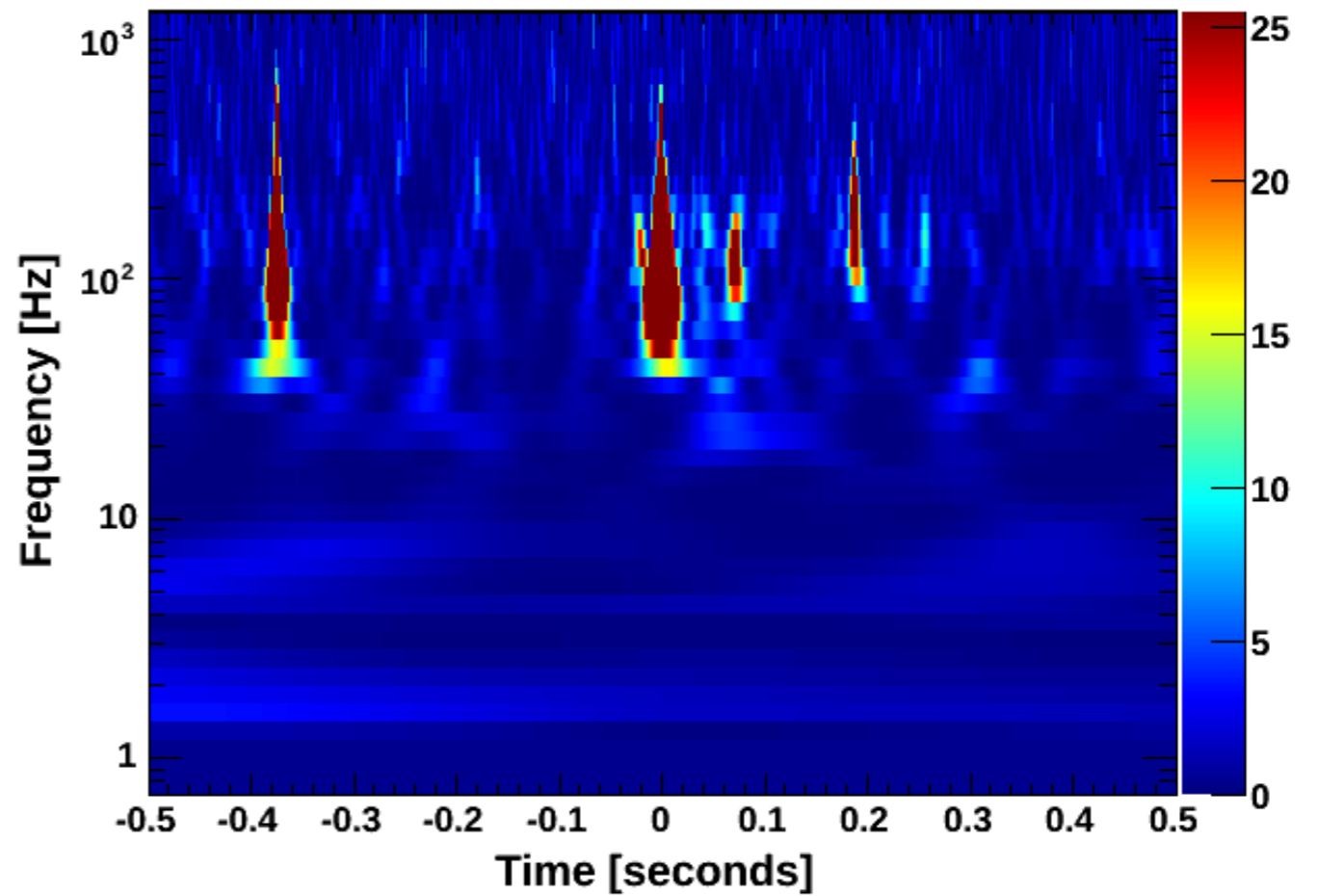
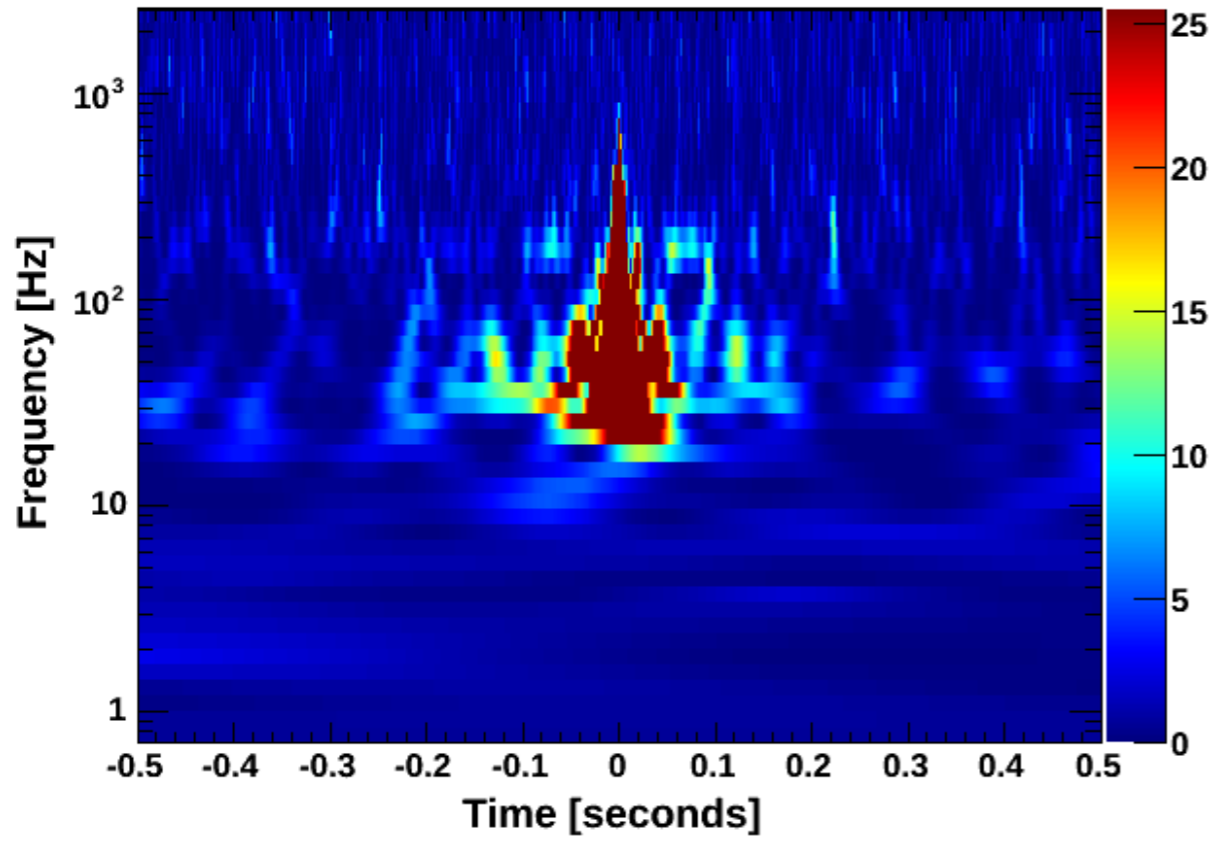


RF Beats documentation

- Brief description: These are beats of two or more RF oscillators that sweep quickly through the audio range. Largely fixed at LHO in DARM (still see in MCL, other channels), were very bad at LLO in DARM until mitigation in mid-ER8, end ER8/O1 primarily only at higher frequencies.
- Relevant alogs:
 - LLO: 17961, 17707, 17690, 17611, 17210, 17191, 17090, 17016, 16298, 19915, 19986, 20033
 - LHO: 17506, 17452, 19079
- Other documentation: T1500466, G1500809

3. L1 Koi Fish

L1:GDS-CALIB_STRAIN at 1126081773.573 with Q of 5.7

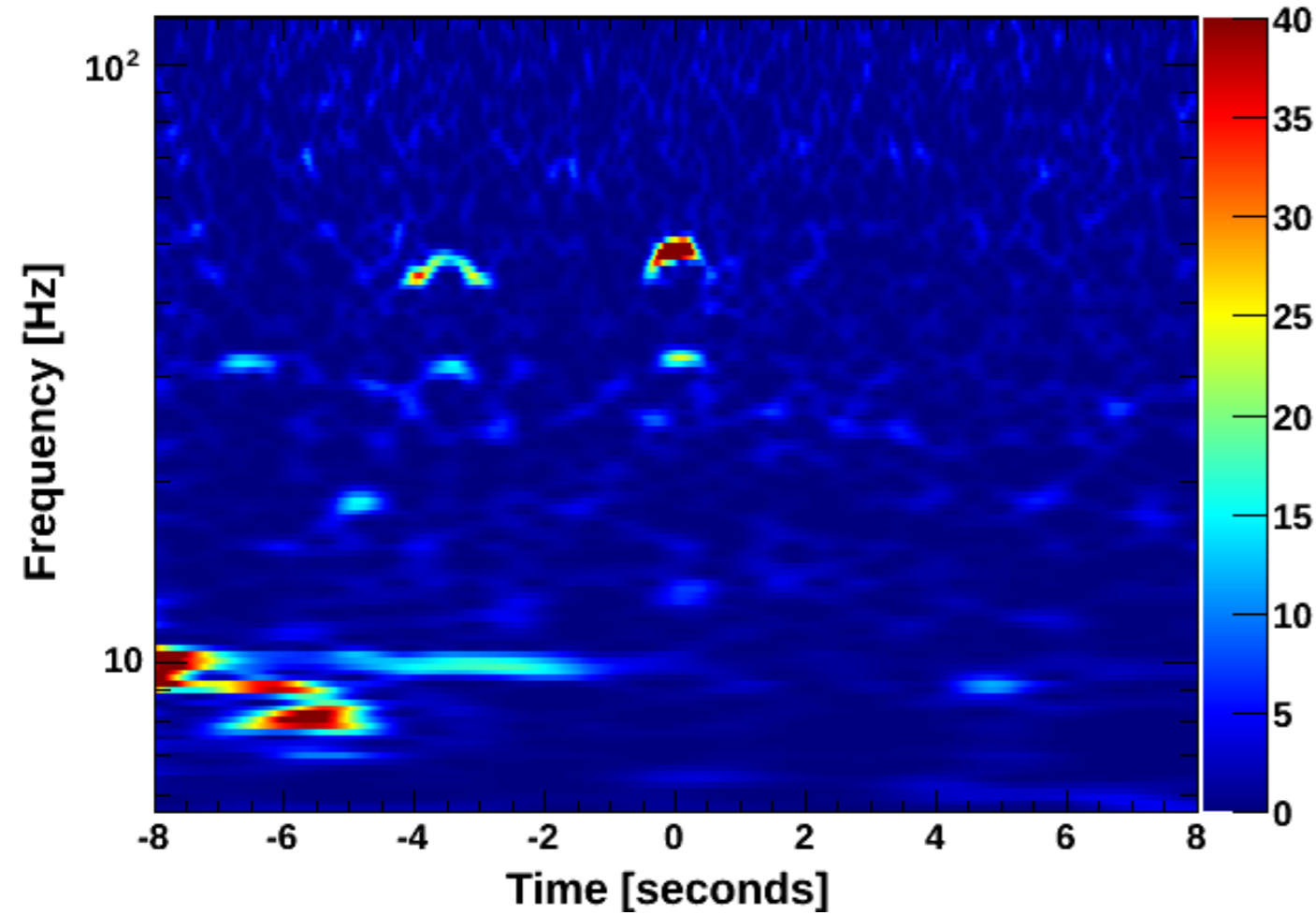


L1 Koi Fish documentation

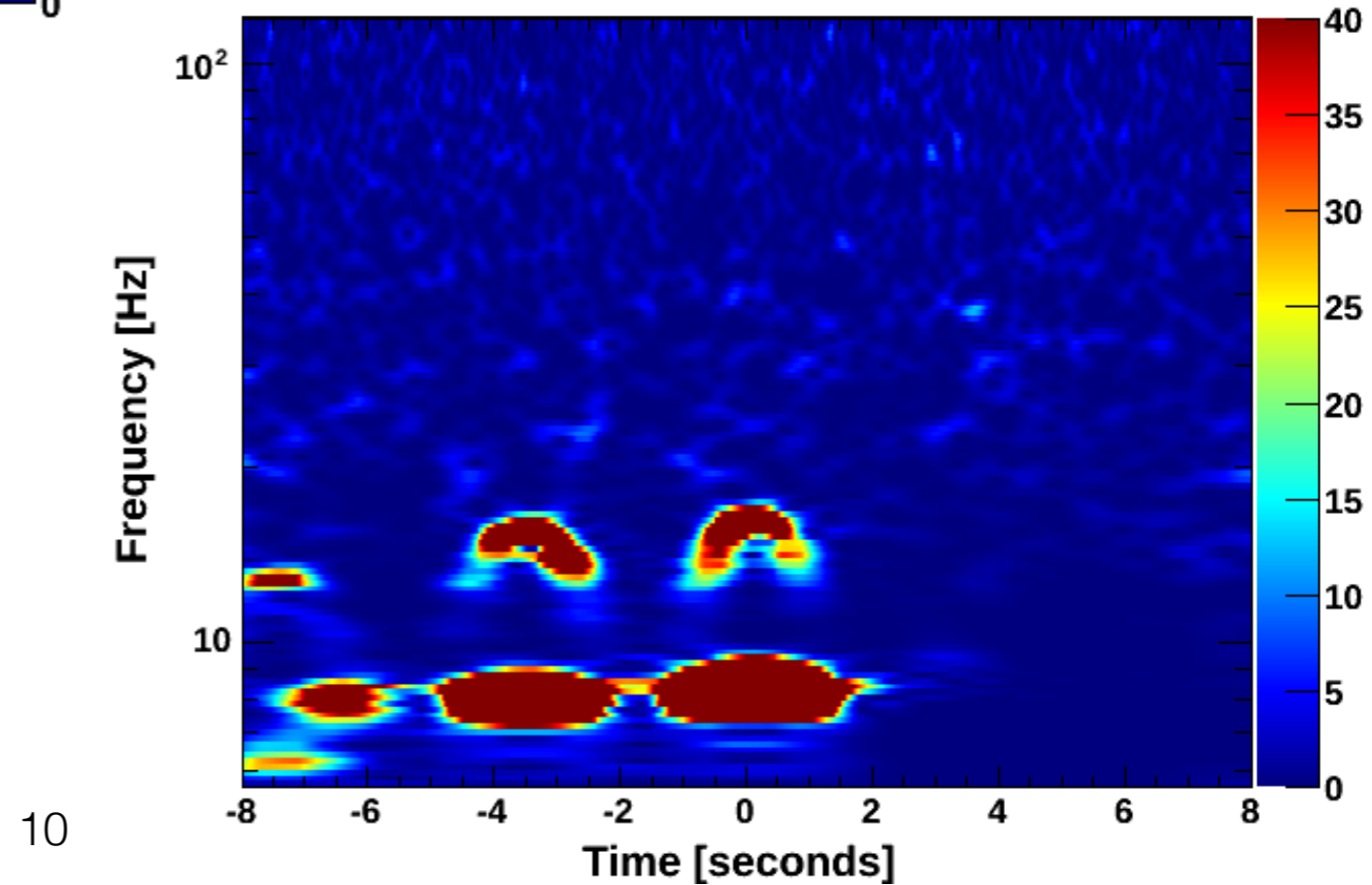
- Brief description:
- Relevant alogs:
 - LLO: LHO:
- Other documentation:

4. LHO end-Y scattered light

H1:GDS-CALIB_STRAIN at 1128504773.156 with Q of 45.3



H1:ASC-Y_TR_B_NSUM_OUT_DQ at 1128504773.156 with Q of 45.3

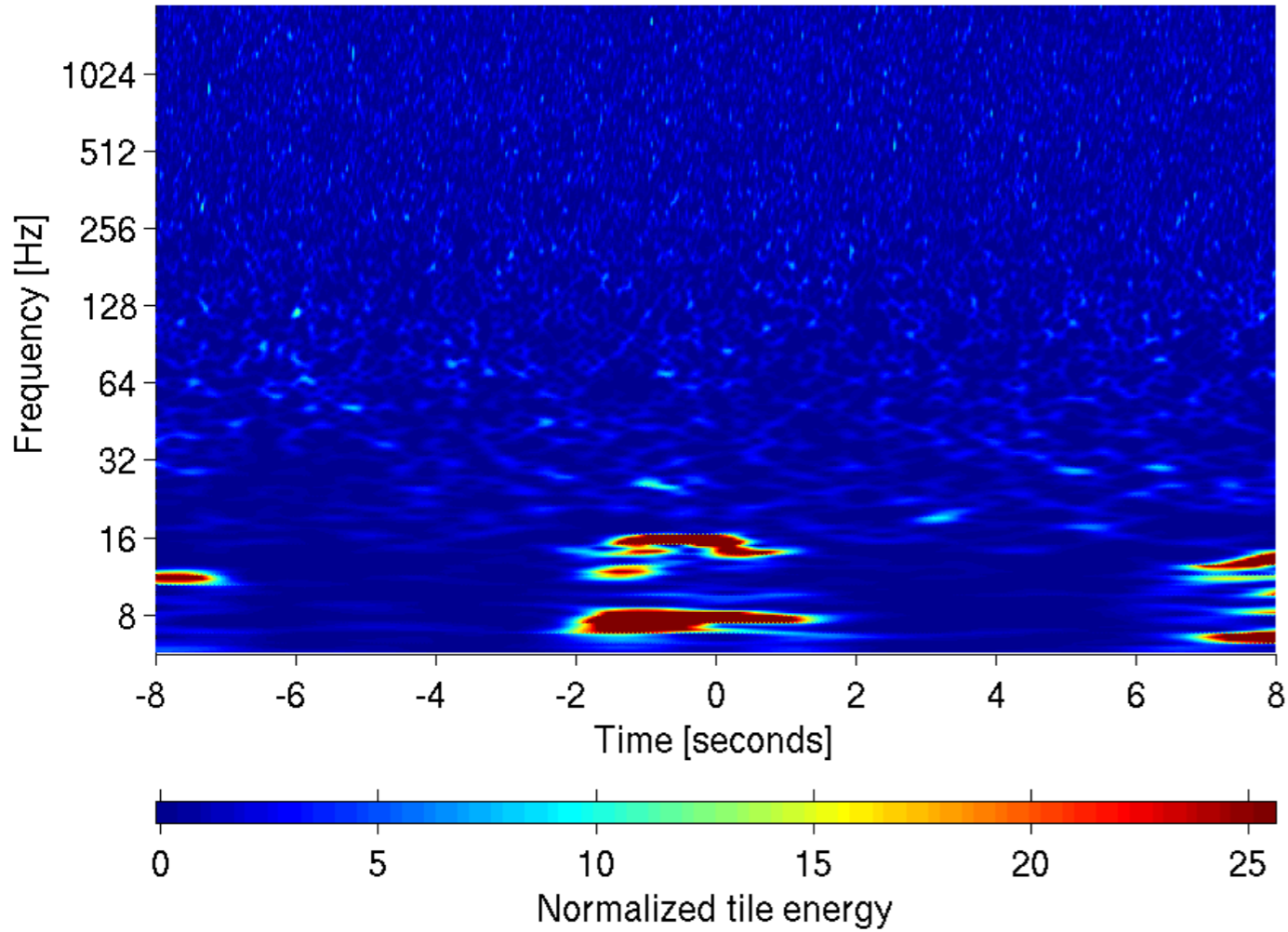


LHO end-Y scattered light documentation

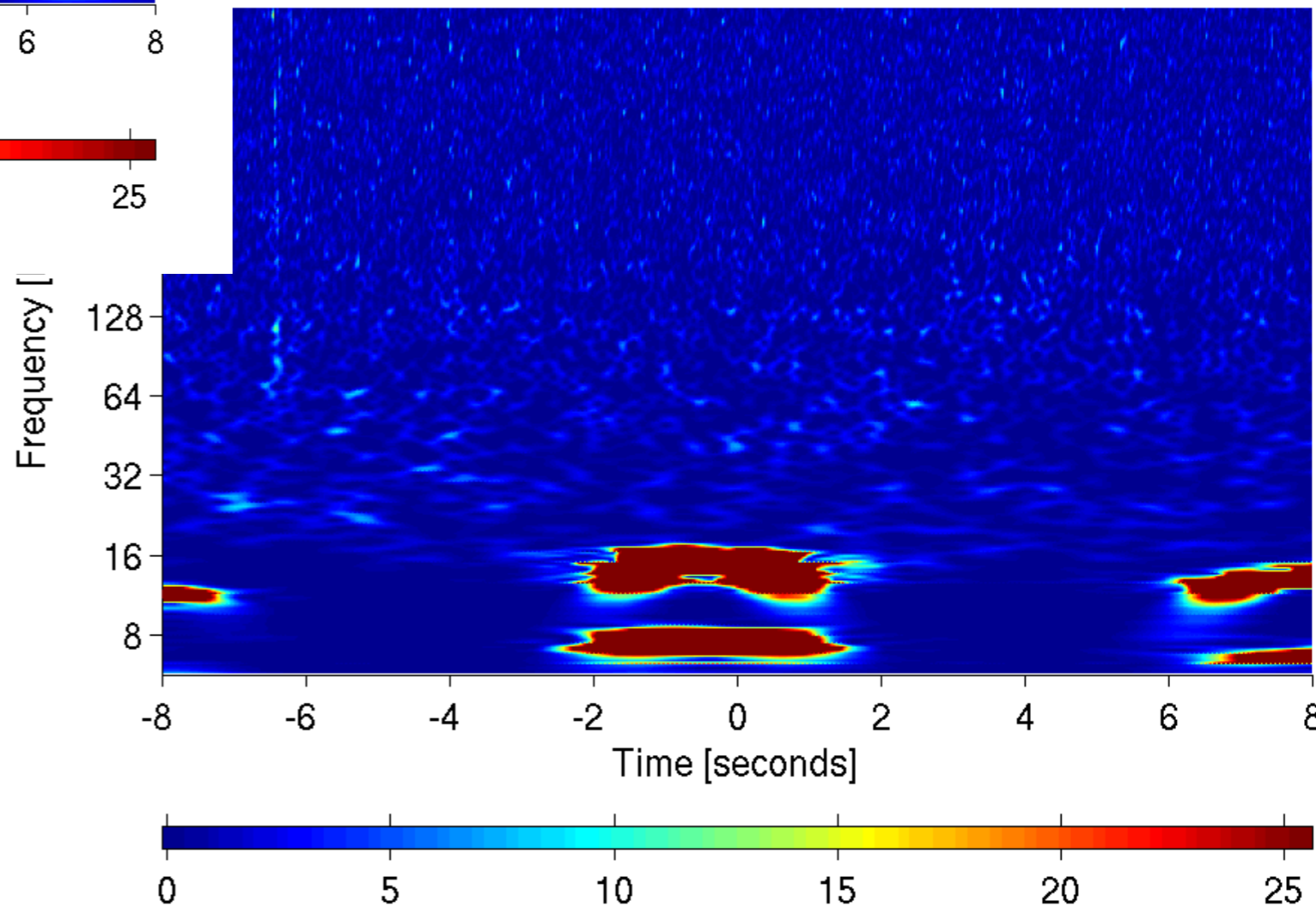
- Brief description: End-Y quadrant photodiodes detect low frequency scattering, many multiples higher at the same time we see scattering in DARM. Appears to correlate with ETMY microseismic-driven motion
- Relevant alogs:
 - LLO:
 - LHO: [22405](#)
- Other documentation:

5. LLO SRM scattered light

L1:GDS-CALIB_STRAIN at 1128676351.375 with Q of 45.3



L1:LSC-SRCL_OUT_DQ at 1128676351.375 with Q of 45.3



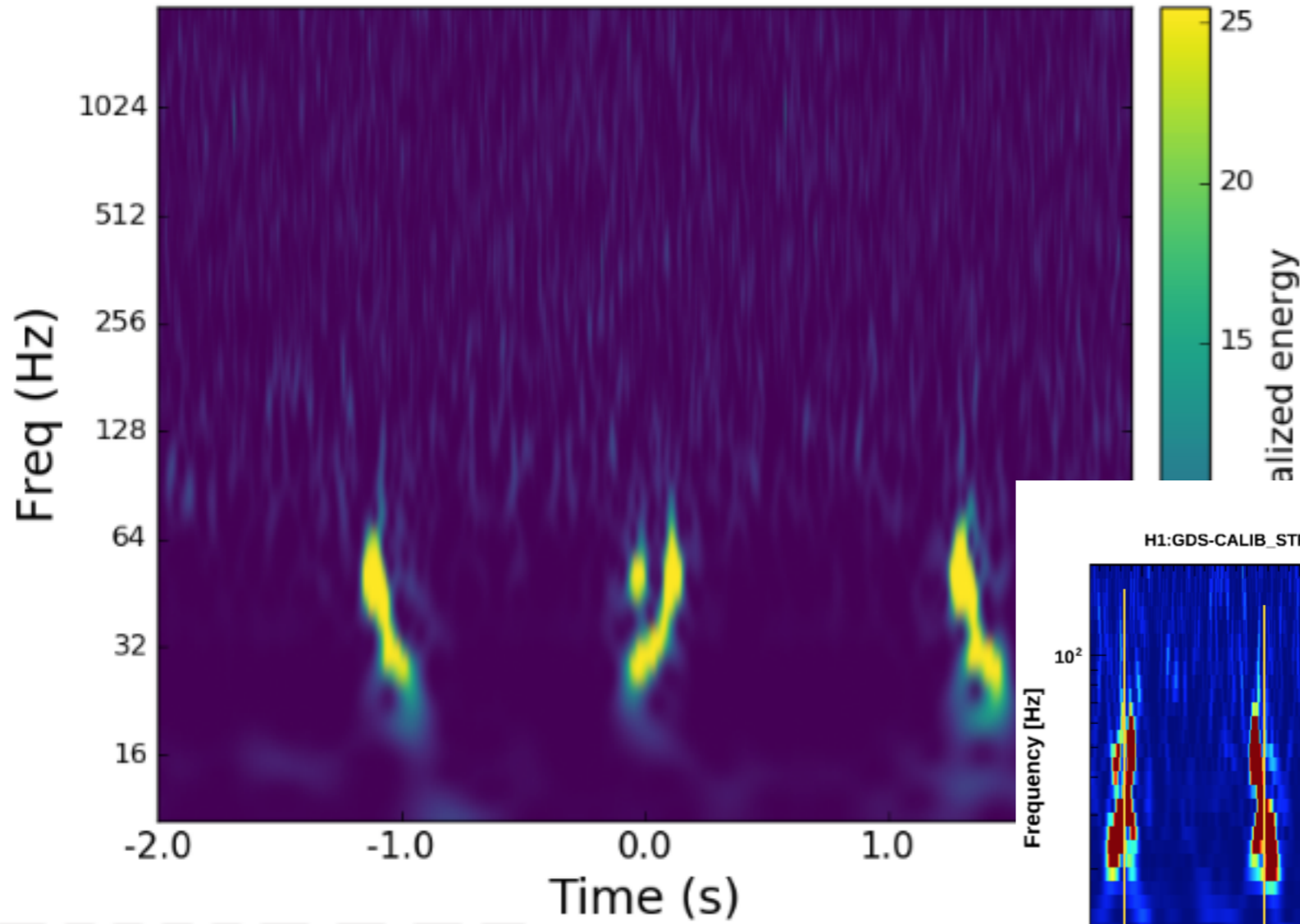
LLO SRM scattered light documentation

- Brief description: Relevant alogs:
 - LLO: 21759
 - LHO:
- Other documentation:

[Subject 1956084](#)

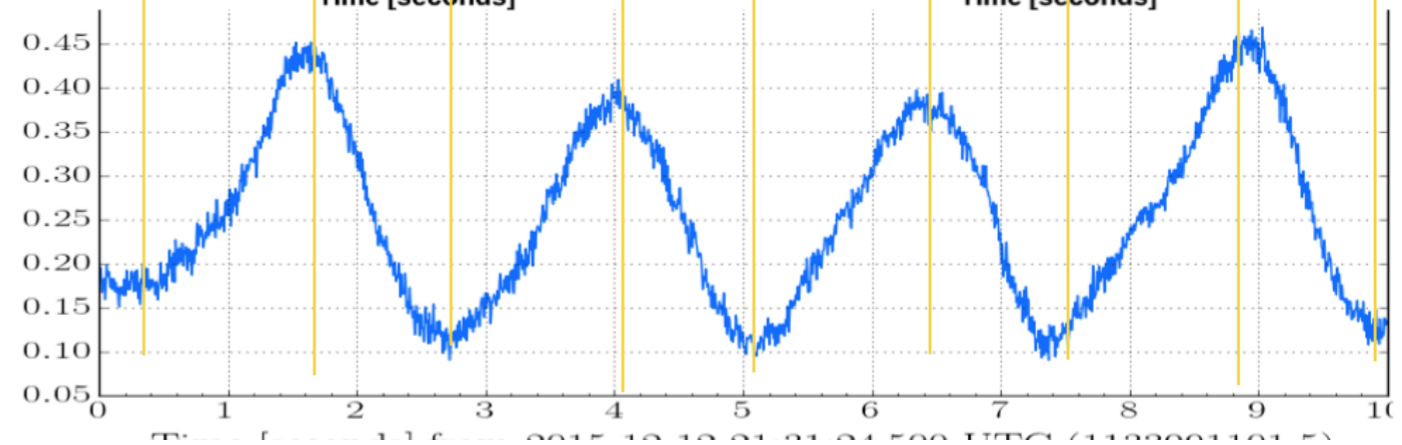
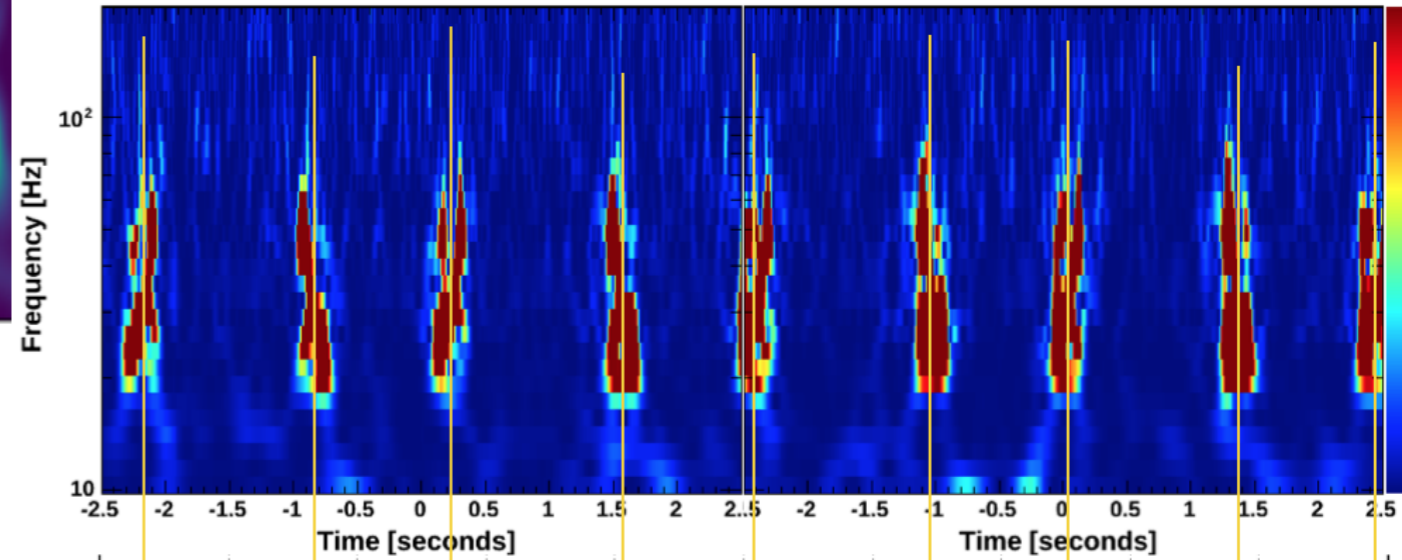
6. LHO Paired Doves

Hanford



H1:GDS-CALIB_STRAIN at 1133991104.000 with Q of 9.8

H1:GDS-CALIB_STRAIN at 1133991109.000 with Q of 9.8



LHO Paired Doves

Documentation

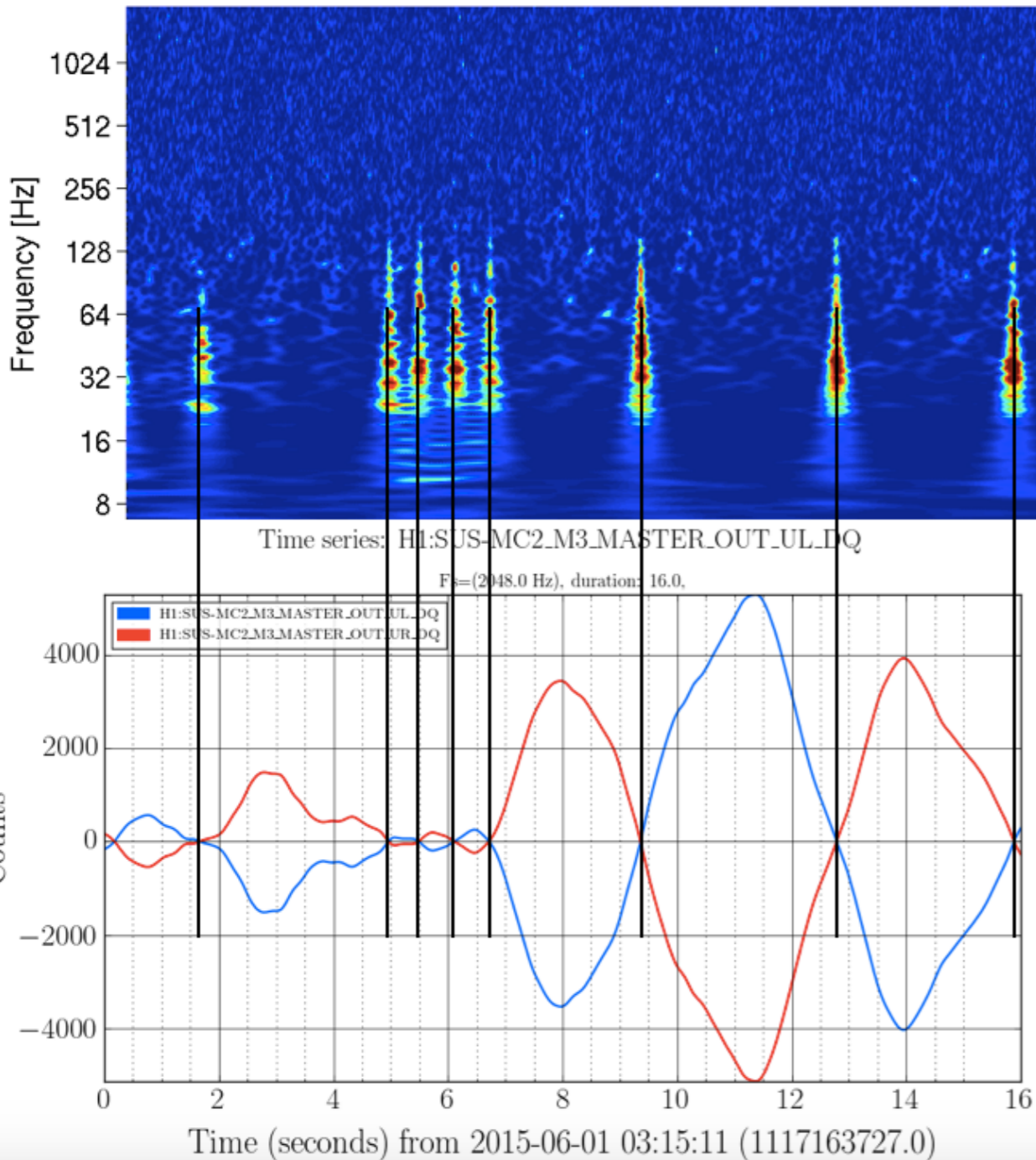
- Brief description: 15-70Hz glitches that repeat at $2 \times 0.4\text{Hz}$ and have alternating positive and negative Δf . GravitySpy user [EcceruElme](#) found a couple of disparate times where we get alternating up and down changing frequency glitches and they seem to be driven by 0.4Hz motion, and the place we've found that best correlates in timing is extrema of SR2 pitch (even though the resonance is probably just from the BeamSplitter)
- Relevant alogs:
 - LLO:
 - LHO:
- Other documentation: [GravitySpy page](#)

7. DAC glitches

Example .tgz files of PNGs: [LHO](#)
[March 2015](#), [LLO](#) Aug 2014

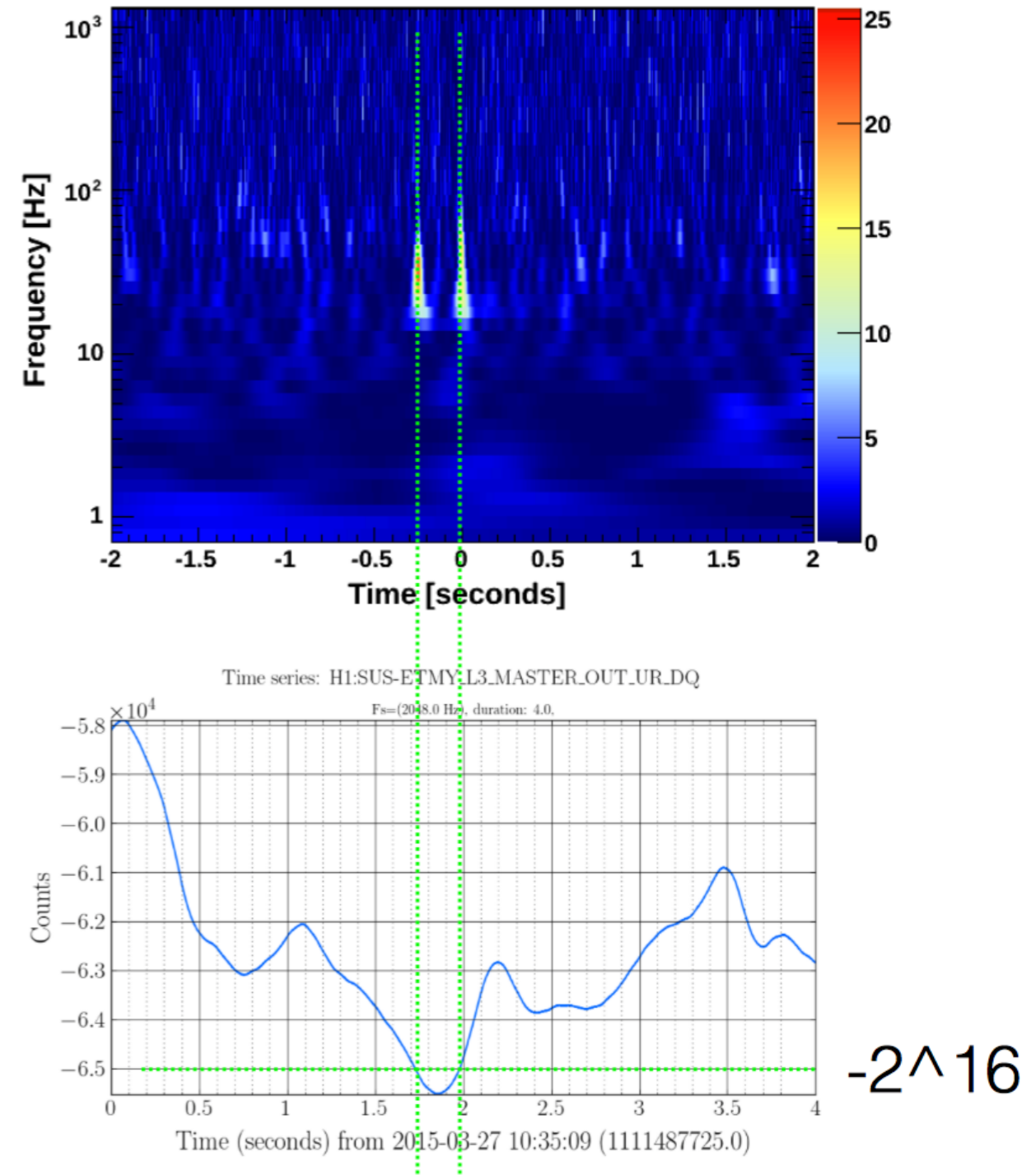
Historical example of zero crossing:

H1:LSC-MCL_OUT_DQ at 1117163735.355 with Q of 45.3



Historical example of -2^{16} crossing:

H1:CAL-DELTA_EXTERNAL_DQ at 1111487726.984 with Q of 5.7

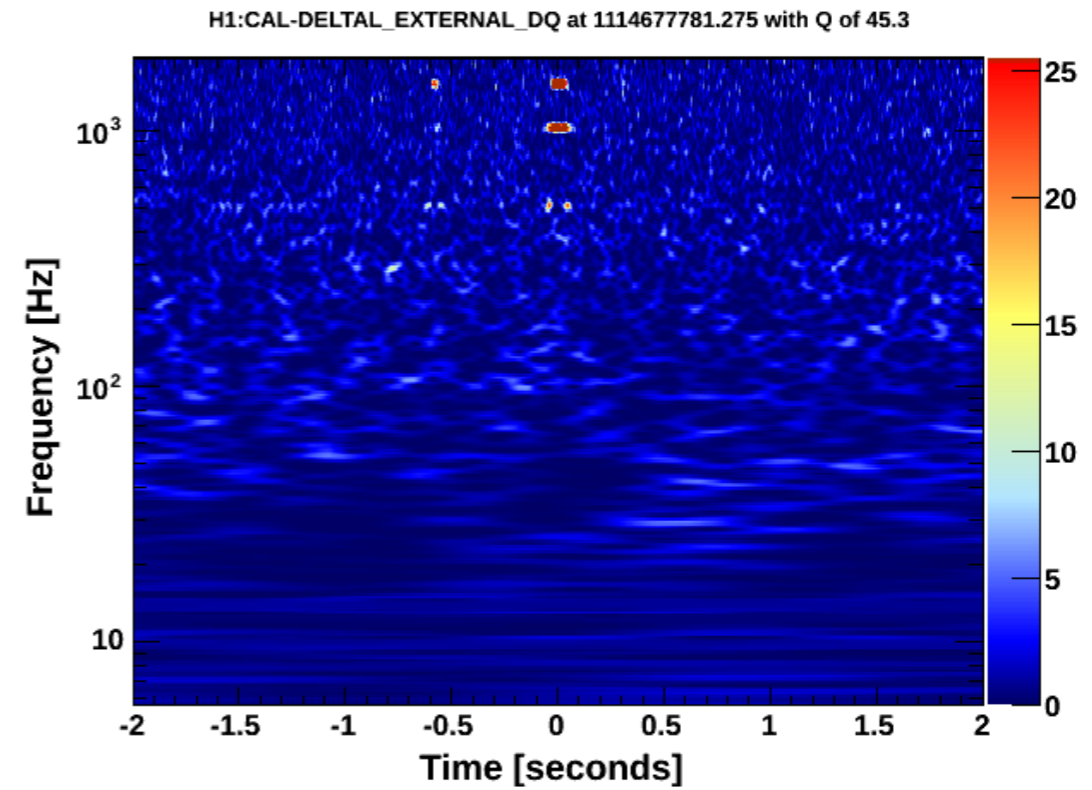
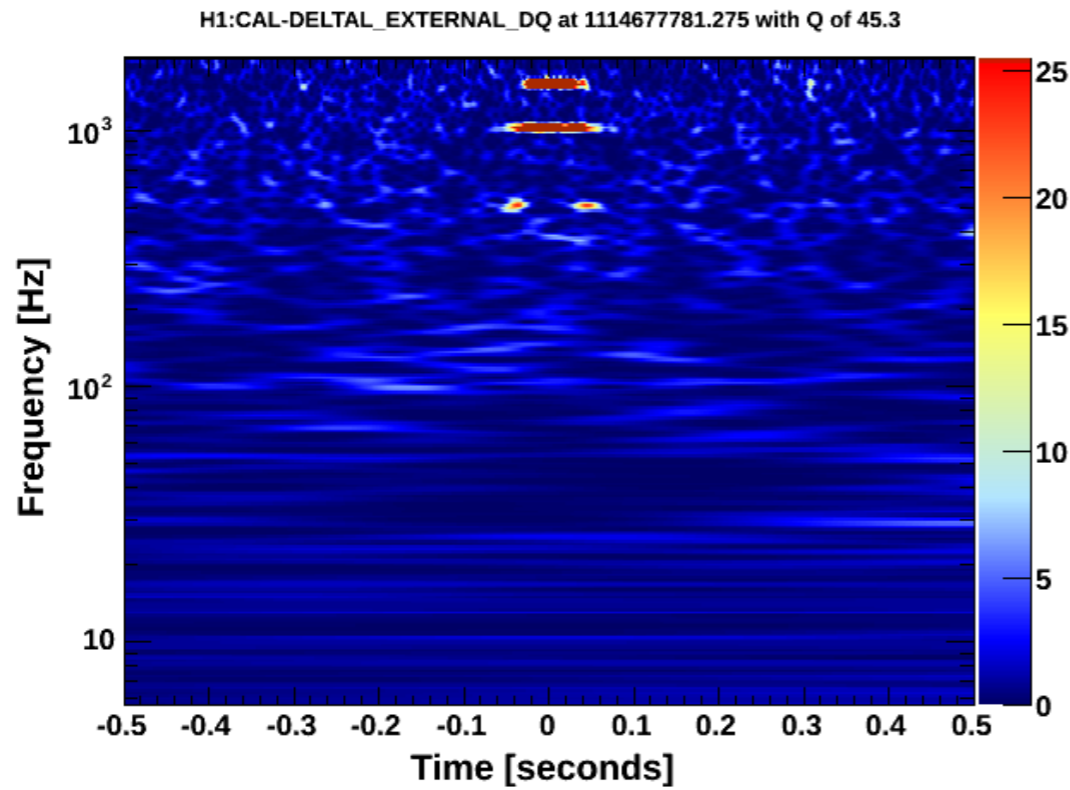


DAC glitches documentation

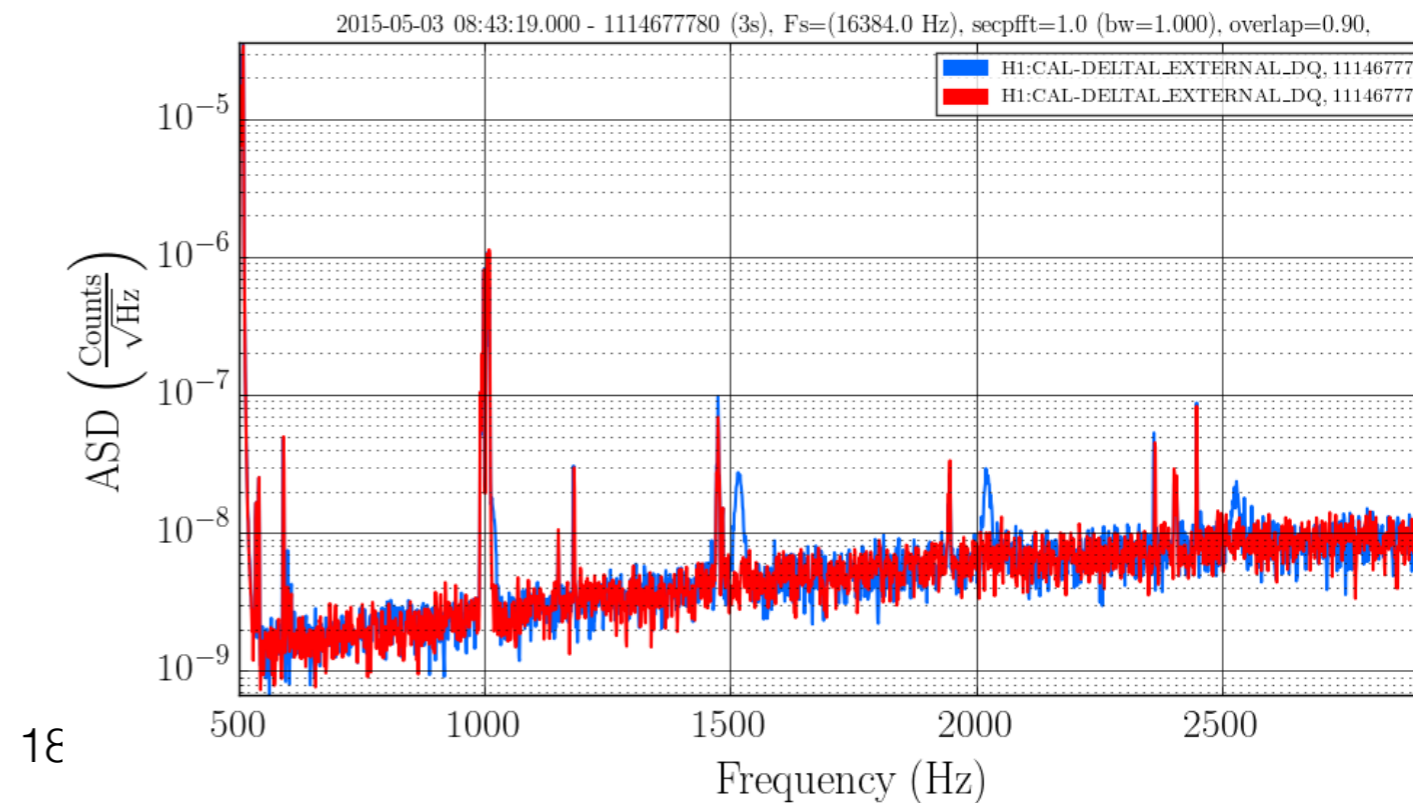
- Brief description: aLIGO 18-bit digital to analog converters glitch when they cross 0 or $\pm 2^{16}$. LIGO Lab upgraded most of the 18-bit DAC cards by mid-July 2015 and diagnostics show these are very reduced.
- Relevant alogs:
 - LLO: 16376, 14964, 14060, 13940, **19708 (diagnostics of retro-fitted DAC cards)**
 - LHO: 17555, 18739
- Other documentation: T1400649

8. $n^*505\text{Hz}$ glitches

LHO examples: <http://ldas-jobs.ligo-wa.caltech.edu/%7Eareeda/500Hz-harmonics-rd2.tgz>



Spectrum: H1:CAL-DELTA_EXTERNAL_DQ



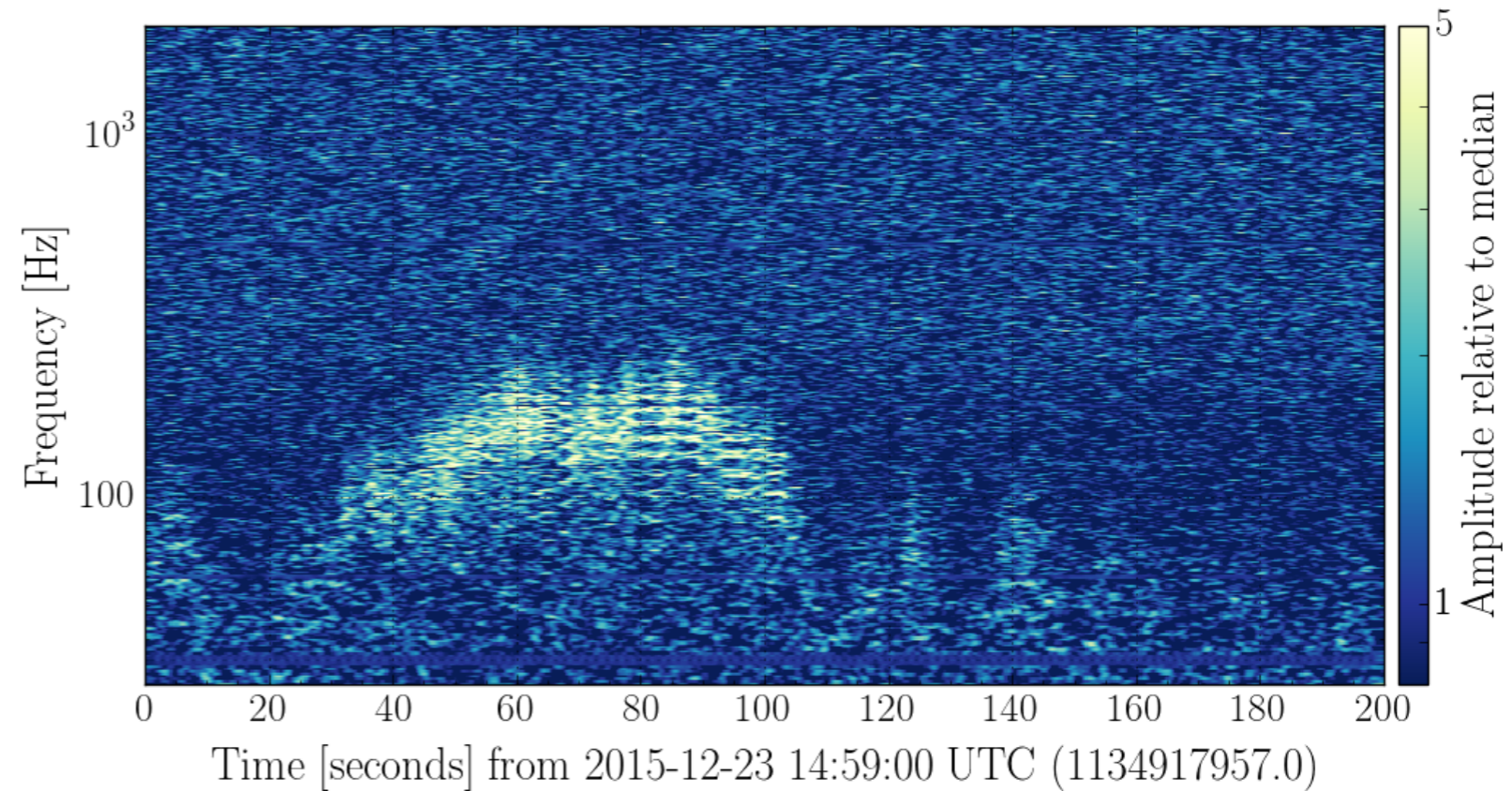
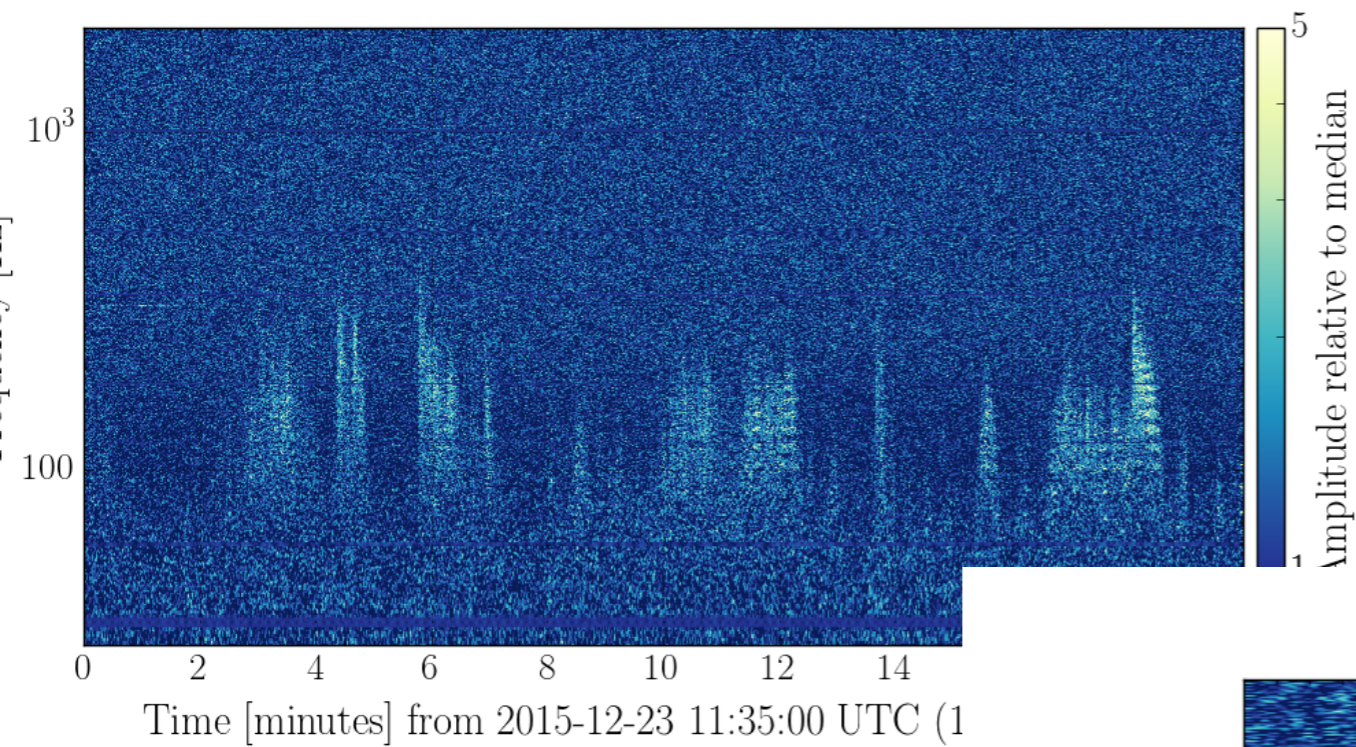
n*505 Hz glitches documentation

- Brief description: Something similar seen in both LHO and LLO. But don't think we've seen these in ER8 or O1, so possibly solved by violin mode damping?
- Relevant alogs:
 - LLO:
 - LHO:
- Other documentation: [G1500774](#)

98. Blue Mountain Glitches

- TJ says: This has been the other worst offender, but mostly at LLO: <https://sugar-jobs.phy.syr.edu/~tjmassin/cbc/DQ/O1/60-200Hz-noise/60-200Hz-noise-1200s.png>
- Zoomed in it looks like a scattering fringe, but the frequency is rather high. I used Josh's scattering code and couldn't find an obvious culprit: <https://sugar-jobs.phy.syr.edu/~tjmassin/cbc/DQ/O1/60-200Hz-noise/60-200Hz-noise-200s.png>
- So far these are unsolved

9. Blue Mountain Glitches



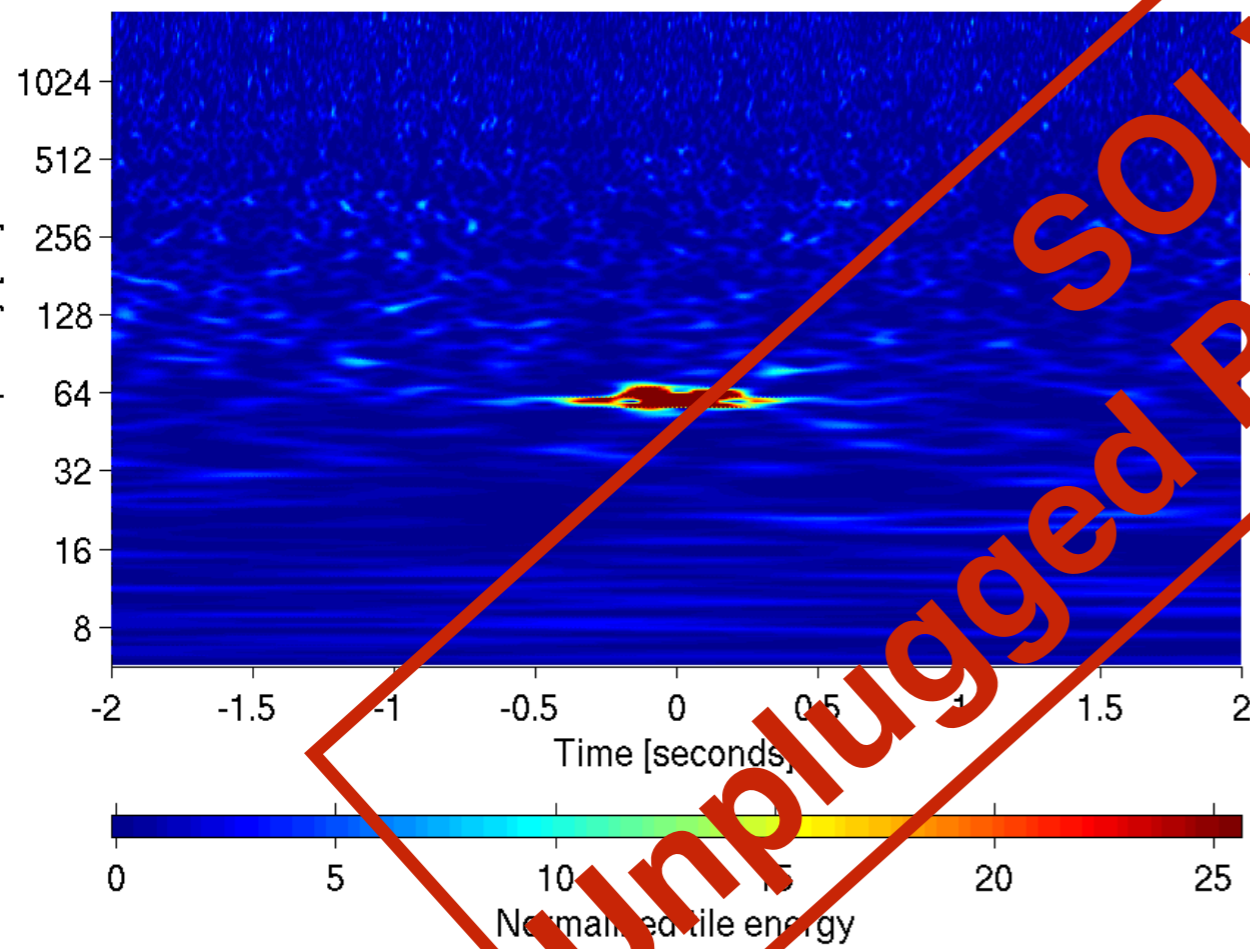
9. O1 glitches I haven't had time to write up yet

- Here are some wicked strong whistles for LLO for the golden set (you'd want to regenerate the images) <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=23869>
- Here is a very common O1 type of LLO glitch, that I think is related to scattering, but has been very hard to pin down: <https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=22242>

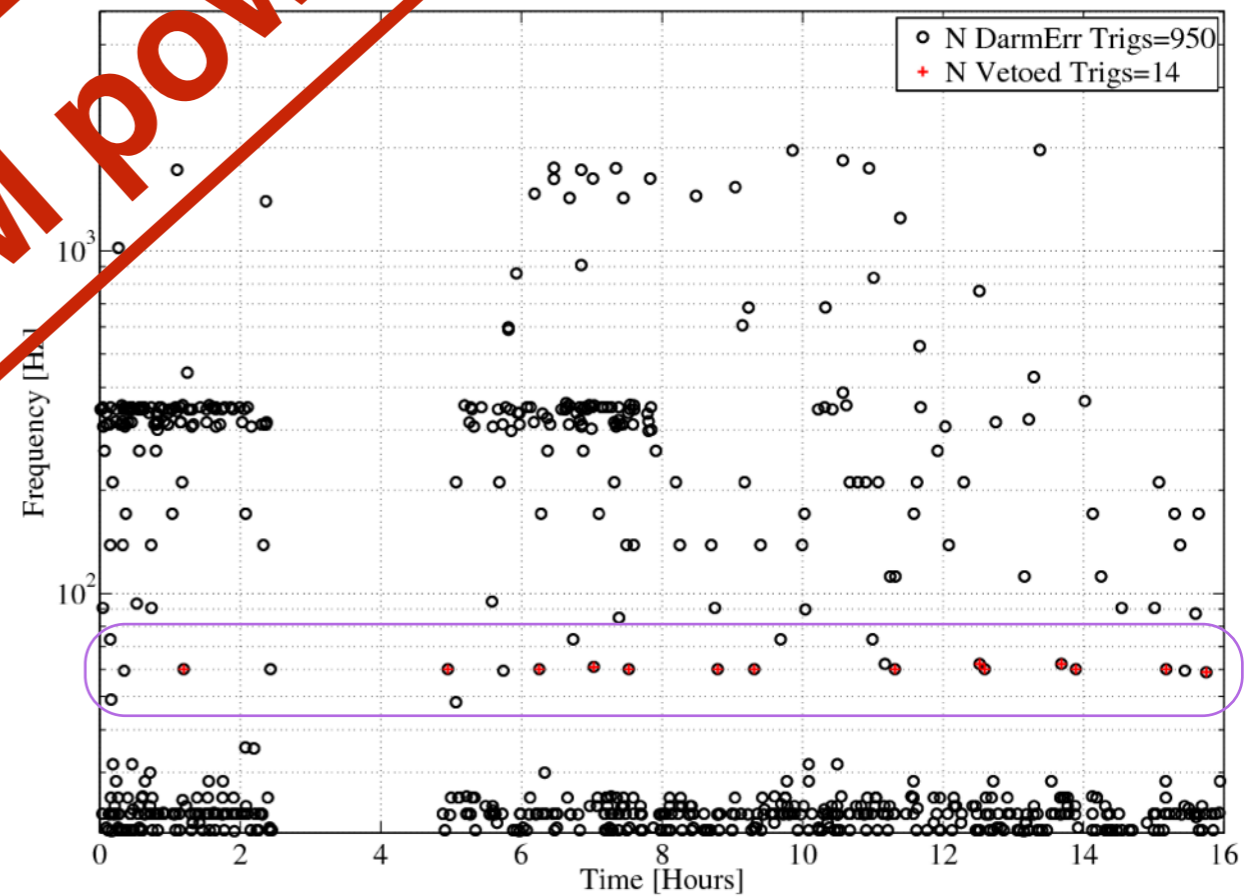
10. LHO End-Y 60 Hz electromagnetic glitches

H1 Examples: TBA

H1:CAL-DELTA_EXTERNAL_DQ at 1117601846.844 with Q of 45.3



Time-frequency Map: Detector=H1, Round=4, Winner=PEM-EY_MAG_EBAY_SEIRACK_X_DQ_C
Times offset of GPS=1117584016, UTC=2015-06-06 00:00:00



Unplugged PEM power supply

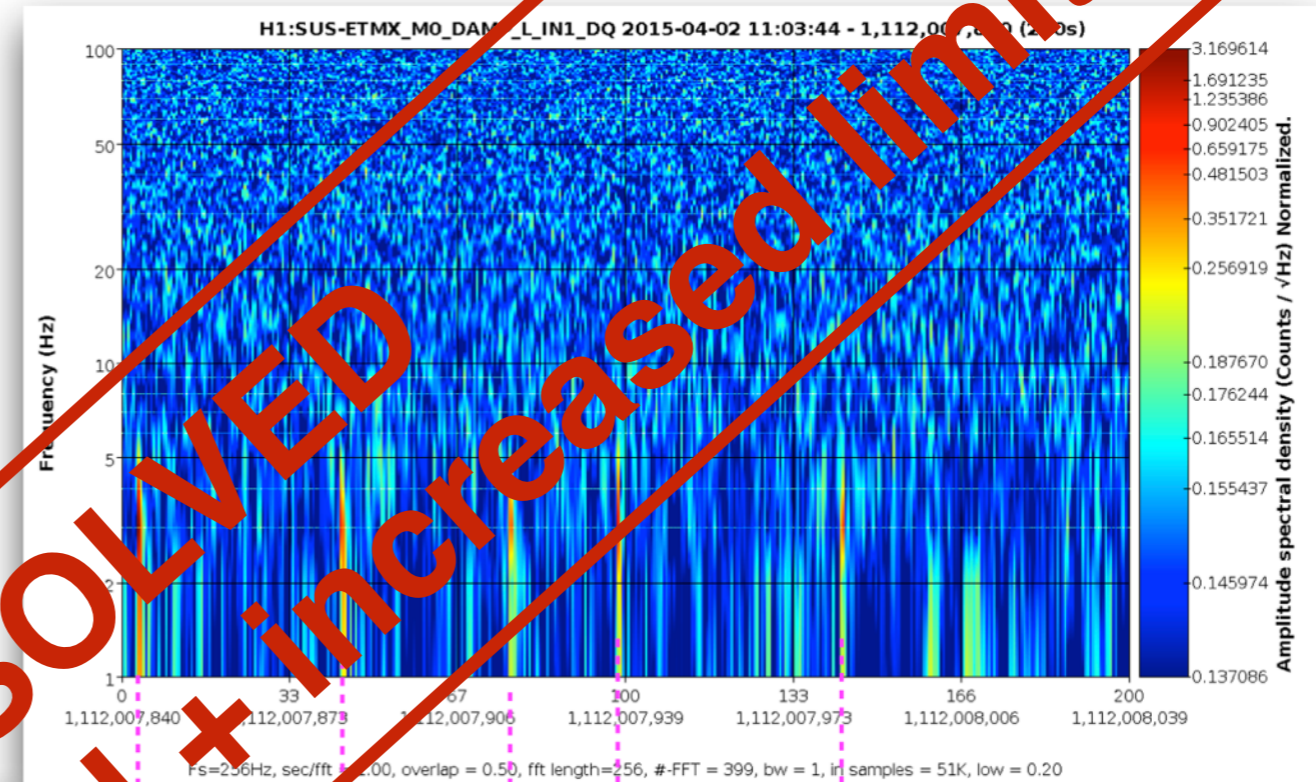
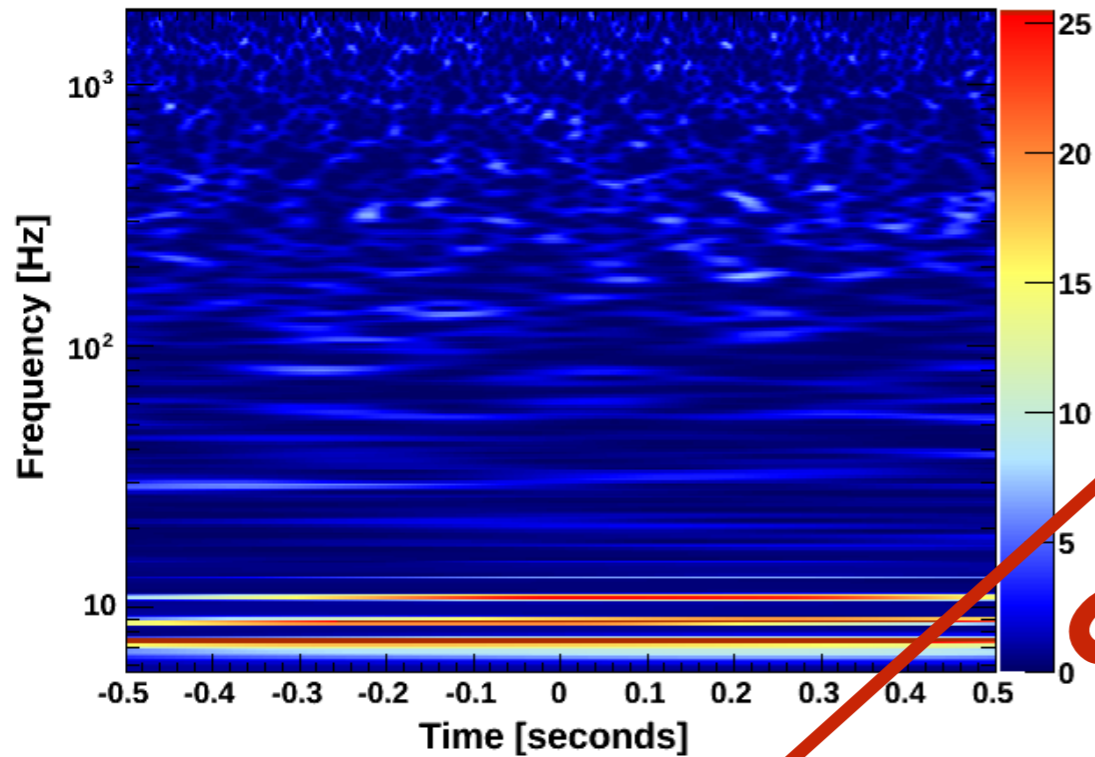
LHO End-Y electromagnetic glitches documentation

- Brief description: Strong glitches around the 60Hz line at end-Y at LHO that happen once every ~76 minutes.
- Relevant alogs:
 - LLO:
 - LHO: 18936 FIX Unplugged a PEM power supply 23483
- Other documentation:

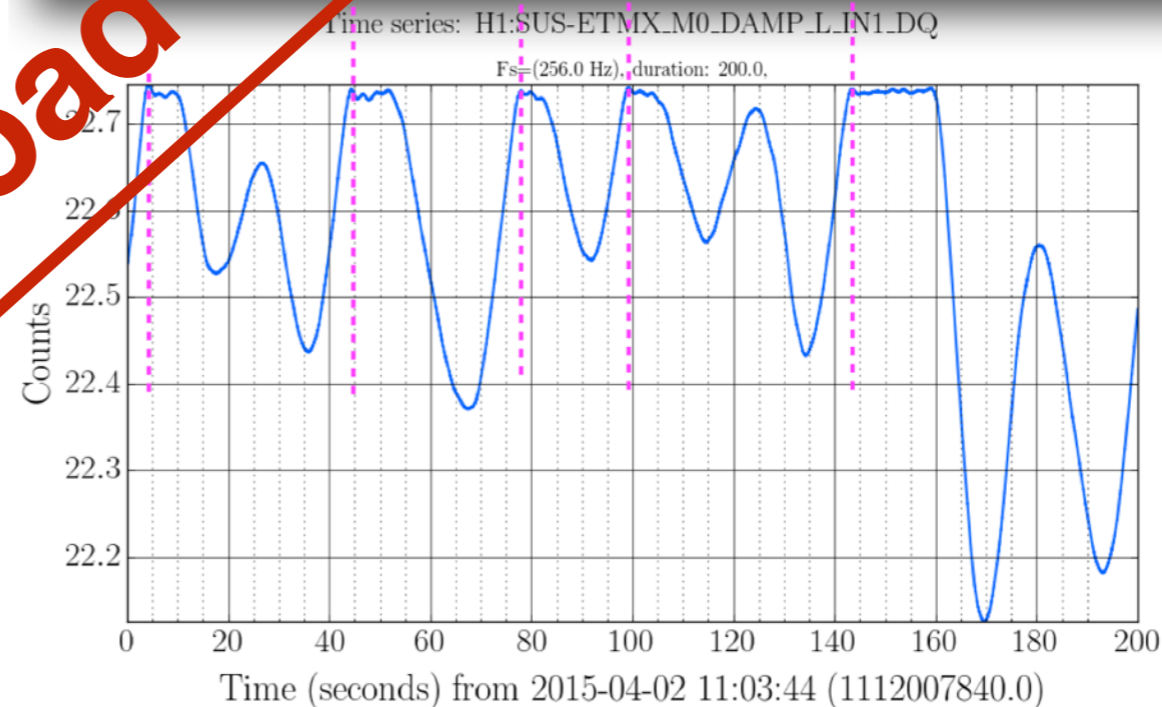
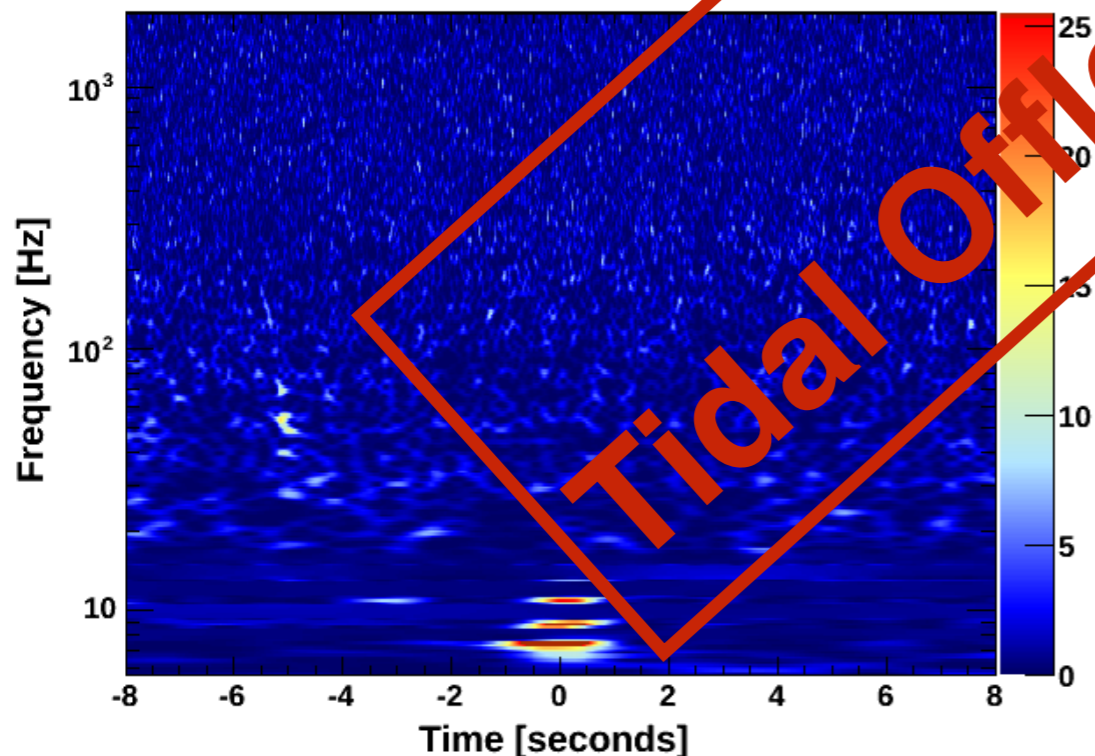
11. Common tidal control signal to ETMs hitting its software limit

H1 Examples: <http://ldas-jobs.ligo-wa.caltech.edu/~areeda/Round1-21050402.tgz>

H1:CAL-DELTAL_EXTERNAL_DQ at 1112006050.750 with Q of 45.3



H1:CAL-DELTAL_EXTERNAL_DQ at 1112006050.750 with Q of 45.3

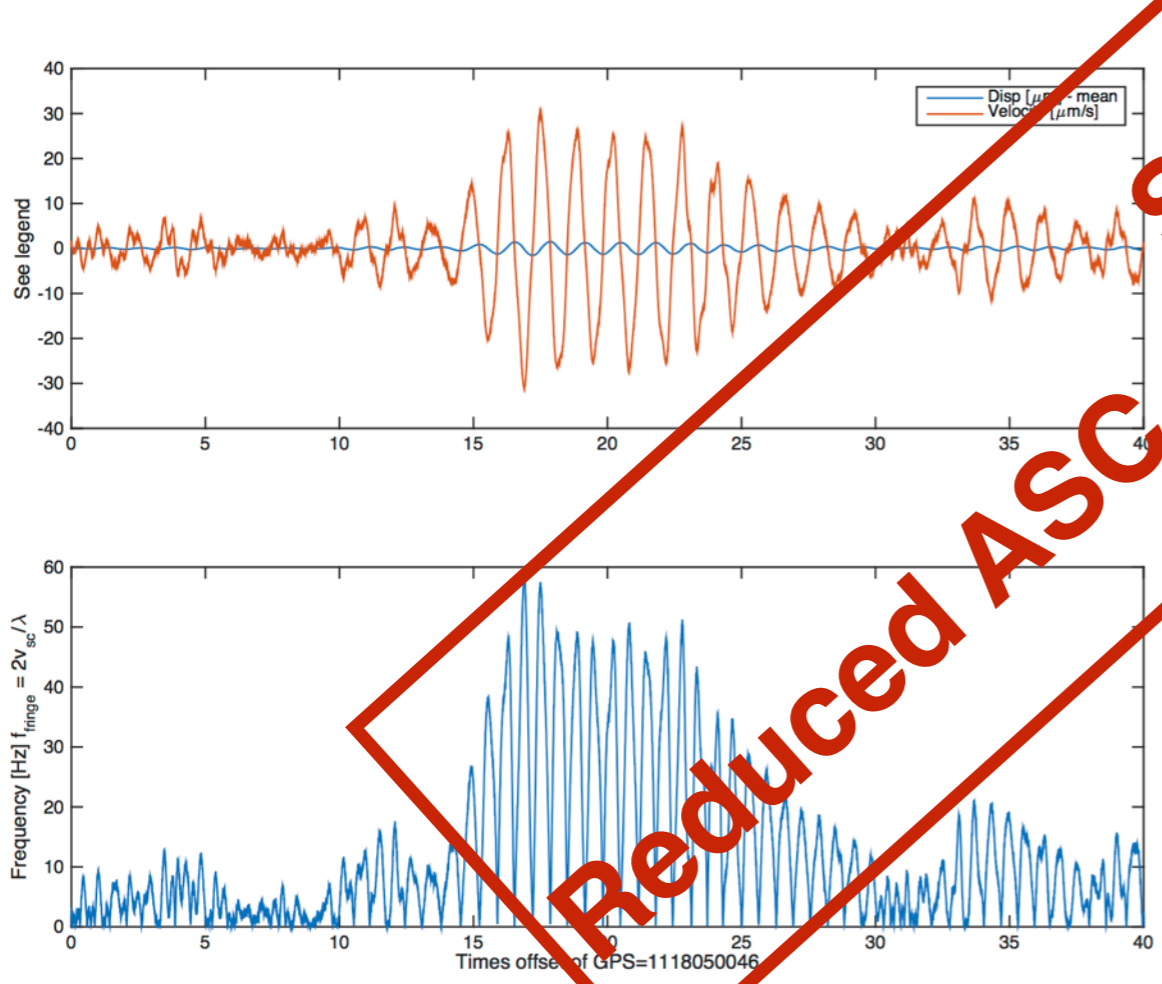


Common tidal control signal for the ETMs was hitting its software limit documentation

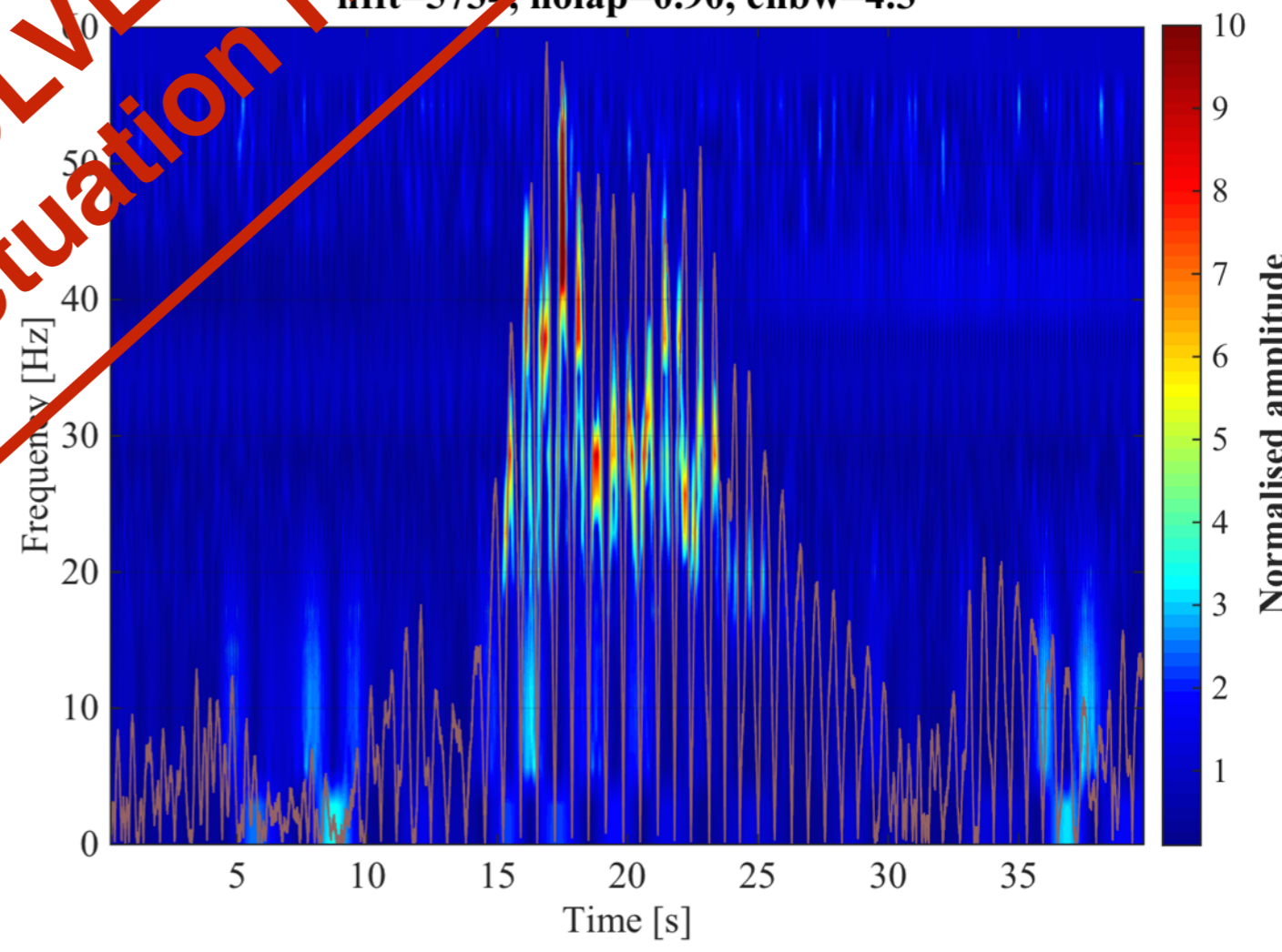
- Brief description: When common tidal hits its control limits, the discontinuities cause glitches in DARM. At LHO common tidal limits have been increased from 1 micron to 10 microns, fixing the problem so far.
- Relevant alogs:
 - LHO: Not seen yet
 - LHO: 17654, 18748
- Other documentation:

12. OMC L scattering fringes

H1 Examples: https://ldas-jobs.ligo-wa.caltech.edu/~daniel.vanderhyde/mon_scat/6_2015/25HZ_THRESHOLD/



Spectrogram of 01-H1:CAL-DELTA_EXTERNAL_DQ
fs = 10534 : 40s from 2015-06-11 09:27:10 -
nfft=5734, nolap=0.90, enbw=4.3

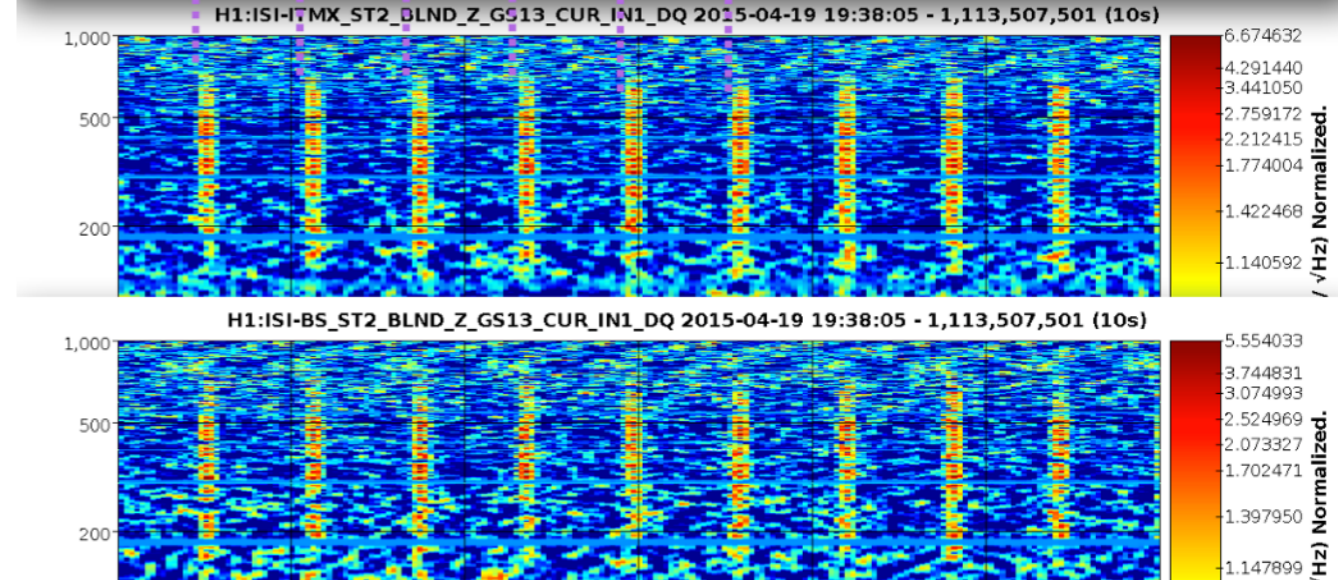
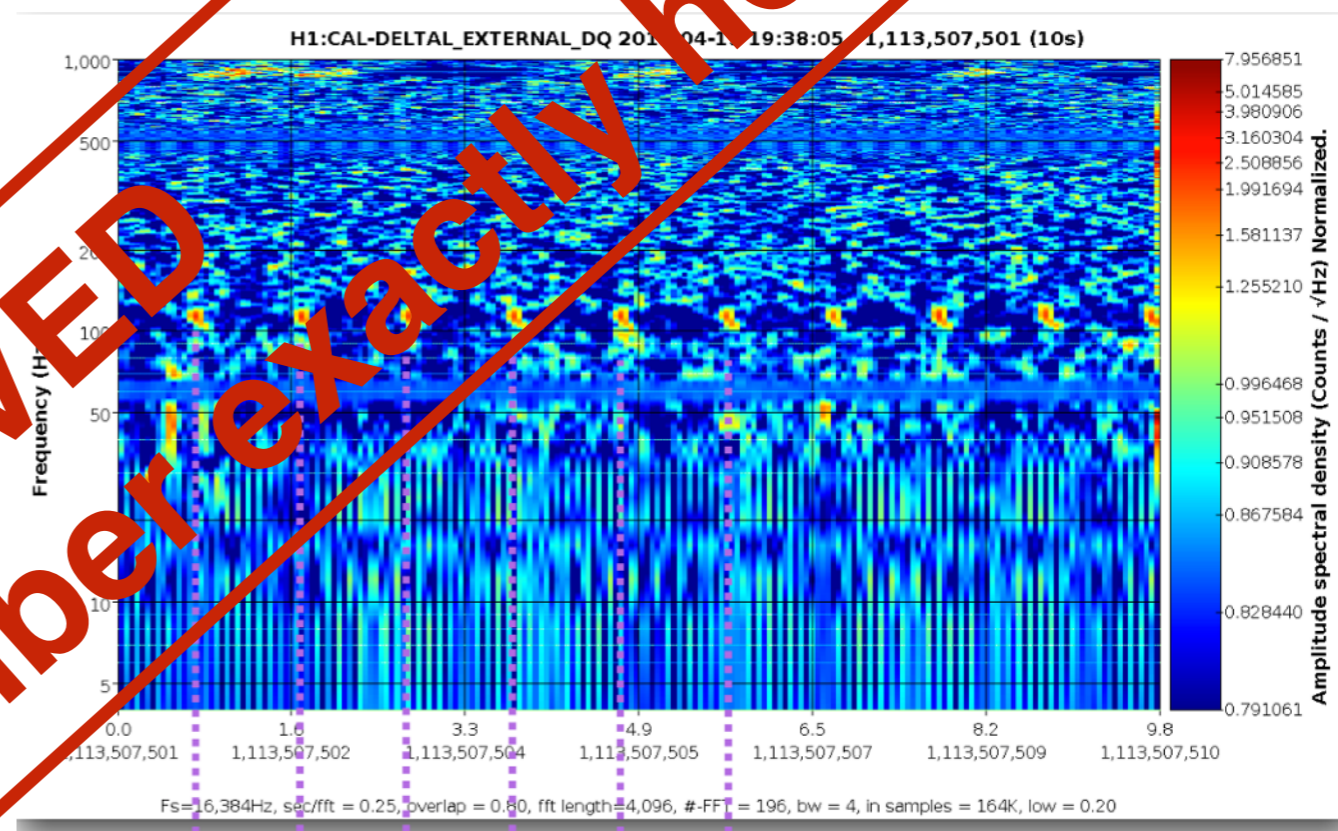
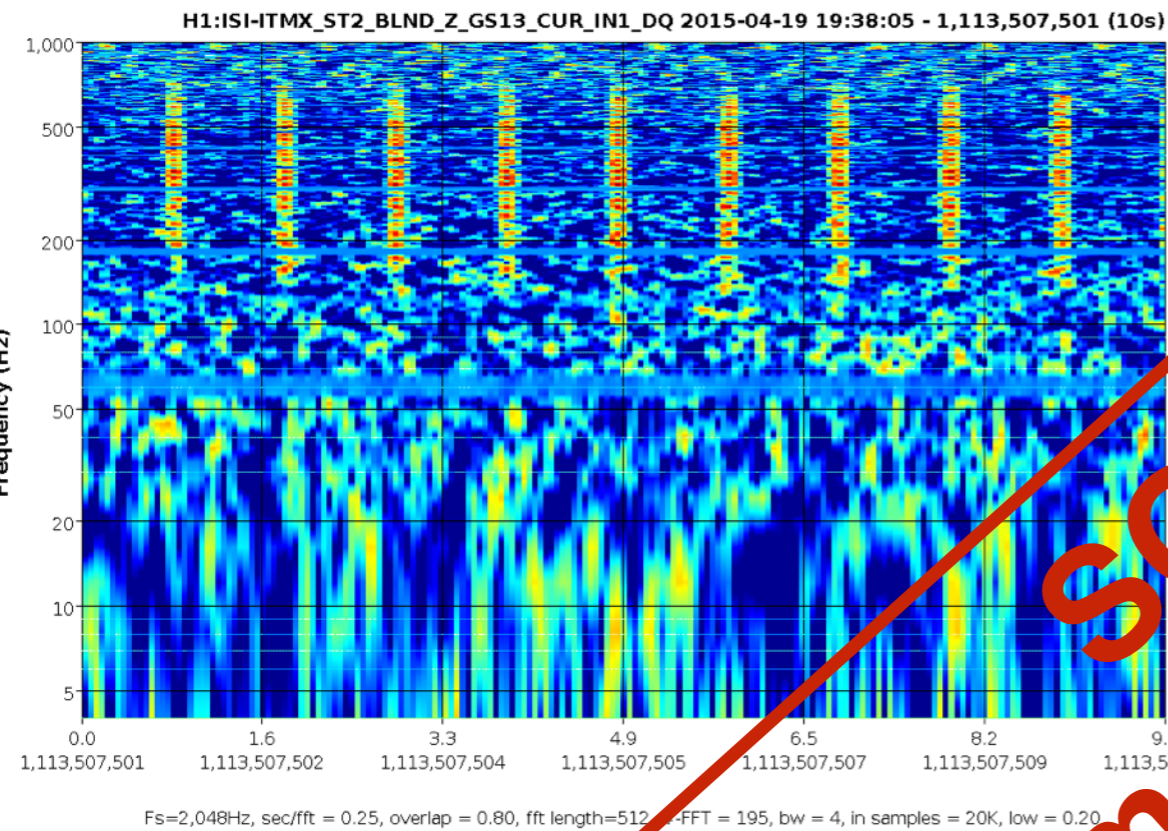


Reduced ASC actuation RMS to H1 OMC SOLVED

OMC L scattering fringes documentation

- Brief description: Fringes at H1 correlate well with OMC motion, mostly $f < 50\text{Hz}$ in DARM.
- Relevant alogs:
 - LLO: 18510, 18384 (note scatter in general, not OMC L)
 - LHO: 19195, 17919, 17264, 17910, 17904, 17273,
Decreased OMC motion: 20087
- Other documentation: Detchar wiki

13. Hartmann Wavefront Sensor Camera Glitches

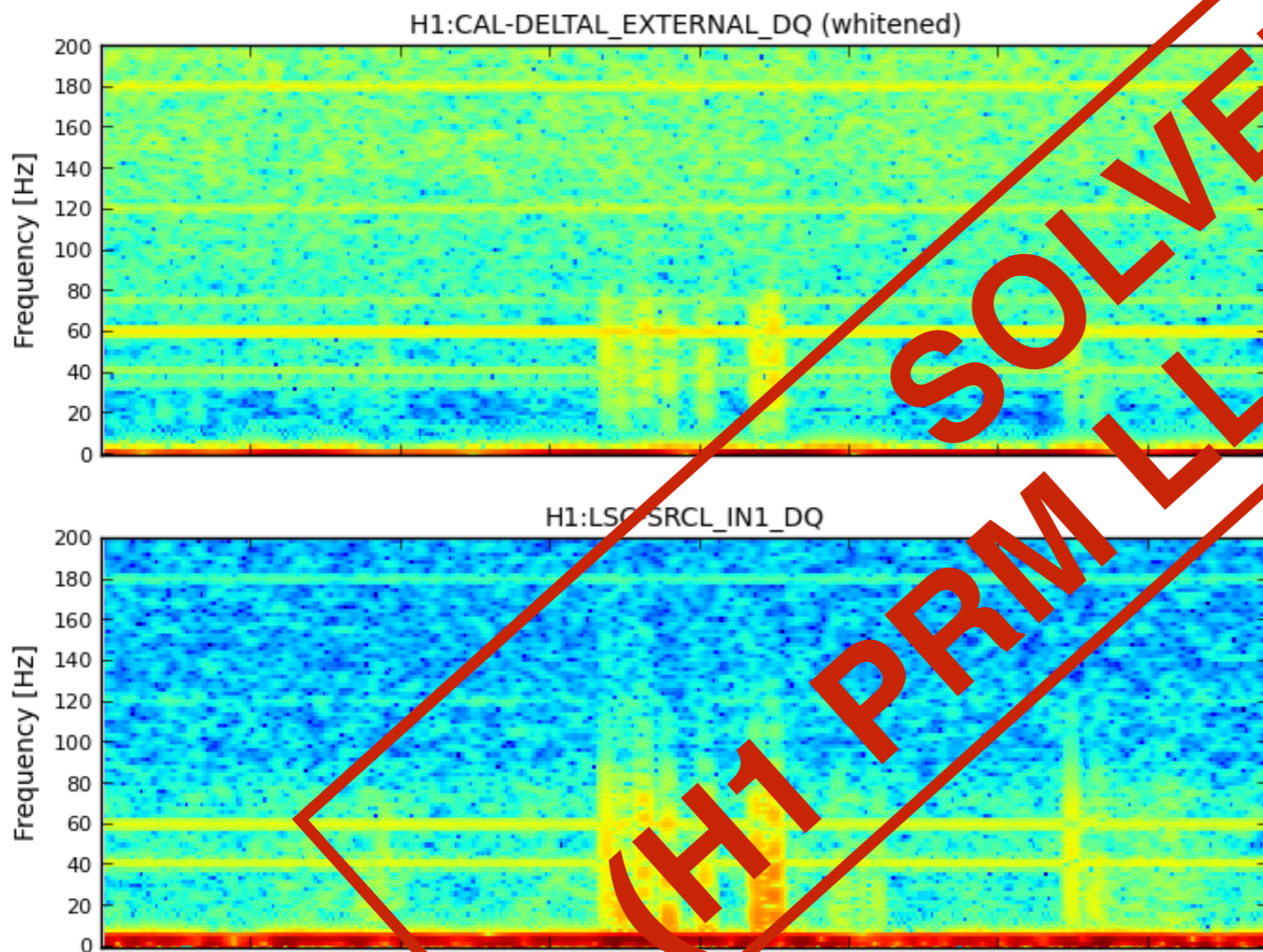


(Don't remember exactly how)

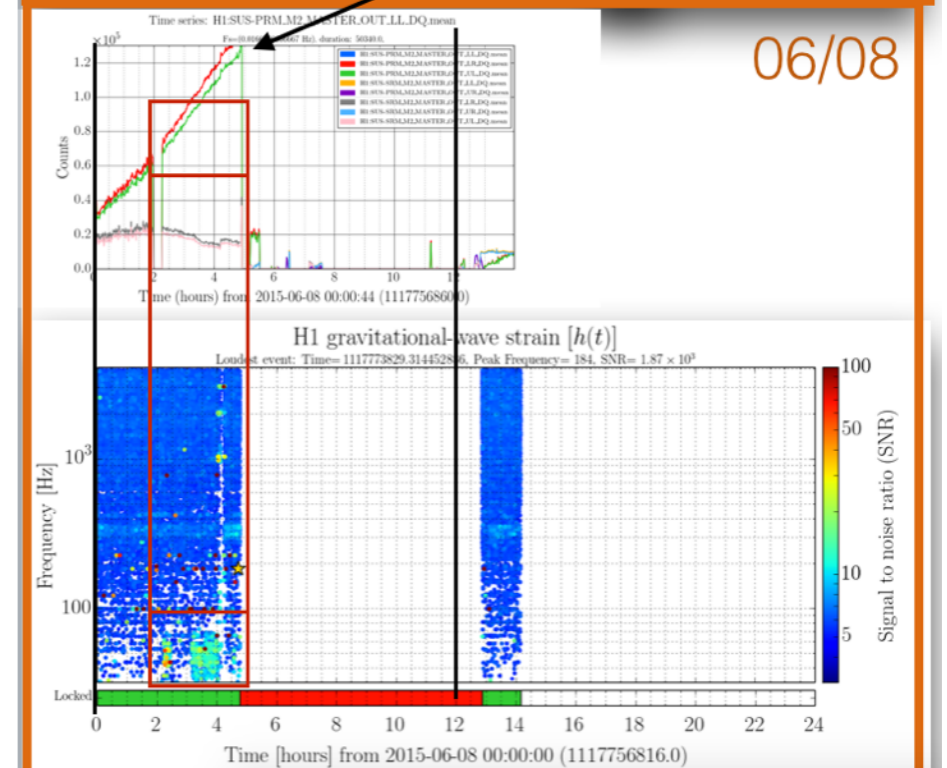
Hartmann Wavefront Sensor Camera glitches documentation

- Brief description: The Hartmann Wavefront Sensor, used for TCS, was observed to cause once-per-second glitches in other channels at LHO. **Work was done to fix this and check it's fixed, right??**
- Relevant alogs:
 - LLO:
 - LHO: 17970, 17971, 18531
- Other documentation:

14. PRCL/SRCL glitches



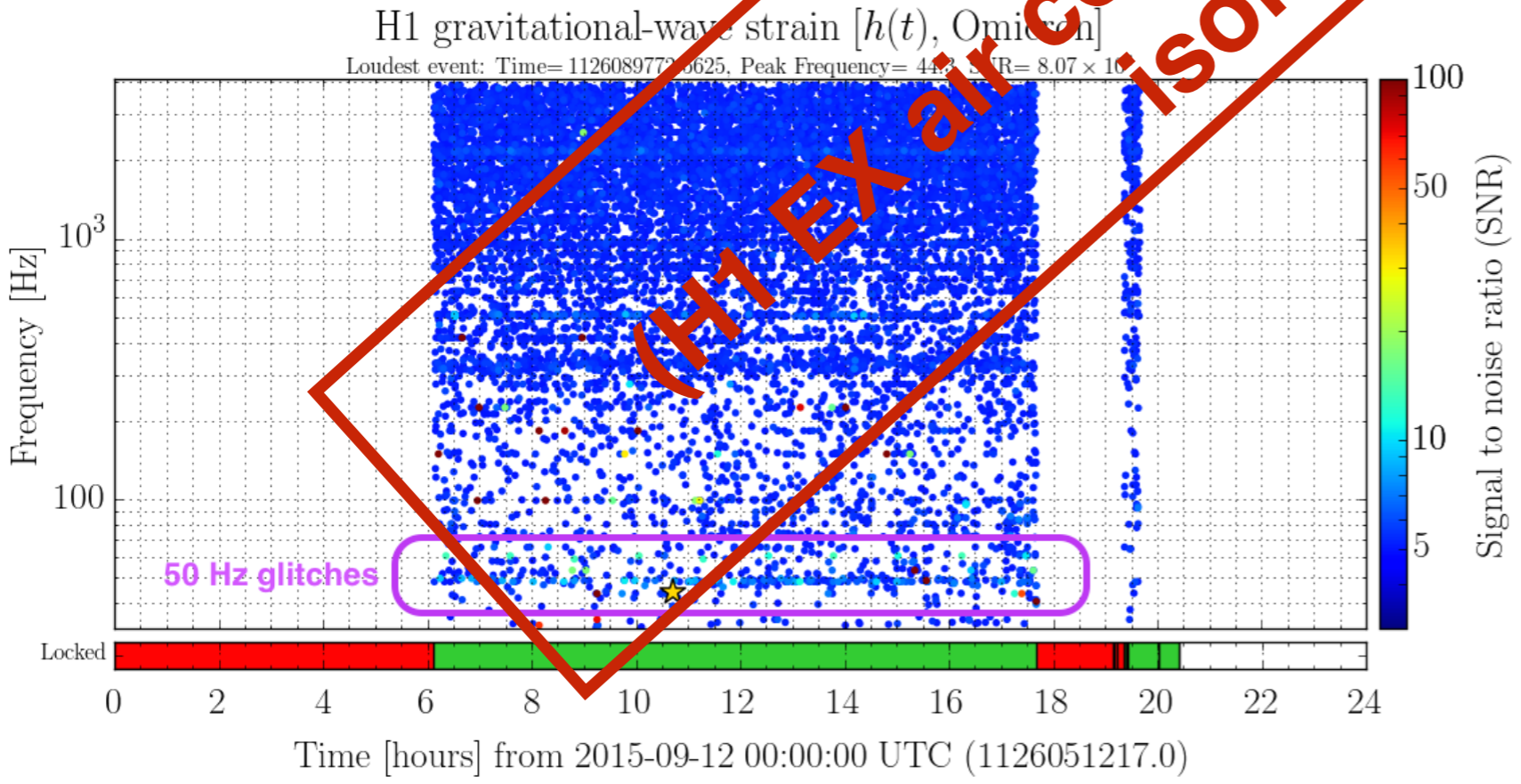
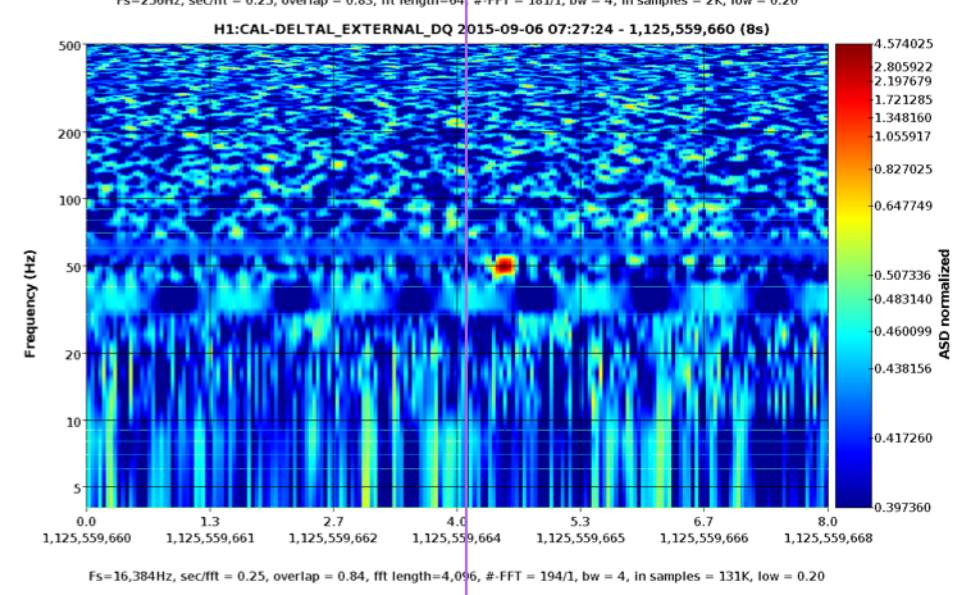
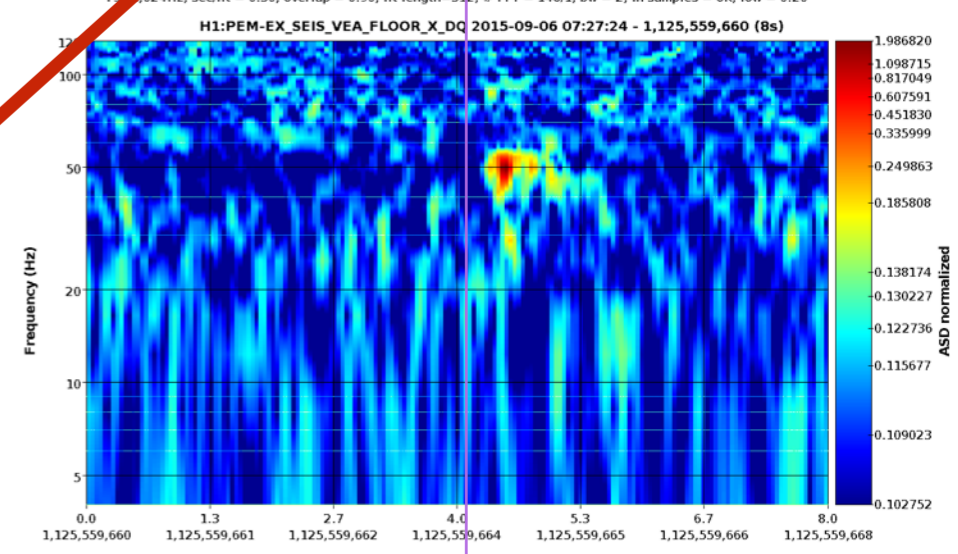
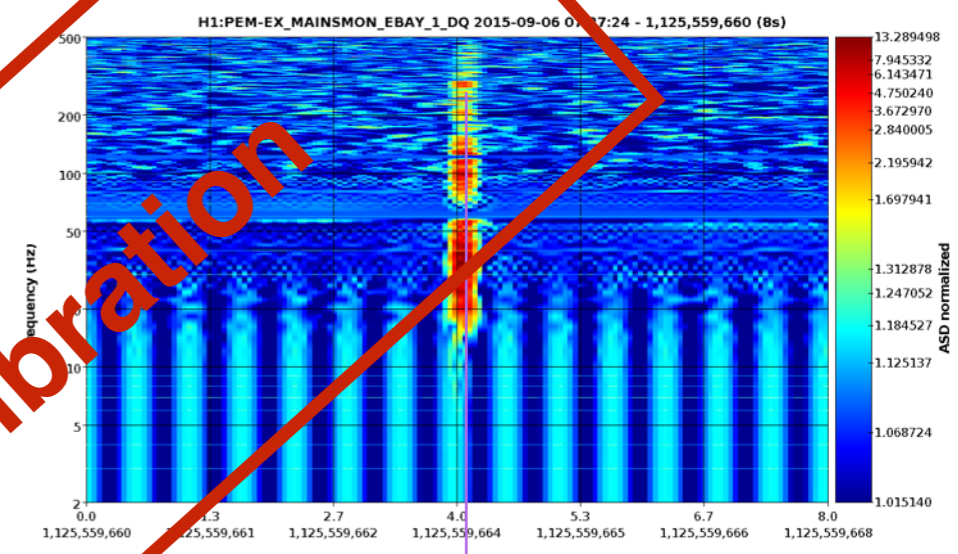
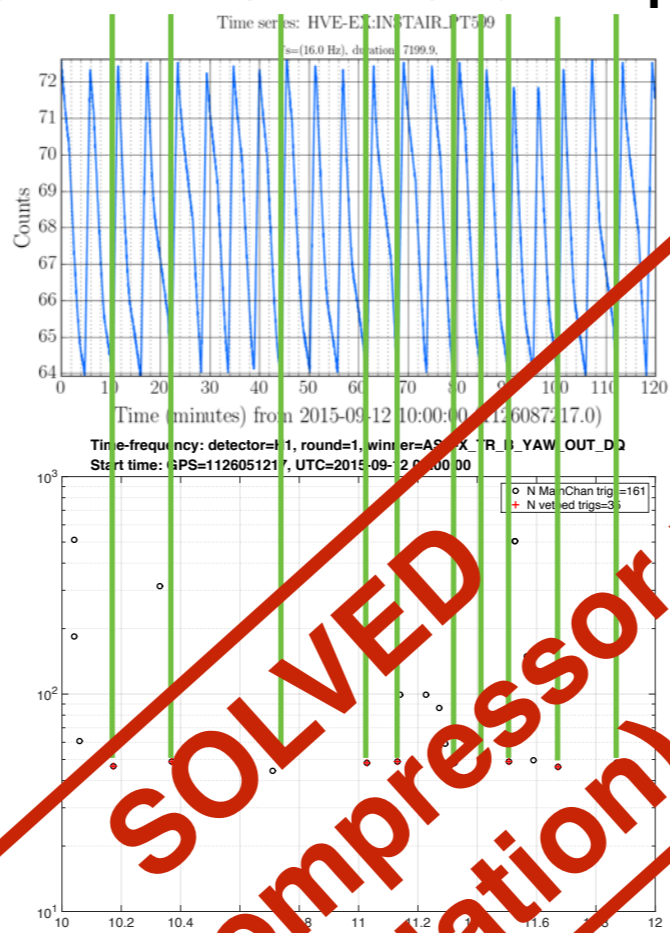
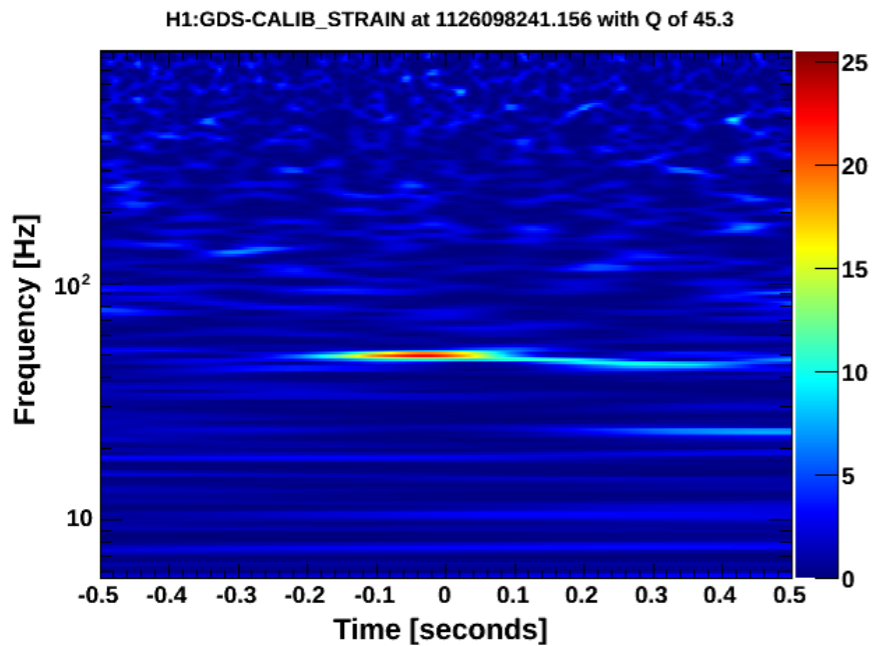
SOLVED
(H1 PRM LLL Coil Driver)



PRCL/SRCL glitches documentation

- Brief description: Low-frequency 10-80Hz glitches in DARM, coincident with louder low frequency glitches in PRCL and SRCL. Connection with DAC glitches probably a red herring. **Solved, PRM M3 LL Coil Driver.**
- Relevant alogs:
 - LLO: N/A
 - LHO: 18815, 18983, 20801
- Other documentation:

15. LHO End-X 50Hz air compressor glitches



SOLVED
(H1 EX air compressor vibration isolation)

LHO EX Mains glitches documentation

- Brief description: 50Hz glitches in DARM caused by EX Mains glitches that happen 400+/-70ms earlier, reliably matched to the 5hp air compressor starting up, couple through EX Seismic. The seismic isolation for this air compressor was shorted, and was replaced.

- Relevant alogs:

- LLO: N/A

- LHO: 21436, 22119, 22081

- Other documentation:

SOLVED
(H1 EX air compressor vibration isolation)



Time-frequency: detector=H1, round=8, winner=HPI-ETMX_BLIND_L4C_Y_IN1_DQ
Start time: GPS=1127271617, UTC=2015-09-26 03:00:00

