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

LIGO Detector Characterization Group
Maintained by Josh Smith

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
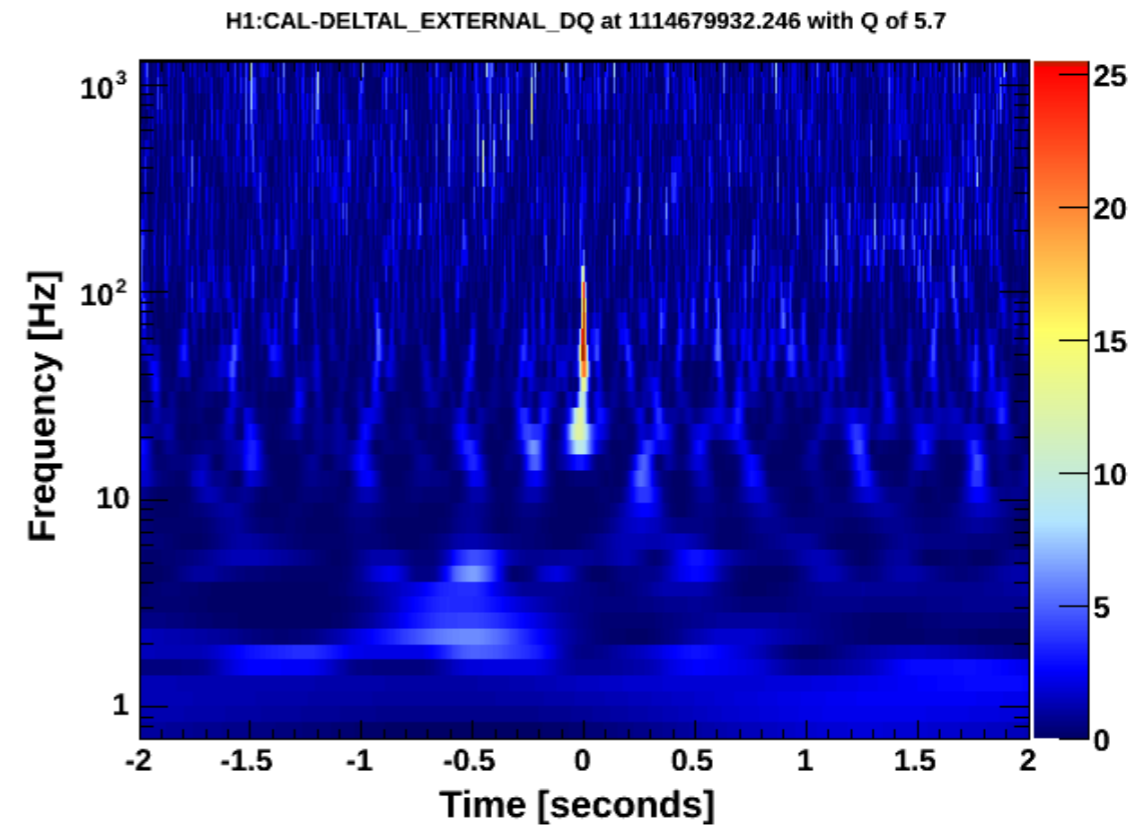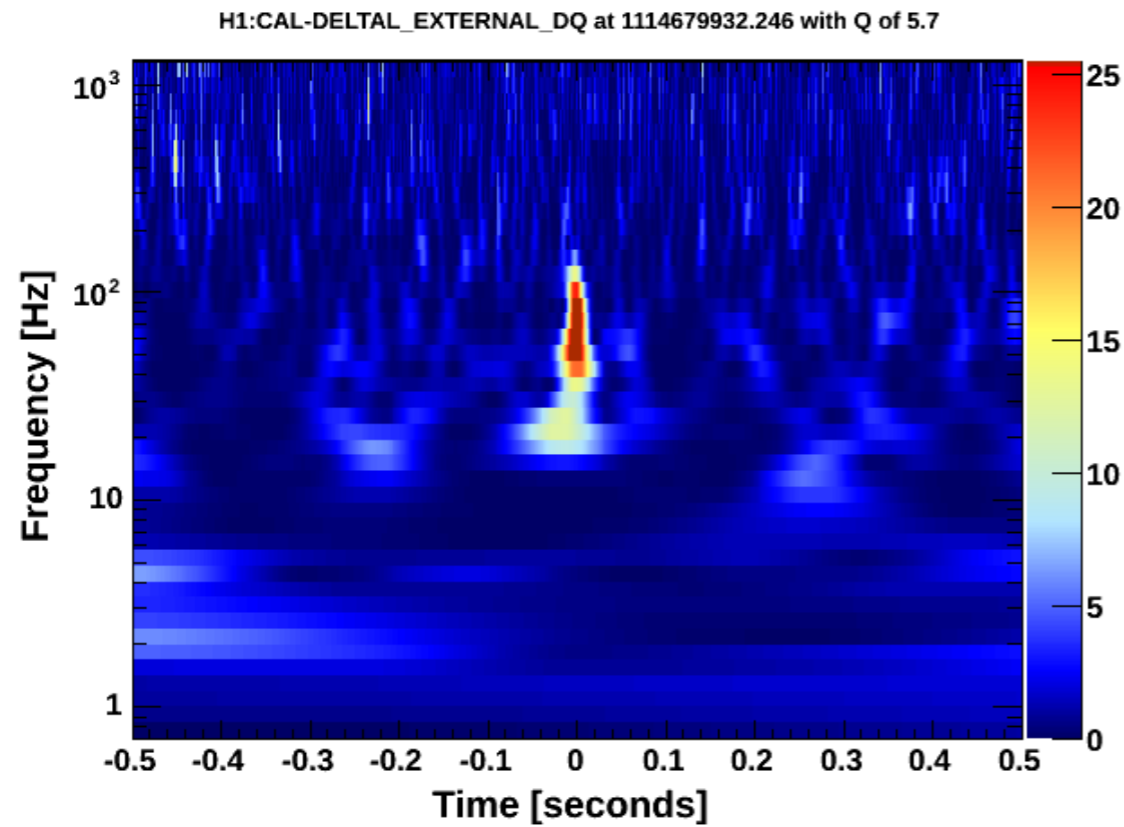- D. provides links to alog pages and wikis for more information

Table of Contents

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

1. Blip glitches

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

H1:CAL-DELTAL_EXTERNAL_DQ at 1114679932.246 with Q of 5.7

H1:CAL-DELTAL_EXTERNAL_DQ at 1114679932.246 with Q of 5.7

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?
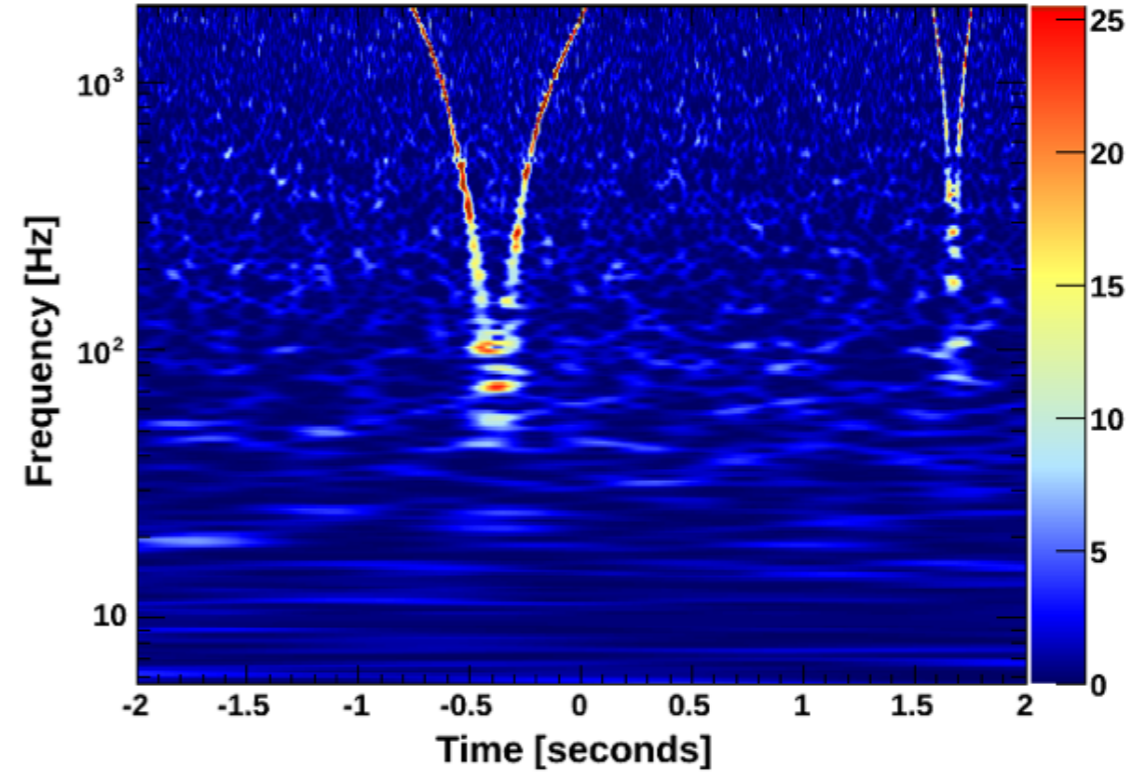
- Other documentation: Some blip times and scans link

2. RF Beats

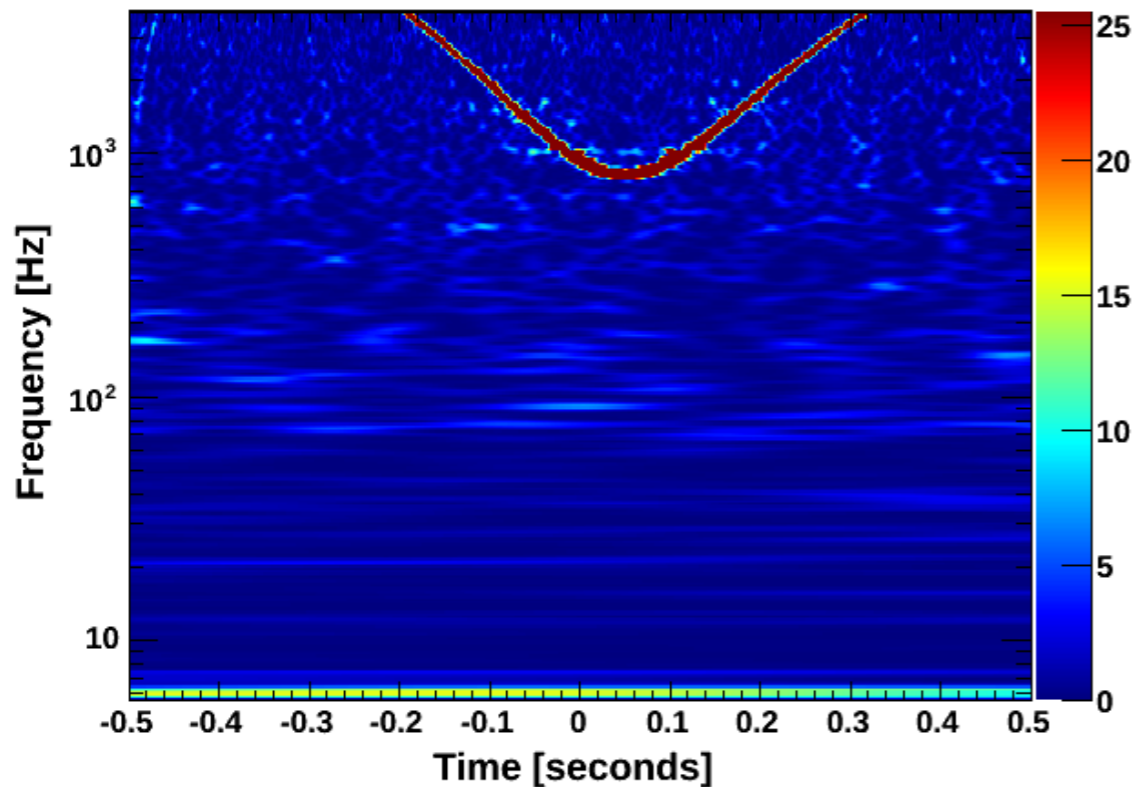Examples: https://ldas-jobs.ligo.caltech.edu/~areeda/josh-20150828.tgz
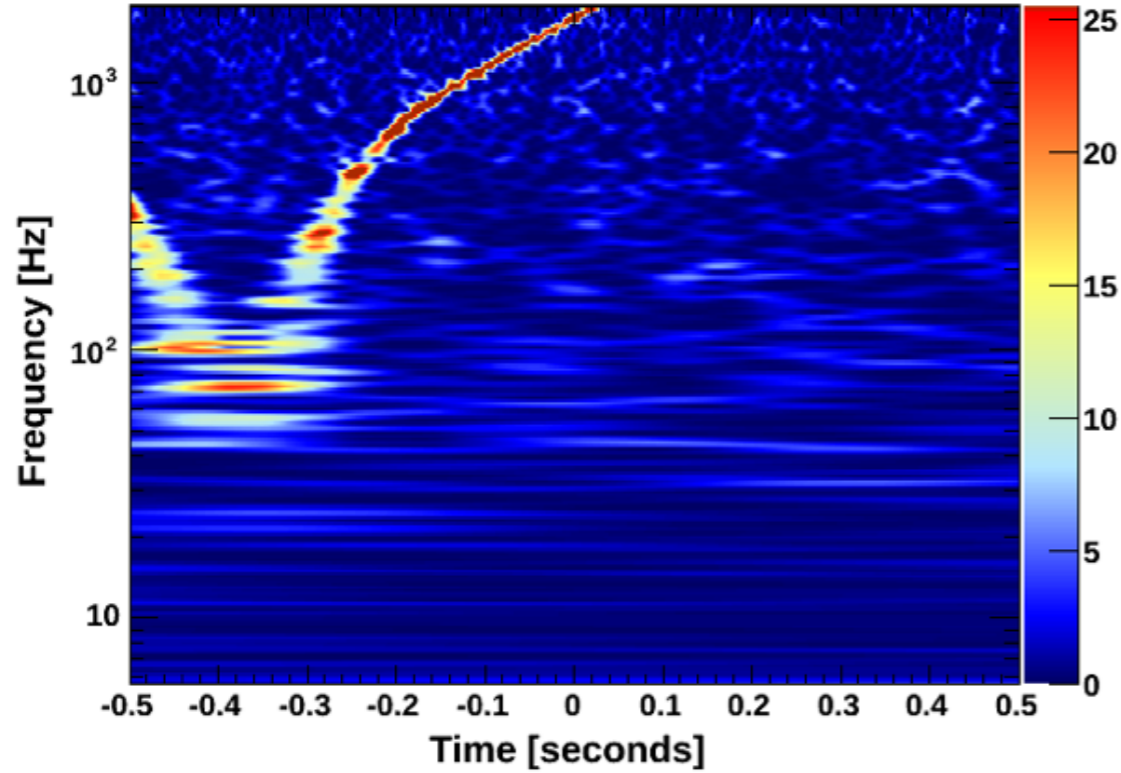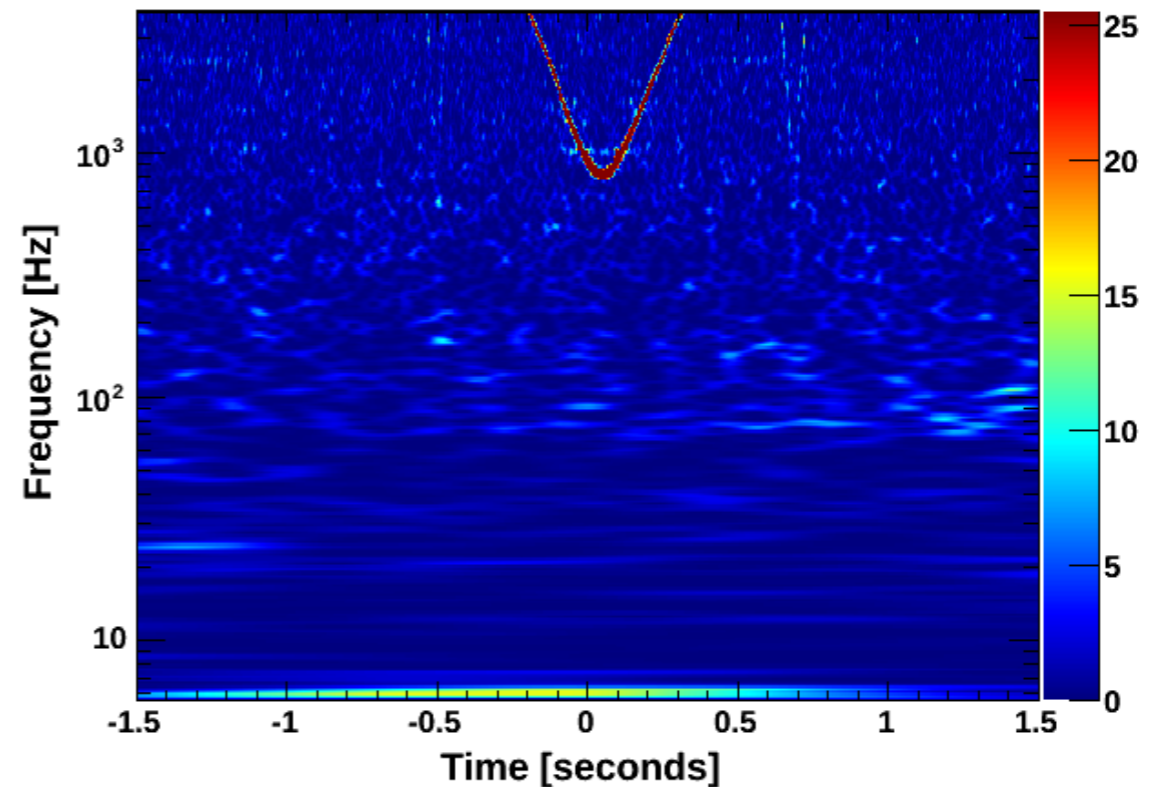
RF Beats documentation

- 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
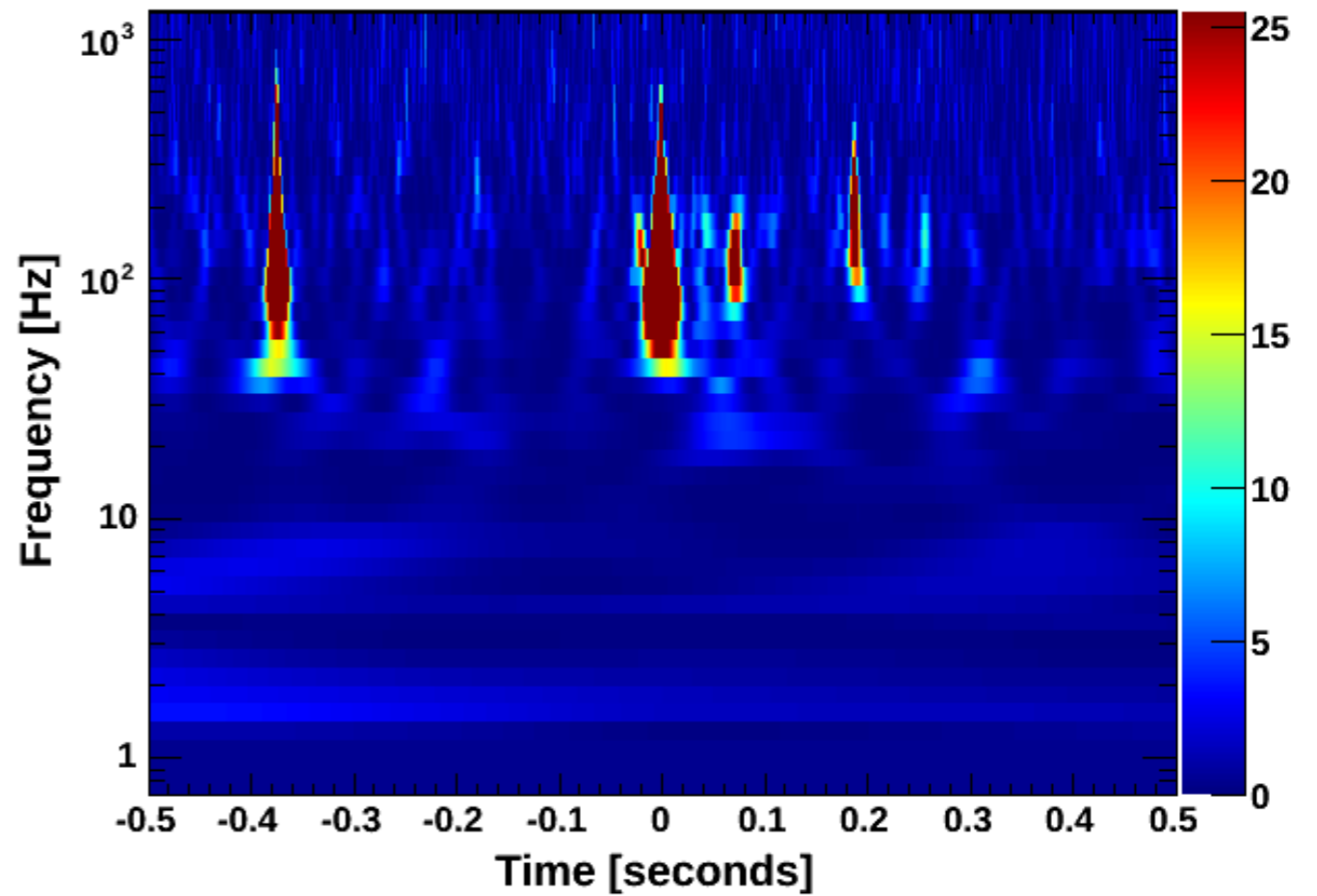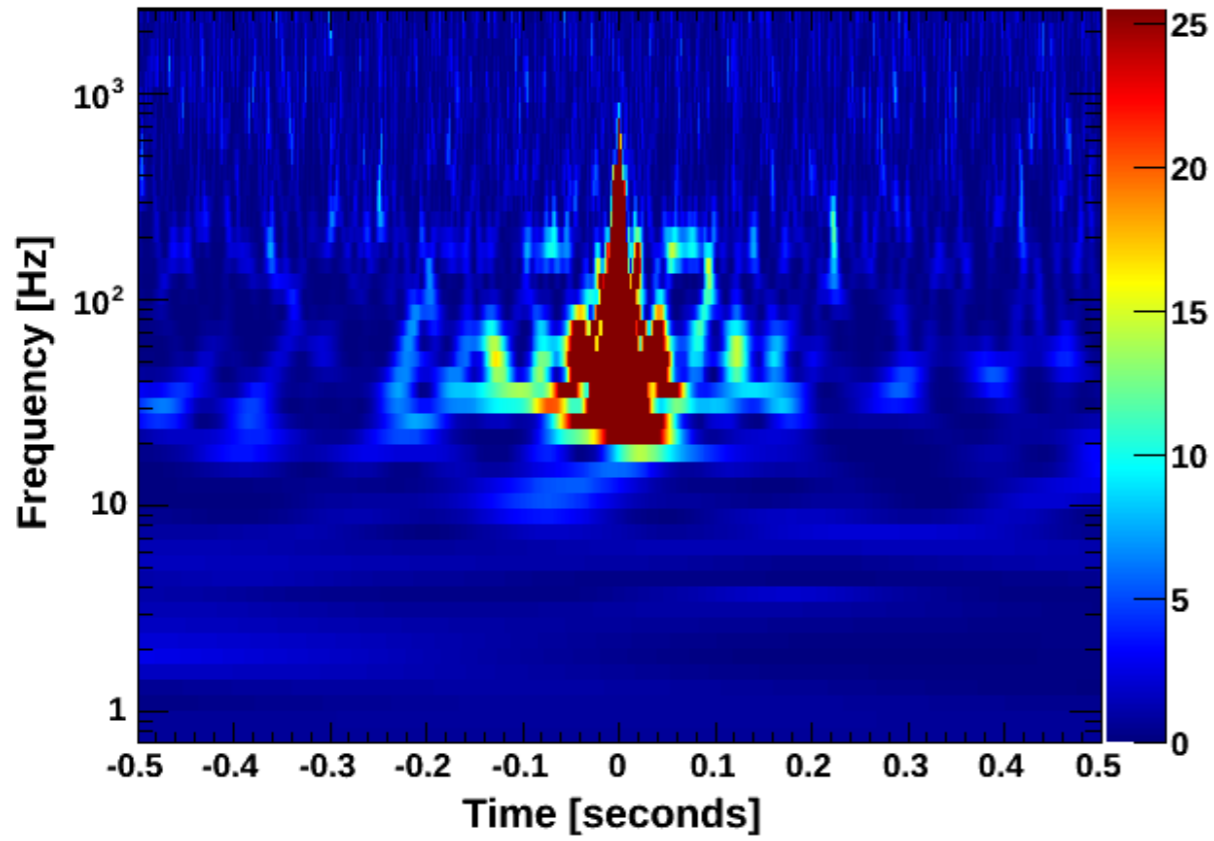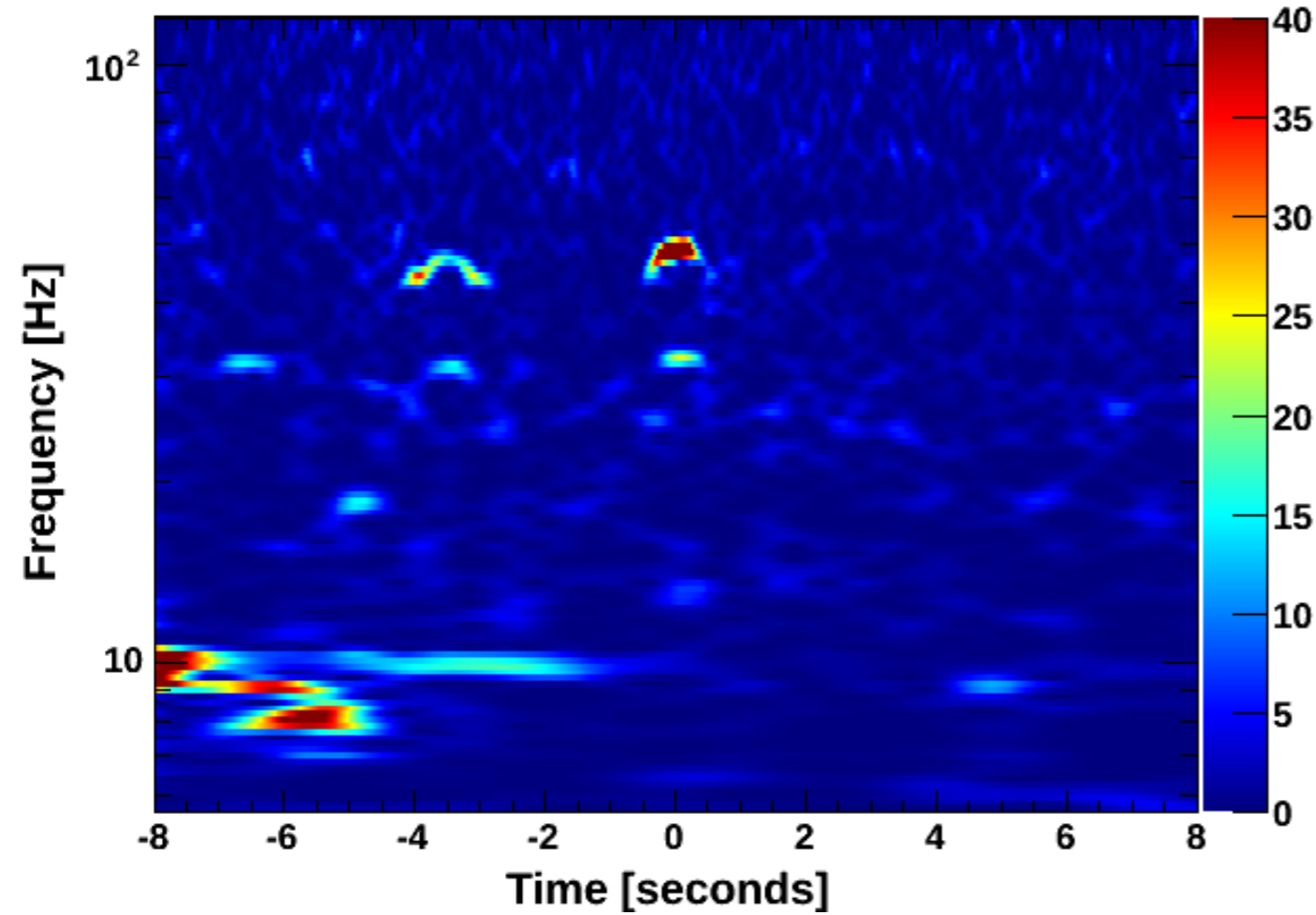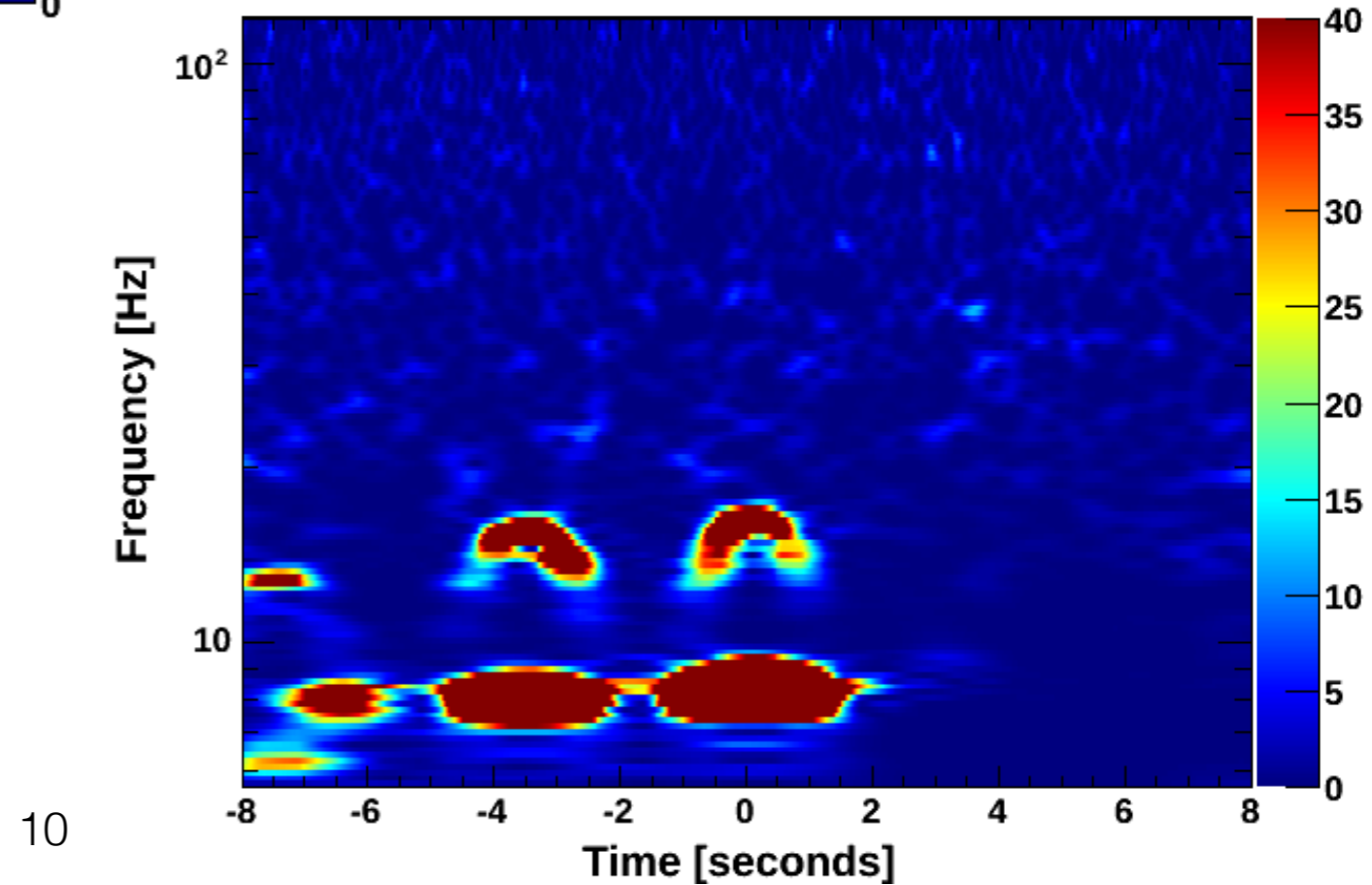
L1 Koi Fish documentation

- 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

10

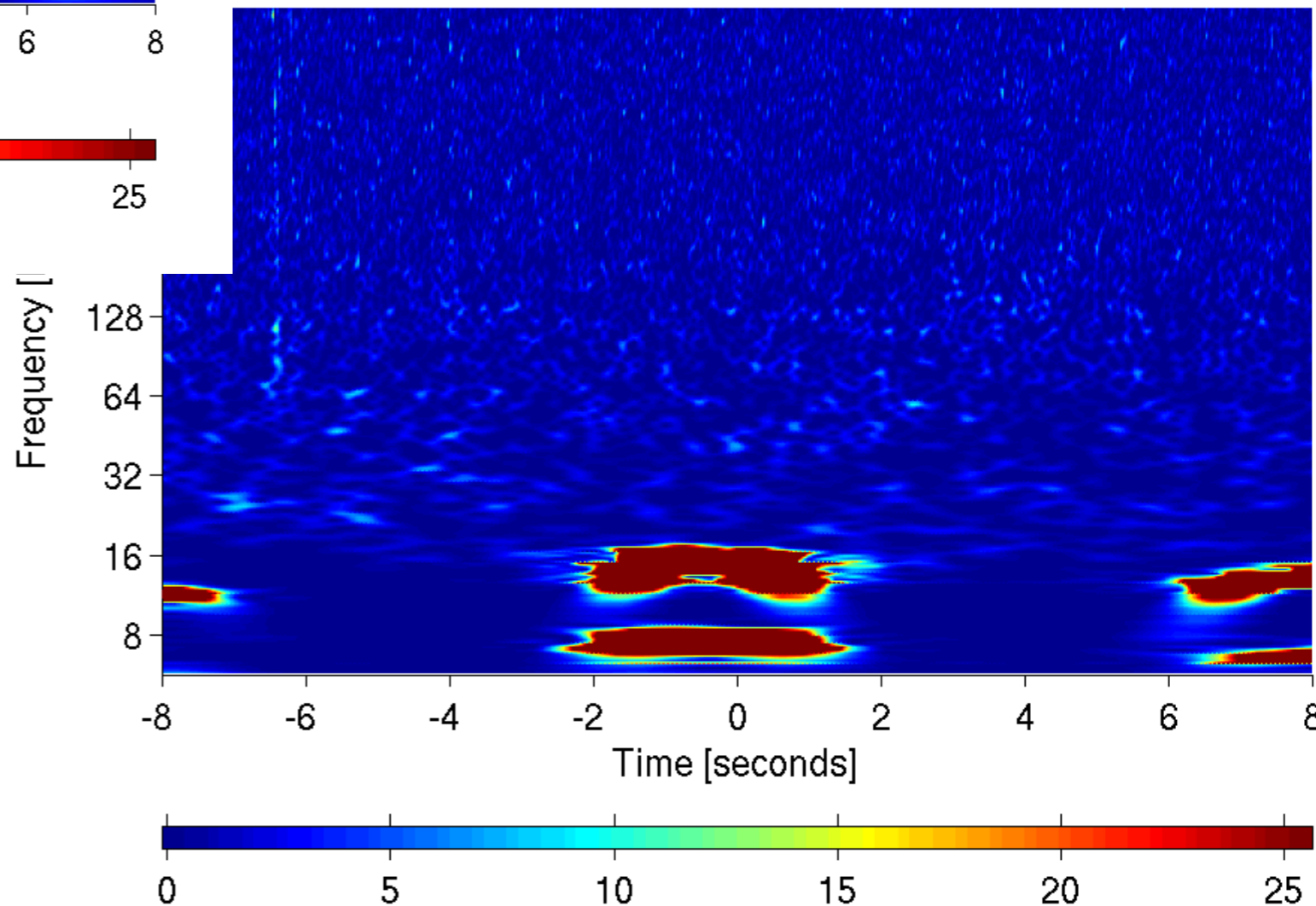# LHO end-Y scattered light documentation

- 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
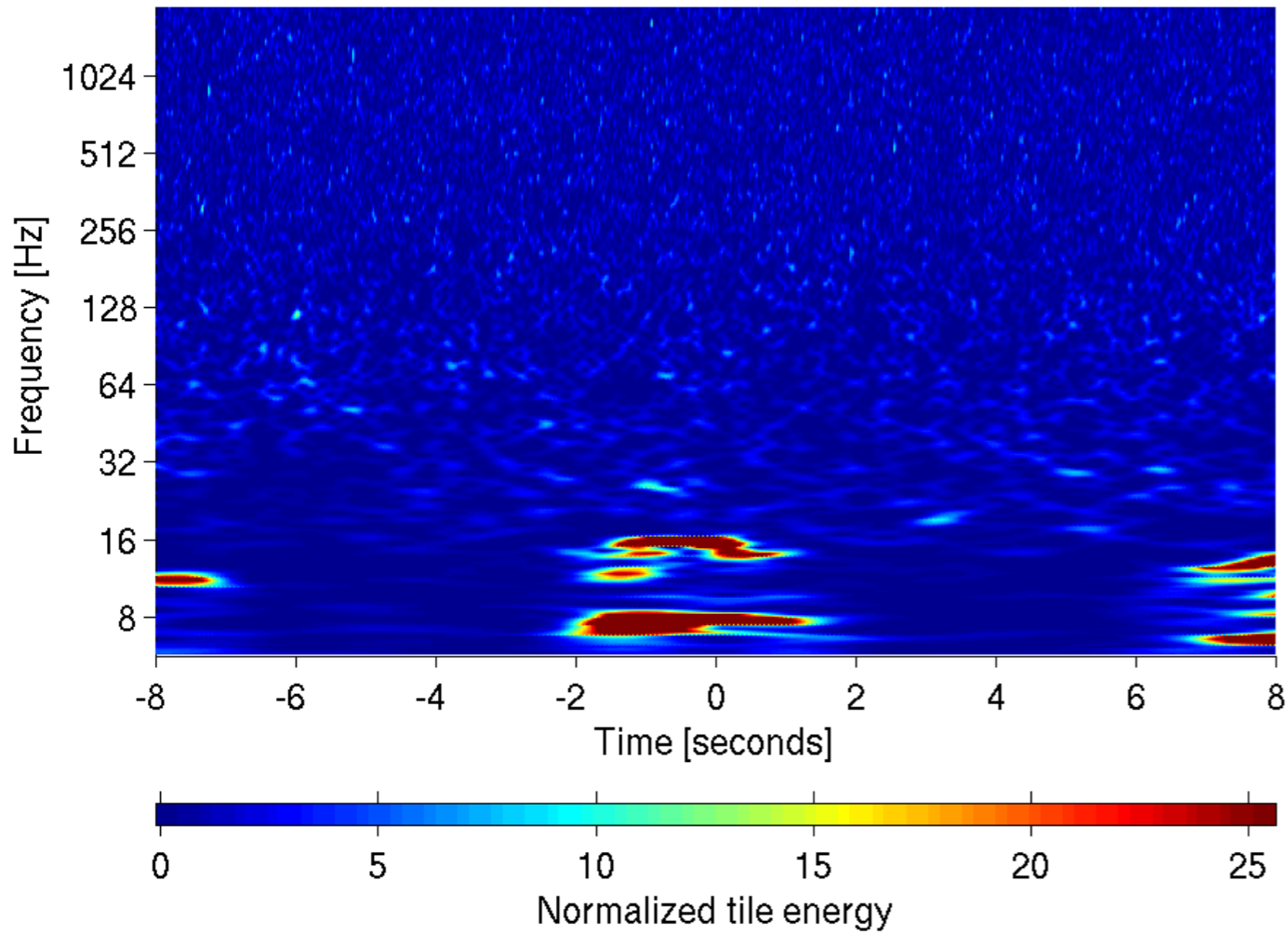
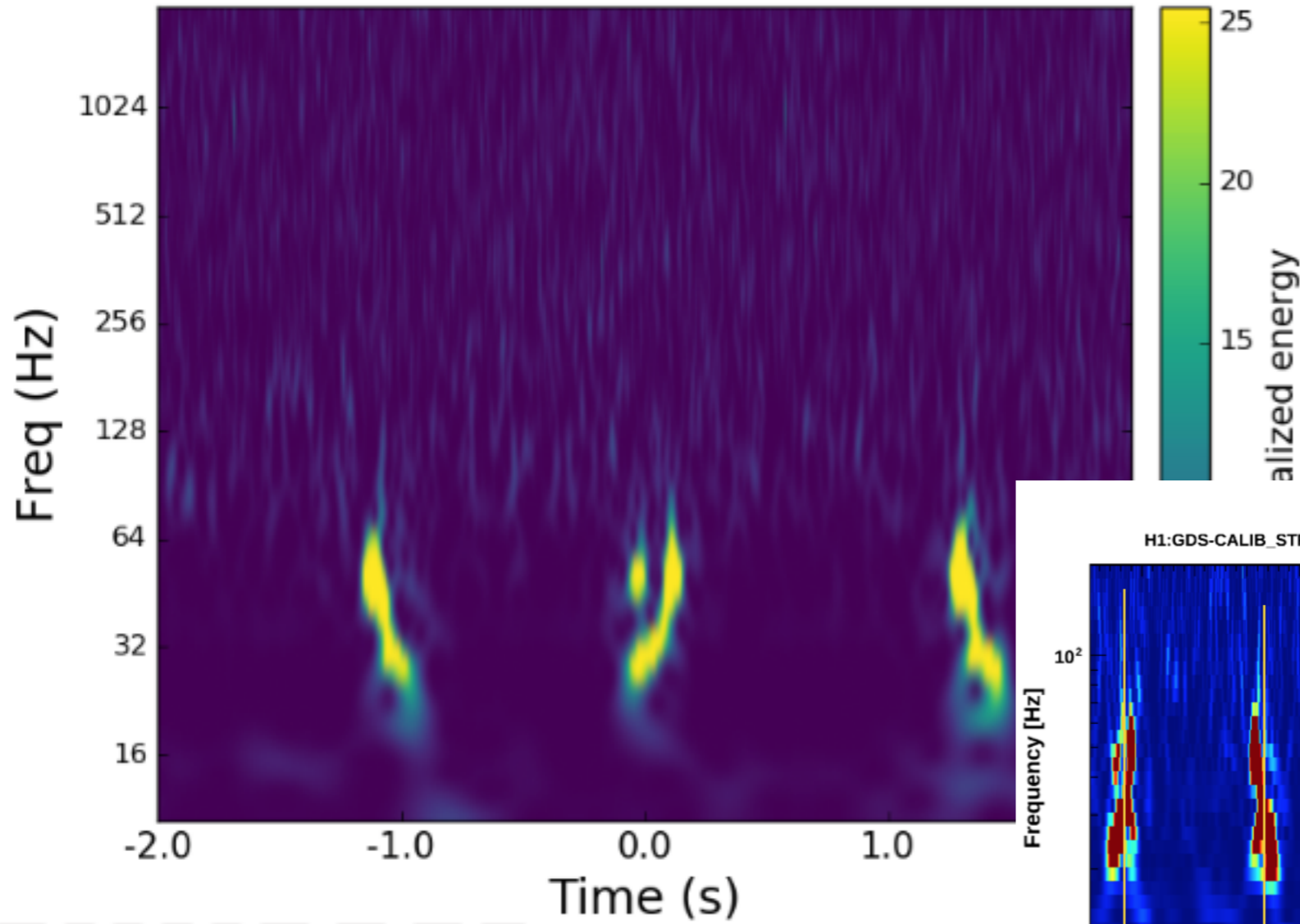L1:LSC-SRCL_OUT_DQ at 1128676351.375 with Q of 45.3

LLO SRM scattered light documentation

- Brief description: Relevant alogs:

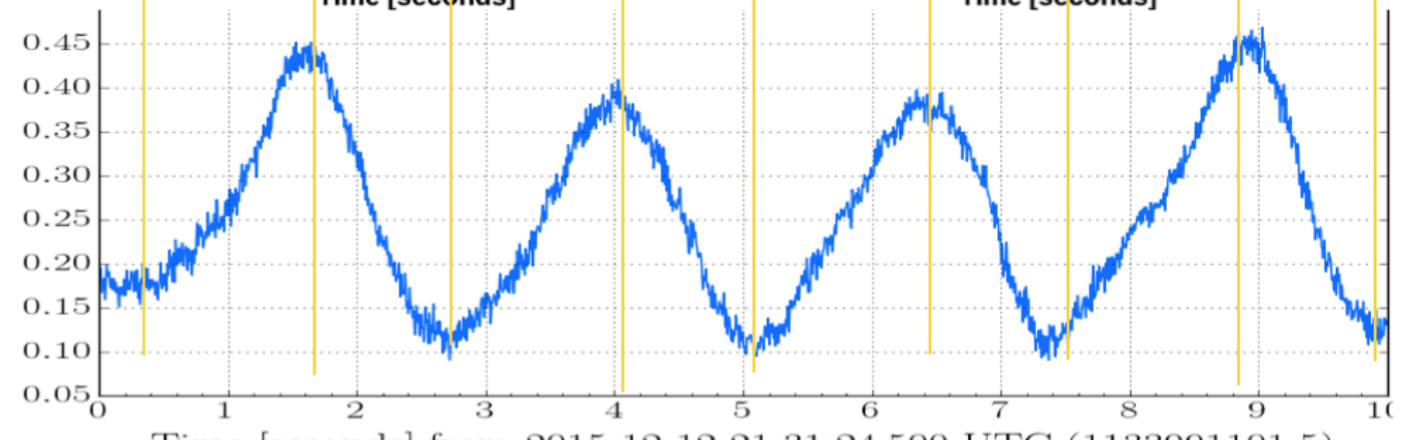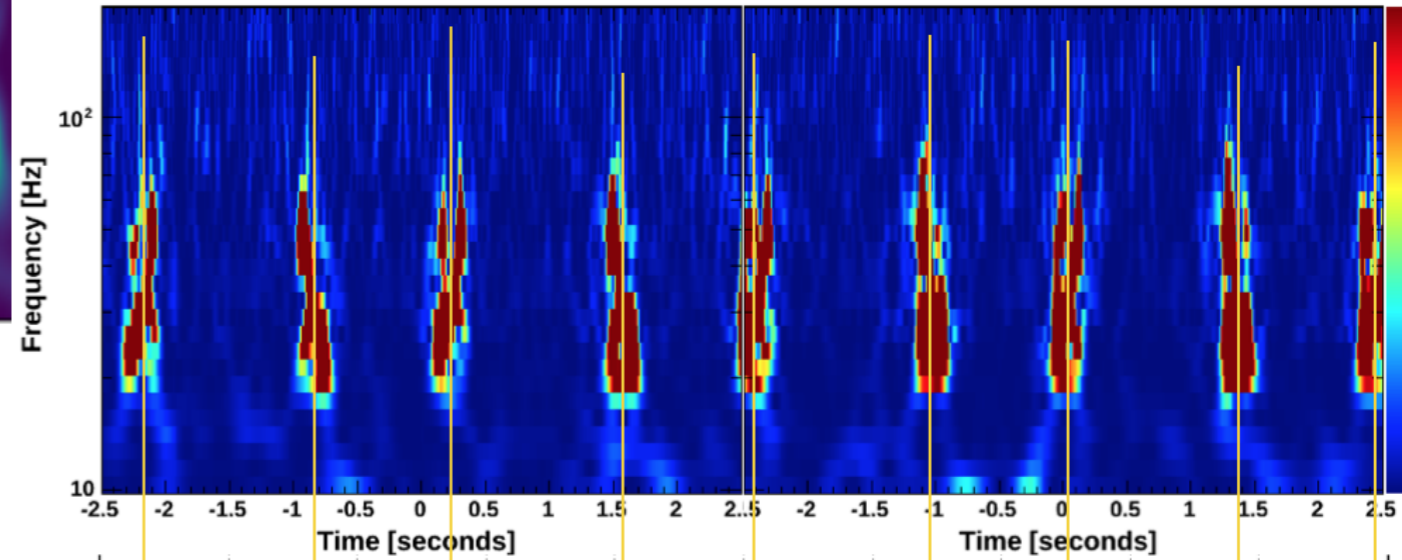 - LLO: <u>21759</u>

  - LHO:

- Other documentation:

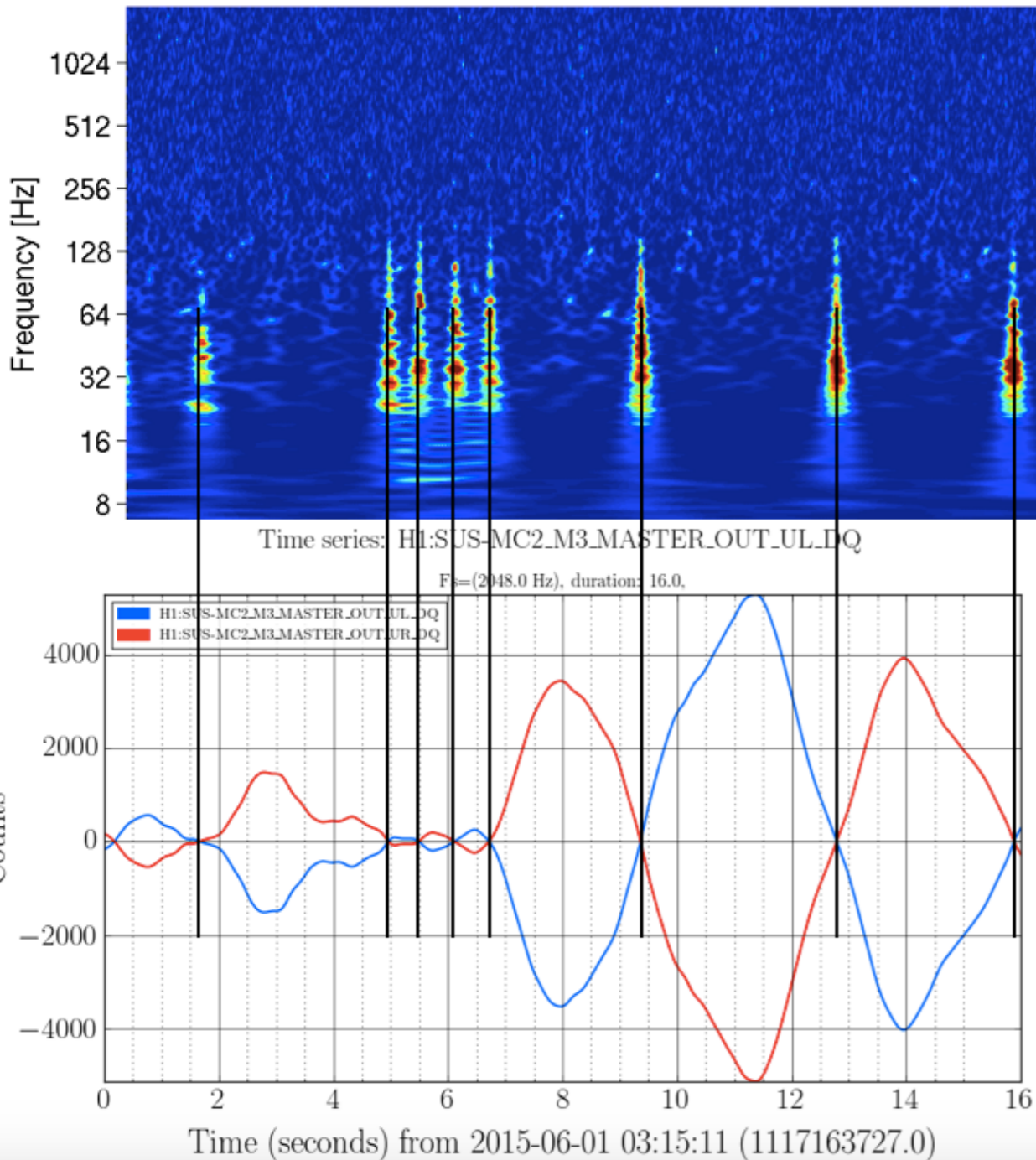# 6. LHO Paired Doves

Subject 1956084

14

LHO Paired Doves Documentation

- Brief description: 15-70Hz glitches that repeat at 2x0.4Hz and have alternating positive and negative delta f. 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: 27138

- Other documentation: GravitySpy page

7. DAC glitches

Historical example of zero crossing:

Historical example of -2^16 crossing:

H1:LSC-MCL_OUT_DQ at 1117163735.355 with Q of 45.3

Time series: H1:SUS-MC2_M3_MASTER_OUT_UL_DQ

Fs=(2048.0 Hz), duration: 16.0,

Time (seconds) from 2015-06-01 03:15:11 (1117163727.0)

0

16

H1:CAL-DELTAL_EXTERNAL_DQ at 1111487726.984 with Q of 5.7

Time series: H1:SUS-ETMY_L3_MASTER_OUT_UR_DQ

Fs=(2048.0 Hz), duration: 4.0,

Time (seconds) from 2015-03-27 10:35:09 (1111487725.0)
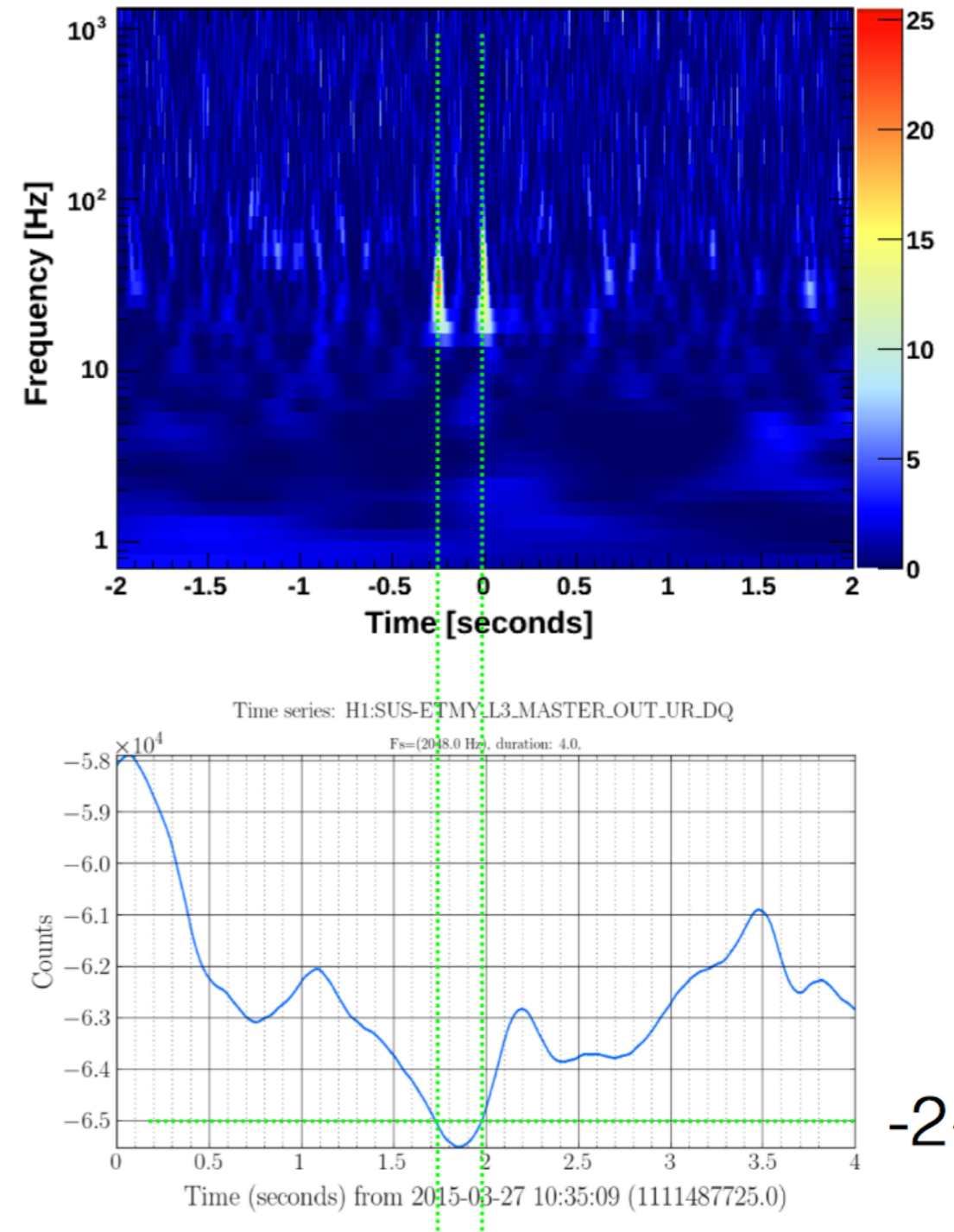
-2^16

DAC glitches documentation

- Brief description: aLIGO 18-bit digital to analog converters glitch when they cross 0 or +/-2^16. LIGO Lab upgraded most of the 18-but 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*505Hz glitches

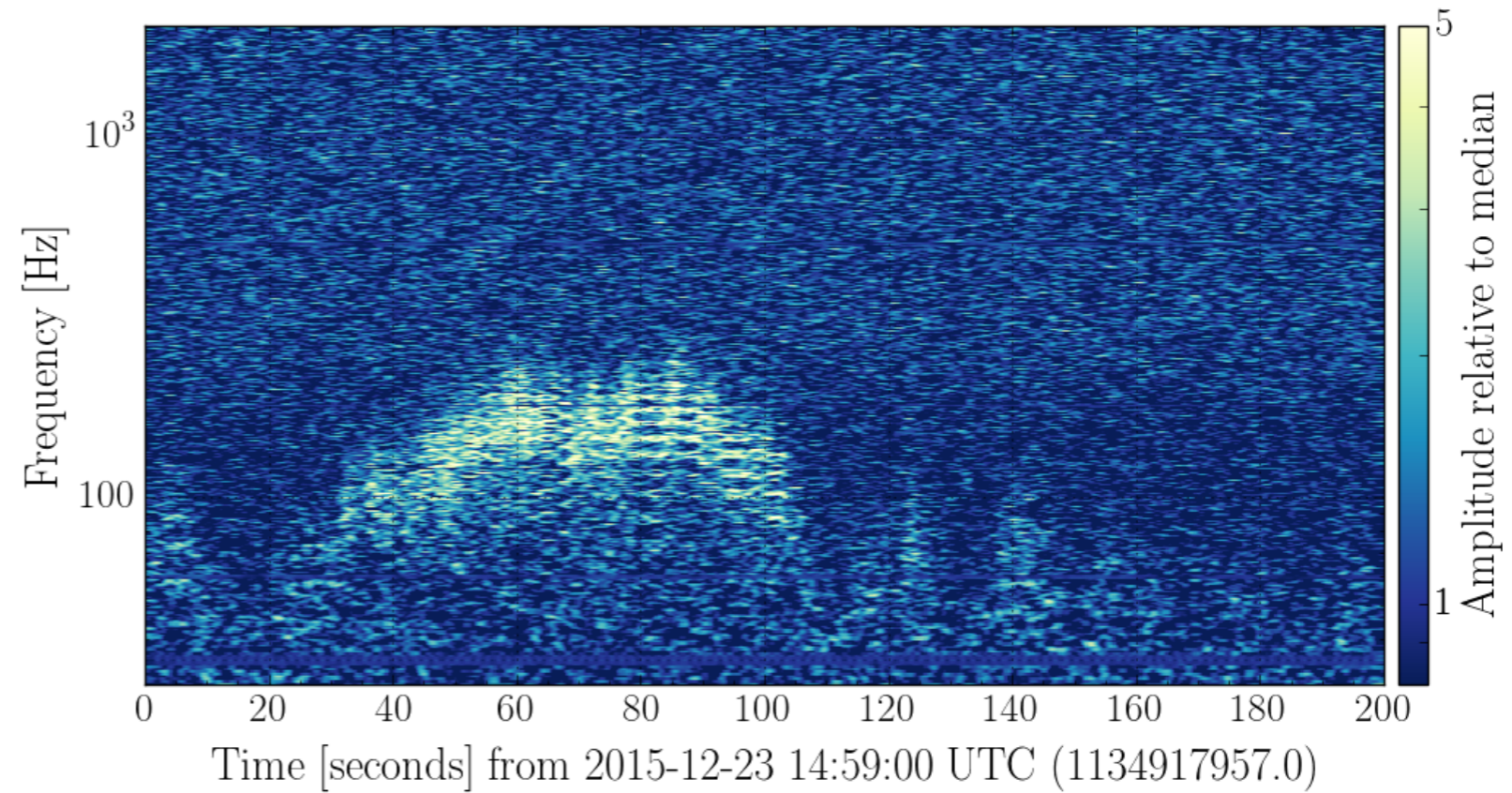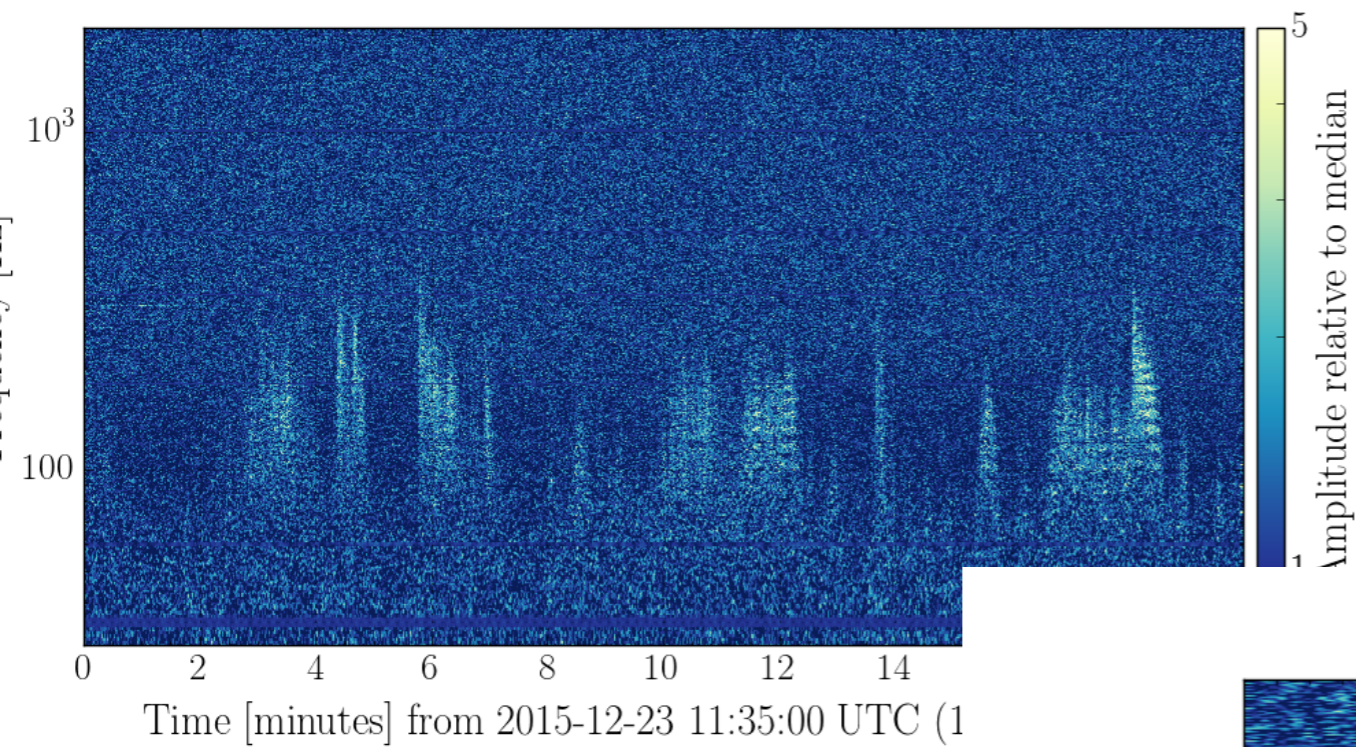LHO examples: http://ldas-jobs.ligo-wa.caltech.edu/%7Eareeda/500Hz-harmonics-rd2.tgz
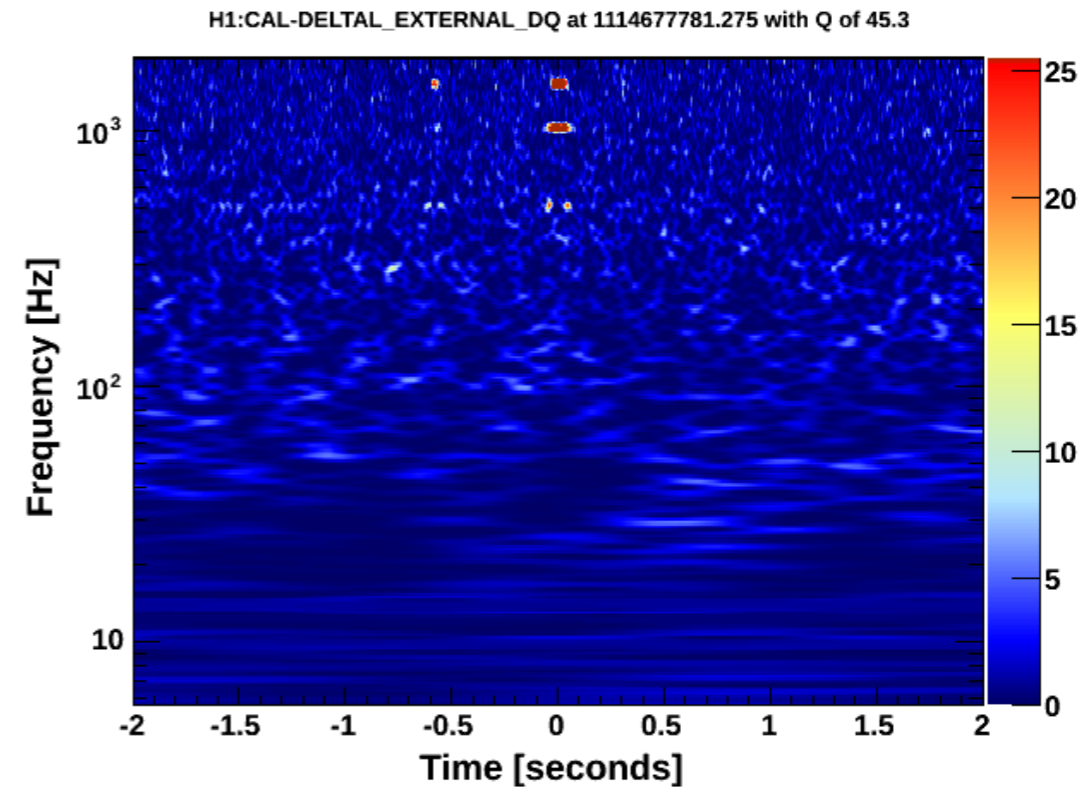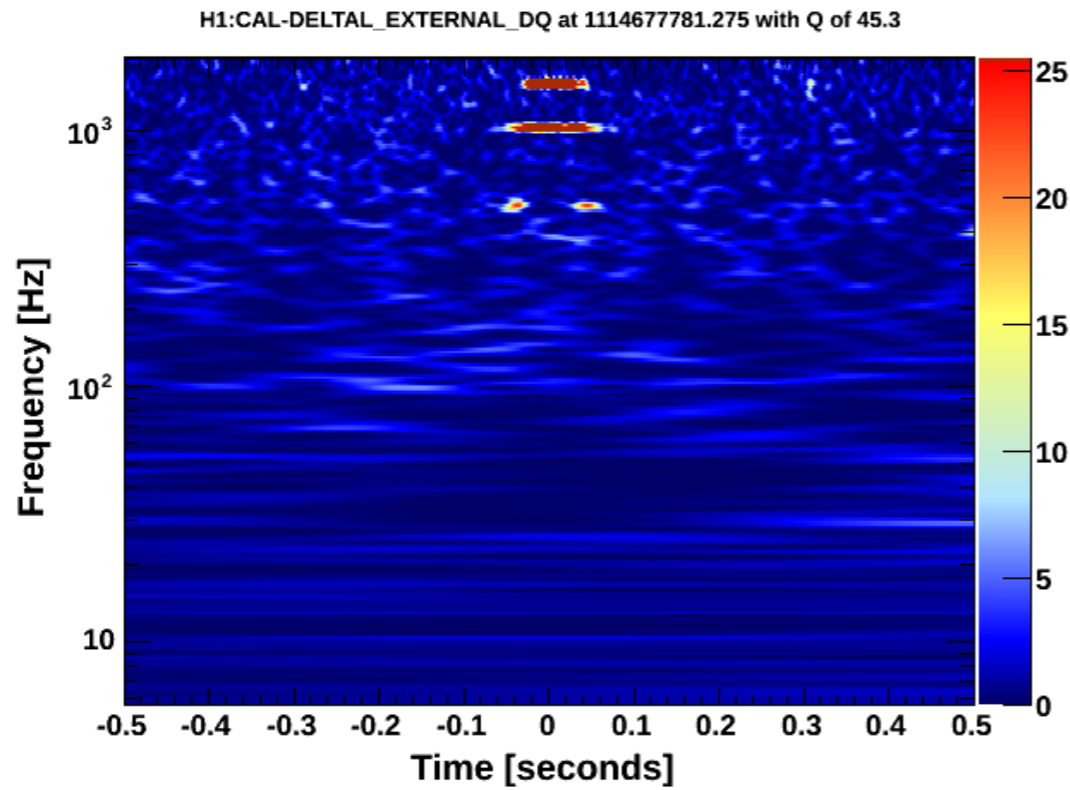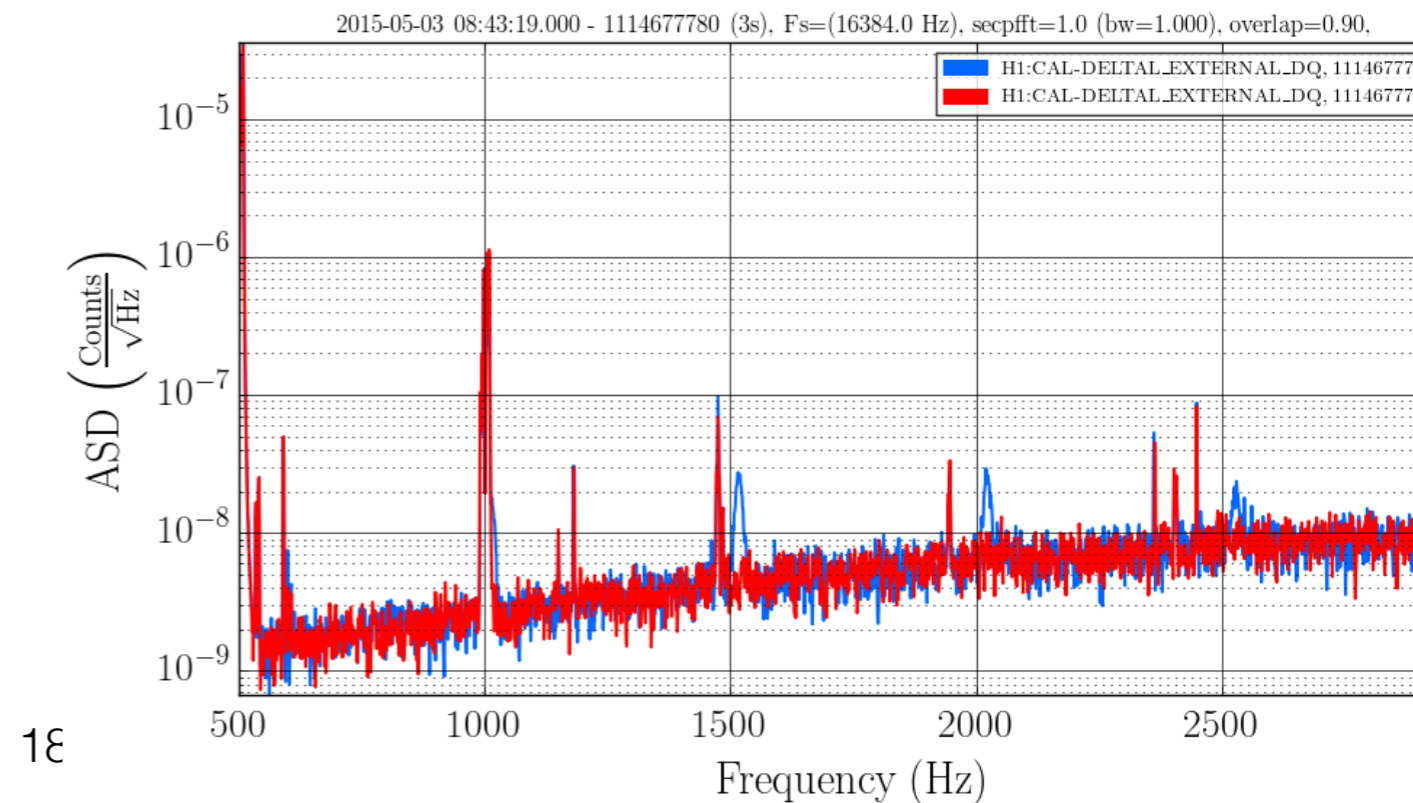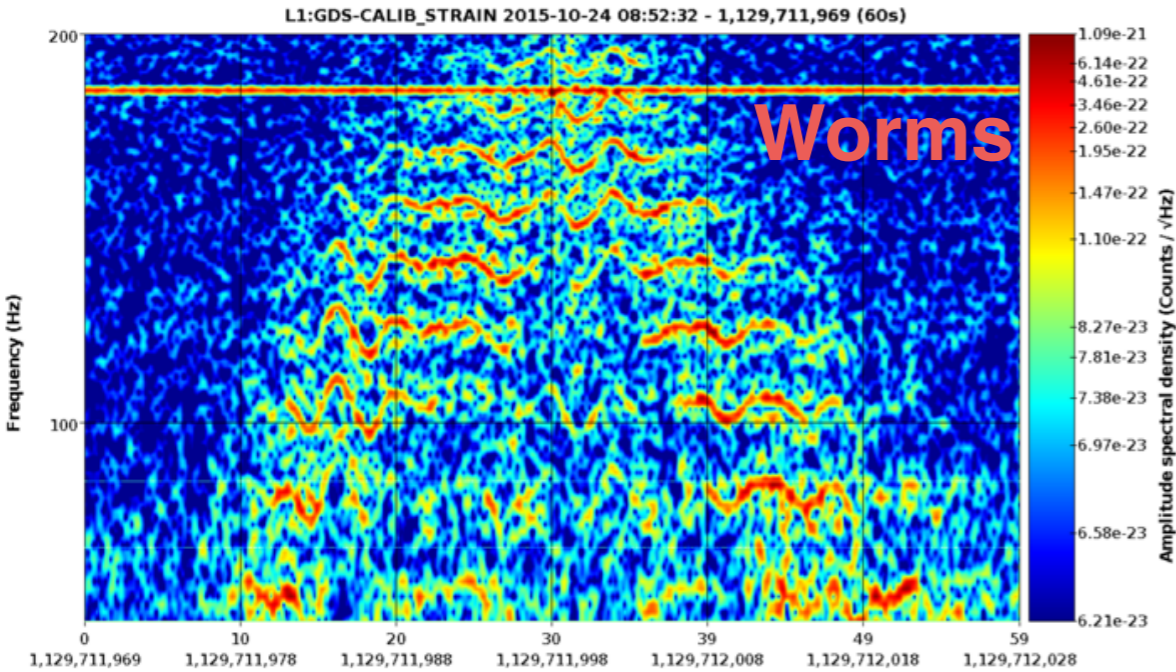
n*505 Hz glitches documentation

- 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

9. Blue Mountain Glitches
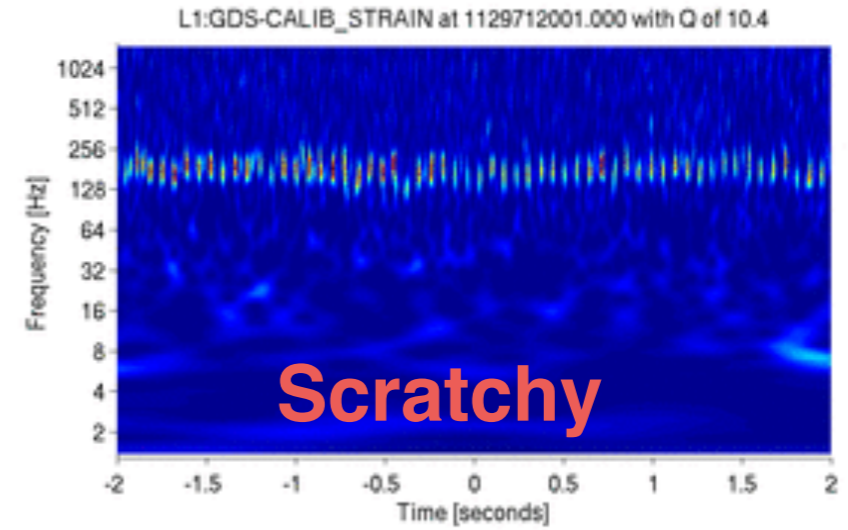
Blue Mountains (in FFT) = Worms (in FFT) = Scratchy (in Omega)
AKA, how Omega Scan fails miserably for strange data
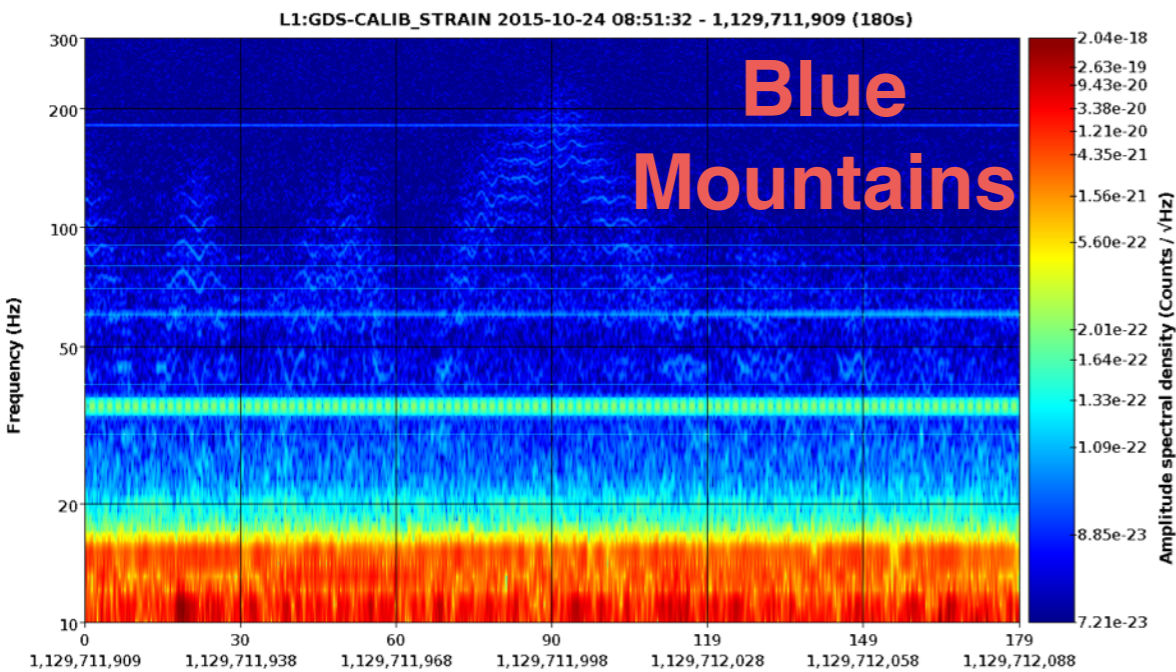
What FFTs see (1 sec FFT, 0.9 olap)

Worms

link

Blue Mountains

link

Fs=16,384Hz, sec/fft = 1.00, overlap = 0.90, fft length=16,384, #-FFT = 1791, bw = 1, in samples = 2,949K, low = 0.20

What omega scan sees
(t=0 here is t=34 seconds to left)

Scratchy

link

link

GravitySpy calls this a "scratchy" link
L1:GDS-CALIB_STRAIN
1129712003.8418 j8vhrEA8I4

9. 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. 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
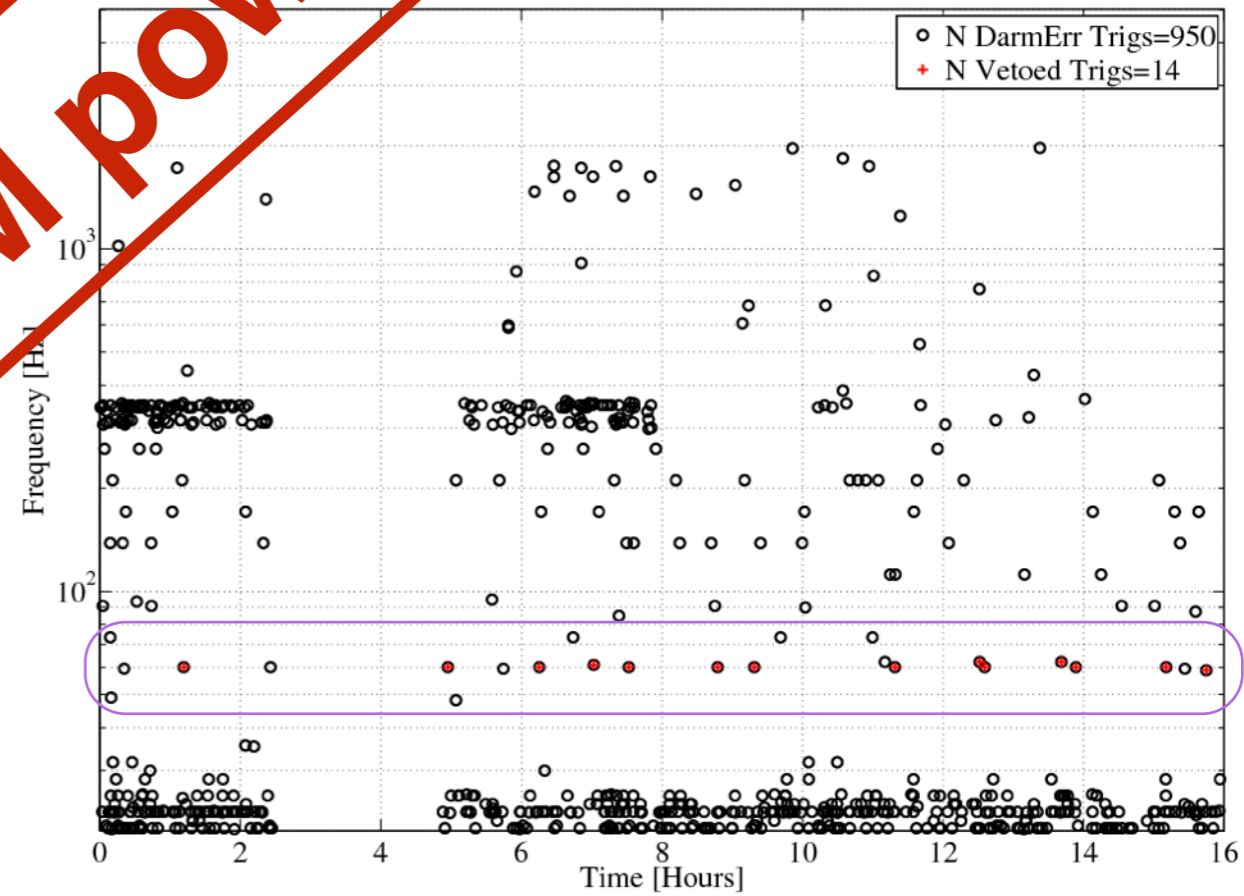
10. LHO End-Y 60 Hz electromagnetic glitches

H1 Examples: TBA

H1:CAL-DELTAL_EXTERNAL_DQ at 1117601846.844 with Q of 45.3
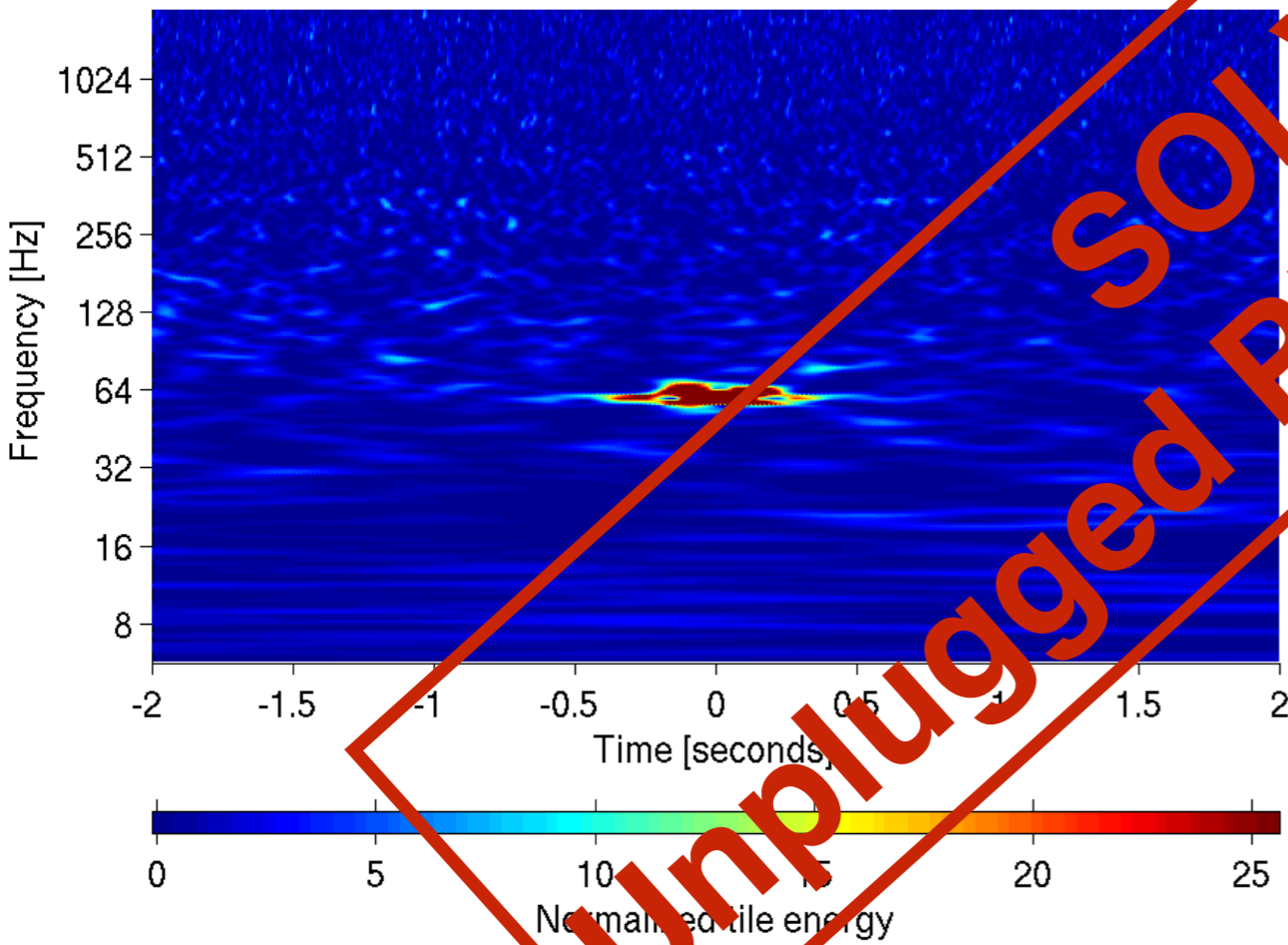
Time Frequency Map: Detector=H1, Round=4, Winner=PEM-EY_MAG_EBAY_SEIRACK_X_DQ_C
Times offset of GPS=1117584016, UTC=2015-06-06 00:00:00
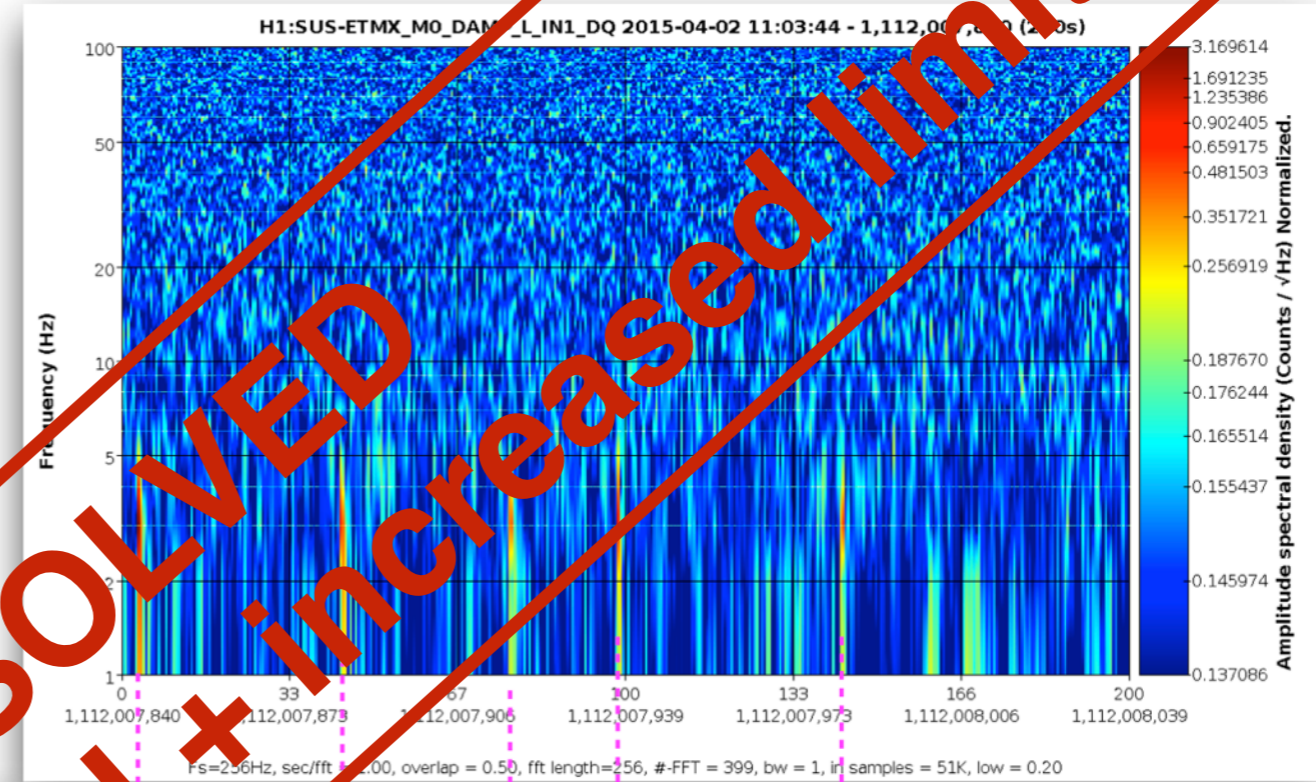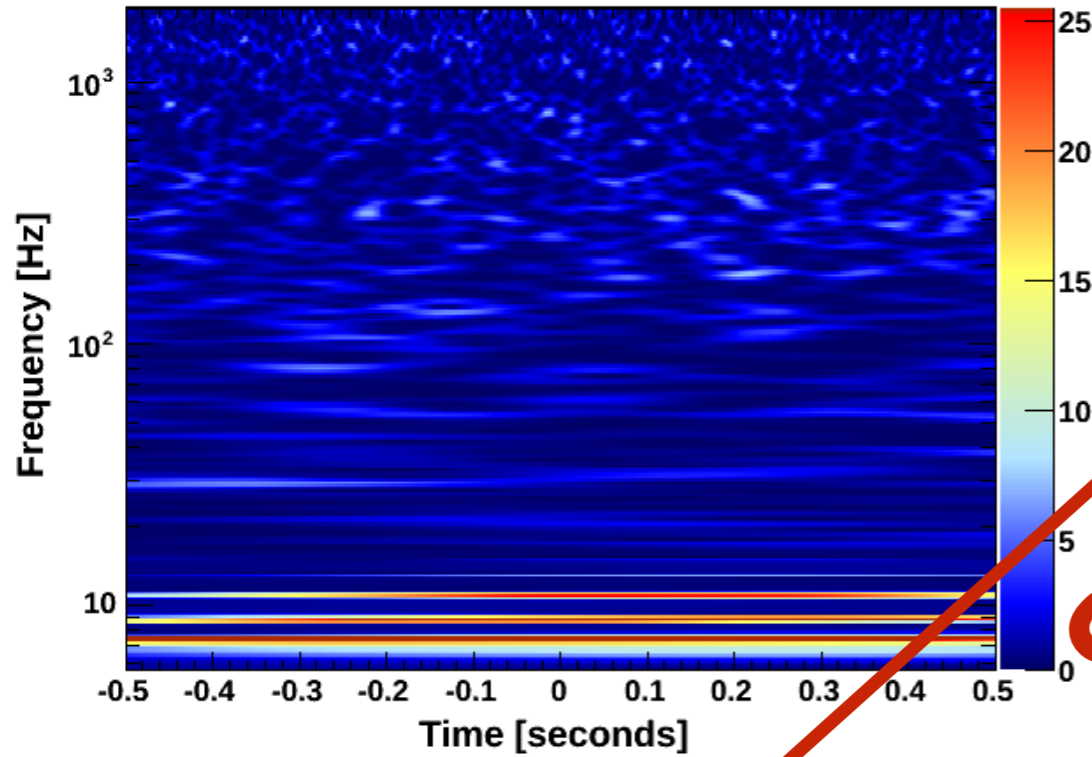
SOLVED
Unplugged PEM power supply

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
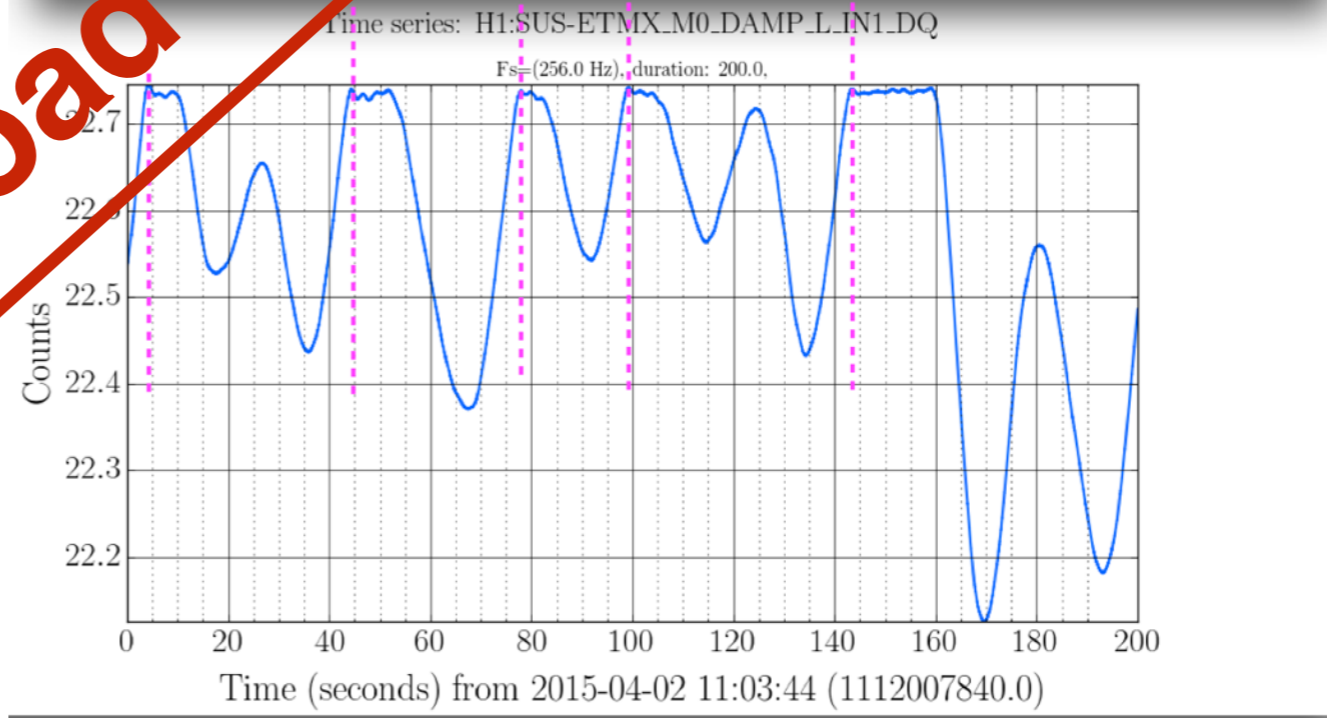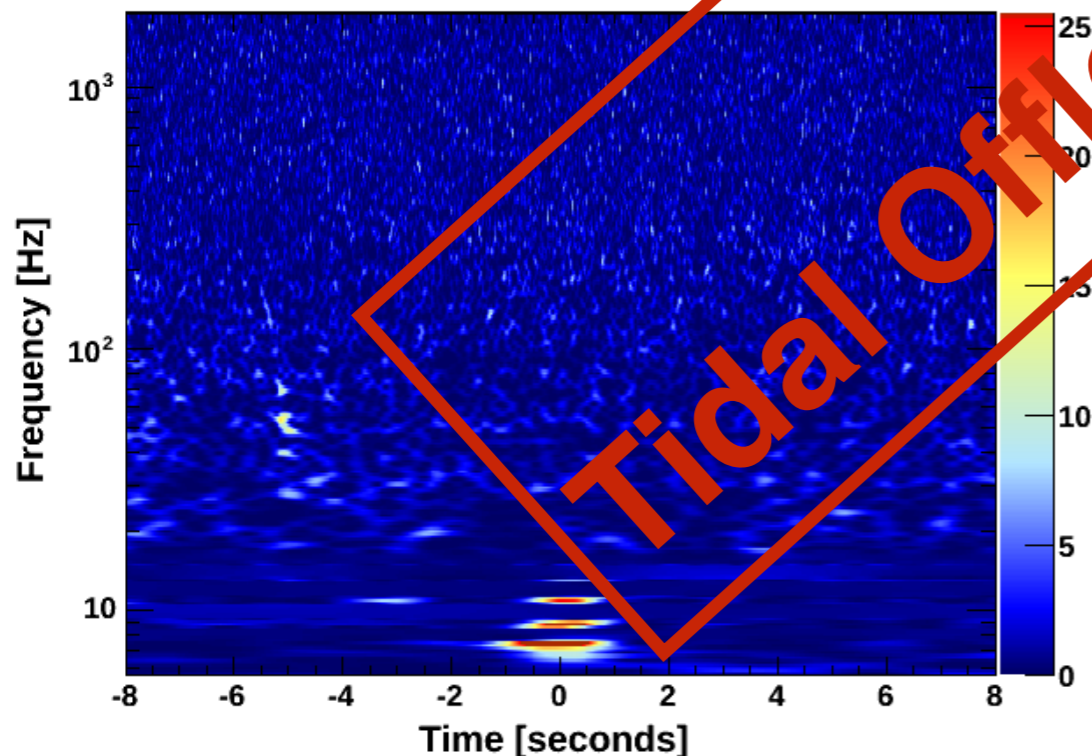
- Other documentation:

SOLVED PEM power supply Unplugged PEM power supply

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

H1 Examples: http://ldas-jobs.ligo-wa.caltech.edu/~areeda/Round1-2105402.tgz

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:

  - LLO: Not seen yet

  - LHO: 17654, 18748

- Other documentation:

SOLVED
Tidal Offload + increased limits

12. OMC L scattering fringes

H1 Examples: https://ldas-jobs.ligo-wa.caltech.edu/~daniel.vanderhyde/mon_scat/6_2015/25HZ_THRESH/
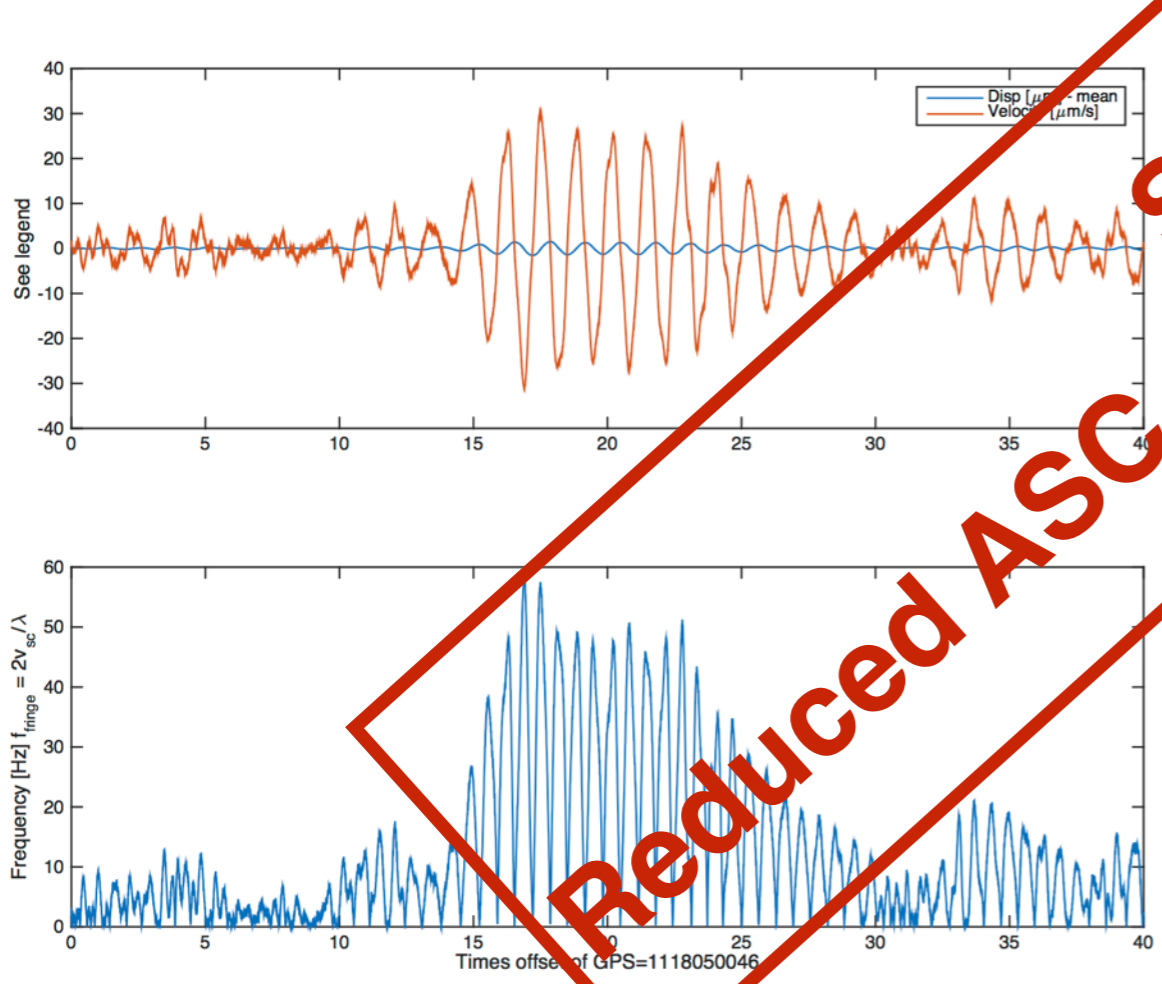
SOLVED RMS to H1 OMC
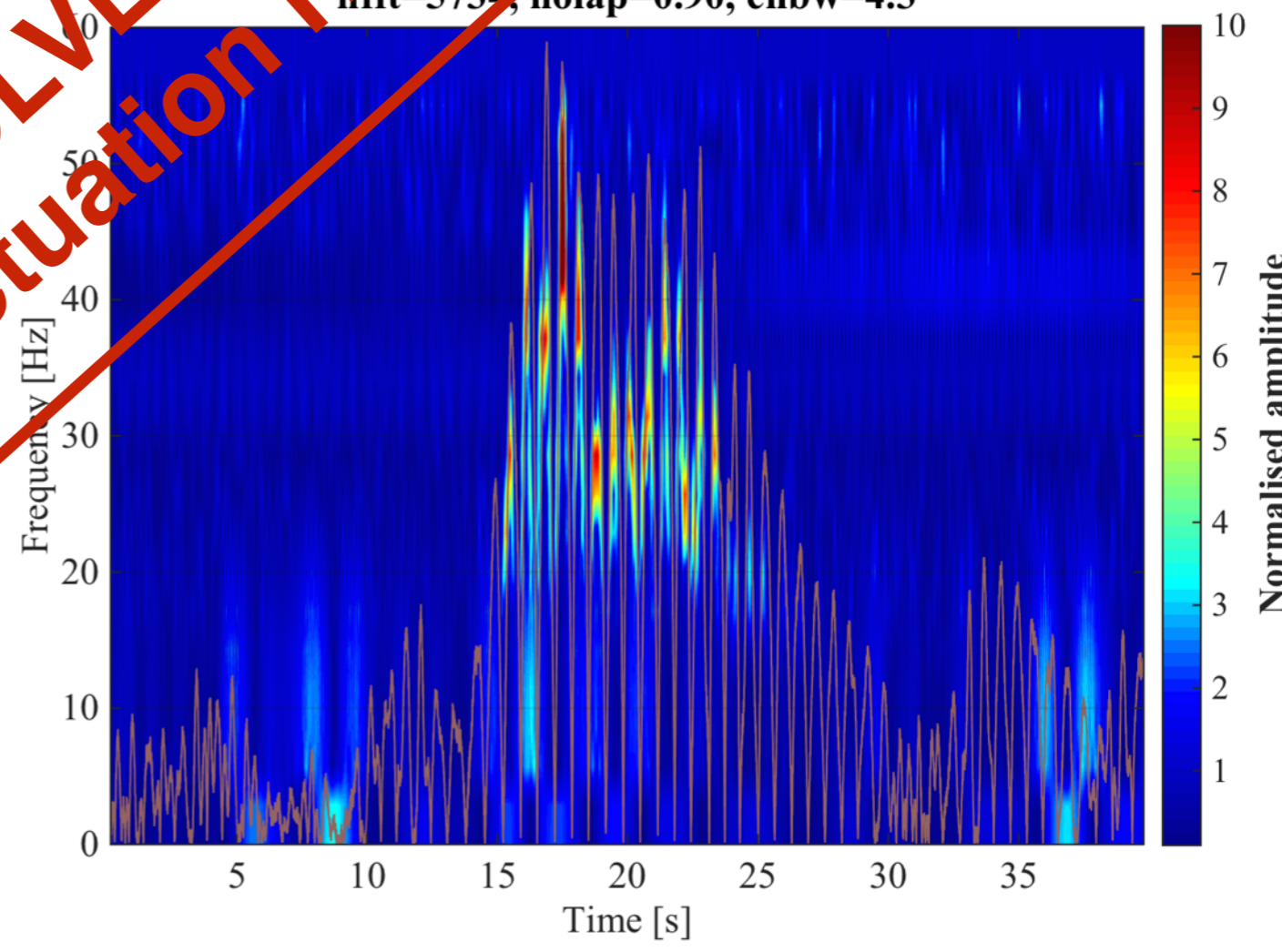
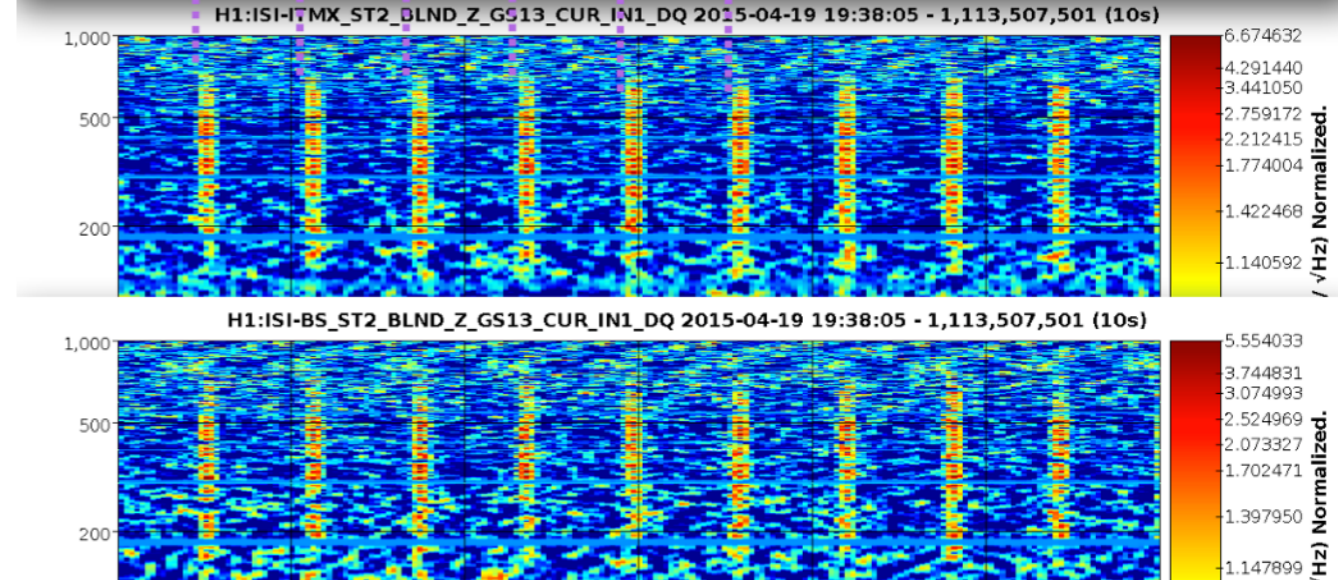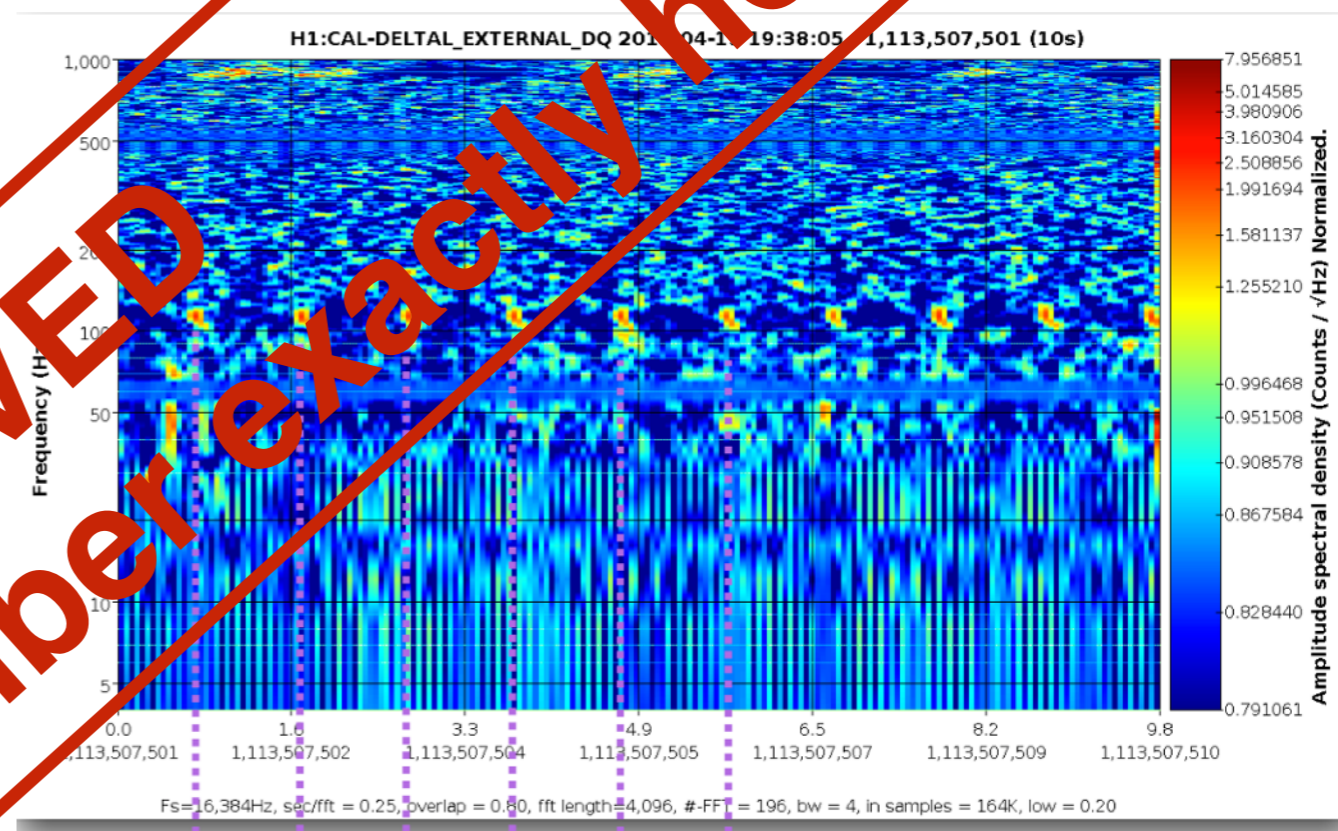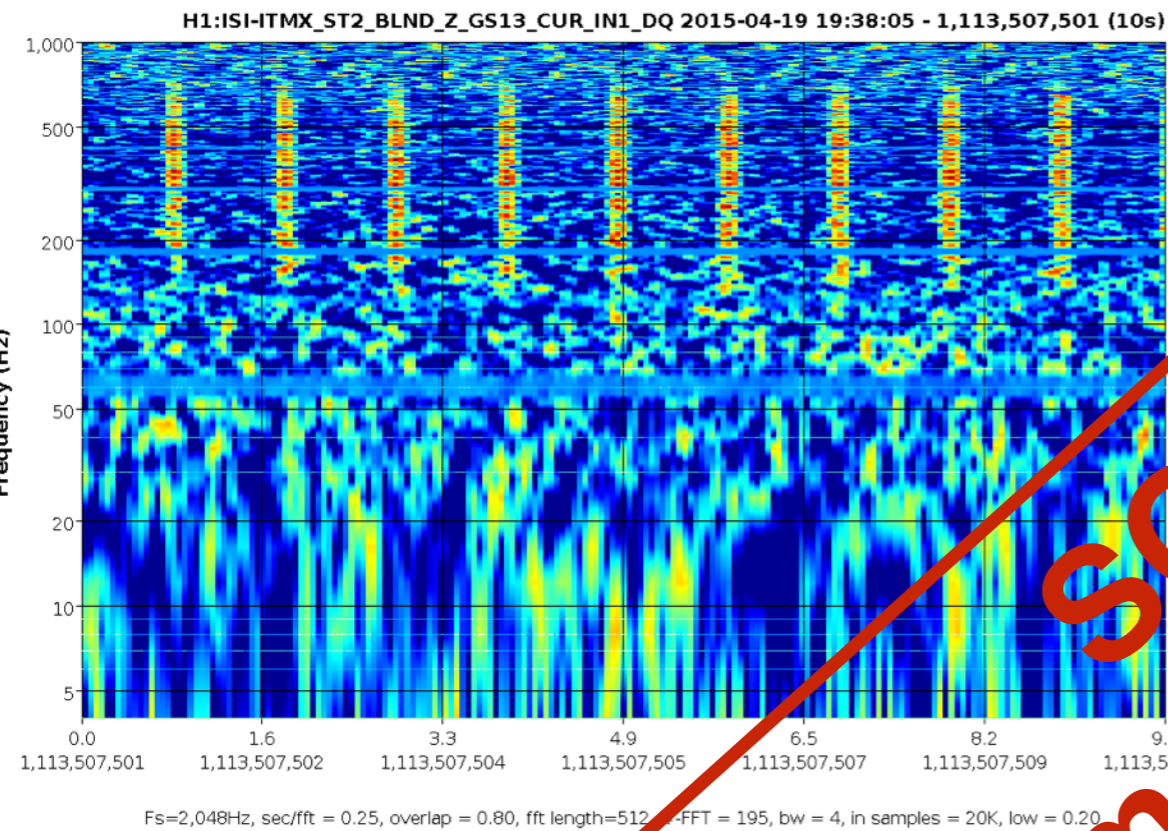**Reduced ASC actuation**

OMC L scattering fringes documentation

- Brief description: Fringes at H1 correlate well with OMC motion, mostly f<50Hz 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

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: 17972, 17971, 18531

- Other documentation:

**SOLVED (Don't remember exactly how)**

14. PRCL/SRCL glitches

SOLVED
(H1 PRM LL Coil Driver)

32
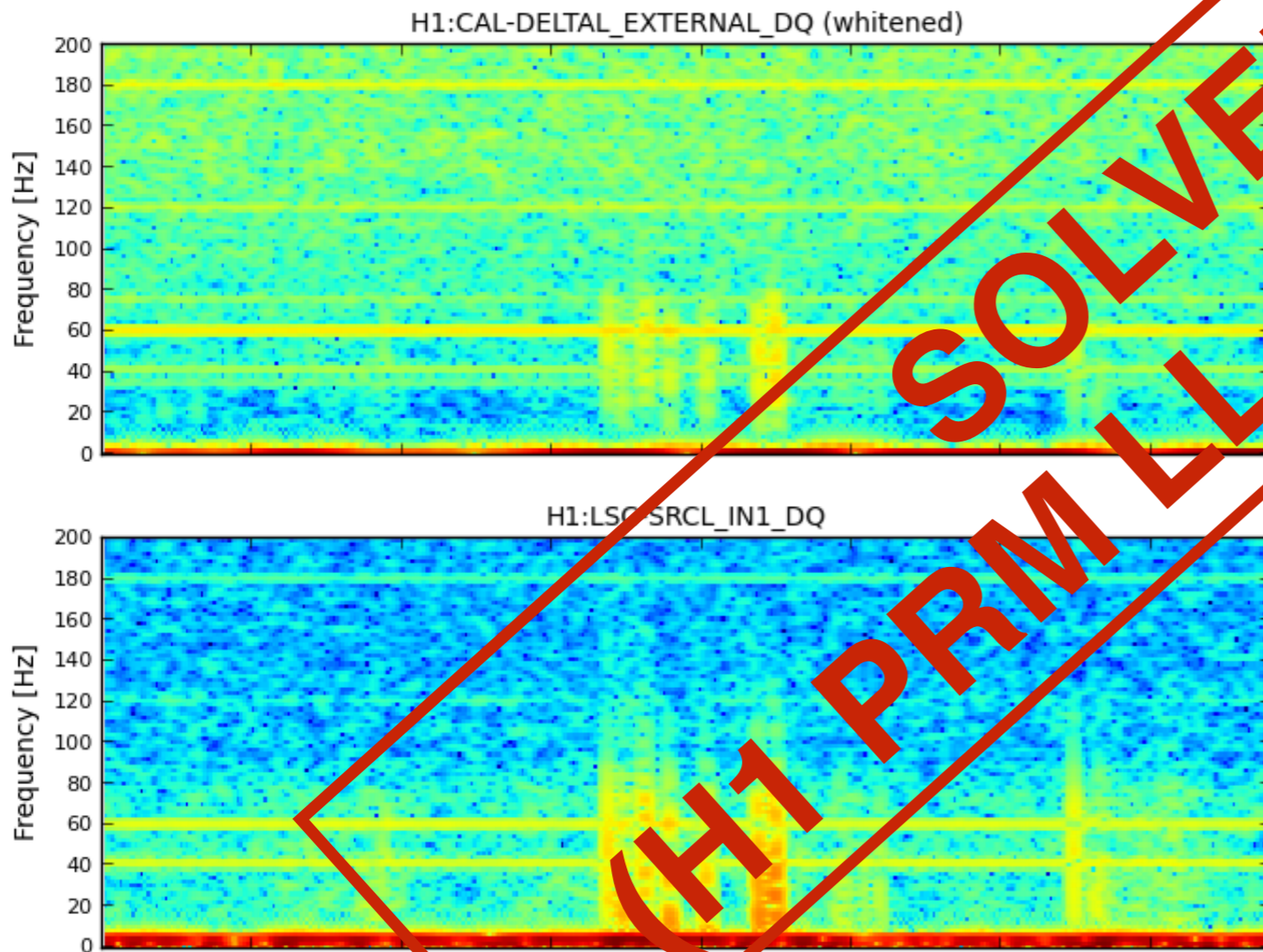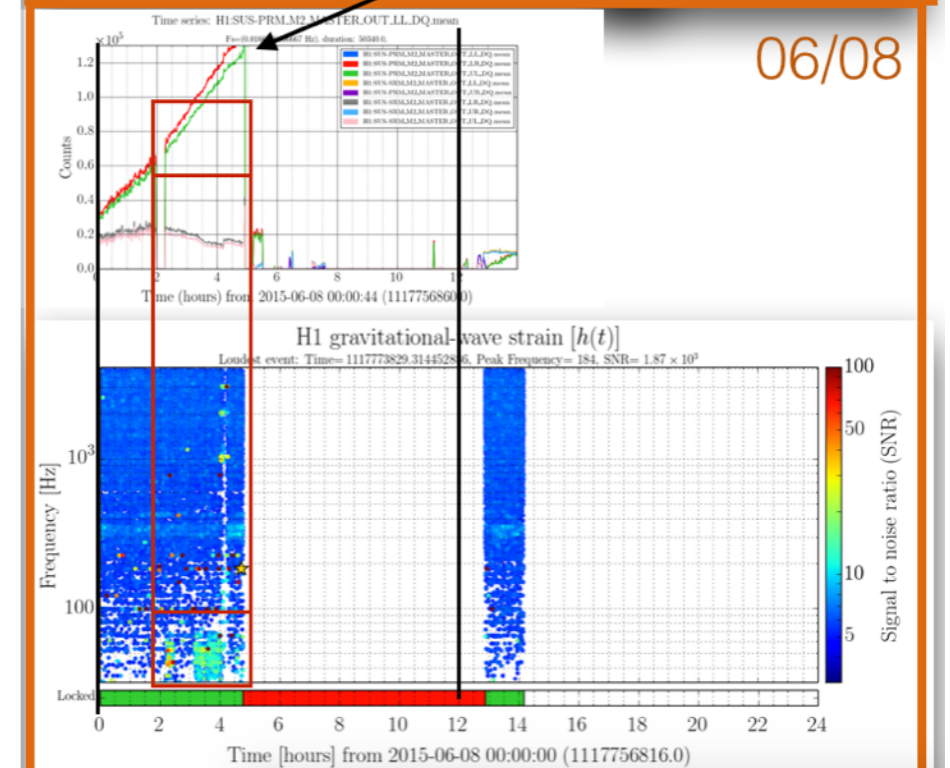
PRCL/SRCL glitches documentation

- 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:

~~SOLVED~~
~~(H1 PRM LL Coil Driver)~~

15. LHO End-X 50Hz air compressor glitches
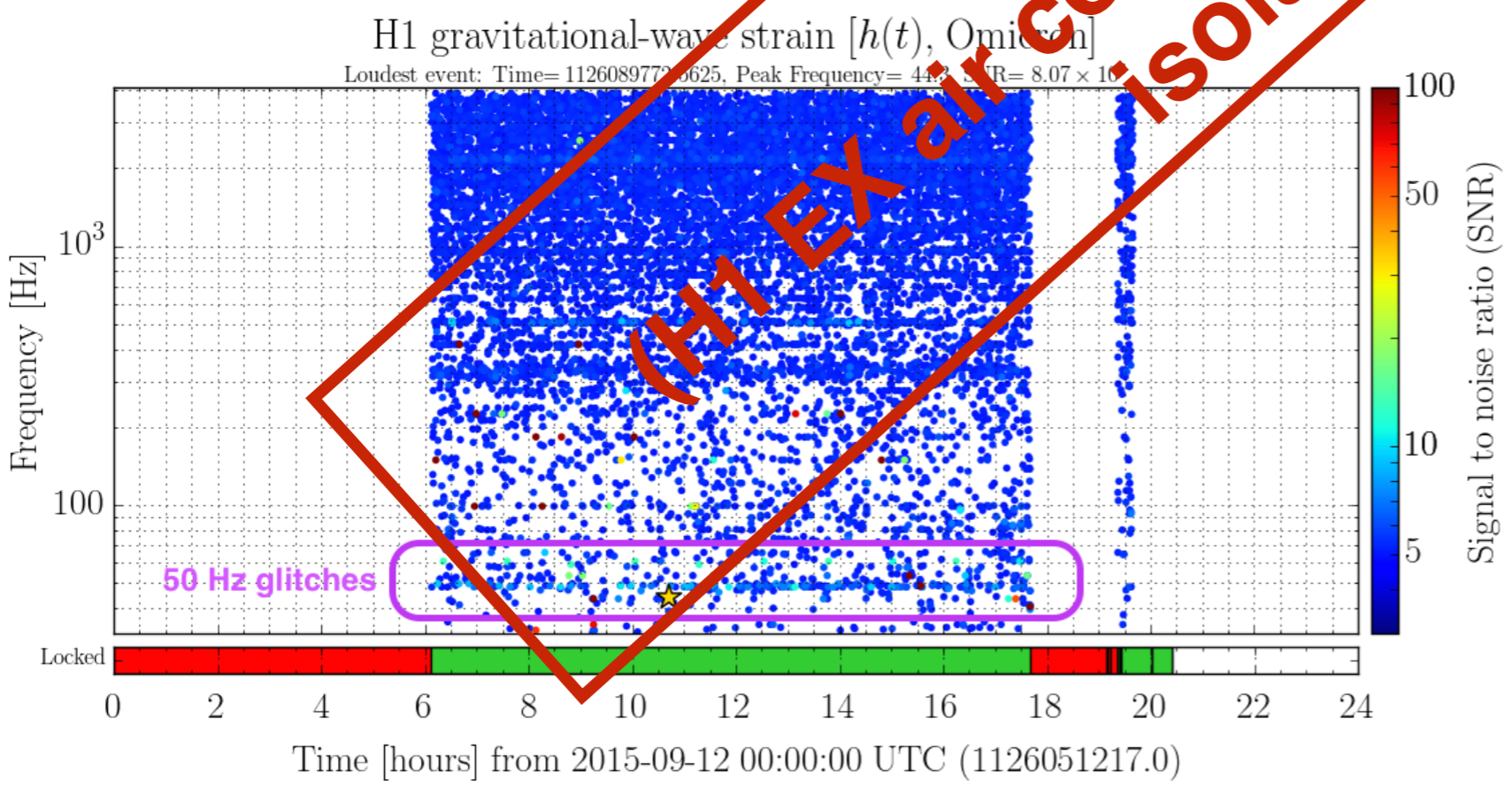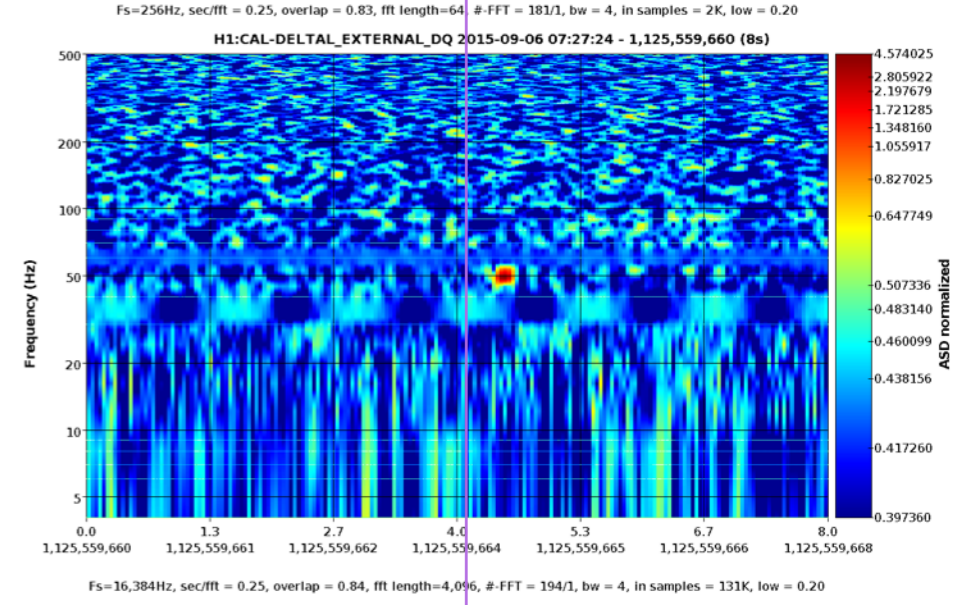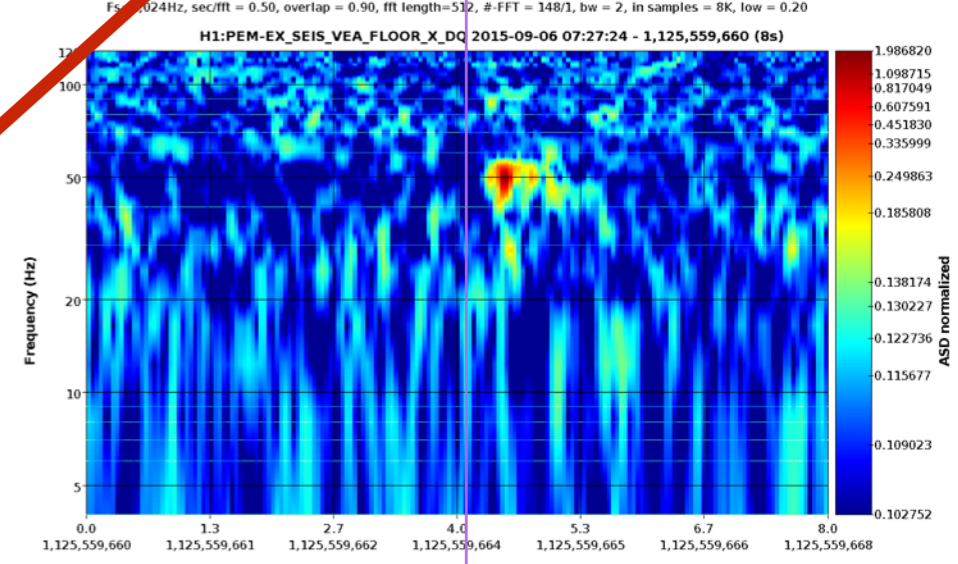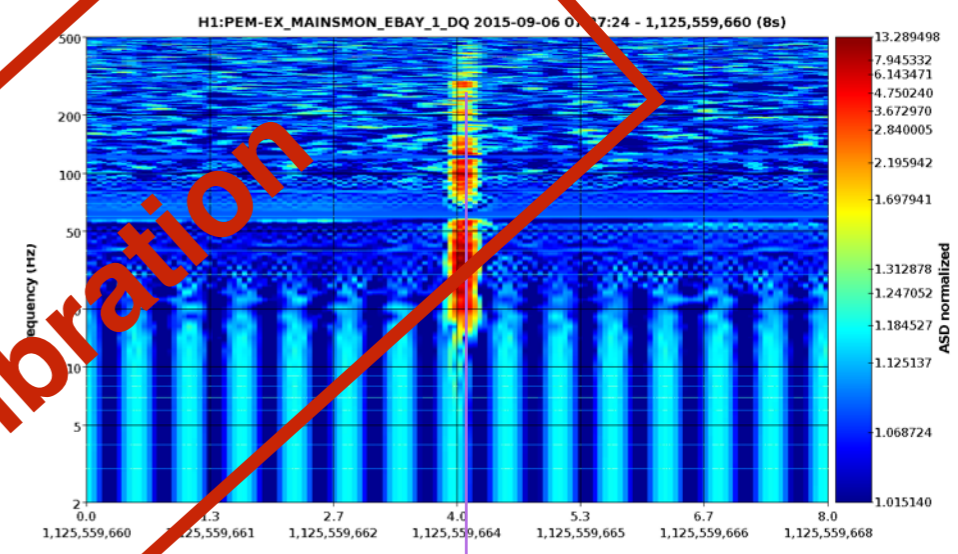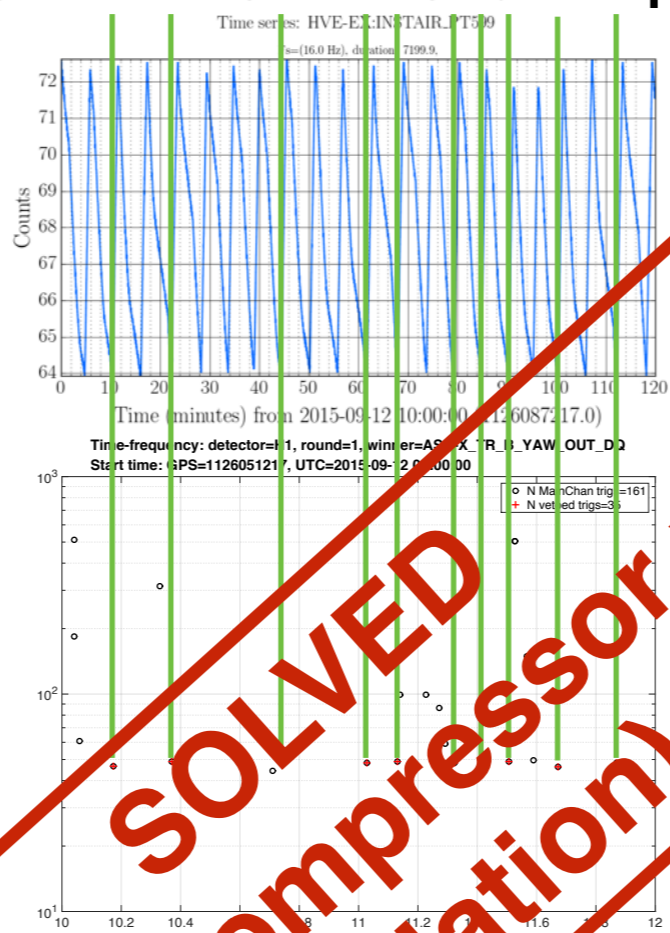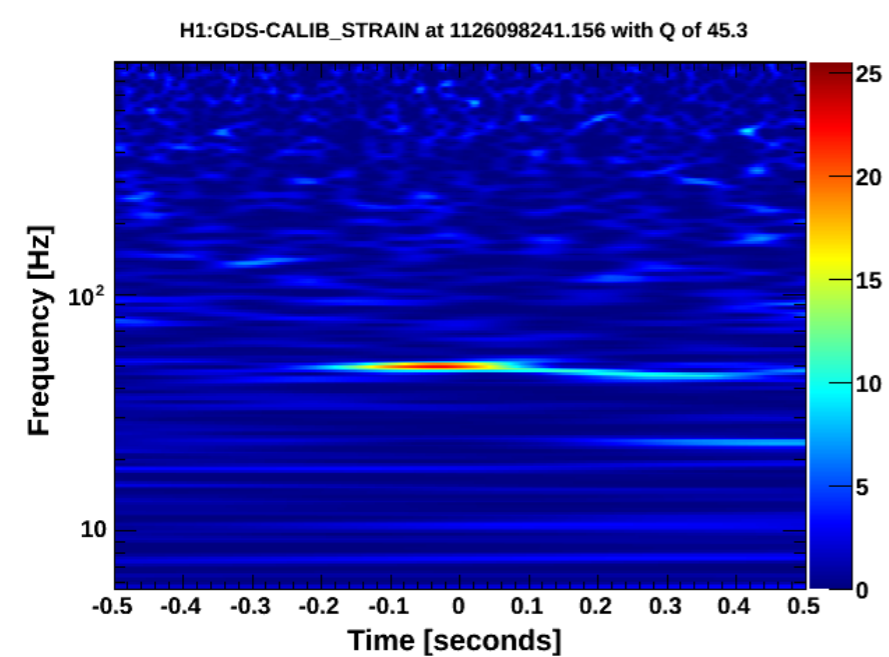
SOLVED
(H1 EX air compressor vibration isolation)

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_BLND_L4C_Y_IN1_DQ
Start time: GPS=1127271617, UTC=2015-09-26 03:00:00

SOLVED
(H1 EX air compressor vibration isolation)

N MainChan trigs=6038
N vetoed trigs=71