

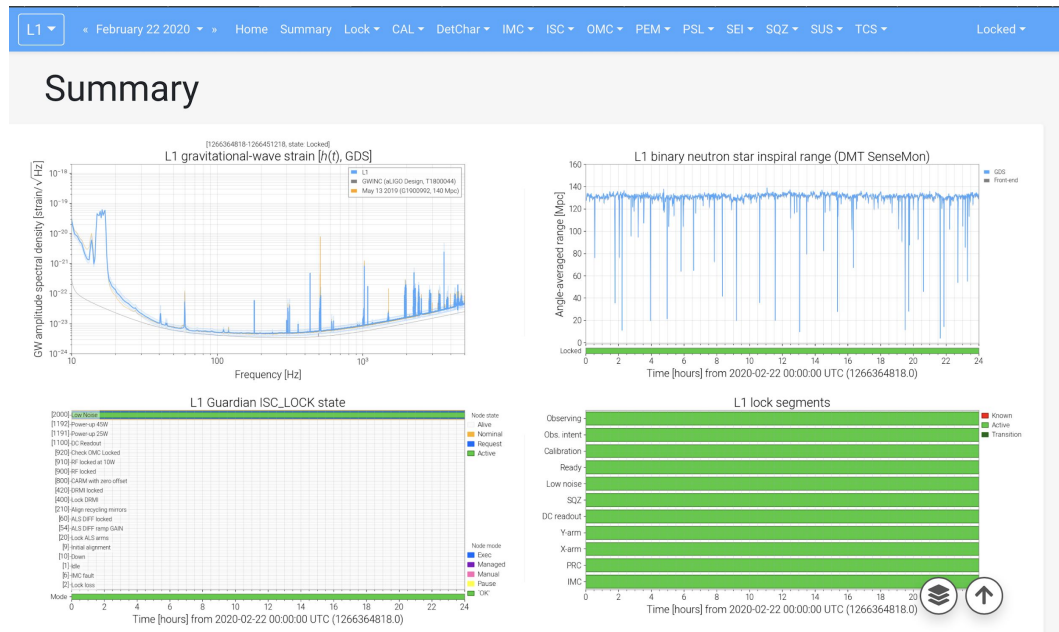
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# Worst offenders in O3a/O3b

Sidd, TJ  
for DetChar

# Detector characterization

- Identify noise and noise sources in the detector and monitor its performance
- Development and maintenance of detchar tools required for data analysis
- Validation of gravitational wave signals
- Back and forth communication with the commissioning team to help improve detector's performance



# Glitch categories in O3b

ML confidence: 0.95

| Glitch              | Count | Percent |  |
|---------------------|-------|---------|--|
| Scattered_Light     | 55216 | 72.6%   |  |
| Extremely_Loud      | 5308  | 7.0%    |  |
| Koi_Fish            | 3243  | 4.3%    |  |
| Blip                | 3189  | 4.2%    |  |
| Blip_Low_Frequency  | 1676  | 2.2%    |  |
| Low_Frequency_Burst | 1592  | 2.1%    |  |
| Tomte               | 1261  | 1.7%    |  |
| Fast_Scattering     | 1141  | 1.5%    |  |
| Whistle             | 1137  | 1.5%    |  |
| Low_Frequency_Lines | 709   | 0.9%    |  |

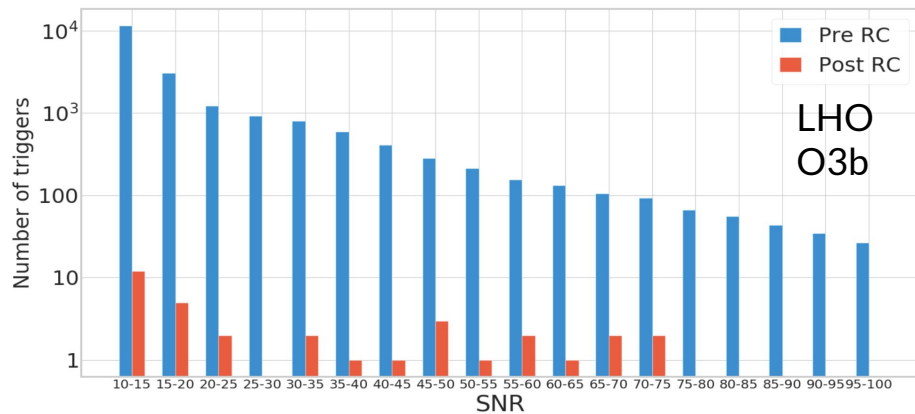
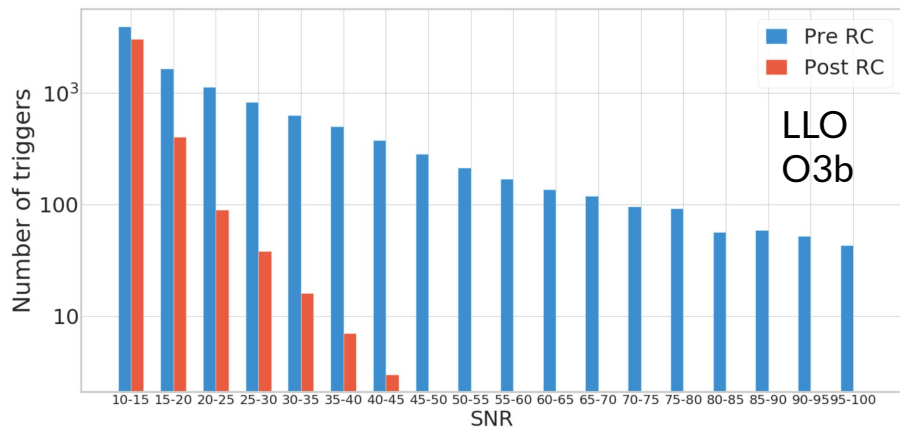
GravitySpy H1

ML confidence: 0.95

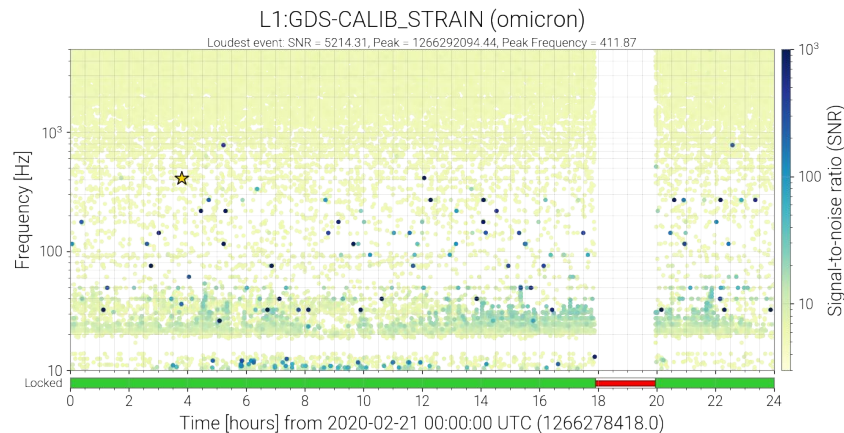
| Glitch              | Count | Percent |  |
|---------------------|-------|---------|--|
| Scattered_Light     | 41779 | 33.6%   |  |
| Fast_Scattering     | 32230 | 25.9%   |  |
| Tomte               | 21364 | 17.2%   |  |
| Blip_Low_Frequency  | 7774  | 6.3%    |  |
| Whistle             | 5165  | 4.2%    |  |
| Extremely_Loud      | 3226  | 2.6%    |  |
| Low_Frequency_Burst | 2692  | 2.2%    |  |
| Koi_Fish            | 2474  | 2.0%    |  |
| Blip                | 2369  | 1.9%    |  |
| Low_Frequency_Lines | 1843  | 1.5%    |  |

GravitySpy L1

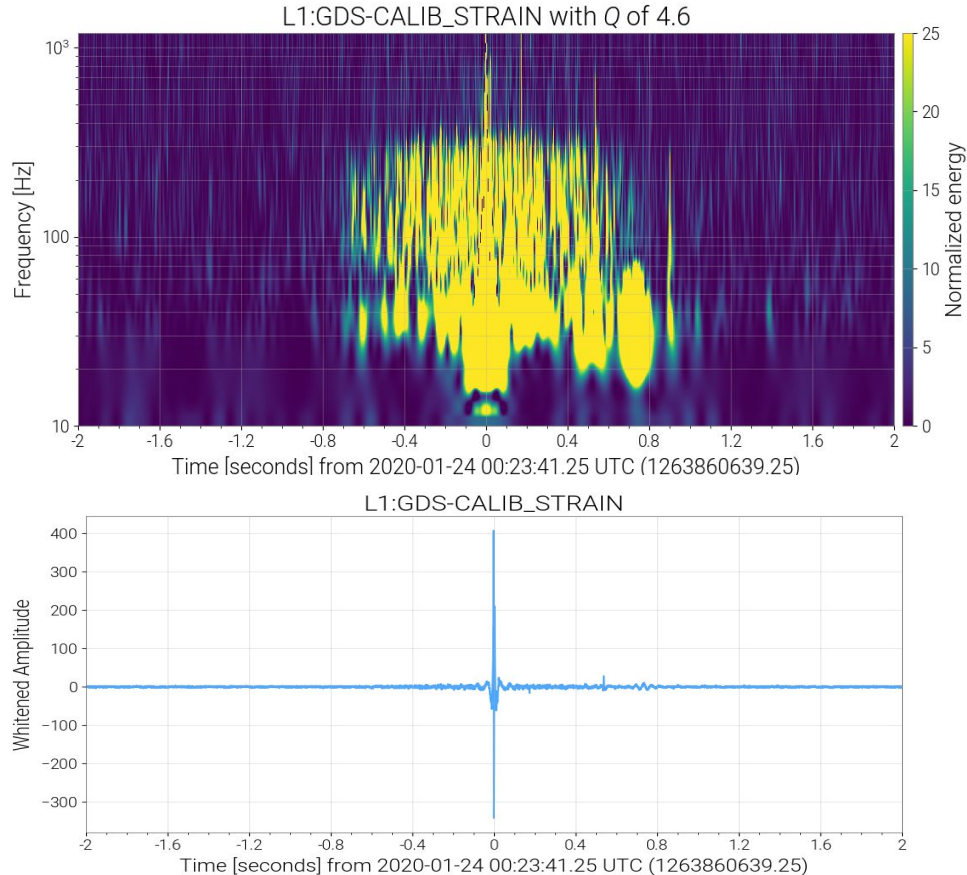
# Scattered Light



- Considerable reduction observed in Slow scattering noise at both L1 and H1 after RC tracking
- See [P2000172](#), [G2000571](#) for more details
- Fast scattering is still a problem during trains and high anthropogenic noise

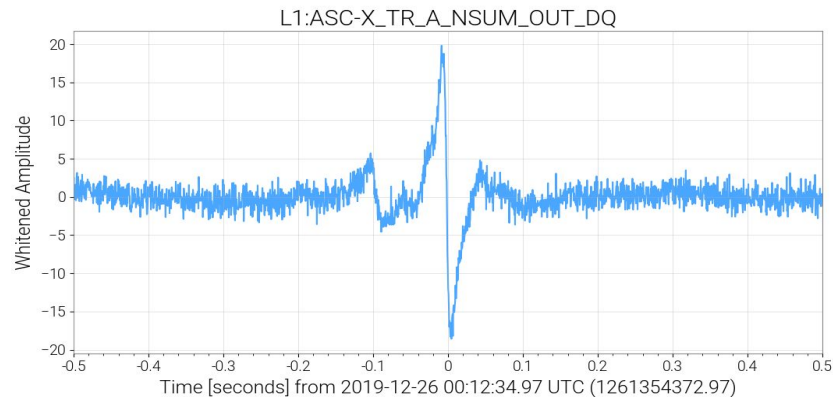
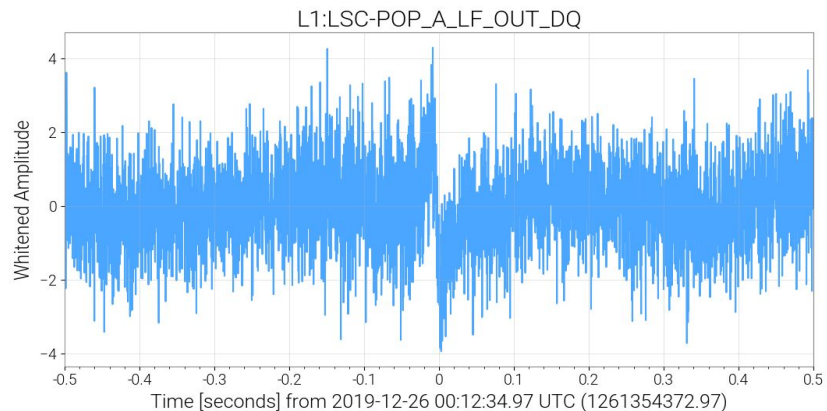
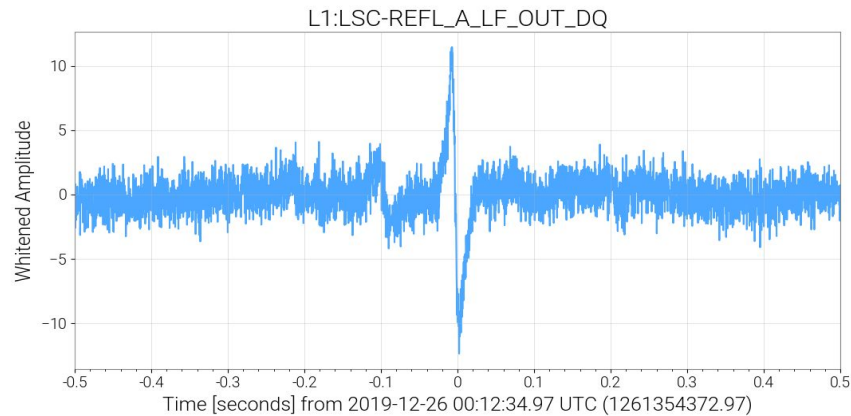
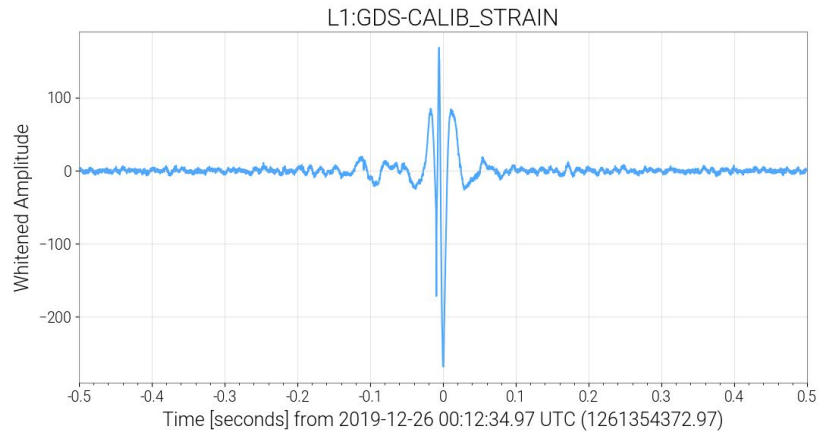


# Loud glitches

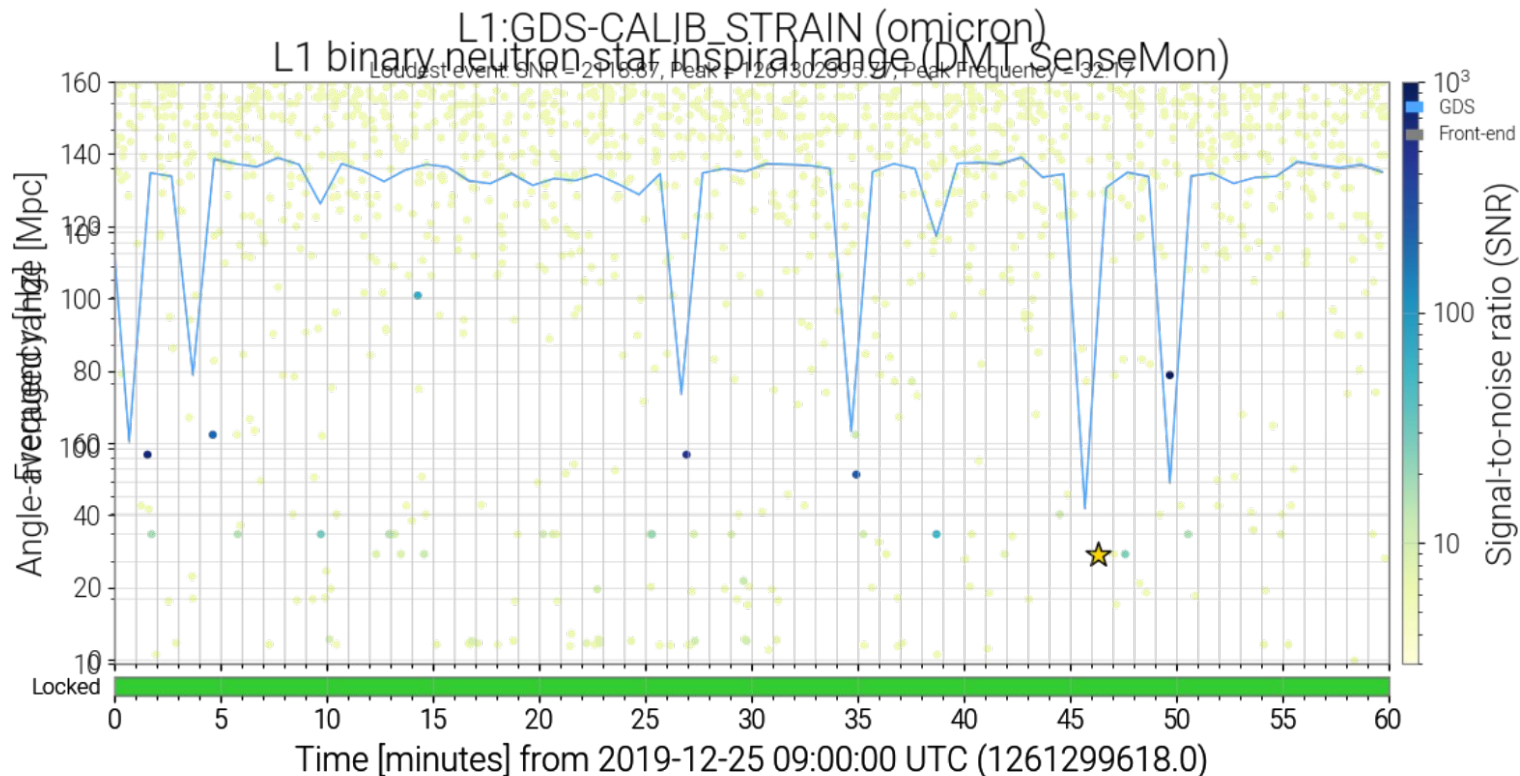


- Responsible for the large drops in range
- Occur with a rate of about 1.75 to 2.75 per hour (SNR > 200)
- Slight decrease in rate from O3a to O3b at both L1 and H1
- Common witnesses  
LSC\_POP/LSC\_REFL, TRX/TRY

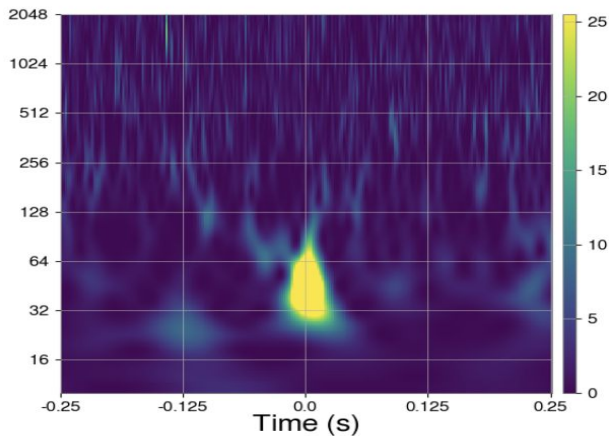
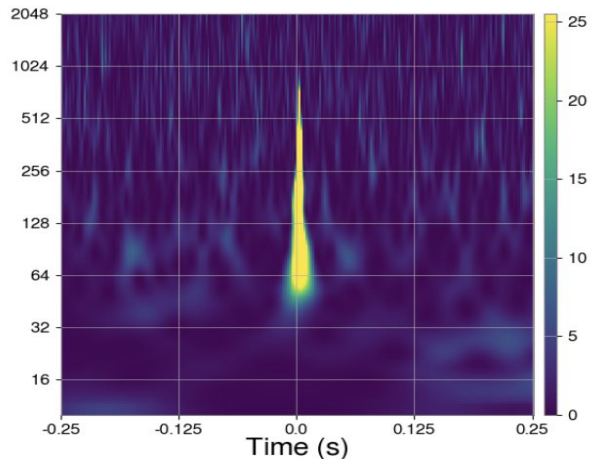
# Loud glitches



# Loud glitches $\longrightarrow$ Range drops



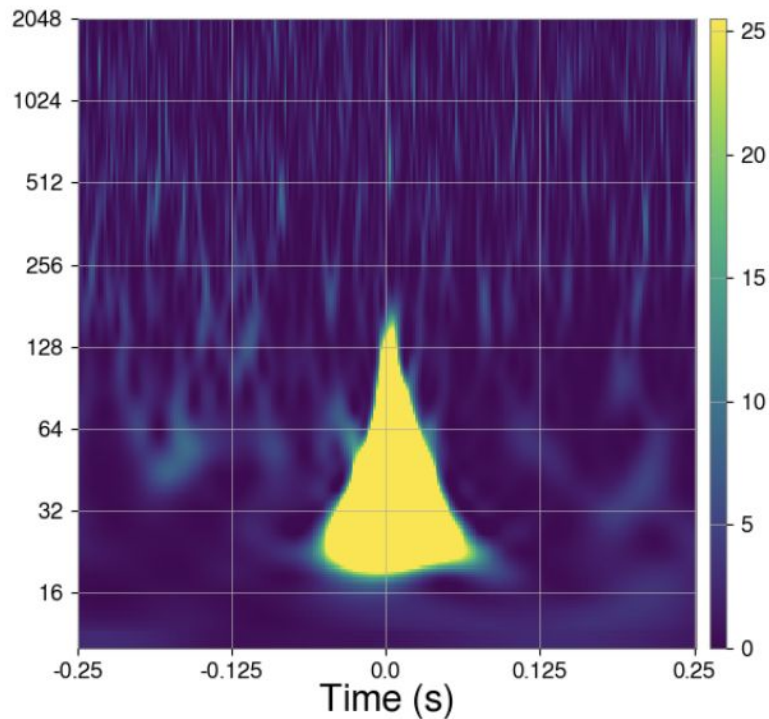
# Blips and low frequency blips



- Short duration glitches with large frequency bandwidth  $O(100)$  Hz
- Look like gravitational wave signals of compact binaries with large total mass
- Coupling mechanism not well understood
- Identified by GravitySpy
- A subclass “Blip\_low\_frequency” recently added to GravitySpy
- See LIGO-[P1800403](#) for more details on investigations

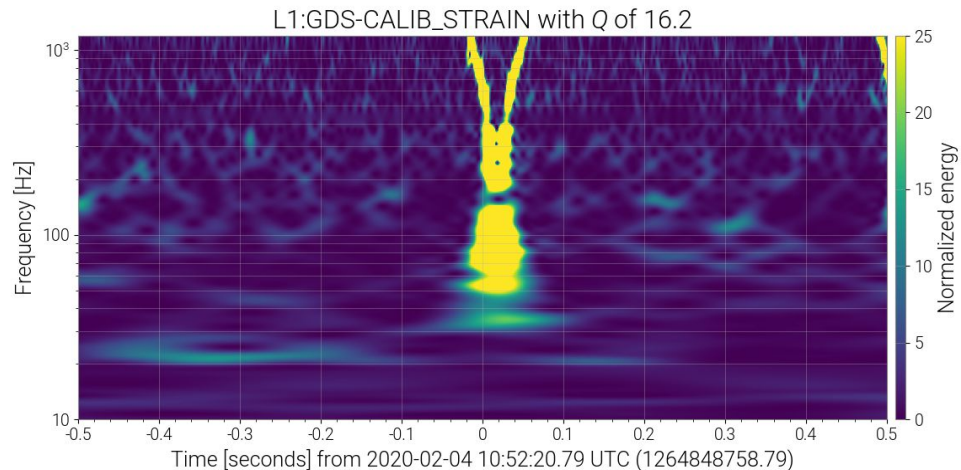


# Tomte

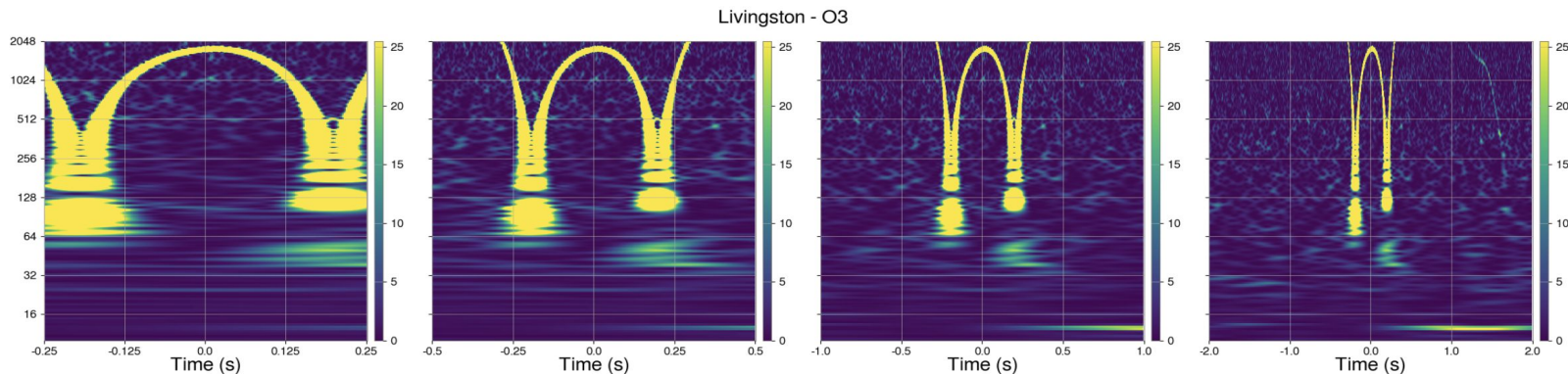


- Short duration glitches, duration longer than blips
- Coupling mechanism not well understood
- Identified by GravitySpy
- Glitch rate went down from  $\sim 9$  per hour in the beginning of O3b to  $\sim 2$  per hour during the end of O3b. See also [comment](#)

# Whistles



- Witness channels include POP/REFL, PRCL/SRCL
- Sub-categories - U shaped, V shaped, double arch W shaped
- Changes in humidity change the ref cavity transmission. See also [51451](#) and [51330](#)
- Plenty of whistle glitches on [Jan 10](#) and [Feb 4](#) at L1



# What do we veto?

Missing data/bad calibration

Pre-lockloss data

Hardware injections

Unexpected activity on site  
(forklifts, LN2 trucks, crane  
running)

Gated times that exceed 3  
seconds

Incorrect configurations (gain  
settings, shutters left open,  
etc.)

Camera shutter glitches

SQZ ASC saturations

Chillers switching on/off

Earthquakes

Thunder

Parametric instability ringing  
up

High wind

High violins

OMC DCPD (ADC) or ESD  
(DAC) overflows

Loud whistles witnessed by  
REFL/POP

RF modulation noise

# Why don't we veto more?

For O3, improvements to search pipelines have resulted in diminishing returns for CAT2 vetoes

Focus on CAT1 vetoes, times that are not considered nominal science mode data

Personpower - developing vetoes takes a lot of time and we have a large number of events to validate and/or retract

For each retraction, we are asked "why wasn't this vetoed?"

Low latency data quality is even harder, searches don't want to miss a real signal - we only veto very obvious mechanisms (OMC DCPD ADC overflows)

# Contacting DetChar

Drop us an email at [detchar@ligo.org](mailto:detchar@ligo.org)

For summary page requests, either email the mailing list or file an issue at:  
<https://git.ligo.org/detchar/ligo-summary-pages/issues>

We have two weekly telecons:

DetChar main call: Mondays at 11 AM CST

DetChar working call: Thursdays at 11 AM CST

Specific issues that require follow-up can be tagged as DetChar in the alog or in FRS

At LLO, the LSU DetChar contingent is a great contact point