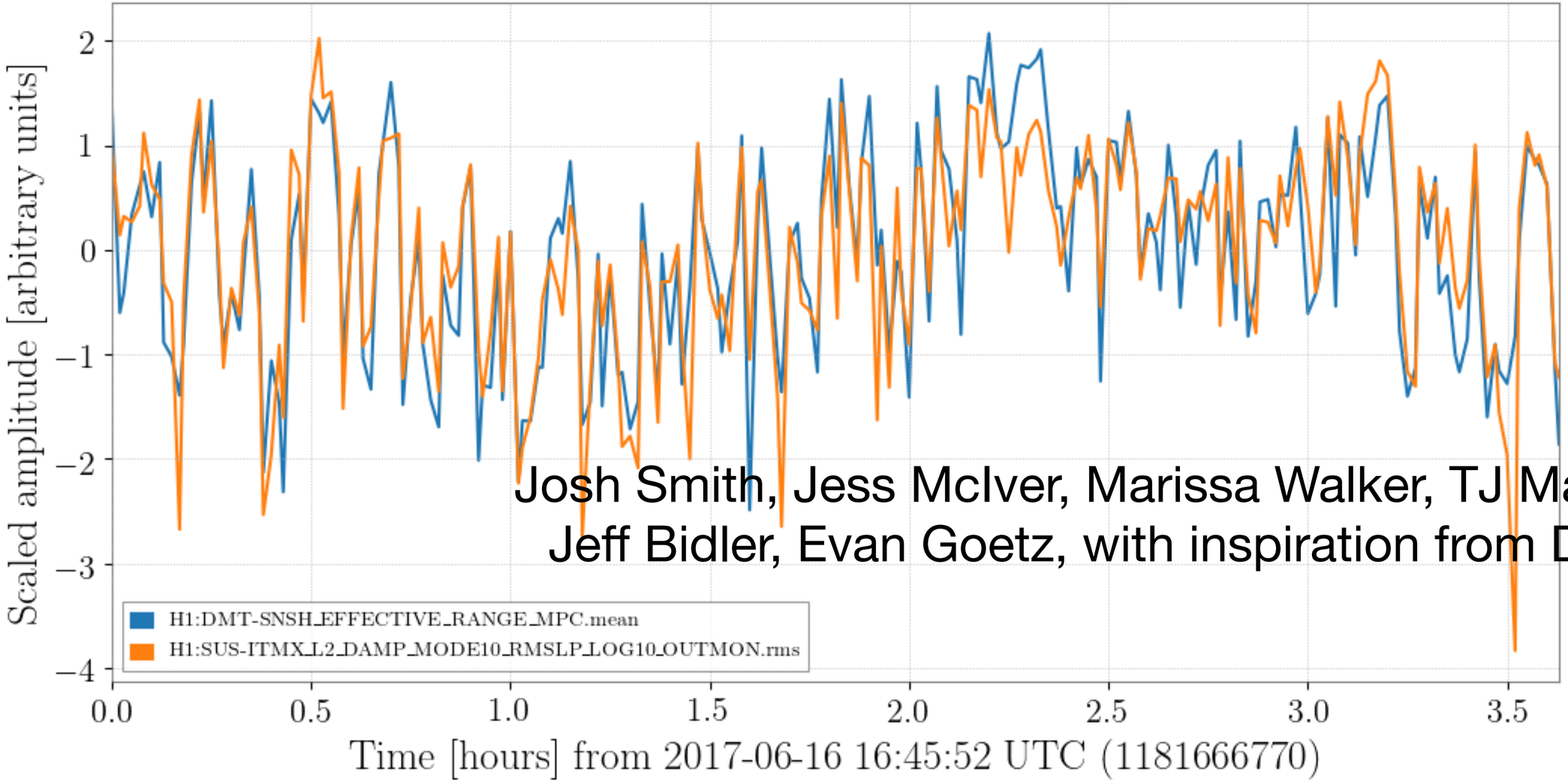
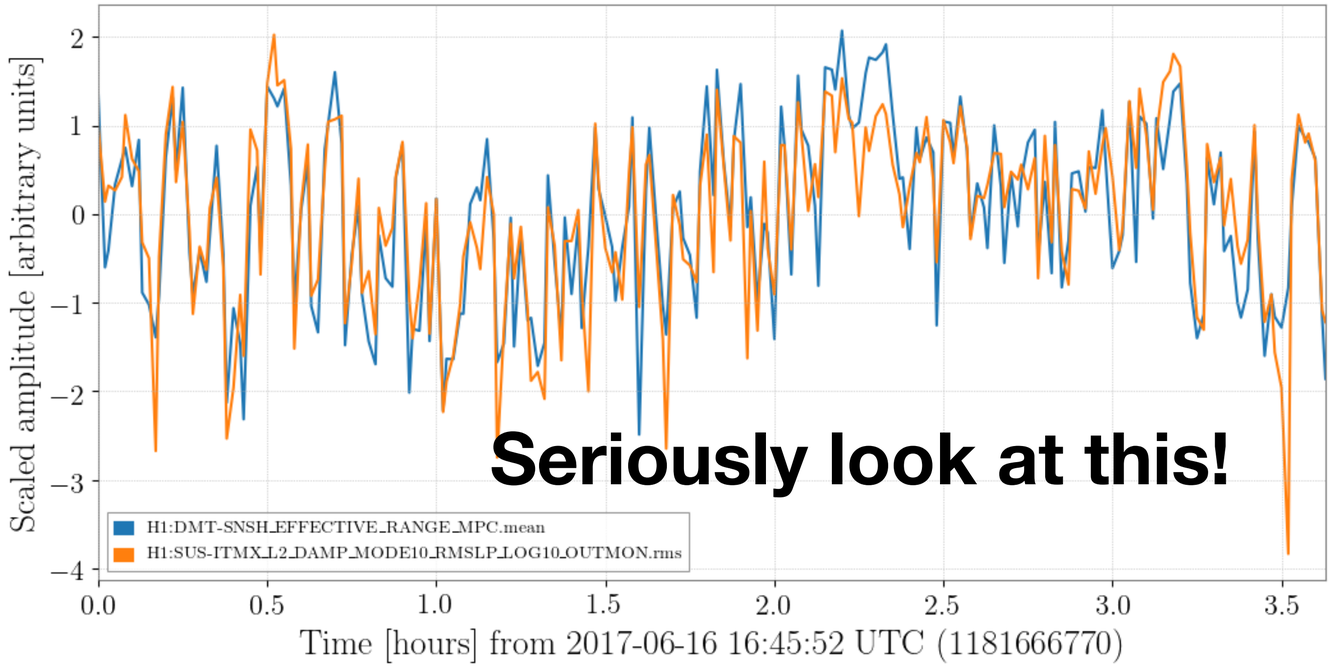
Why the heck does
H1:SUS-ITMX_L2_DAMP_MODE10_RMSLP_LOG10_OUTMON
correlate with range?

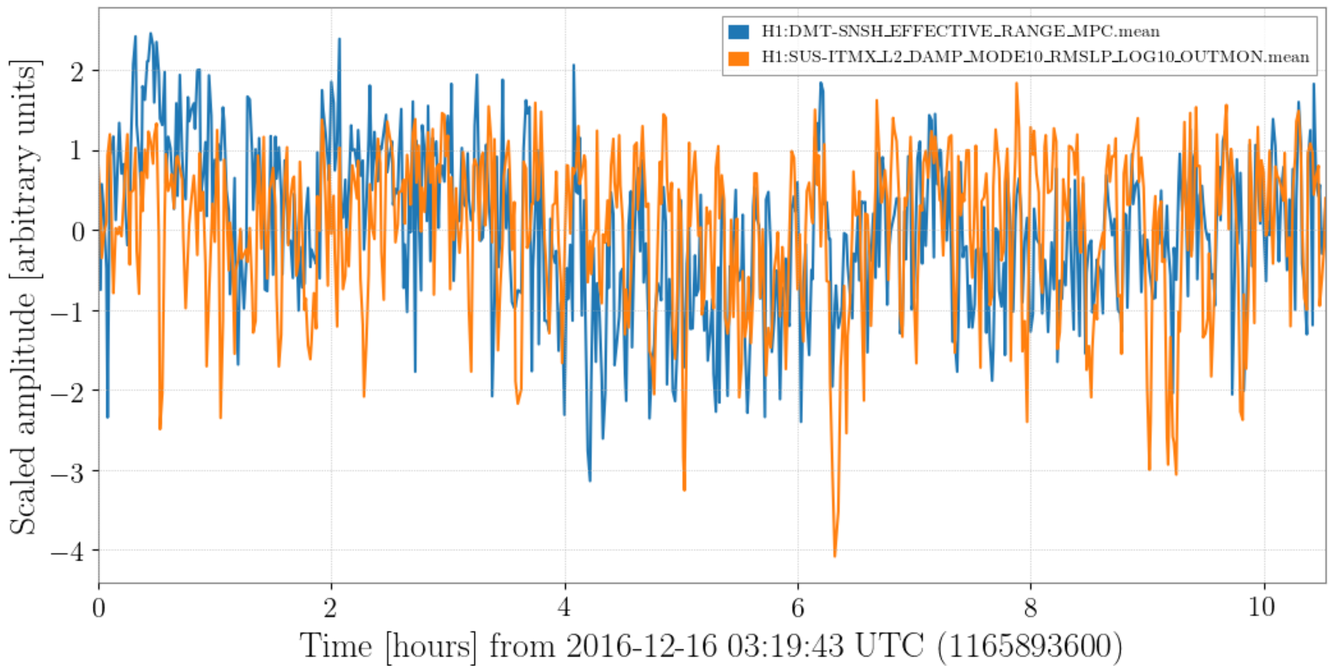


Josh Smith, Jess McIver, Marissa Walker, TJ Massinger,
Jeff Bidler, Evan Goetz, with inspiration from Detchar

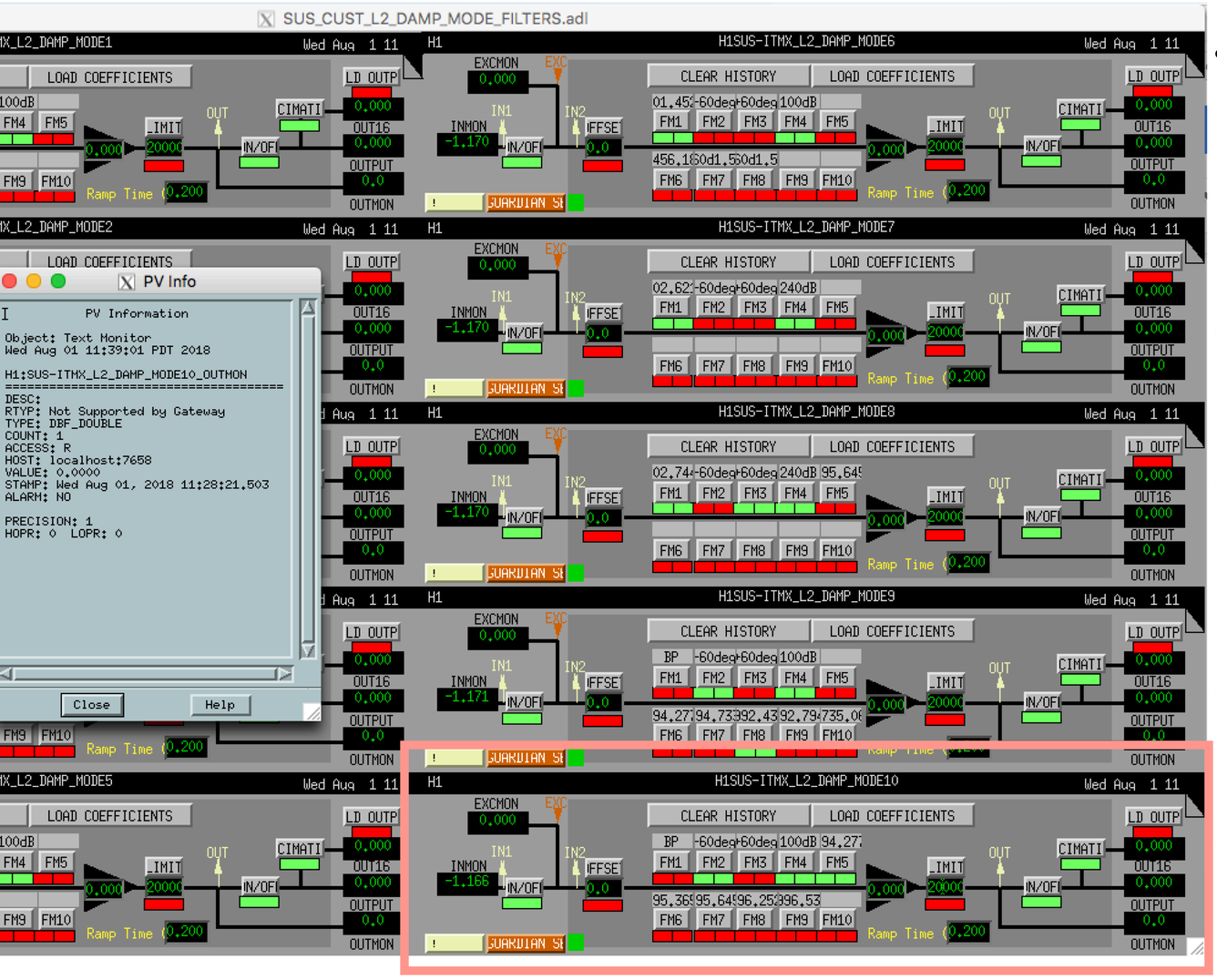
Background

- lasso correlations (arxiv) searches for channels that correlate with slow changes in BNS range
  - H1 O2 pages are here
  - MODE10 was picked by lasso in 123/714 O2 lock segments [txt summary]
- **We don't think this is related to glitches, but it correlates really well with the fast 1-3 Mpc-peak-peak rattiness in the range!**

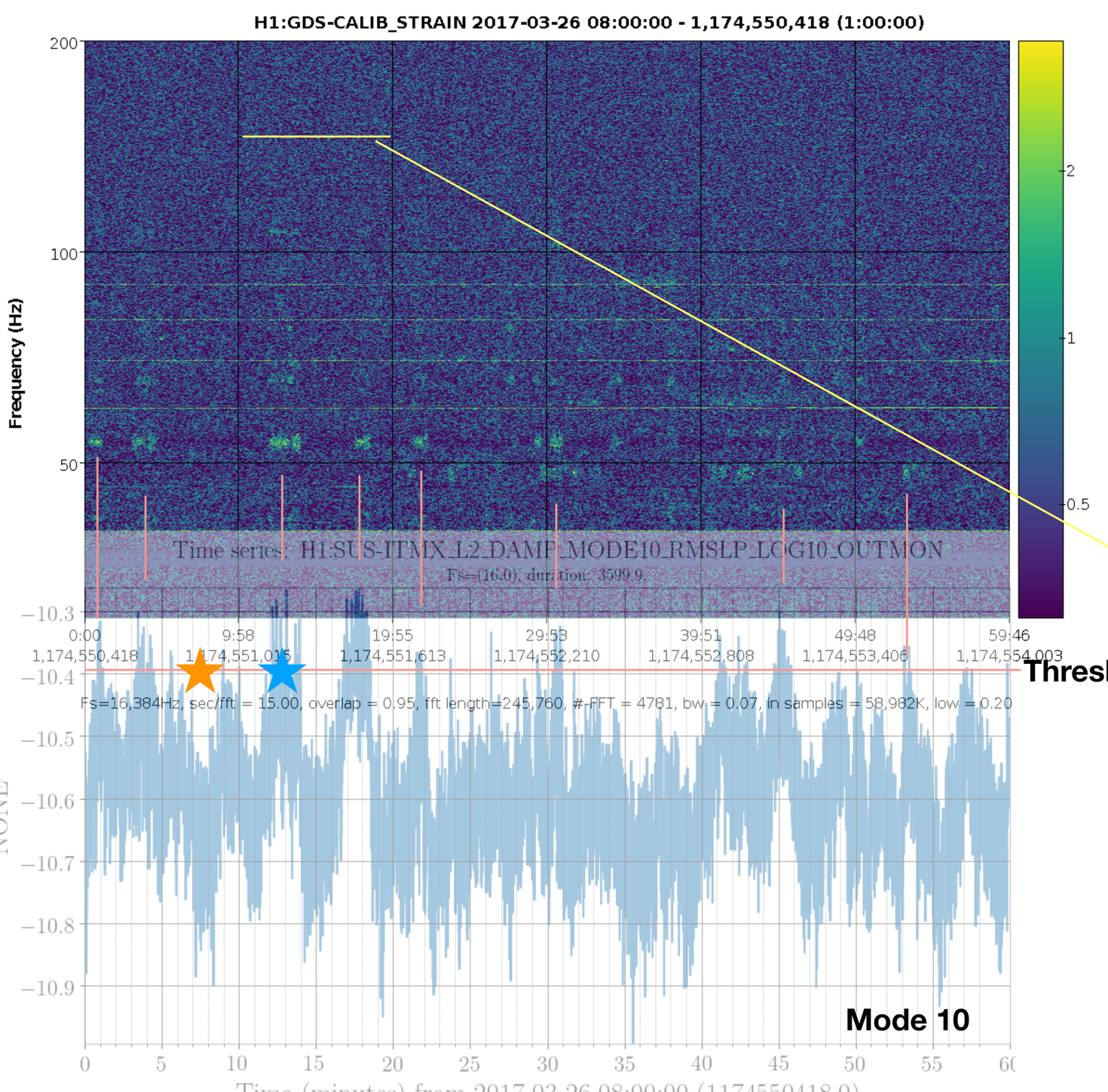




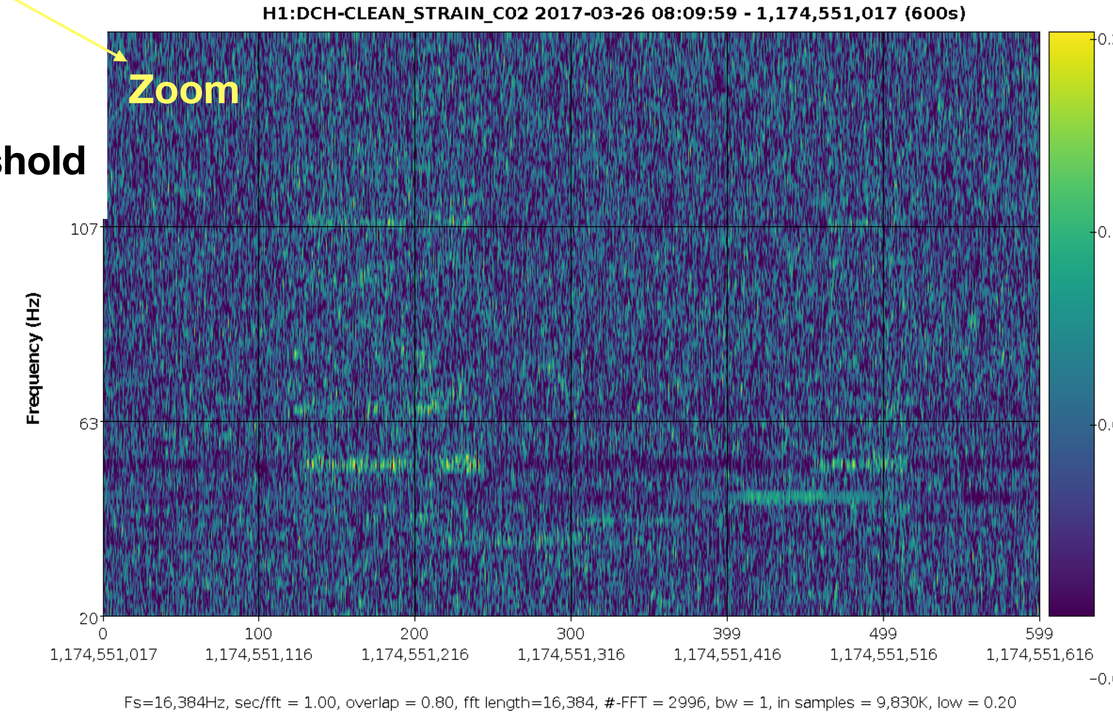
What we observe

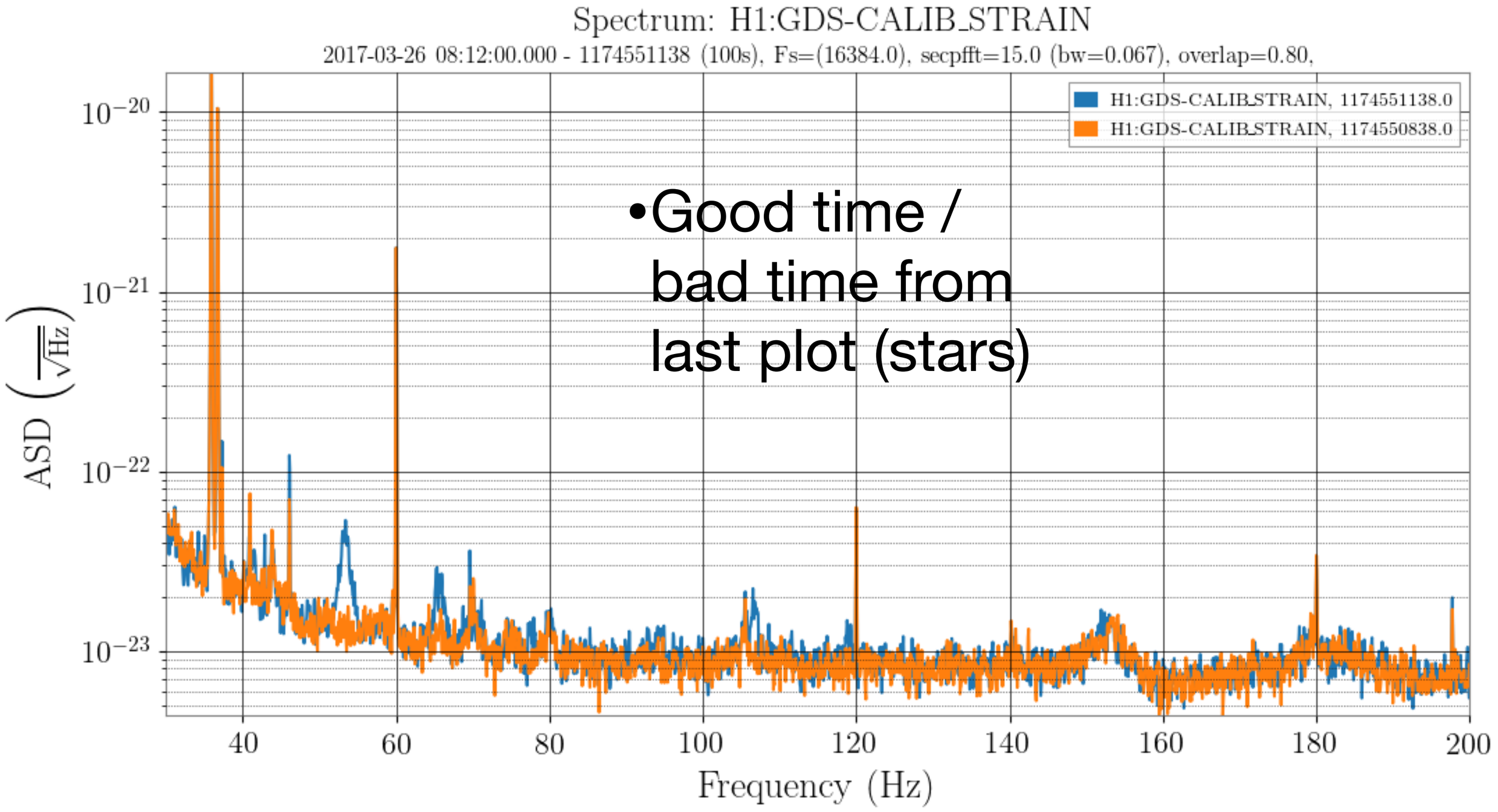


- H1:SUS-ITMX_L2_DAMP_MODE10_RMSLP_LOG10_OUTMON monitors OMC DARM and does some phase, gain, and strong bandpassing around 994.27Hz
- The amplitude of and change in amplitude of this violin mode actually seems quite small
- When this channel gets above -10.4 it seems to predict some noise-bumps will appear in DARM
- The bumps are spaced by ~12Hz and move around in frequency (together) by a few Hz
- Keith Riles has reported violin modes being seen to beat and down convert similar to this



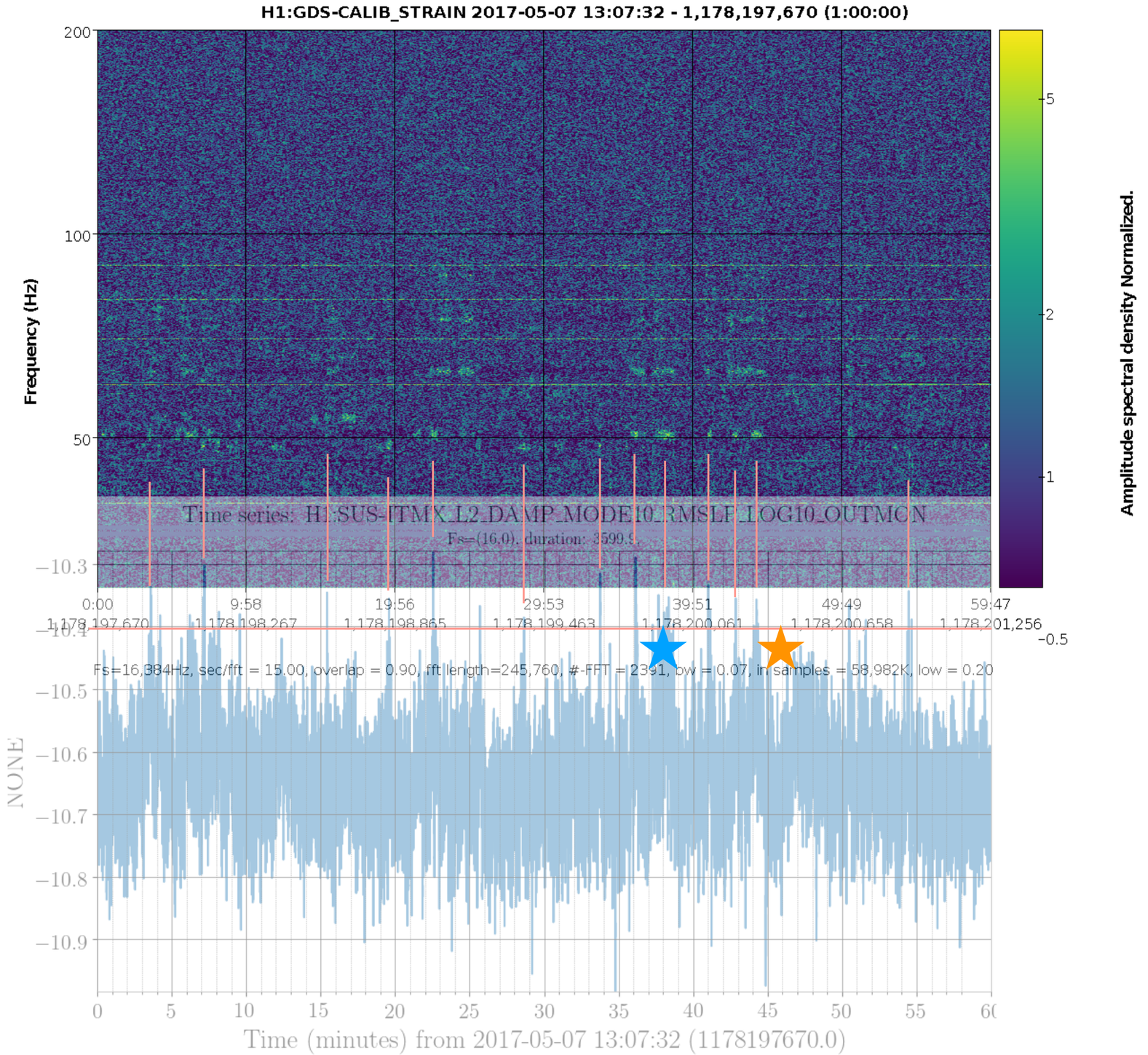
- When the MODE10 channel goes above -10.4 we see noise bumps appear in strain
- Stars mark times in next plot

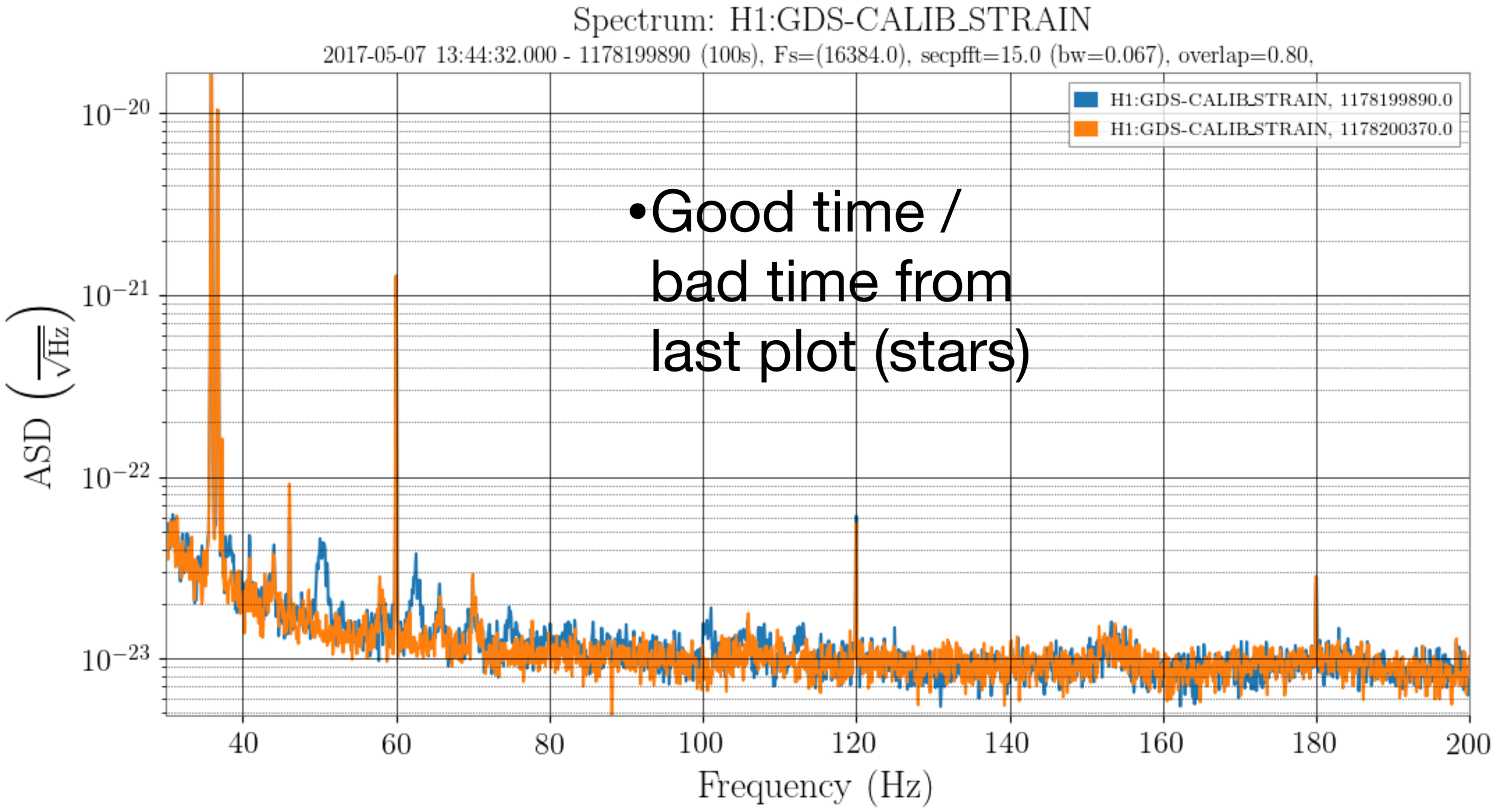




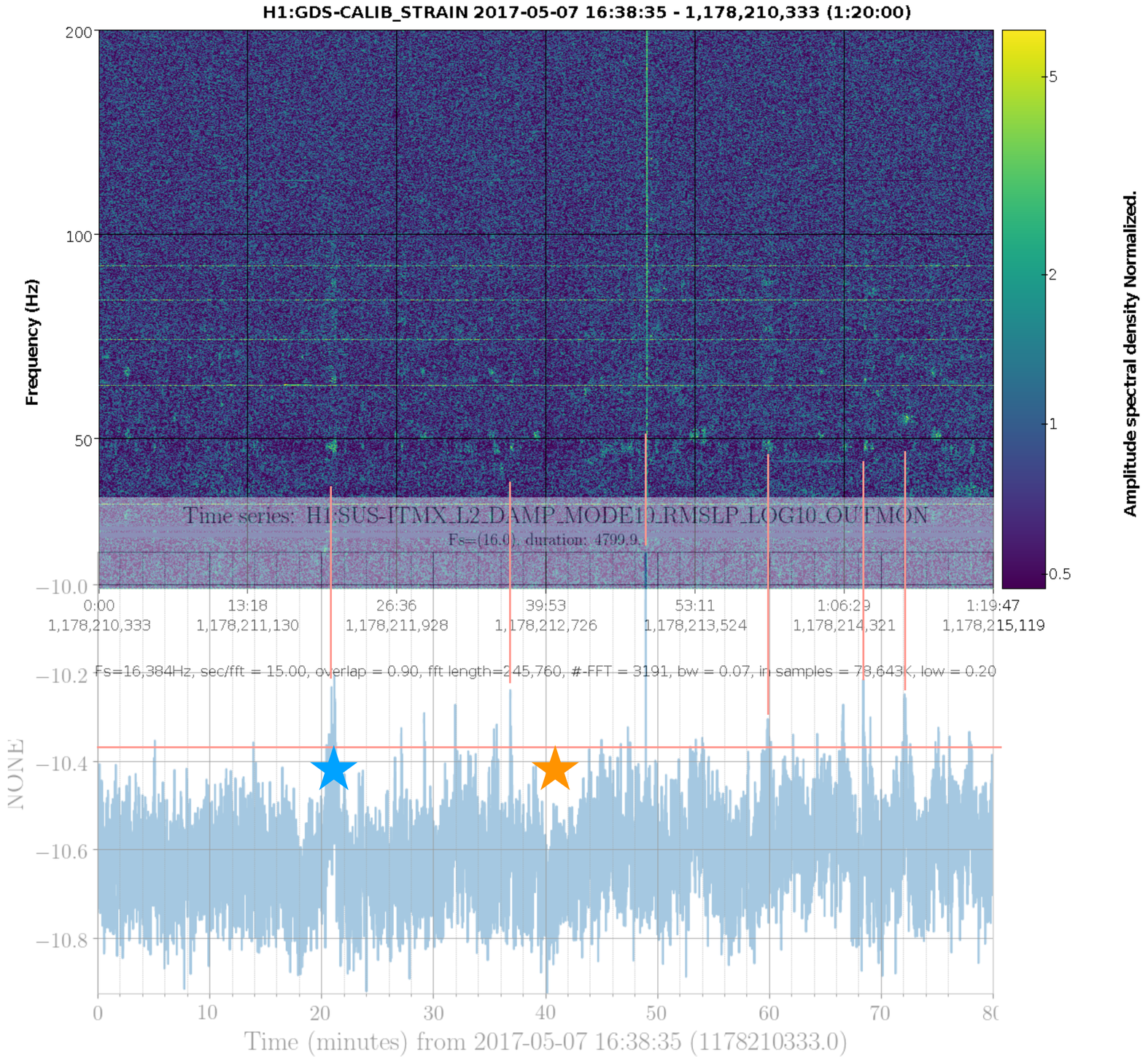
- Good time / bad time from last plot (stars)

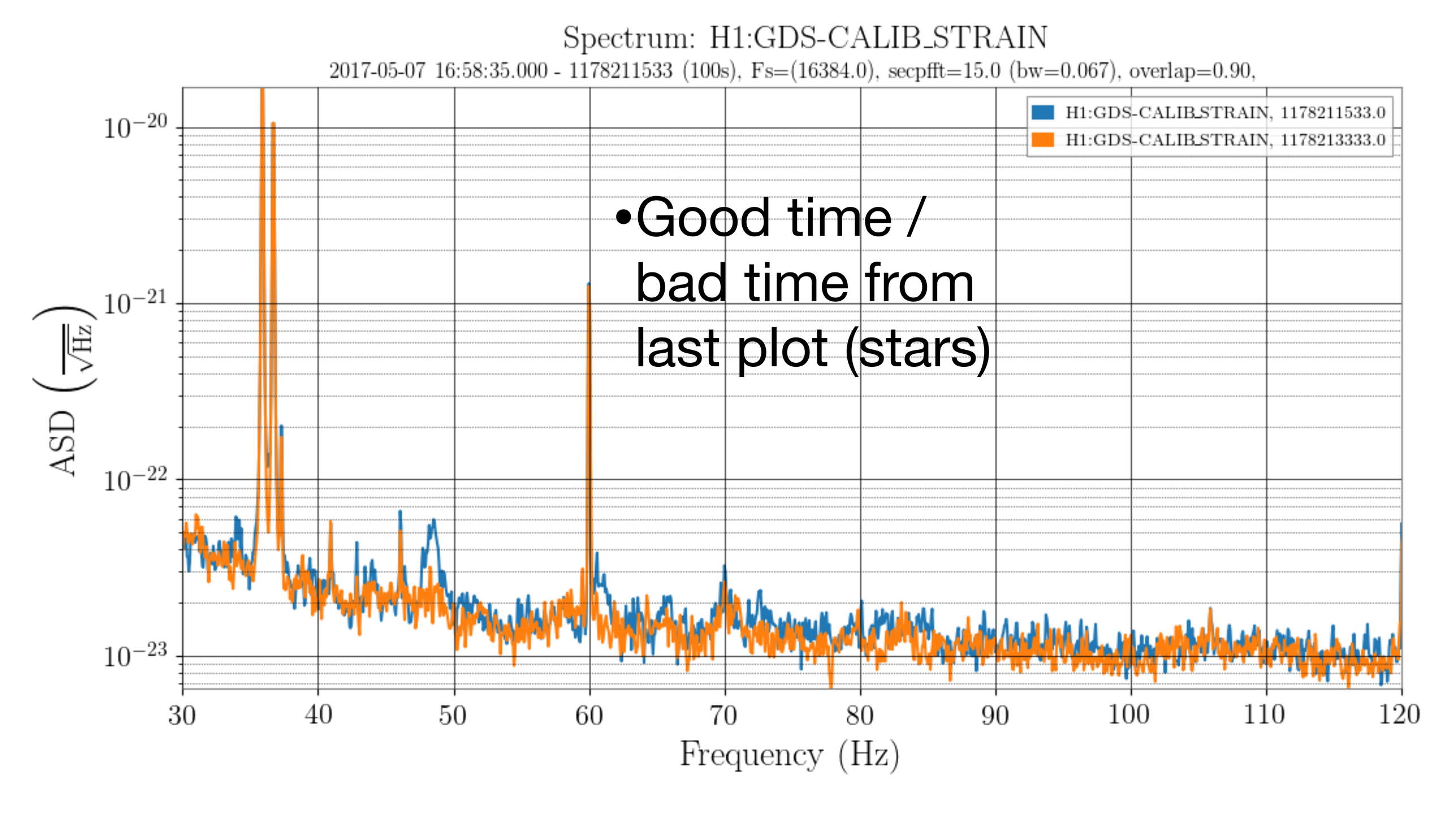
- When the MODE10 channel goes above -10.4 we see noise bumps appear in strain
- Stars mark times in next plot

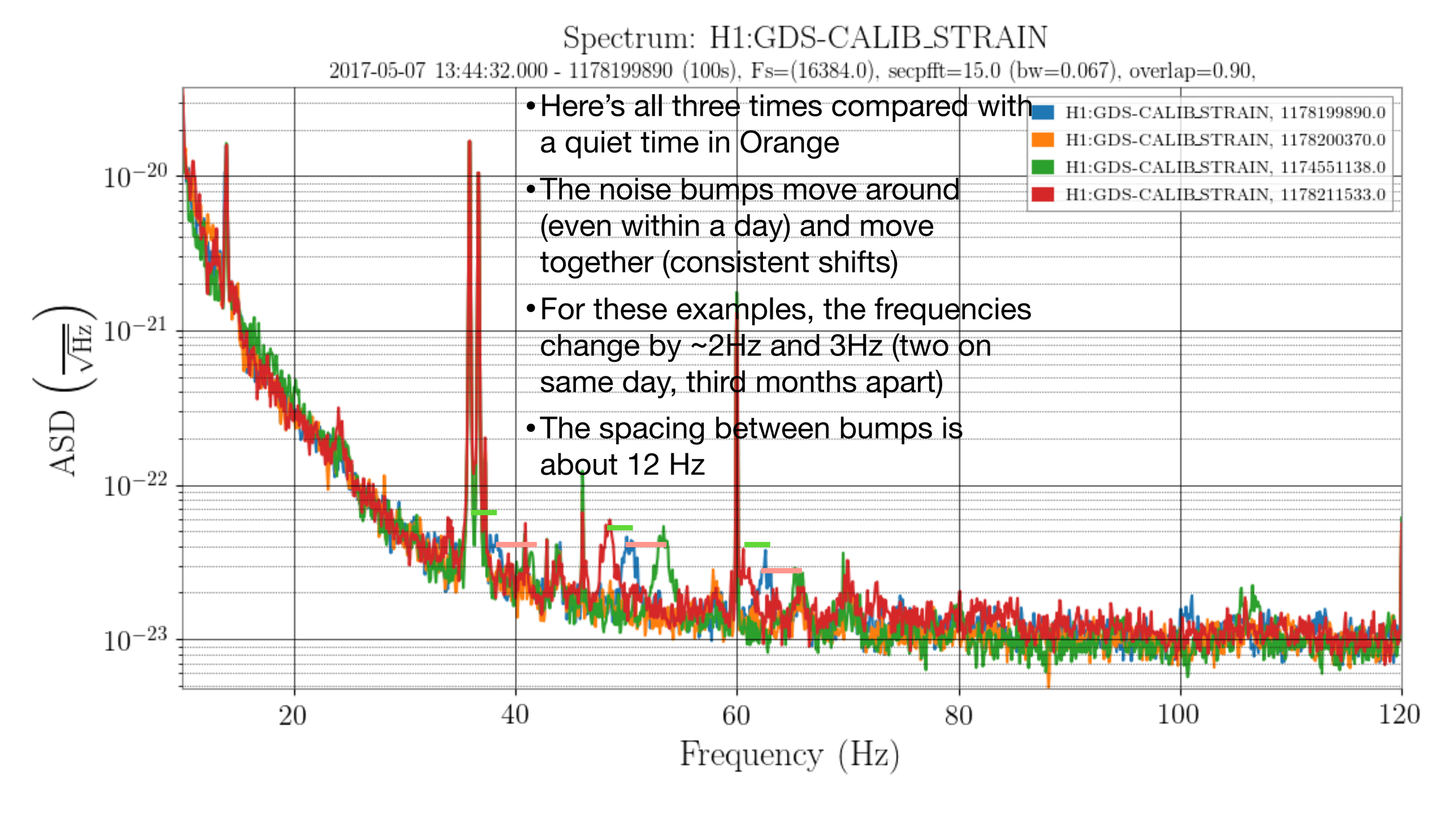



Spectrum: H1:GDS-CALIB_STRAIN
2017-05-07 13:44:32.000 - 1178199890 (100s), Fs=(16384.0), secpfft=15.0 (bw=0.067), overlap=0.80,
H1:GDS-CALIB_STRAIN, 1178199890.0
H1:GDS-CALIB_STRAIN, 1178200370.0
•Good time / bad time from last plot (stars)
ASD $\left(\frac{}{\sqrt{\text{Hz}}}\right)$
10^{-20}
10^{-21}
10^{-22}
10^{-23}
40
60
80
100
120
140
160
180
200
Frequency (Hz)

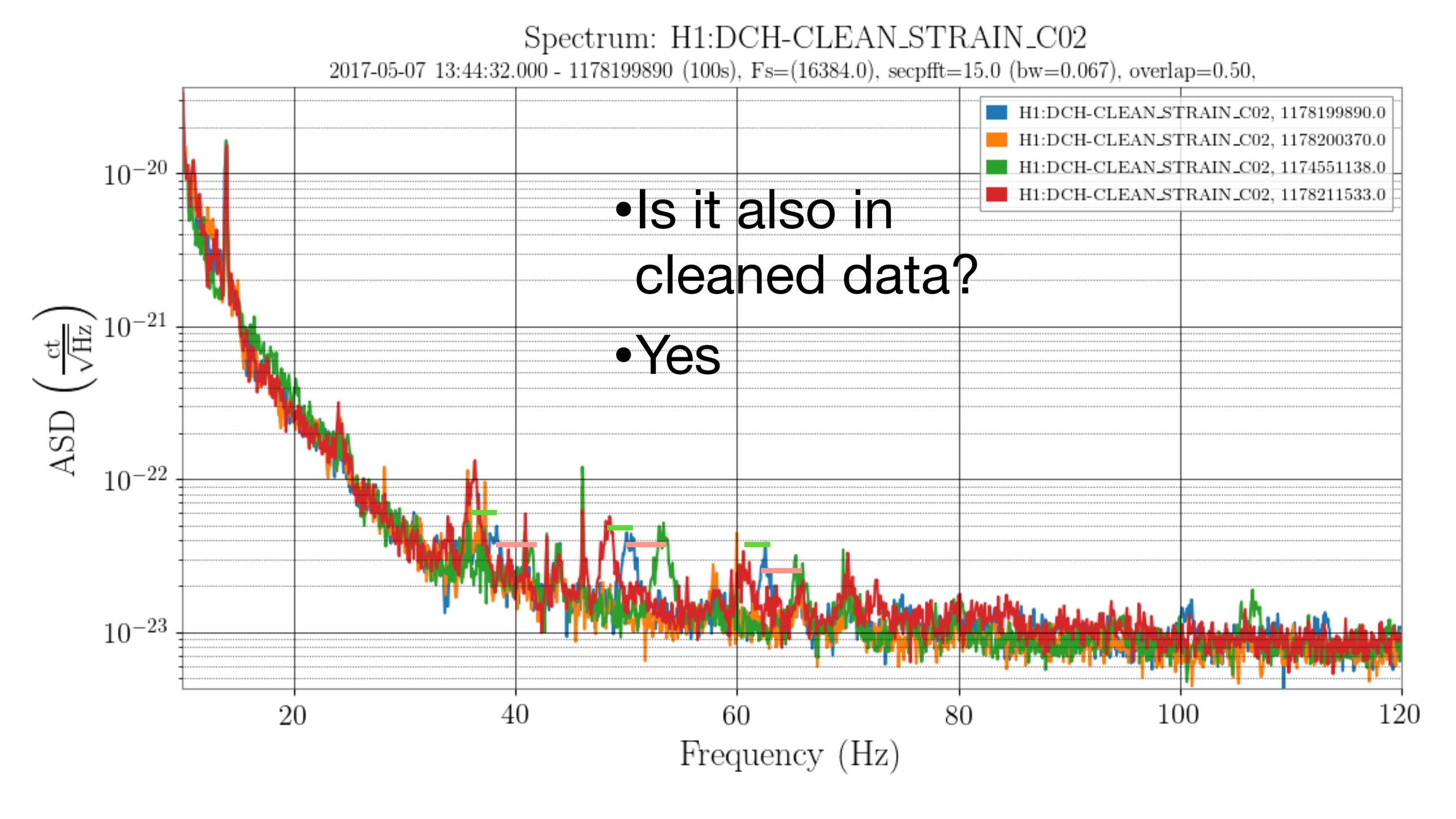
- When the MODE10 channel goes above -10.4 we see noise bumps appear in strain
- Stars mark times in next plot

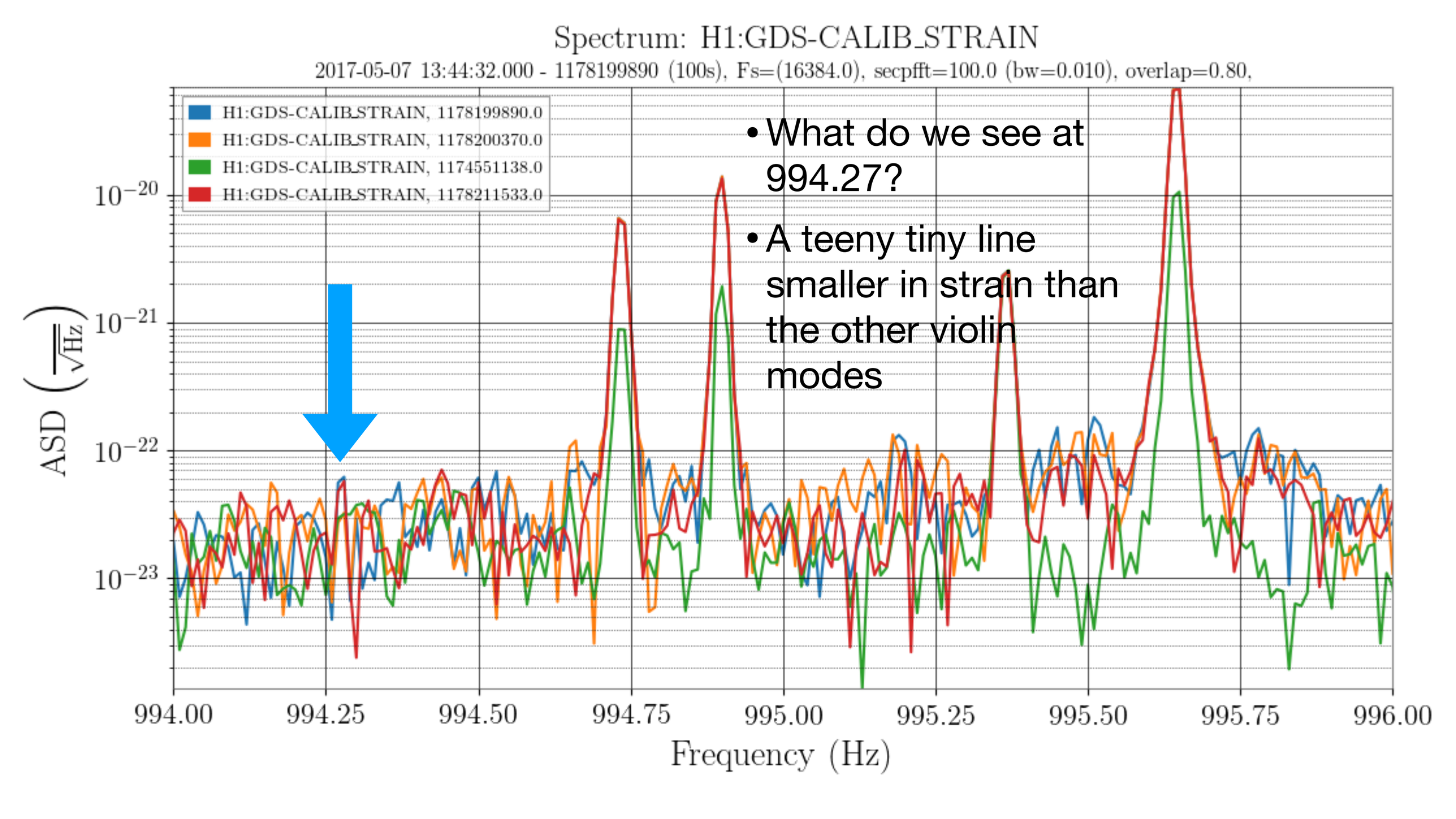


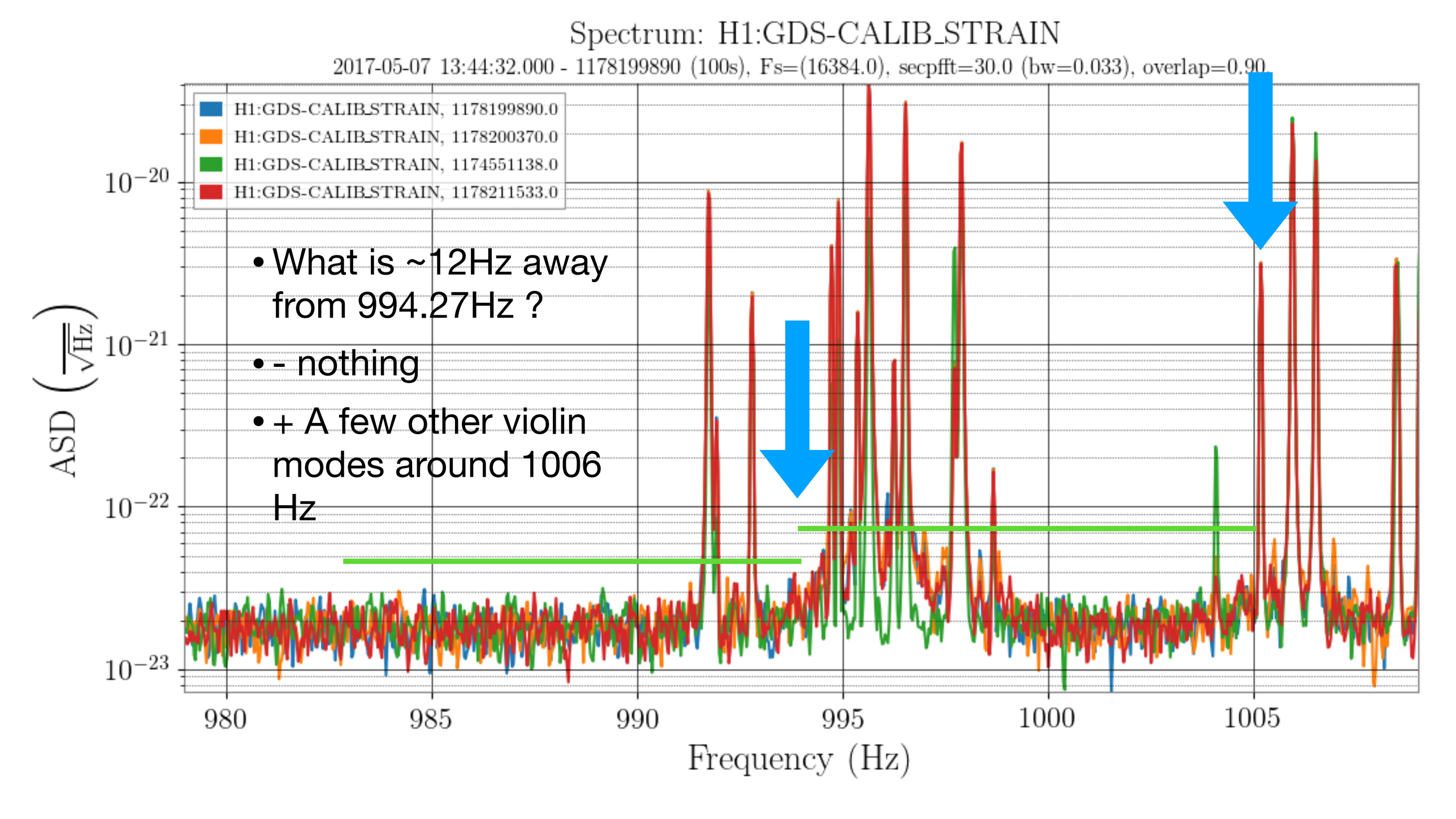

Spectrum: H1:GDS-CALIB_STRAIN
2017-05-07 16:58:35.000 - 1178211533 (100s), Fs=(16384.0), secpfft=15.0 (bw=0.067), overlap=0.90,
H1:GDS-CALIB_STRAIN, 1178211533.0
H1:GDS-CALIB_STRAIN, 1178213333.0
•Good time / bad time from last plot (stars)
ASD $\left(\frac{}{\sqrt{\text{Hz}}}\right)$
10^{-20}
10^{-21}
10^{-22}
10^{-23}
30
40
50
60
70
80
90
100
110
120
Frequency (Hz)



- Here's all three times compared with a quiet time in Orange
- The noise bumps move around (even within a day) and move together (consistent shifts)
- For these examples, the frequencies change by ~2Hz and 3Hz (two on same day, third months apart)
- The spacing between bumps is about 12 Hz


Spectrum: H1:DCH-CLEAN_STRAIN_C02
2017-05-07 13:44:32.000 - 1178199890 (100s), Fs=(16384.0), secpfft=15.0 (bw=0.067), overlap=0.50,
H1:DCH-CLEAN_STRAIN_C02, 1178199890.0
H1:DCH-CLEAN_STRAIN_C02, 1178200370.0
H1:DCH-CLEAN_STRAIN_C02, 1174551138.0
H1:DCH-CLEAN_STRAIN_C02, 1178211533.0
•Is it also in cleaned data?
•Yes
10^{-20}
10^{-21}
10^{-22}
10^{-23}
ASD $\left(\frac{\text{ct}}{\sqrt{\text{Hz}}}\right)$
20
40
60
80
100
120
Frequency (Hz)


Spectrum: H1:GDS-CALIB_STRAIN
2017-05-07 13:44:32.000 - 1178199890 (100s), Fs=(16384.0), secpfft=100.0 (bw=0.010), overlap=0.80,
H1:GDS-CALIB_STRAIN, 1178199890.0
H1:GDS-CALIB_STRAIN, 1178200370.0
H1:GDS-CALIB_STRAIN, 1174551138.0
H1:GDS-CALIB_STRAIN, 1178211533.0
• What do we see at 994.27?
• A teeny tiny line smaller in strain than the other violin modes
ASD $\left(\frac{}{\sqrt{\text{Hz}}}\right)$
10^{-20}
10^{-21}
10^{-22}
10^{-23}
994.00
994.25
994.50
994.75
995.00
995.25
995.50
995.75
996.00
Frequency (Hz)


Spectrum: H1:GDS-CALIB_STRAIN
2017-05-07 13:44:32.000 - 1178199890 (100s), Fs=(16384.0), secpfft=30.0 (bw=0.033), overlap=0.90
H1:GDS-CALIB_STRAIN, 1178199890.0
H1:GDS-CALIB_STRAIN, 1178200370.0
H1:GDS-CALIB_STRAIN, 1174551138.0
H1:GDS-CALIB_STRAIN, 1178211533.0
• What is ~12Hz away from 994.27Hz ?
• - nothing
• + A few other violin modes around 1006 Hz
10^{-20}
10^{-21}
10^{-22}
10^{-23}
ASD $\left(\frac{}{\sqrt{\text{Hz}}}\right)$
980
985
990
995
1000
1005
Frequency (Hz)

Questions

- What is the coupling mechanism?
  - Could it be violin modes beating with something to down convert?
  - Or a violin line or its damping feedback saturating or compressing when its amplitude is above some level?
- Are the violin modes extra high on the days we see them? Not really, the first example with the highest MODE10 is actually a day when violin modes in general are very small
- Is it the same in cleaned data? Yes.