Identifying Noise Coupling in GW Detectors - II: Tools

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IUCAA - DetChar Workshop

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OUTLINE

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03 NOISE SOURCES AND TYPES OF NOISE

04 AUXILIARY CHANNELS

05 COUPLING MECHANISMS

06 TOOLS TO IDENTIFY NOISE COUPLING AND EXAMPLES

07 CONCLUSIONS

INTRODUCTION

Small environmental or instrumental disturbances can enter the detector and mimic or mask astrophysical signals

Understanding how noise couples into the main gravitational-wave channel is essential for improving detector sensitivities

DETECTOR CHARACTERIZATION (DETCHAR)

AND DETCHAR GROUP RESPONSIBILITIES

Focus on instrumentation and data quality

Understand how noise affects detector performance

Identify and characterize noise sources

Support noise mitigation efforts

Develop tools to track noise coupling

Works closely with commissioning

Monitor detector state

Flag data-quality (DQ) issues

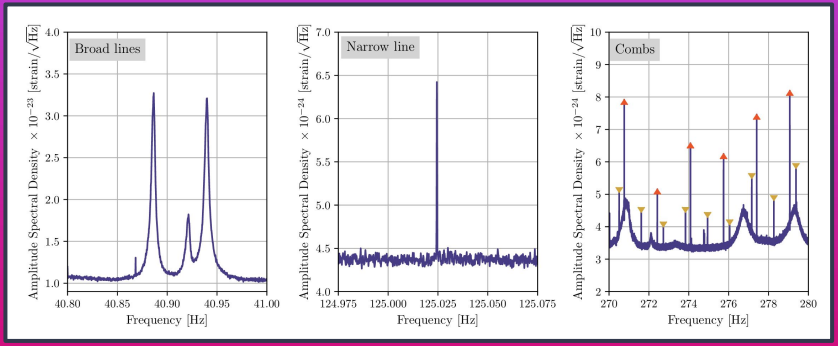
Provide DQ information for pipelines

Validate candidate events

NOISE SOURCES AND TYPES OF NOISE

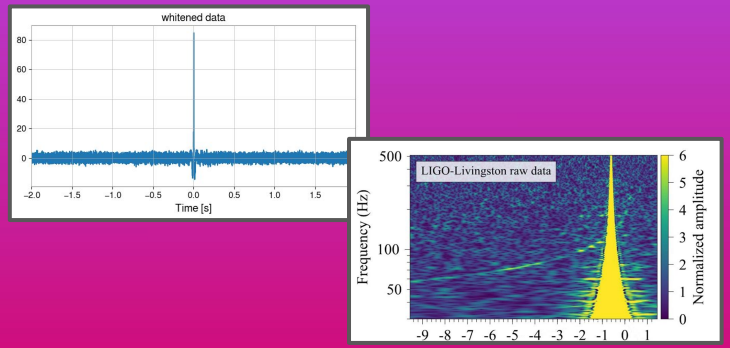
Different noise sources produce distinct signatures in the data: stationary, non-stationary, broadband, narrowband, or transient. We usually split them into two main types:

Persistent (or slowly time-varying) artifacts are usually referred to as ***lines***.



Soni et al. (205)

Short-duration artifacts are usually referred to as ***glitches***.



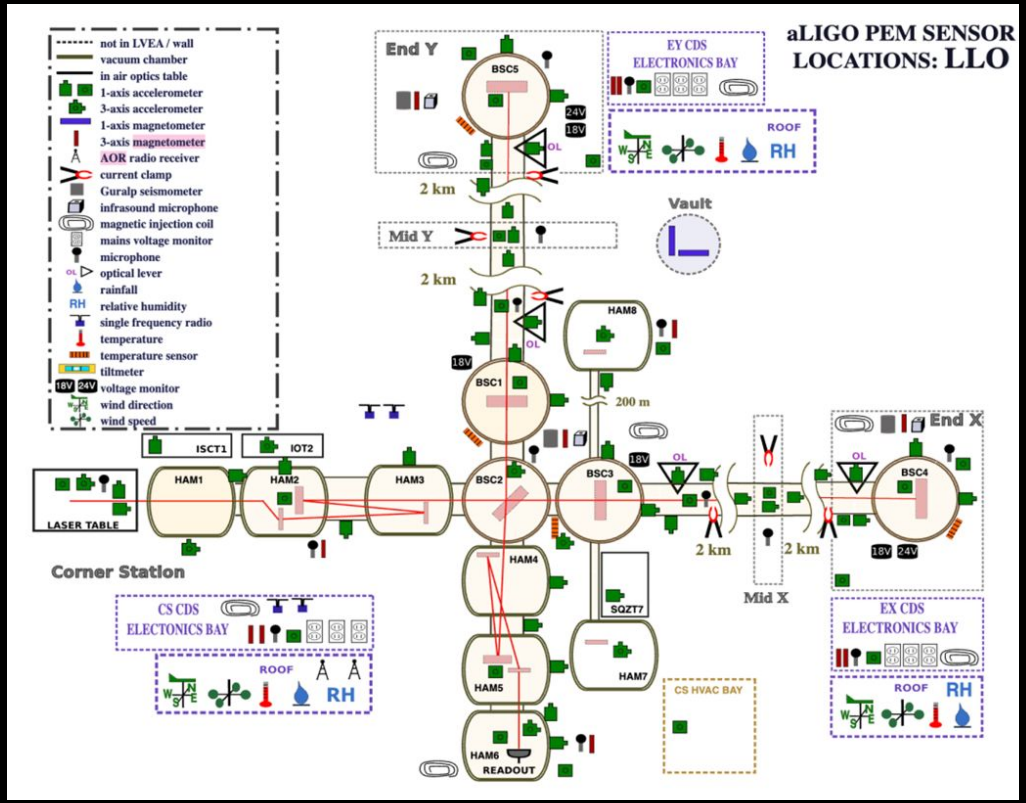
Abbott, Benjamin P., et al. (2017)

Identifying which is which is the first step toward understanding coupling

AUXILIARY CHANNELS

How can we identify the noise source?

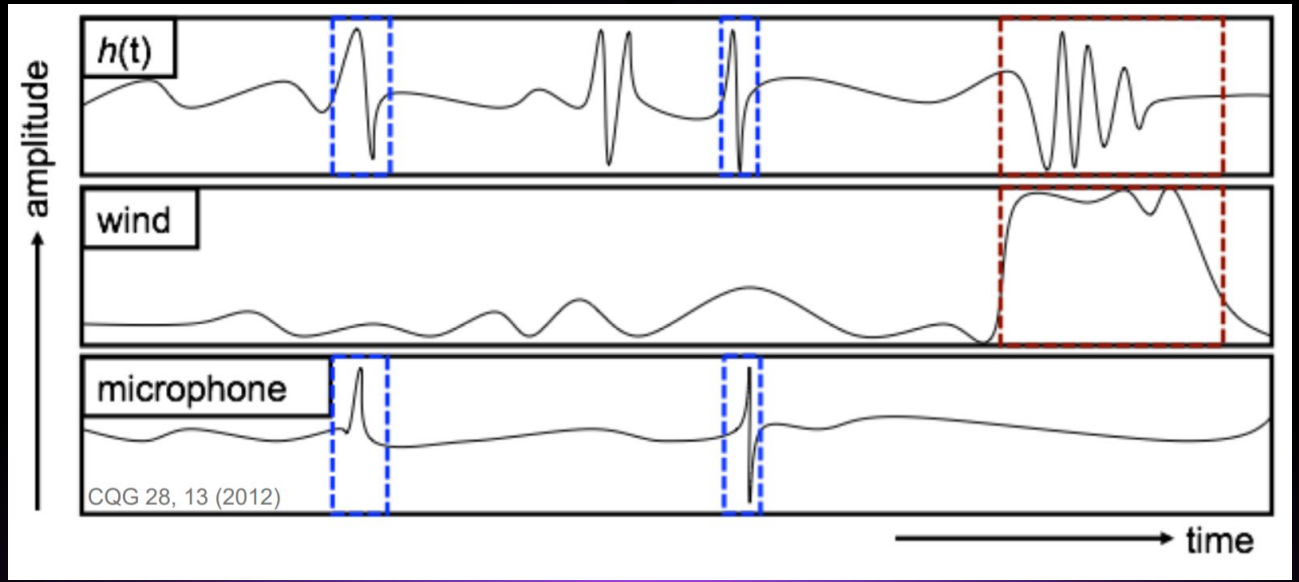
- Noise can originate anywhere, DARM shows the effect, and auxiliary channels help to show the cause



pem.ligo.org

AUXILIARY CHANNELS

We monitor thousands of channels: seismometers, microphones, magnetometers, temperature sensors, suspension sensors, alignment signals, and control signals to help us to identify where the noise originates and how it propagates.



Smith et al. (2011)

COUPLING MECHANISMS

We **are concerned with noise that couples into the gravitational-wave channel (DARM)**, and this coupling can occur through different pathways:

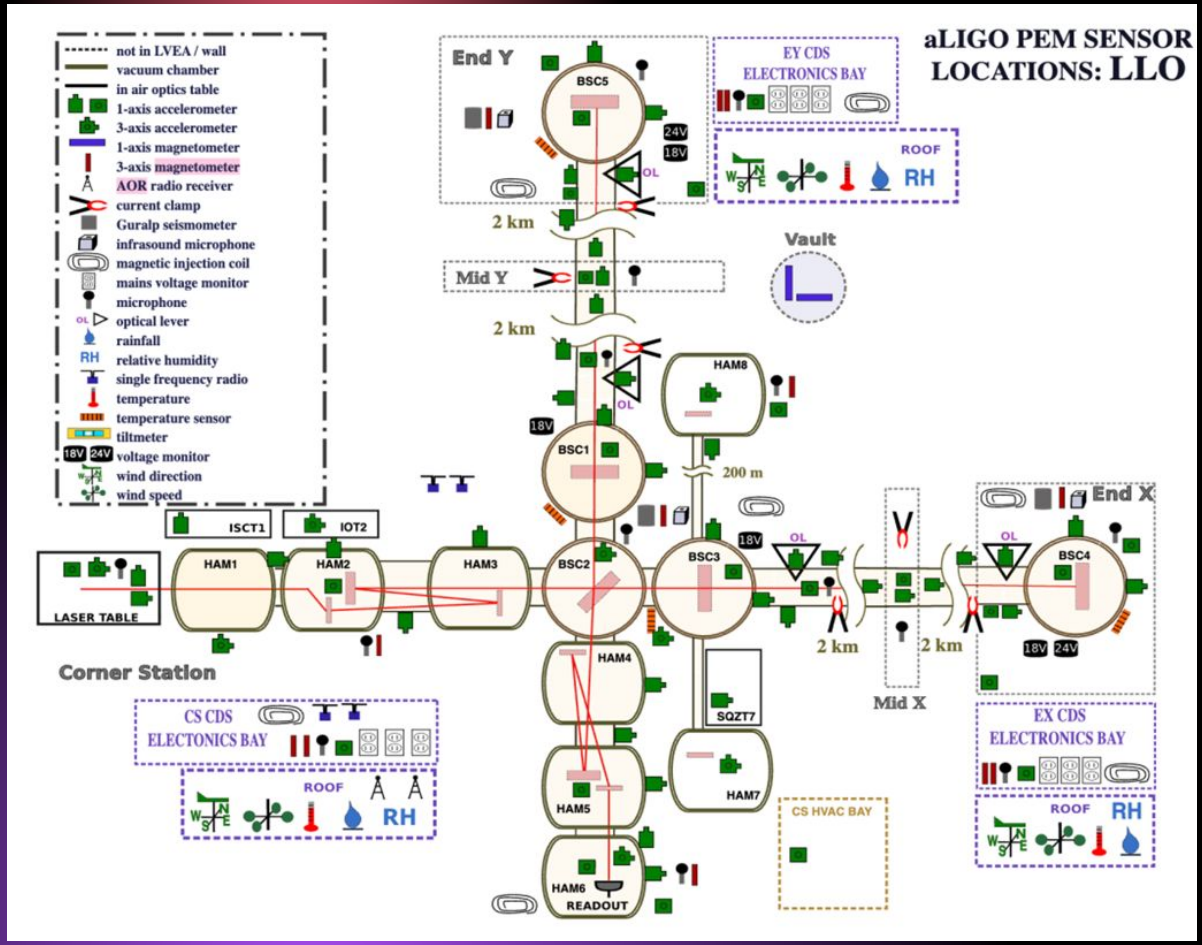
Physical Coupling	Optical Coupling	Control or Digital Couplings
Ground motion - suspensions - surfaces	Scattered Light	ADC saturation
Magnetic fields - coil-magnet actuators	Beam Jitter - motion of input optics	Cross-coupling between DOFs (angular - longitudinal)
Acoustic noise - optical benches		

The DetChar group works to identify these coupling pathways and relies on several tools to do so.

What are these tools (and websites), and how do they help us identify noise coupling?

TOOLS

As mentioned, the interferometer is large and distributed over many subsystems, so auxiliary channels are essential for identifying where noise is entering and how it couples to DARM.



TOOLS

As mer
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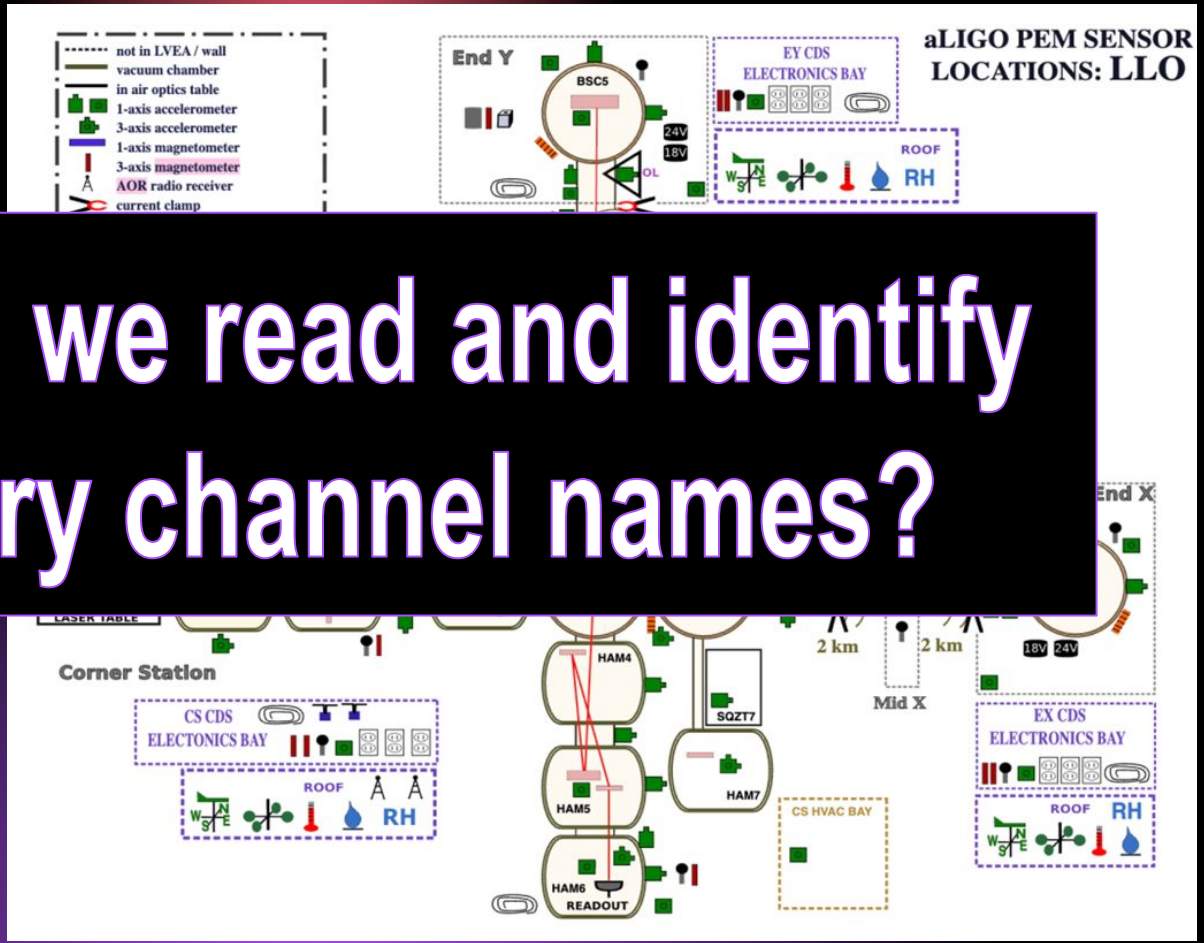
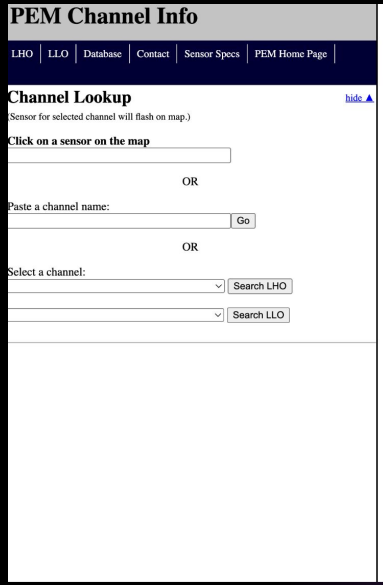
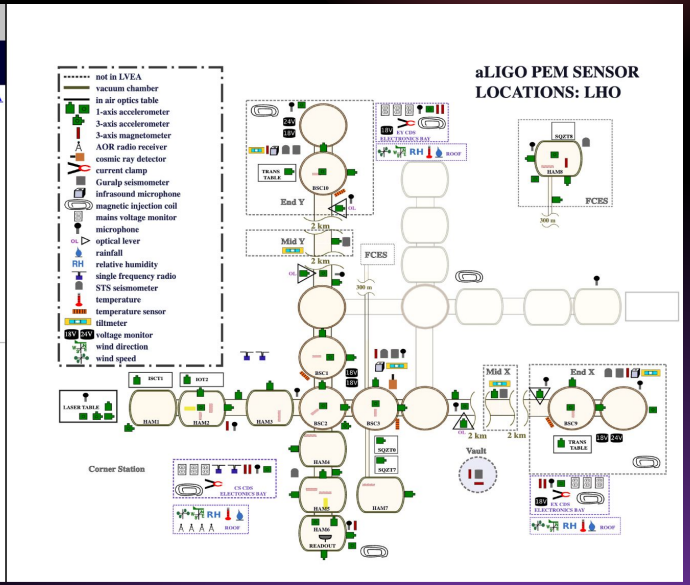


“TOOLS” - PEM.LIGO.ORG





Visualizes where each environmental sensor is installed (arms, corner station, electronics bays, vacuum chambers)

Includes sensor type and orientation

Allows channel lookup by name or by clicking on the detector map

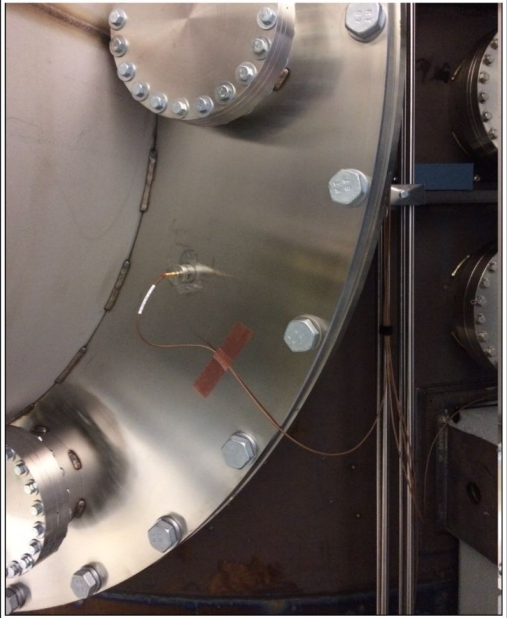
“TOOLS” - PEM.LIGO.ORG

PEM Channel Info

LHO | LLO | Database | Contact | Sensor Specs | PEM Home Page

Channel Lookup

show ▼



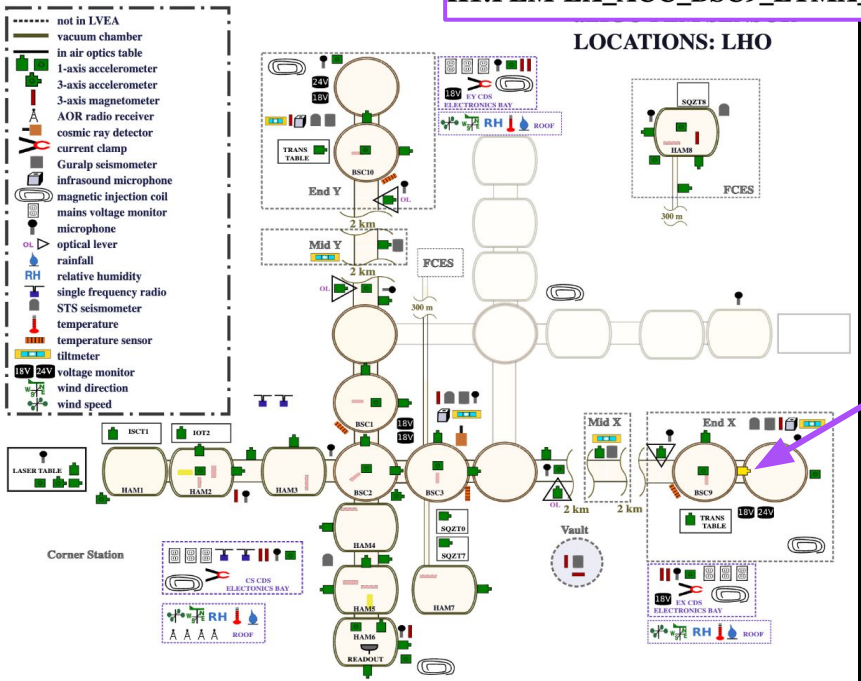
PEM Channel Info

LHO | LLO | Database | Contact | Sensor Specs | PEM Home Page

Channel Lookup

show ▼

H1:PEM-EX_ACC_BSC9_ETMX_X



Created by Maggie Tse, Vincent Roma, Terra Hardwick

Last Updated: December 2025 by Samantha Callos

Instructions for editing website

“TOOLS” - Inside LIGO

https://wiki.ligo.org/Main/InsideLIGO

Inside LIGO: A Guide for the Perplexed *

(A work in progress)

- Inside LIGO: A Guide for the Perplexed *
- Introduction - what is this guide, who is it for, and how might it help you (or vice-versa)?
- Abbreviations, names, and a few concepts (the main list)
- Some LIGO-related Locations
- Some LIGO groups (incomplete list)
- Interferometer subsystems (possibly incomplete list)
- LIGO time periods (ER1, ER2, ..., S1, S2, ..., O1, O2, O3, ..., OPA, VSR, ...)
  - Status of the run, IFOs, etc.
    - Current + future run plans
    - IFO (and other) statuses
    - Detection events (incl. candidate events)
  - Notes on time zones
- Misc. reference stuff
  - IFO and other site abbreviations, colors, etc.
  - Some useful website/IP address pairs
  - Some notable LIGO-related NSF grants
- Some guides for new LIGO members
- Apps and websites for GW (and other astrophysical) notifications
- Some commonly-used LIGO websites (and some less-commonly-used-but-useful ones) (and some non-LIGO ones)
- Some useful and/or interesting plots
- The Title

“TOOLS” - Inside LIGO

https://wiki.ligo.org/Main/InsideLIGO

ACB = Arm Cavity Baffle = "A non-reflective (in IR) metal structure suspended in the chamber." [Brian O'Reilly, 2023.01.23 email] (e.g., slide 4 here: "LLO Status for DetChar F2F January 2023" - https://dcc.ligo.org/G2300082 ; also here: "ETMY ACB 1.6 Hz resonance makes fringes in DARM" - 27 July 2022 - https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=60927)

acc = accelerometer

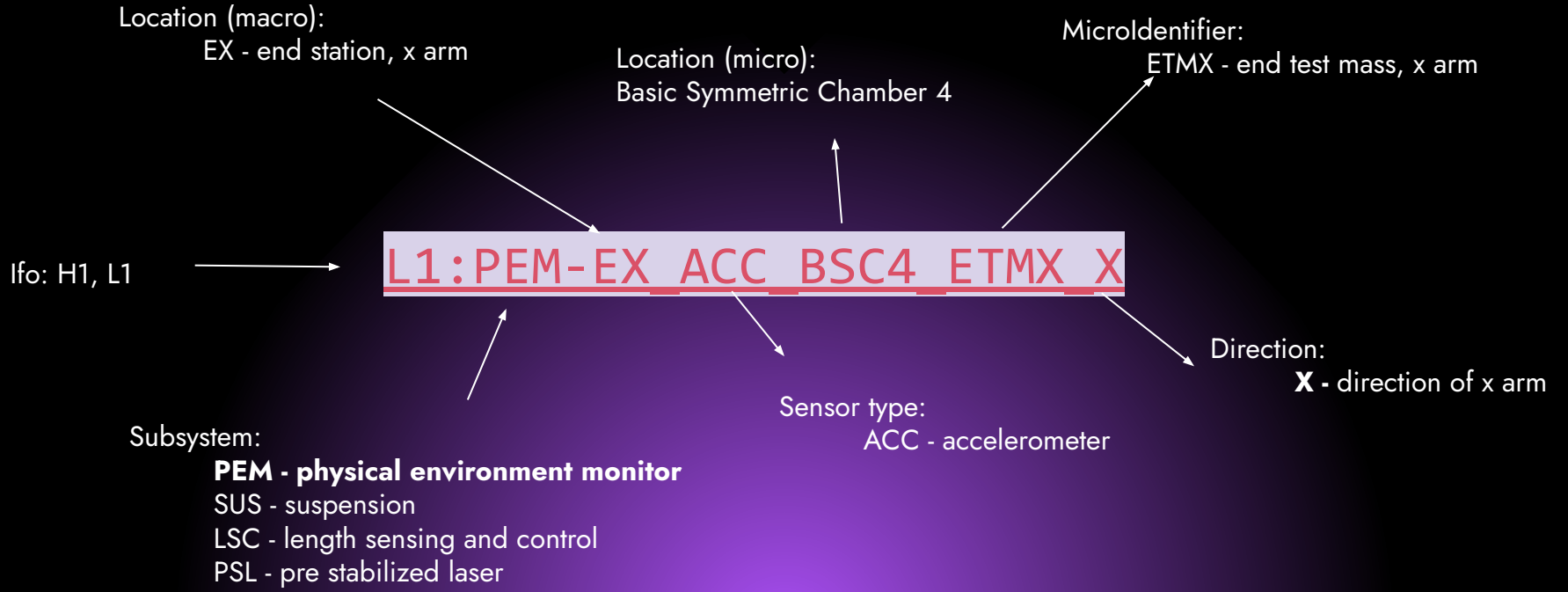
ASD = amplitude spectral density = "a measure of a signal's amplitude at different frequencies. It's essentially the square root of the Power Spectral Density (PSD)." (Gemini, 2024.12.03); given in units of 1/sqrt(Hz); example here: https://www.gw-openscience.org/o2speclines/

BSC = basic symmetric chamber = "large vacuum chamber enlosing the suspended core optics" [1] (includes chambers containing ETMs - https://dcc.ligo.org/LIGO-E1201012); a HAM-like vacuum chamber "bubble" along the length of a beam tube (presumably "symmetric" because the beam tube comes in on one side and goes out the other, so the chamber could be rotated 180 degrees horizontally and used the same way [note: this is not correct, since BSCs 1-5 can be seen in this diagram (https://pem.ligo.org/channelinfo/index.php?channelname=L1%3APEM-CS_ACC_BSC3_ITMX_X), and they include 3 different shapes, including the "+" shaped beam splitter chamber, the "pass-through" bubble chamber, and the "end of the line" chambers at the end of the arms]) - see diagram here: https://www.ligo.caltech.edu/page/ligo20191001

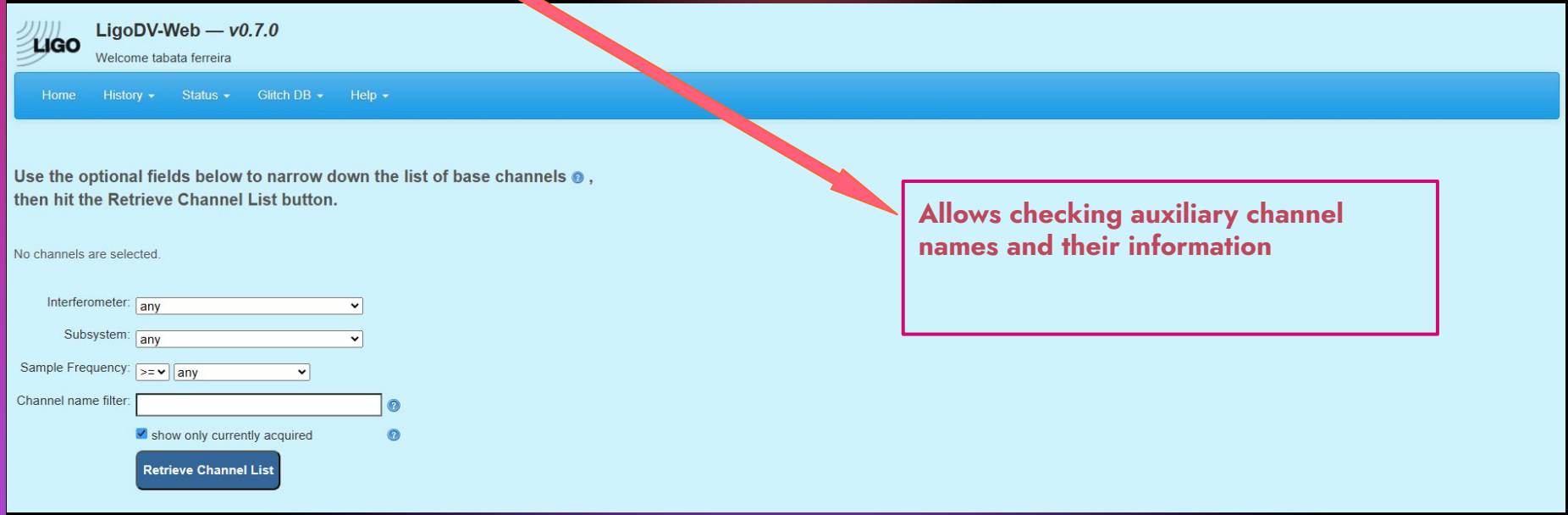
Some other lists of acronyms, abbreviations, etc.:
(the contents of those lists don't need to be repeated here - they're given here more for reference to obscure items)
[1] https://dcc.ligo.org/LIGO-M080375 - "LVC Abbreviations and Acronyms" - this is an excellent resource!
[2] https://wiki.ligo.org/DetChar/CopyOfLLOAcronymWiki
[3] https://www.lsc-group.phys.uwm.edu/ligovirgo/cbcnote/Acronyms [link might be broken]
[4] https://www.lsc-group.phys.uwm.edu/ligovirgo/cbcnote/InspiralAnalysisGlossary (< 400 items in the list, not all defined, but definitions explain what the item is/does and usually a little more) [link might be broken]
[5] https://emfollow.docs.ligo.org/followup-advocate-guide/glossary.html - "LIGO/Virgo/KAGRA Rapid Response Team Level-0 Responder Guide" Glossary
[6] https://wiki.ligo.org/CSWG/LIGOChannelNames
[7] https://dcc.ligo.org/T990033 - LIGO Channel Naming Conventions
[8] https://emfollow.docs.ligo.org/userguide/glossary.html

TOOLS - AUXILIARY CHANNELS

How to read LIGO channel names



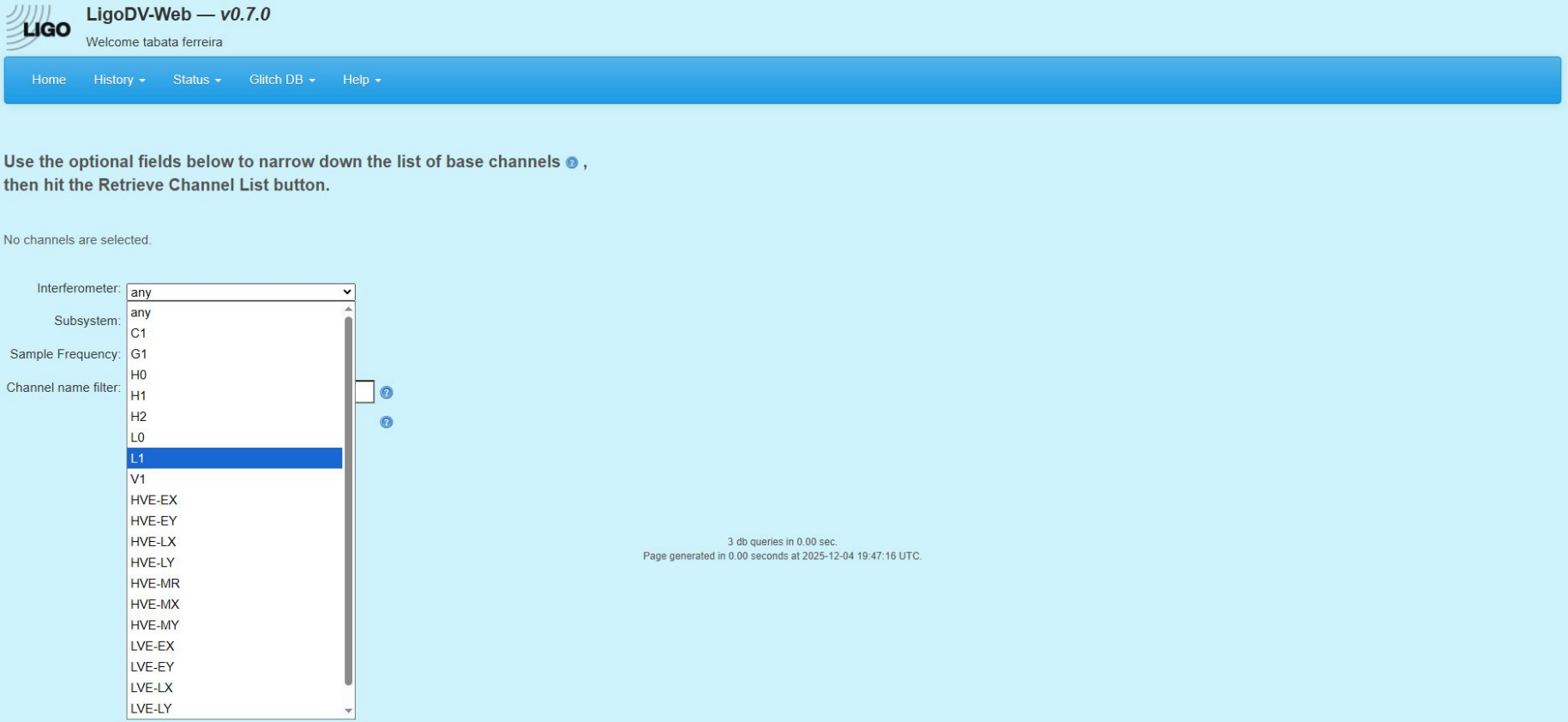
TOOLS - LIGODVWEB



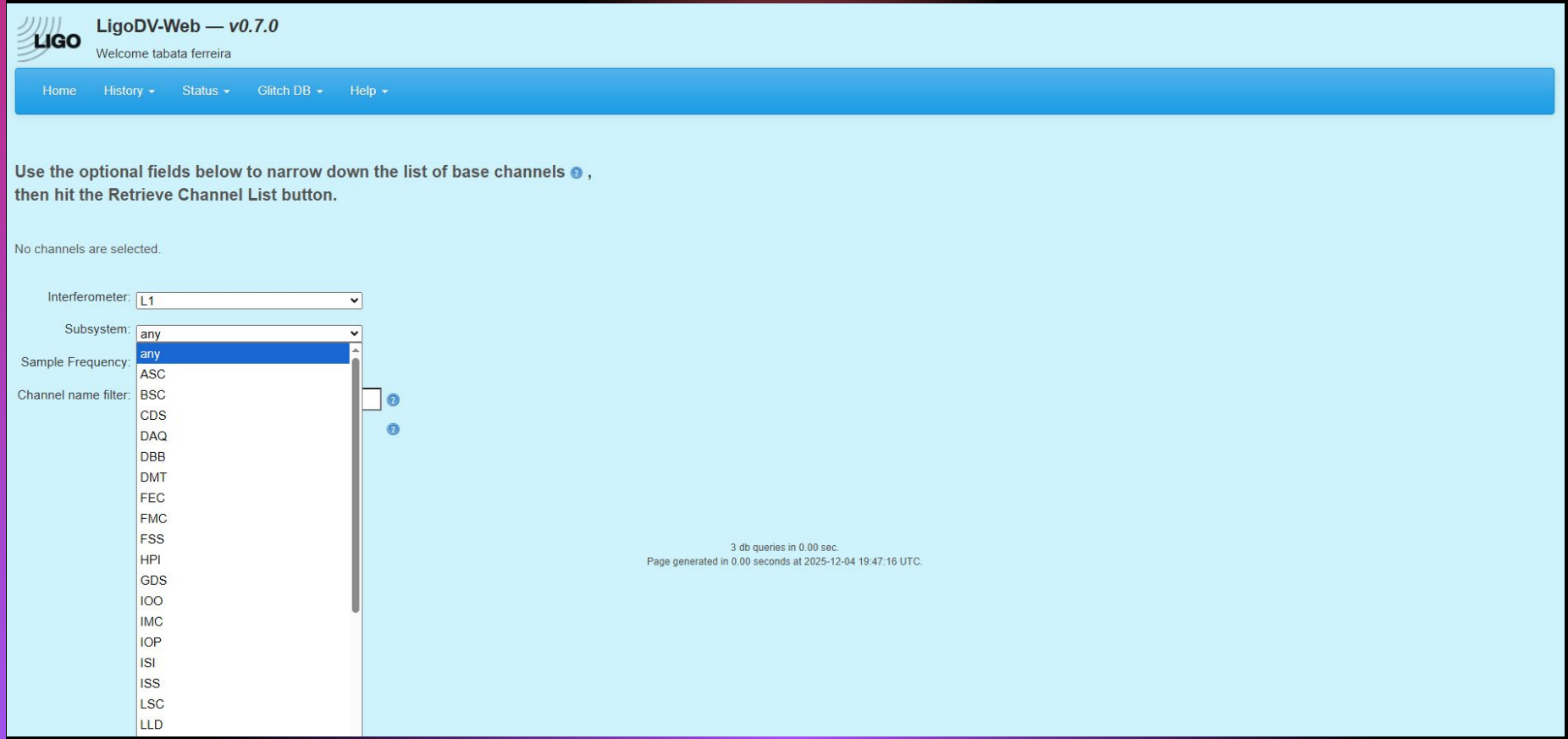
Allows checking auxiliary channel names and their information

https://ldvw.ligo.caltech.edu/ldvw/

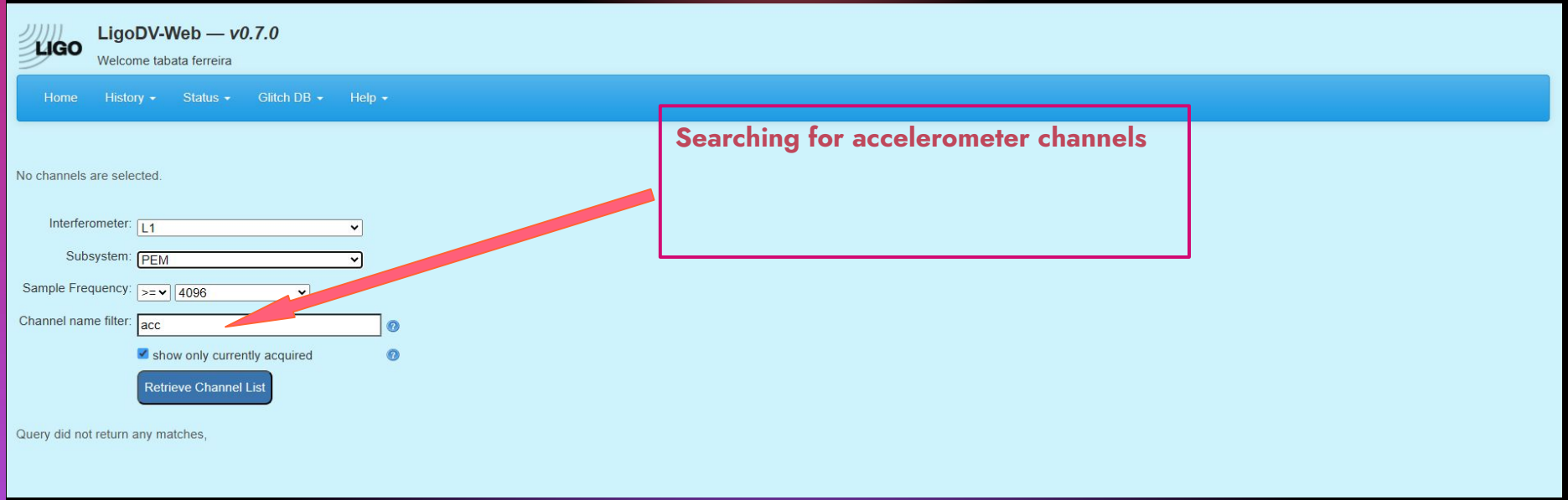
TOOLS - LIGODVWEB



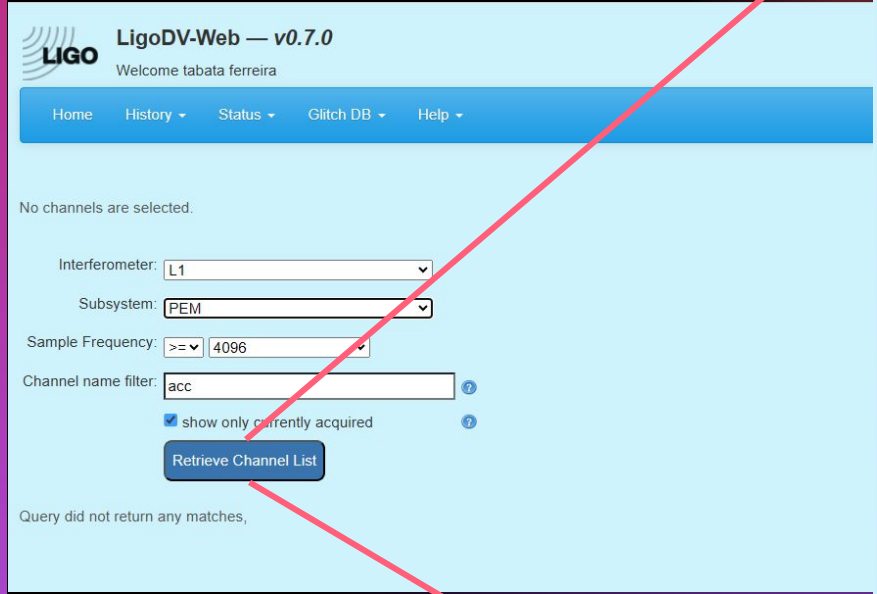
TOOLS - LIGODVWEB



TOOLS - LIGODVWEB

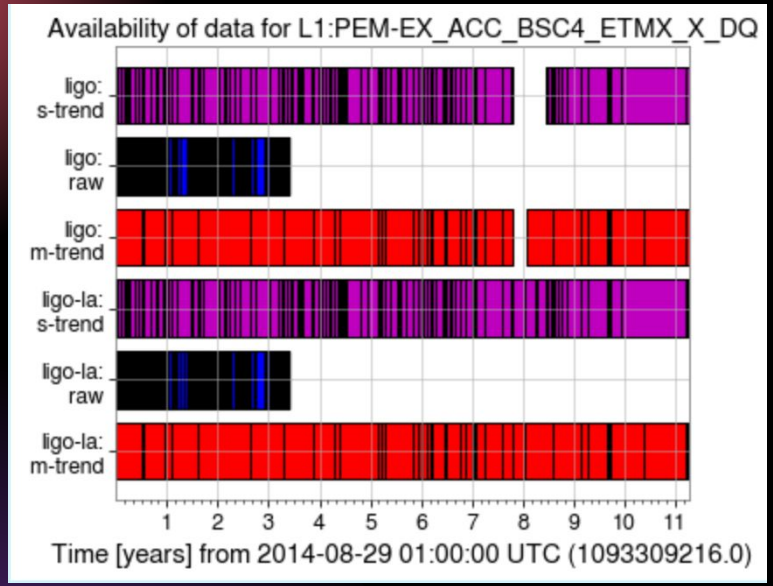


TOOLS - LIGODVWEB

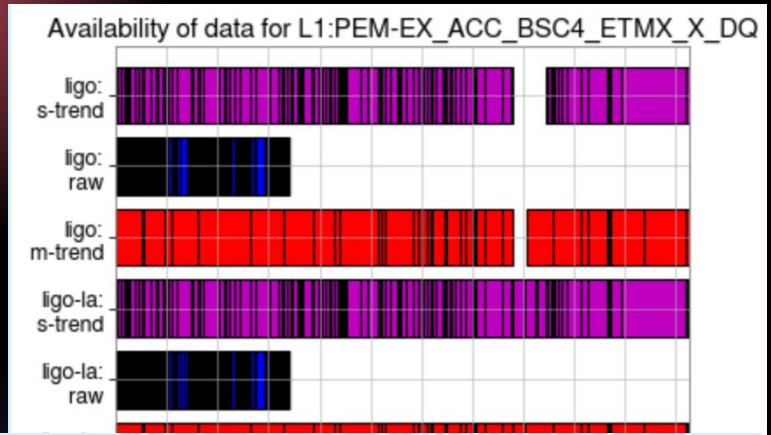


TOOLS - LIGODVWEB

Name	Raw rate(s)	RDS rate(s)	Info links
L1:PEM-EX_ACC_BSC4_ETMX_X_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: mean Second-trend: none			
L1:PEM-EX_ACC_BSC4_ETMX_Y_DQ	2048-16384		
☐ Raw. ☐ Online. Minute-trend: none Second-trend: none			
L1:PEM-EX_ACC_BSC4_ETMX_Z_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none Second-trend: none			
L1:PEM-EX_ACC_OPLEV_ETMX_Y_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none Second-trend: none			



TOOLS - LIGODVWEB



Name	Raw rate(s)	RDS rate(s)	Info links
L1:PEM-EX_ACC_BSC4_ETMX_X_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: mean	Second-trend: non		
L1:PEM-EX_ACC_BSC4_ETMX_Y_DQ	2048-16384		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		
L1:PEM-EX_ACC_BSC4_ETMX_Z_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		
L1:PEM-EX_ACC_OPLEV_ETMX_Y_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		

1. Select time(s)

Start time: 2025-11-12 19:59:32 (gps or YYYY-MM-DD HH:MM)

Duration: 600 (day HH:MM:SS or sec)

+More start times +Repeat options

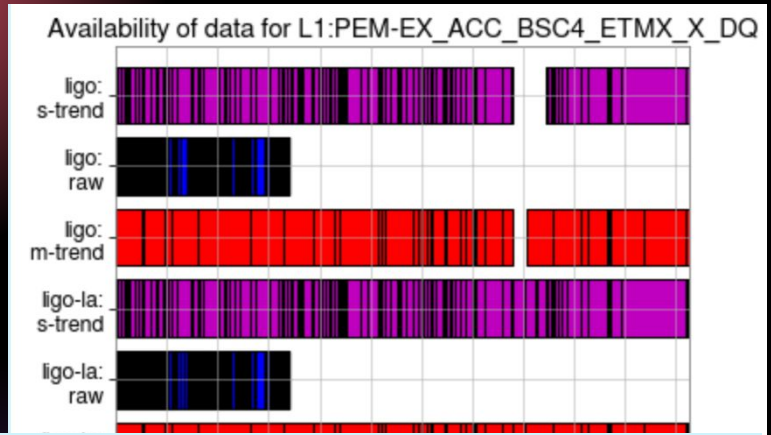
☐ Auto refresh (use repeat count).

Group by: time

2. Select one or more plot types

- **Time Series (GWpy):**
- Spectrum (GWpy):
- Spectrogram:
- Spectrogram (GWpy):
- Coherence (GWpy):
- Transfer function (GWpy):
- X-Y or 3D scatter plot:
- Coherence-spectrogram (GWpy):
- Omega scan (dmt_wplot):
- Q-transform (GWpy):
- BLRMS plot:

TOOLS - LIGODVWEB



Name	Raw rate(s)	RDS rate(s)	Info links
L1:PEM-EX_ACC_BSC4_ETMX_X_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: mean	Second-trend: non		
L1:PEM-EX_ACC_BSC4_ETMX_Y_DQ	2048-16384		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		
L1:PEM-EX_ACC_BSC4_ETMX_Z_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		
L1:PEM-EX_ACC_OPLEV_ETMX_Y_DQ	2048-8192		
☐ Raw. ☐ Online. Minute-trend: none	Second-trend: none		

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Duration: 600 (day HH:MM:SS or sec)

+More start times +Repeat options

☐ Auto refresh (use repeat count).

Time Series (GWpy):

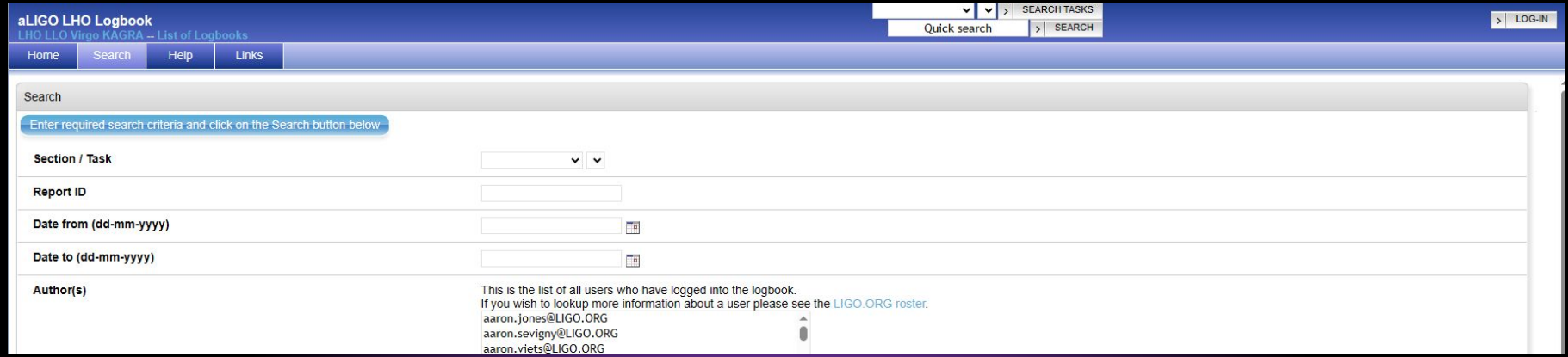
☑ Generate Time series

Set appropriate parameters below:

High pass filter		Corner frequency, default = no filter
Low pass filter		Corner frequency, default = no filter
☐ Log X-axis		Default is linear
X-minimum		Seconds (float) from start or GPS, default = auto
X-maximum		Seconds (float) from start or GPS, default = auto
X-axis zero		Seconds (float) from start or GPS time, default = auto,0 for GPS labels
☐ Add standard segments		Default is no segment ribbons
☐ Log Y		Default is linear
Y-minimum		Default is auto
Y-maximum		Default is auto
☐ Overlay times		Default is to append them on x-axis

TOOLS - Detector Logbooks

By examining channels in the time series, frequency domain, and spectrograms, we can identify anomalies and connect them to recent tests, changes, or updates in the interferometer.



https://alog.ligo-la.caltech.edu/aLOG

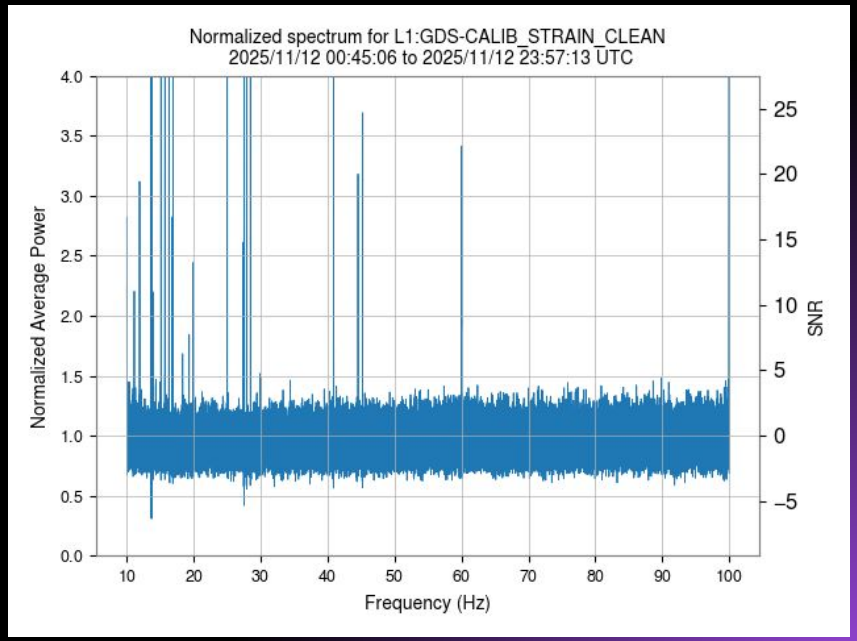
https://logbook.virgo-gw.eu/virgo/

https://alog.ligo-wa.caltech.edu/aLOG

Persistent noise: spectral lines

TOOLS - FSCAN (Lines)

A tool to identify and characterize spectral lines in DARM and in auxiliary channels.



FFT length = 1800 s (variable)
Δf=1/T, allowing us to identify narrow spectral lines

Long-duration FFTs for detailed spectral estimates

Identifies persistent narrowband features

Ideal for stationary / slow noise coupling (calibration lines, violin modes)

Provides daily/weekly spectrograms and line lists for commissioning

$$X(f) = \int x(t) e^{-2\pi i f t}\, dt$$

TOOLS - FSCAN (Lines)

Fscan allows us to track line features over time, and to use coherence between DARM and auxiliary channels to investigate whether those lines are coupled.

L1 General (Detchar) Link

ansel.neunzert@LIGO.ORG - posted 17:43, Thursday 15 June 2023 (65642)

Two more combs in L1 data

In addition to Keith's post about a 10 Hz comb (65599), recent weekly Fscan spectra show two combs at low frequencies.

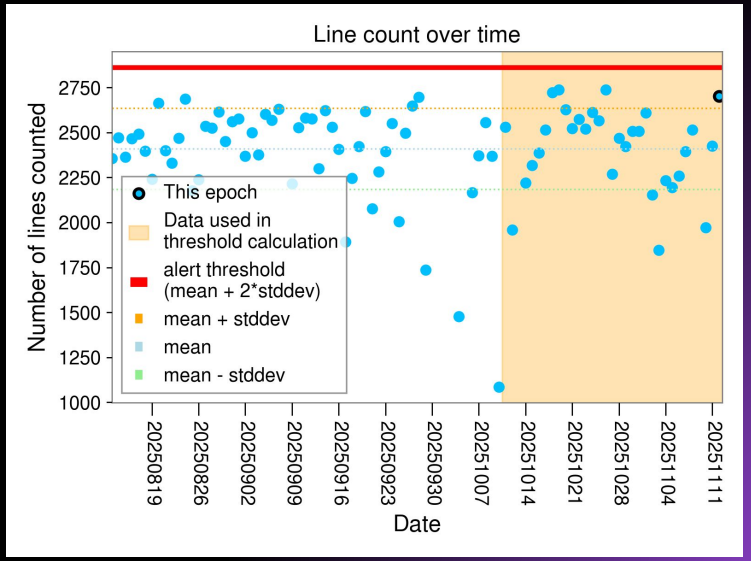
- Odd harmonics of an ~11.9 Hz comb visible up to about 107 Hz. (Comb monitor lists it as 23.80944 Hz spacing with 11.9044 Hz offset.)
- Odd harmonics of a ~0.97 Hz comb visible in the 20-40 Hz region. (Comb monitor lists it as 1.93914 Hz spacing with 0.97 Hz offset.)

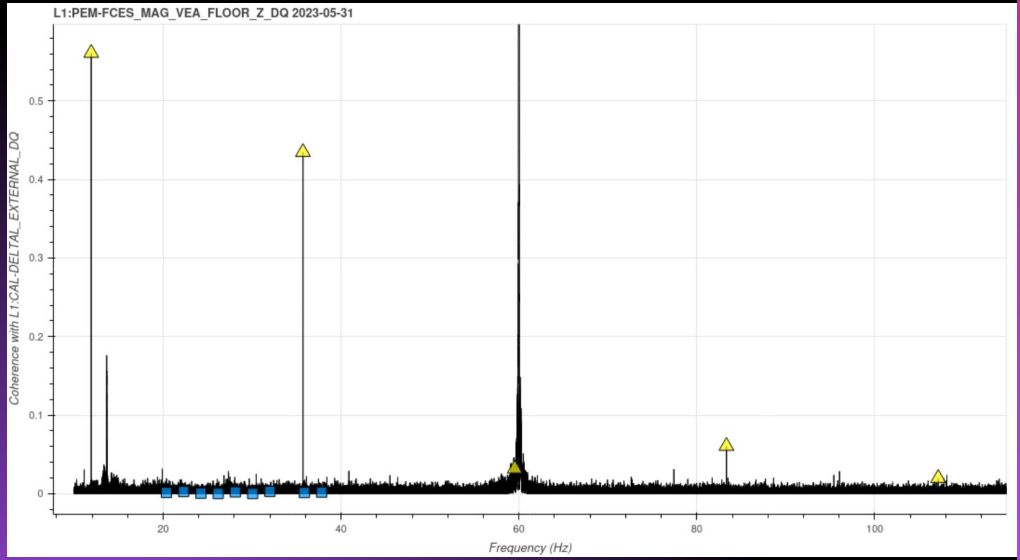
The 11.9 Hz comb is coherent with CS, EX, EY, and FCES magnetometers, as well as AMON and VMON channels. I have not identified any special location where it shows up most strongly.

I haven't seen any notable coherences in Fscan data with either the the 0.97 Hz comb or the 10.0 Hz comb, which are much weaker.

Attached files: (1) weekly average June 7-13, with combs labeled. (2) Coherence with a magnetometer channel, same frequency points labeled (I just picked one channel as a demonstration; it looks like this across many channels.) Note that this second plot is actually from the previous weekly average (May 31-June 6) since the coherence data for the more recent week is still being generated. (See also: Fscan pages for the weeks starting starting June 7, and starting May 31.)

Images attached to this report





TOOLS - FSCAN (Lines) - EXAMPLE

L1 General (Detchar) Link

evan.goetz@LIGO.ORG - posted 14:26, Thursday 21 August 2025 - last comment - 14:56, Thursday 21 August 2025(78216)

Pre- and post-ESD DARM drive swap to ETMY Aug 12 2025

I took a quick look to see if there were any changes to the spectral line features in the L1 h(t) high-resolution Fscan spectra before and after the swap to the ETMY ESD DARM drive (see LLO aLOG 78071).

Using weekly Fscans Aug 6 2025 00:00 UTC - Aug 13 2025 00:00 UTC and Aug 13 2025 00:00 UTC - Aug 20 2025 00:00 UTC, I checked if there were any unusual changes. First, the number of autotagged lines from Aug 6 was 3070 while Aug 13 was 3216. This might be interesting, but looking back to line counts in July 2025, there are also line counts in the 3200 range. So I don't think the raw line count is of particular concern or noticeable difference.

I made spectral ratio plots from the Fscan weekly data and attach the plots in 300 Hz bands. Nothing in particular stands out to me as having gotten worse or improved. The 60 Hz line is a bit worse, and the 180 Hz harmonic is a bit better. Also, a narrow feature at 35.7 Hz seems to have gone away (is this a suspension mode? If so, which one?).

So bottom line, I think we're ok to run like this from the lines perspective.

Images attached to this report

Comments related to this report

anamaria.effler@LIGO.ORG - 14:56, Thursday 21 August 2025 (78218) Link

I think the 35.7 is the third harmonic of the 11.9 Hz comb from Beckhoff, that we had previously tracked as coupling at EX through the ESD. It's interesting if there isn't an equivalent one at EY.

TOOLS - FSCAN (Lines) - EXAMPLE

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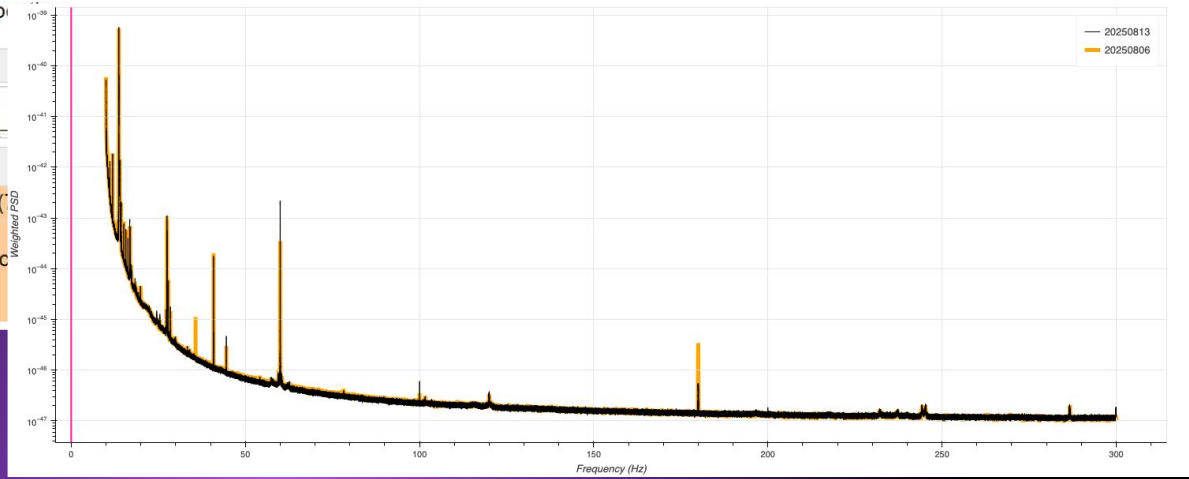
Images attached to this report

Comments related to this report

anamaria.effler@LIGO.ORG - 14:56, Thursday 21 August 2025 (

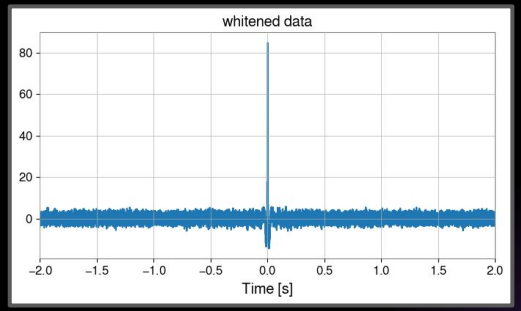
I think the 35.7 is the third harmonic of the 11.9 Hz comb from Bec
EY.



Transient noise: glitches

TOOLS - OMICRON (Glitches)

A tool to identify and characterize transient noise in DARM and in auxiliary channels.



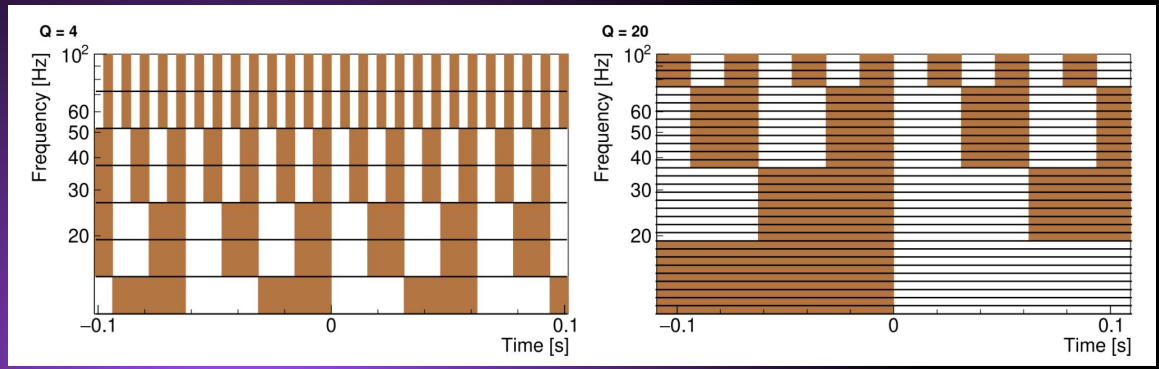
$$X(\tau, \phi, Q) = \int_{-\infty}^{+\infty} x(t) w(t - \tau, \phi, Q) e^{-2i\pi\phi t} dt.$$

$$Q \propto \frac{f_0}{\Delta f_0}$$

Detects excess power in the data;

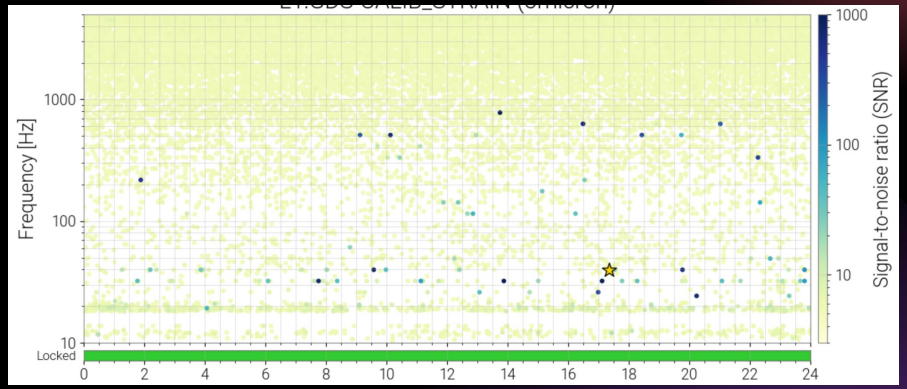
Uses the Q-transform for optimal time-frequency resolution;

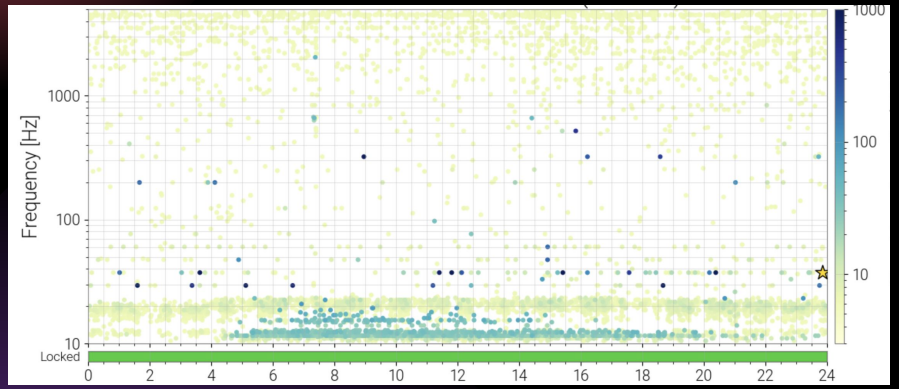
Provides trigger lists, including: peak time, central frequency, SNR, **Q,** duration

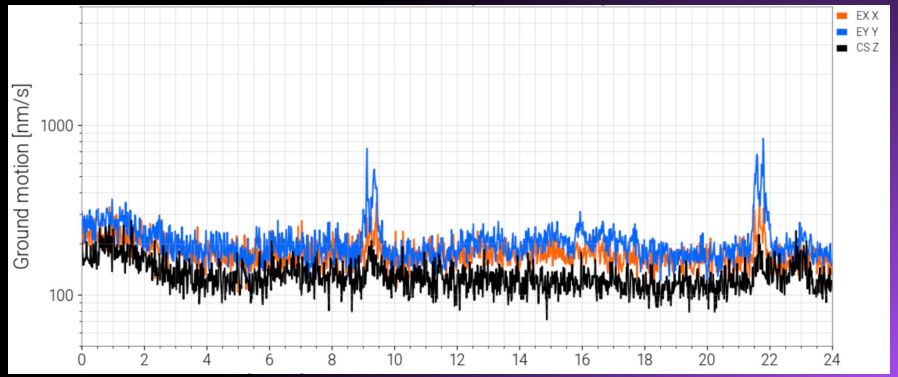


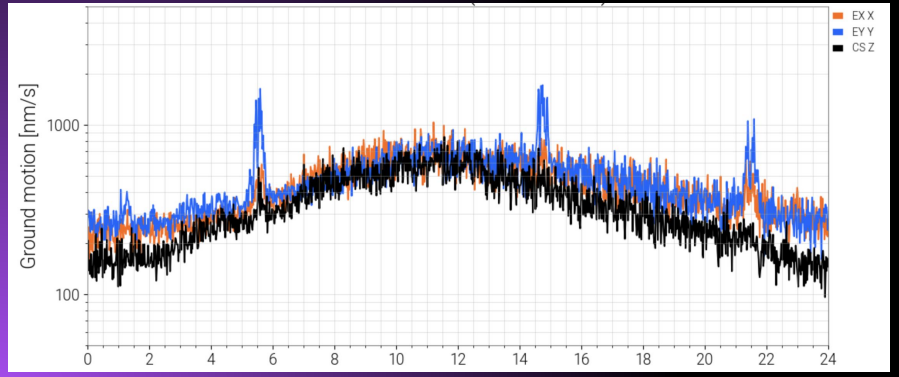
Robinet et al. (2020)

TOOLS - OMICRON (Example)









How can we use Omicron information?

TOOLS - HVETO

A hierarchical method for vetoing noise transients in gravitational-wave detectors

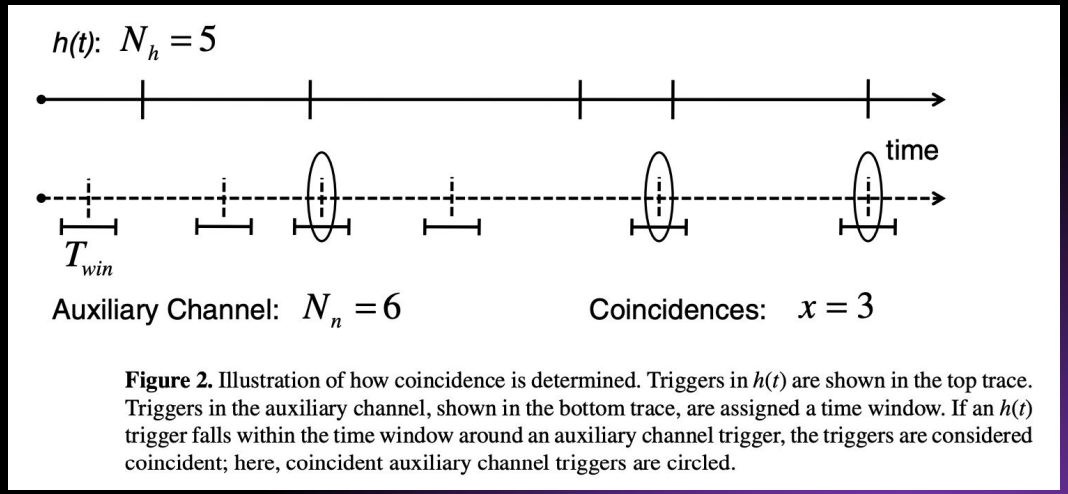


Figure 2. Illustration of how coincidence is determined. Triggers in $h(t)$ are shown in the top trace. Triggers in the auxiliary channel, shown in the bottom trace, are assigned a time window. If an $h(t)$ trigger falls within the time window around an auxiliary channel trigger, the triggers are considered coincident; here, coincident auxiliary channel triggers are circled.

J R Smith et al (2011)

HVeto uses a Poisson probability to quantify how unlikely it is that the observed DARM-AUX coincidences occurred by chance

$$S = -\log_{10}\left(\sum_{k=n}^{\infty} P(\mu, k)\right),$$

HVeto uses Omicron triggers to find statistically significant DARM-AUX coincidences

HVeto then takes these trigger lists and looks for statistically significant time coincidences

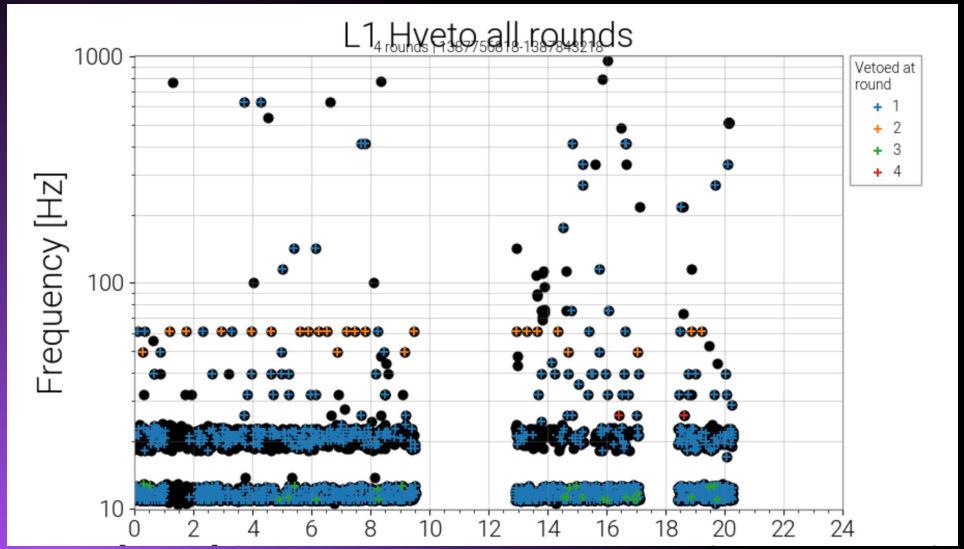
TOOLS - HVETO (Example)

1st round: Find the most significant AUX–DARM coincidence (the winner channel) → veto → remove associated DARM glitches

2nd round: Re-run on remaining DARM triggers → new channel → veto

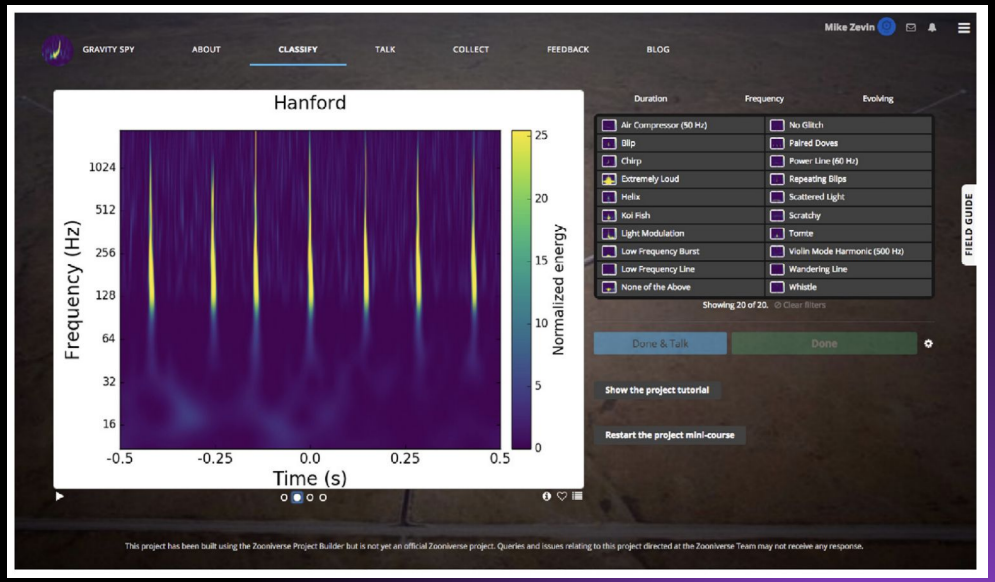
3rd round: Repeat → reveal additional coupling families

Stop: When no significant channels remain



TOOLS - GRAVITY SPY

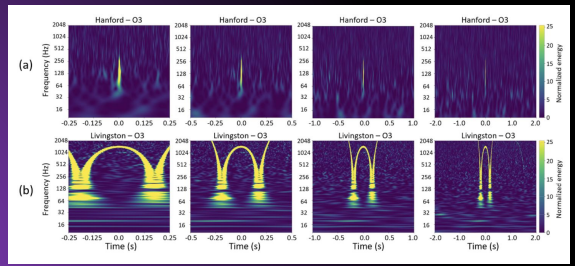
A machine-learning framework for classifying noise transients in gravitational-wave detectors



M Zevin et al. (2017)

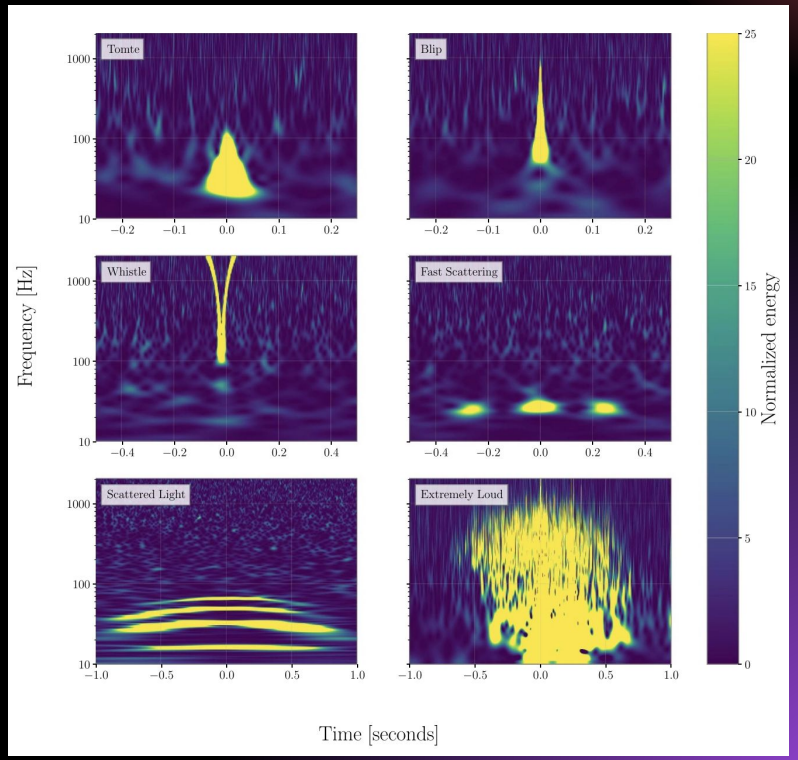
Combines community classifications, DetChar expertise, and a deep-learning pipeline to classify noise transients using Omicron spectrograms

Uses multi-time-window Omega scans of each transient



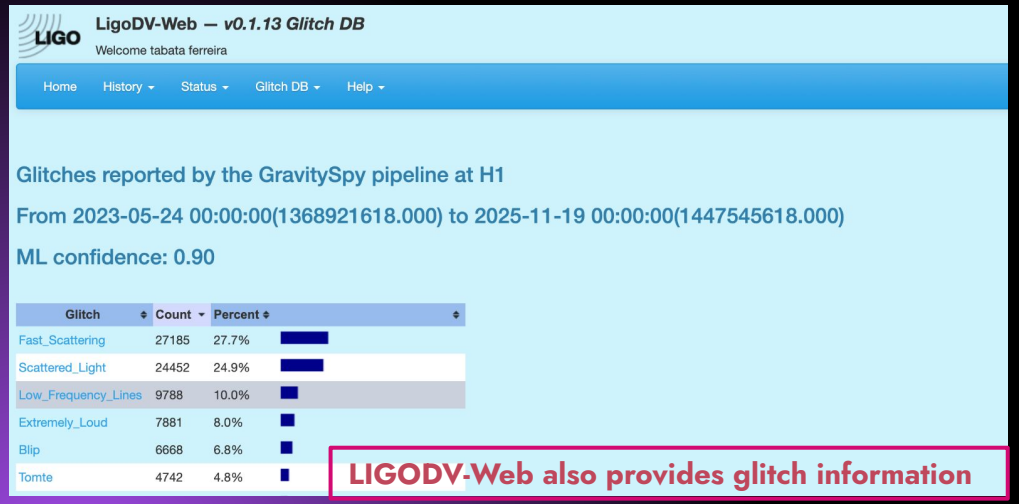
Y Wu et al. (2017)

TOOLS - GRAVITY SPY (Example)



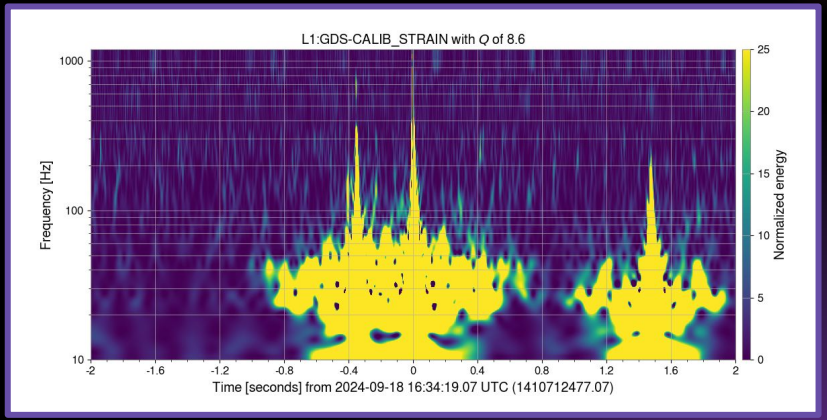
J Glanzer et al. (2020)

Class labels enable DetChar to study glitch populations statistically: counting dominant classes, identifying emerging morphologies, and tracking their evolution over time, which may reveal changes in noise coupling mechanisms.



TOOLS - OMEGA SCAN

We can select a glitch class and investigate its behavior and possible coupling.



TOOLS - OMEGA SCAN

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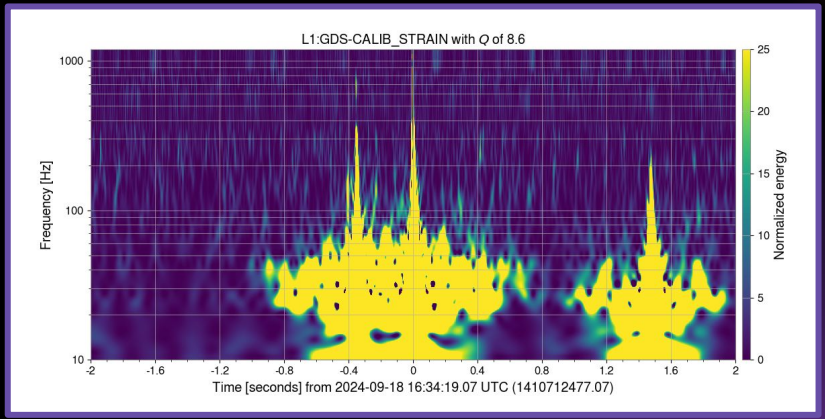
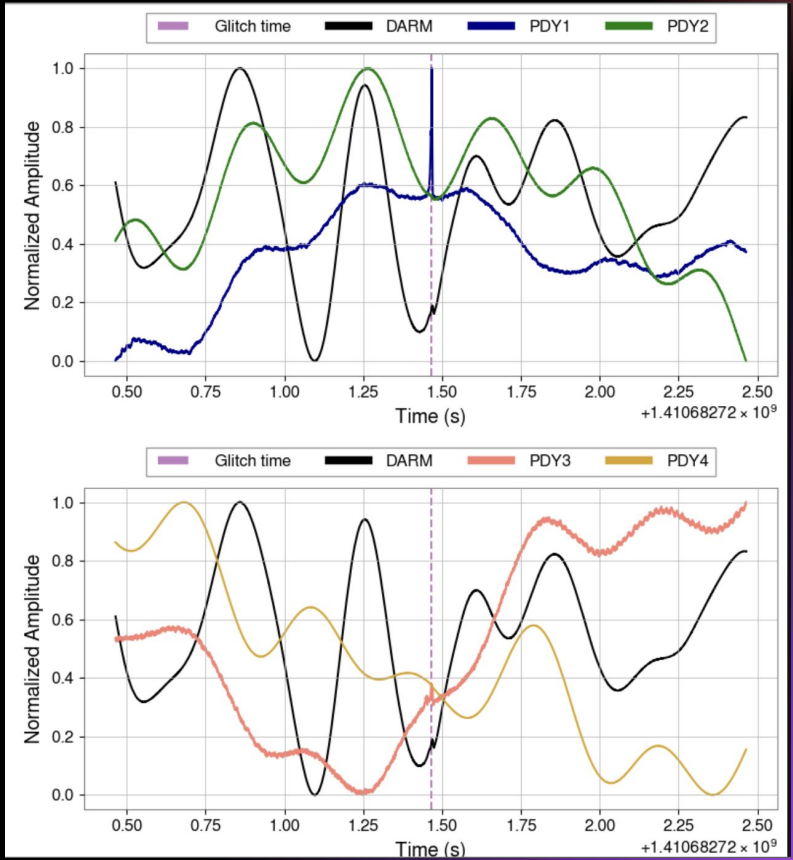
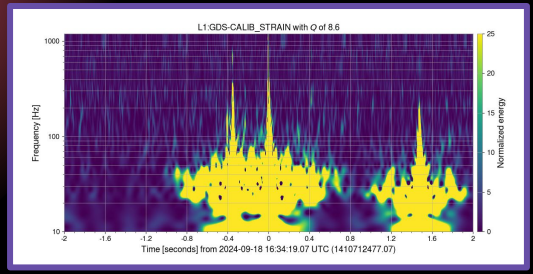
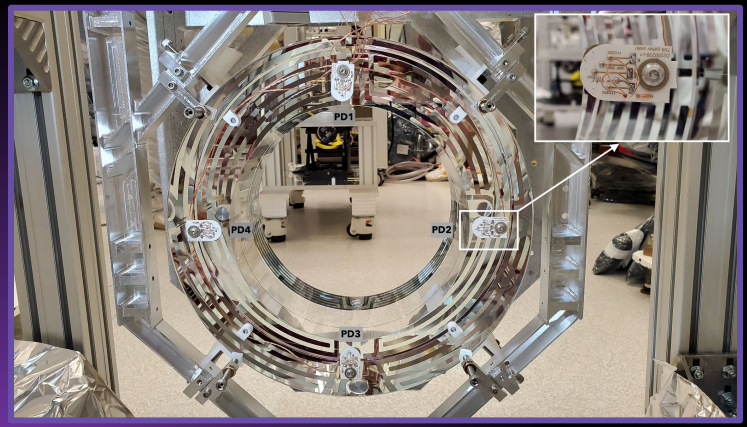


As output, the Omega Batch generates an HTML summary page for each input time, showing the event's spectrograms, trigger properties, and the top auxiliary channels ranked by their correlation with DARM.

TOOLS - OMEGA SCAN (EXAMPLE)

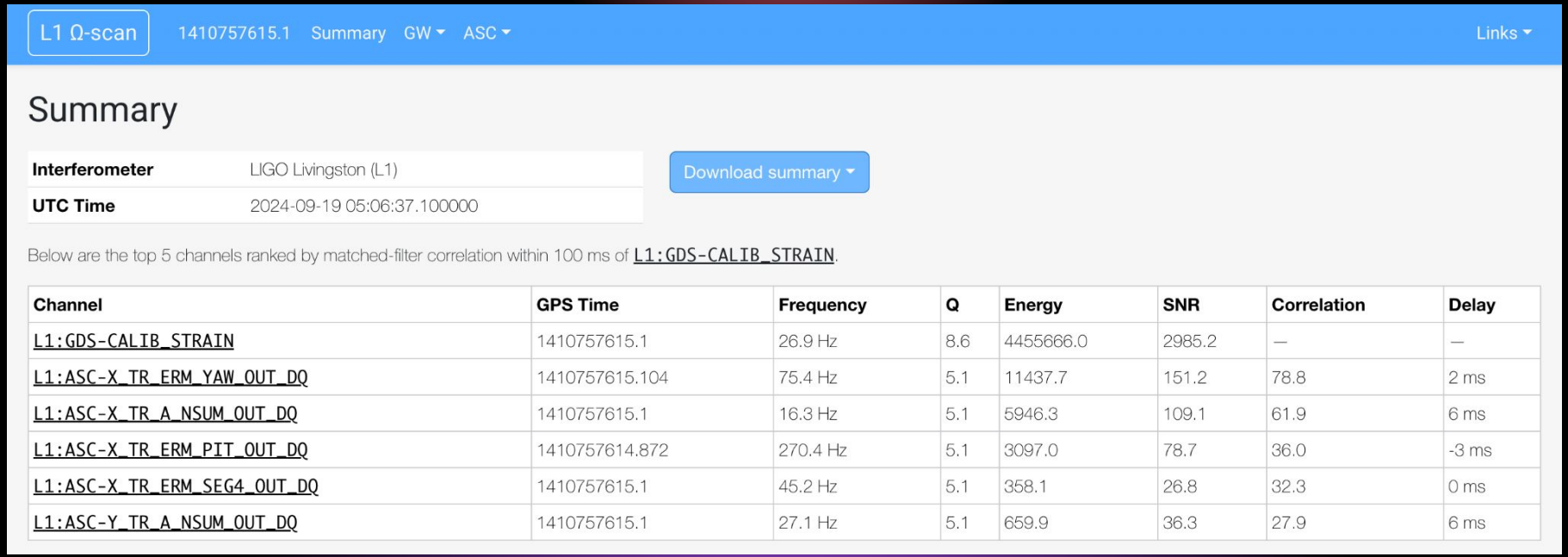






https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=73447

TOOLS - OMEGA SCAN (EXAMPLE)



L1 Ω-scan 1410757615.1 Summary GW ASC Links

Summary

Interferometer	LIGO Livingston (L1)
UTC Time	2024-09-19 05:06:37.100000

Download summary

Below are the top 5 channels ranked by matched-filter correlation within 100 ms of L1:GDS-CALIB_STRAIN.

Channel	GPS Time	Frequency	Q	Energy	SNR	Correlation	Delay
L1:GDS-CALIB_STRAIN	1410757615.1	26.9 Hz	8.6	4455666.0	2985.2	—	—
L1:ASC-X_TR_ERM_YAW_OUT_DQ	1410757615.104	75.4 Hz	5.1	11437.7	151.2	78.8	2 ms
L1:ASC-X_TR_A_NSUM_OUT_DQ	1410757615.1	16.3 Hz	5.1	5946.3	109.1	61.9	6 ms
L1:ASC-X_TR_ERM_PIT_OUT_DQ	1410757614.872	270.4 Hz	5.1	3097.0	78.7	36.0	-3 ms
L1:ASC-X_TR_ERM_SEG4_OUT_DQ	1410757615.1	45.2 Hz	5.1	358.1	26.8	32.3	0 ms
L1:ASC-Y_TR_A_NSUM_OUT_DQ	1410757615.1	27.1 Hz	5.1	659.9	36.3	27.9	6 ms

TOOLS - OMEGA SCAN (EXAMPLE)

L1 Ω-scan 1410757615.1 Summary GW ASC Links

Summary

Channel details

Interfer

UTC Tir

Below are

Channe

L1:GDS

L1:ASC

L1:ASC

L1:ASC

L1:ASC

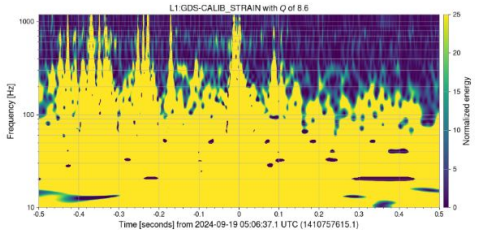
L1:ASC

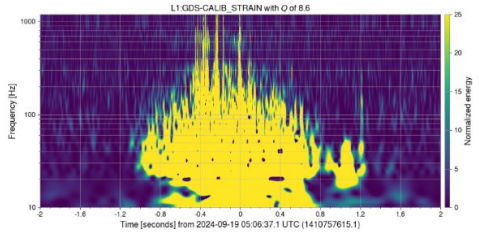
GW: Gravitational Wave Strain

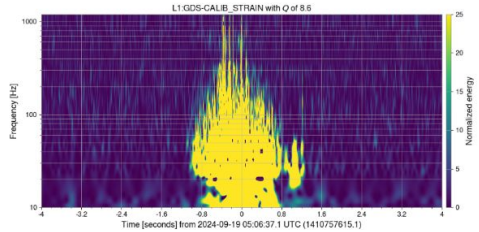
L1:GDS-CALIB_STRAIN

GPS Time	Frequency	Q	Energy	SNR	Correlation	Delay
1410757615.1	26.9 Hz	8.6	4455666.0	2985.2	3823.7	0 ms

Timeseries Spectrogram Eventgram







TOOLS - OMEGA SCAN (EXAMPLE)

L1 Ω-scan | 1410757615.1 | Summary | GW | ASC | Links

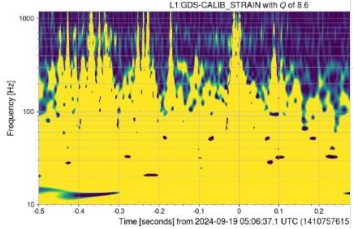
Summary

Channel details

GW: Gravitational Wave Strain

L1:GDS-CALIB_STRAIN

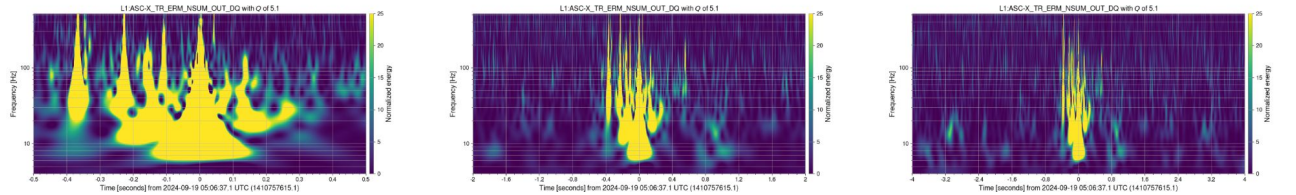
GPS Time	Frequency	Q
1410757615.1	26.9 Hz	8



L1:ASC-X_TR_ERM_NSUM_OUT_DQ

GPS Time	Frequency	Q	Energy	SNR	Correlation	Delay
1410757615.1	45.2 Hz	5.1	15614.8	176.7	135.3	0 ms

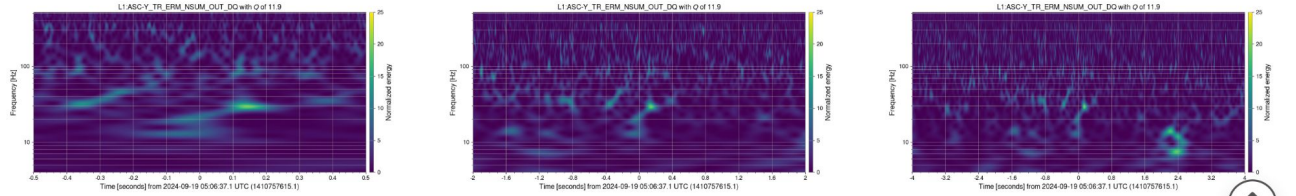
Timeseries | Spectrogram | Eventgram



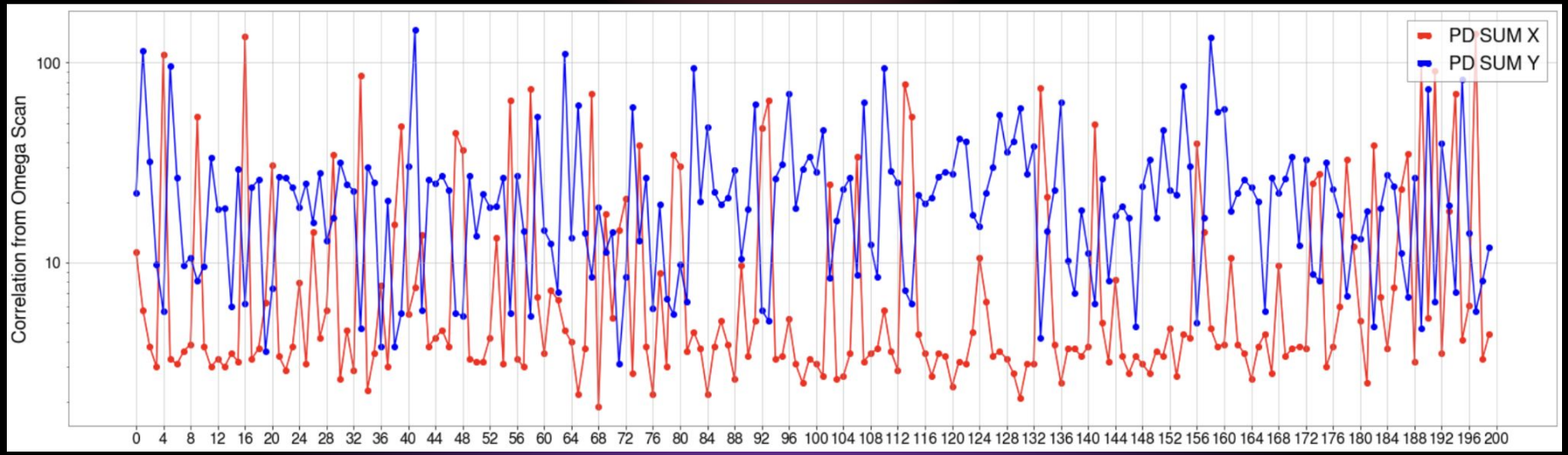
L1:ASC-Y_TR_ERM_NSUM_OUT_DQ

GPS Time	Frequency	Q	Energy	SNR	Correlation	Delay
1410757615.232	28.8 Hz	11.9	19.0	6.2	6.2	6 ms

Timeseries | Spectrogram | Eventgram



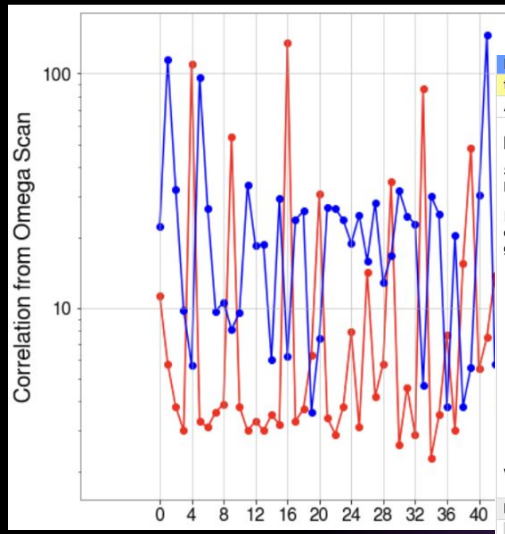
TOOLS - OMEGA SCAN (EXAMPLE)



https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=73447

In this case, the Omega Scan revealed that loud glitches are most often correlated with ERM PDs either in the x-arm or in the y-arm, but not both.

TOOLS - OMEGA SCAN (EXAMPLE)



PD SUM X

L1 ISC (Detchar) Link

tabata.ferreira@LIGO.ORG - posted 18:10, Monday 07 October 2024 (73447)

Analysis of Individual TR ERM PDs During Loud Glitches

[Tabata, Gaby]

Summary: the ERM PDs (alog 72968) have correlations with DARM during loud glitches, and these correlations are, in most cases, only with the X arm or only with the Y arm. The signals of individual PDs increase during loud glitches, consistent with 'dust' scattering light back to the ERM PDs and forward to DARM. According to the OmegaScan analysis, in most cases, at least three PDs are affected during a loud glitch

In the alog 73024, we analyzed the coincidences of Loud Glitches with TR ERM PDs through the SUM channels (ASC-X_TR_ERM_NSUM_OUT_DQ/ASC-Y_TR_ERM_NSUM_OUT_DQ). Here, we present a quick overview of the data for the four individual PDs (L1:ISC-X_TR_ERM_SEG*_OUT_DQ/L1:ISC-Y_TR_ERM_SEG*_OUT_DQ) available from September 17th (alog 73135). For the analysis, we selected the 200 loudest glitches from September 18 to September 30. The lowest SNR in this dataset was 182.

- Looking at the raw normalized time series, the amplitude of the signal in the PDs goes up in most cases. This indicates that if dust is causing this, it is probably scattering the light rather than blocking it. Image 1 presents an example where PD1 (blue) and PD3 (salmon) show an increase in signal during the presence of a loud glitch in DARM (black).

- Image 2 shows the SNR behavior (y-axis) for each PD in the Y arm for 100 glitches (x-axis). We can see that they go up and down together most of the time, suggesting that most of the PDs witness the signal. Interestingly, PD3 in the Y arm seems to have the highest SNR in most cases as well.

- Figure 3 presents the correlation from OmegaScan for the SUM channels for each arm. This illustrates the fact that when there is a high correlation with the X arm, there is a low correlation with the Y arm, and vice versa. In the previous dataset (alog 73024), the number of coincidences with the Y arm was very similar to those with the X arm; however, according to OmegaScan, the PDs in the Y arm show more correlations in this dataset.

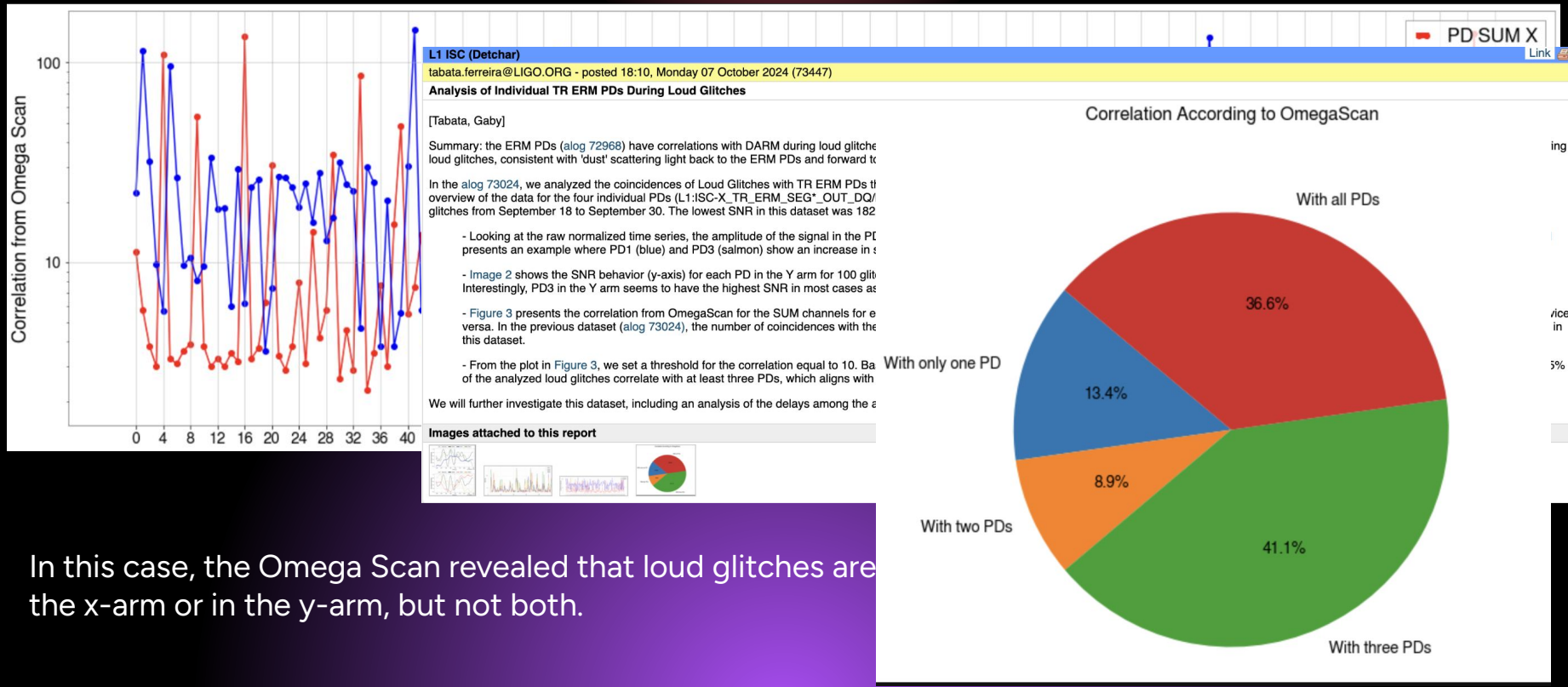
- From the plot in Figure 3, we set a threshold for the correlation equal to 10. Based on this threshold, we calculated the percentage of PDs that have correlations above 10. As illustrated in Figure 4, more than 75% of the analyzed loud glitches correlate with at least three PDs, which aligns with the plot presented in Figure 3.

We will further investigate this dataset, including an analysis of the delays among the affected individual PDs. In addition, we will calculate the coherence to cross-check with OmegaScan.

Images attached to this report

In this case, the Omega Scan revealed that loud glitches are most often correlated with ERM PDs either in the x-arm or in the y-arm, but not both.

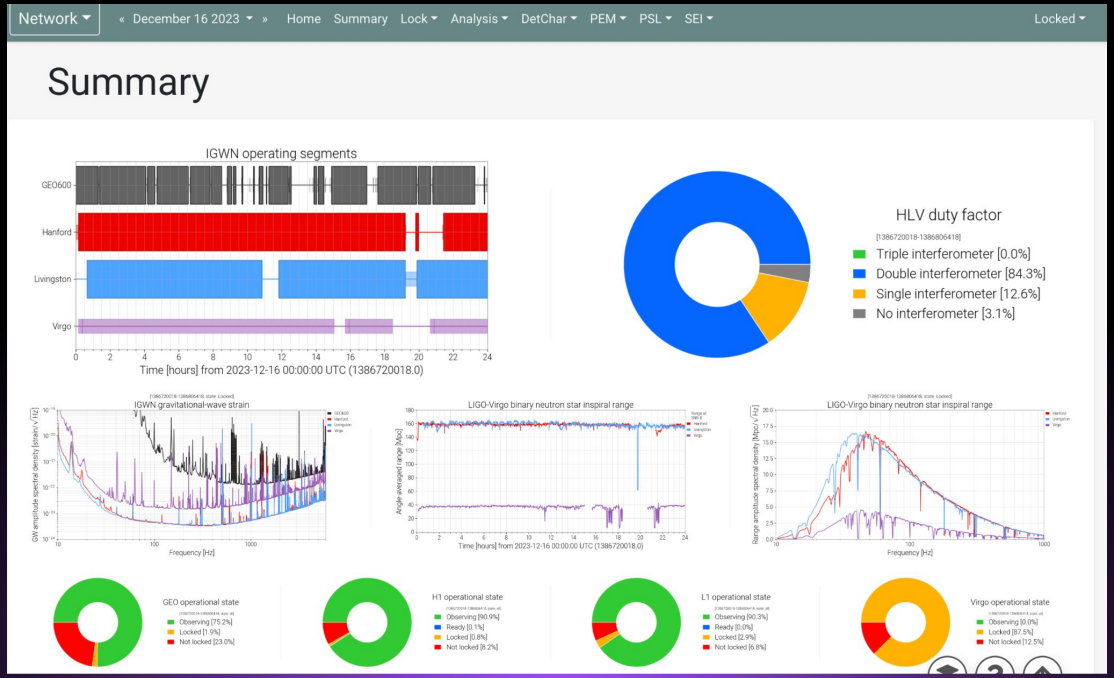
TOOLS - OMEGA SCAN (EXAMPLE)



In this case, the Omega Scan revealed that loud glitches are
the x-arm or in the y-arm, but not both.

TOOLS - SUMMARY PAGES

Pages that provide daily and real-time summaries of detector performance, environmental conditions, and data-quality indicators, integrating information from multiple diagnostic tools.



TOOLS - SUMMARY PAGES

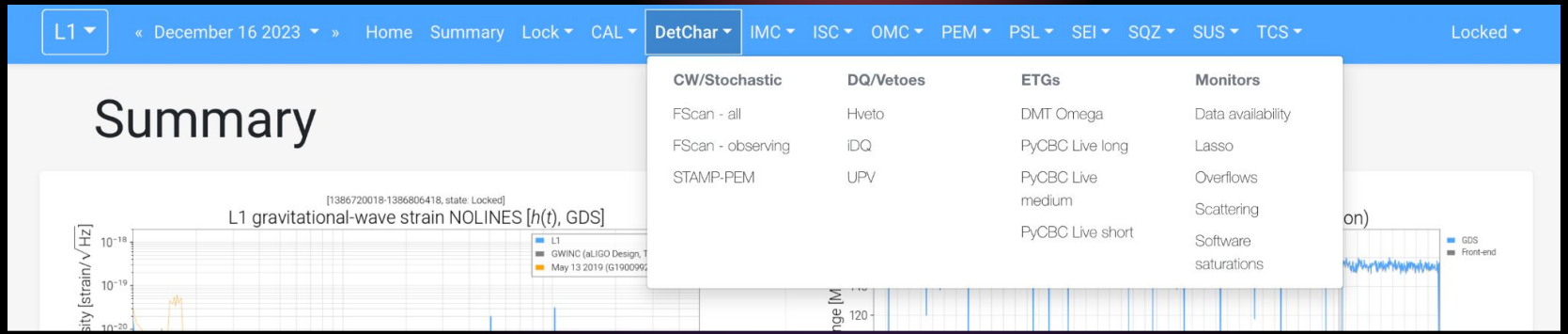
Pages that provide daily and real-time summaries of detector performance, environmental conditions, and data-quality indicators, integrating information from multiple diagnostic tools.

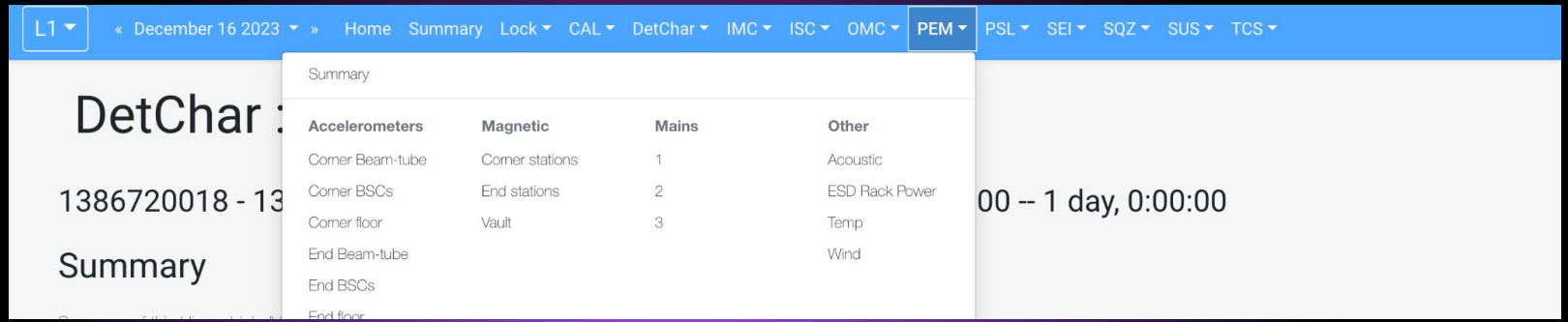
https://ldas-jobs.ligo-la.caltech.edu/~detchar/summary/

https://ldas-jobs.ligo-wa.caltech.edu/~detchar/summary/

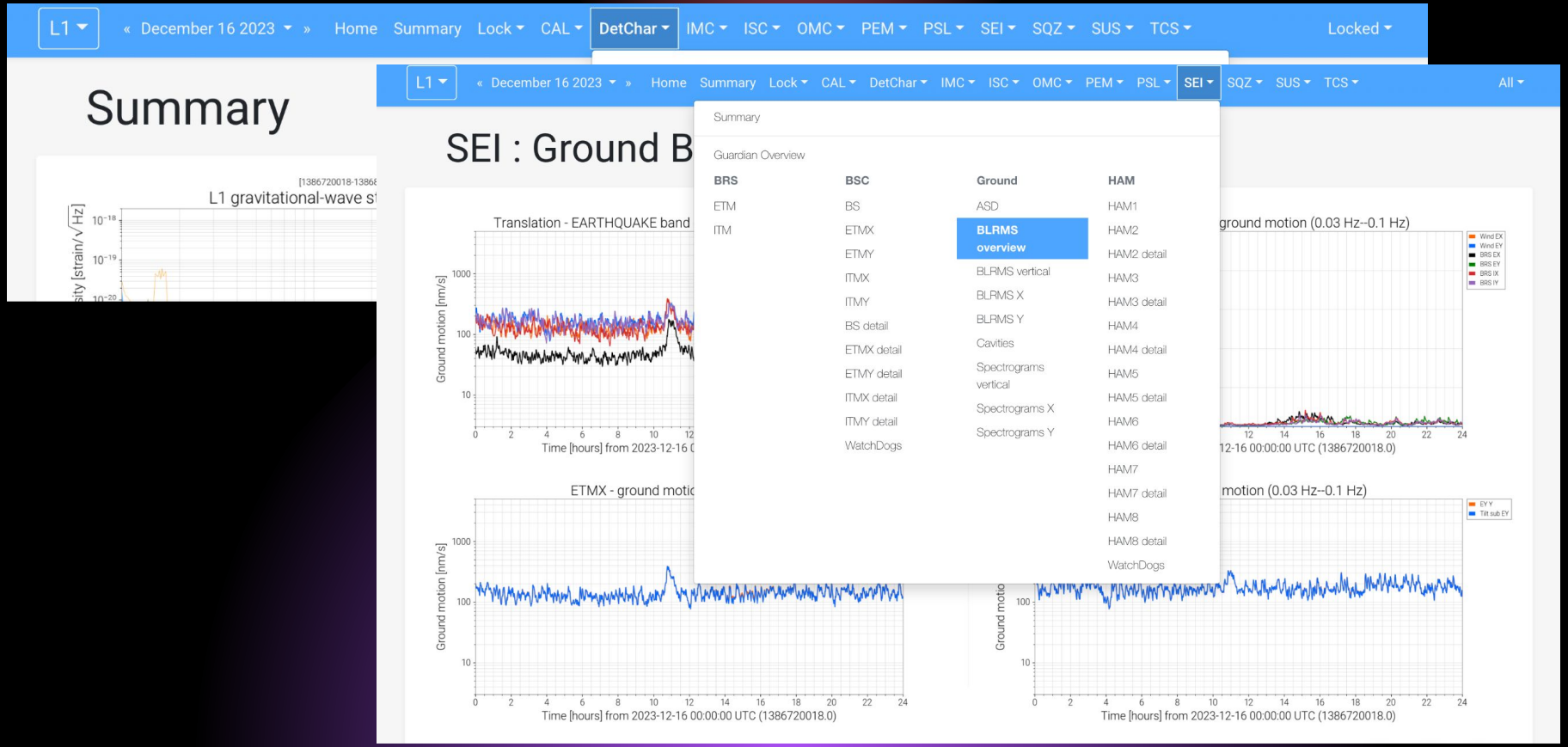
https://vim.virgo-gw.eu

TOOLS - SUMMARY PAGES

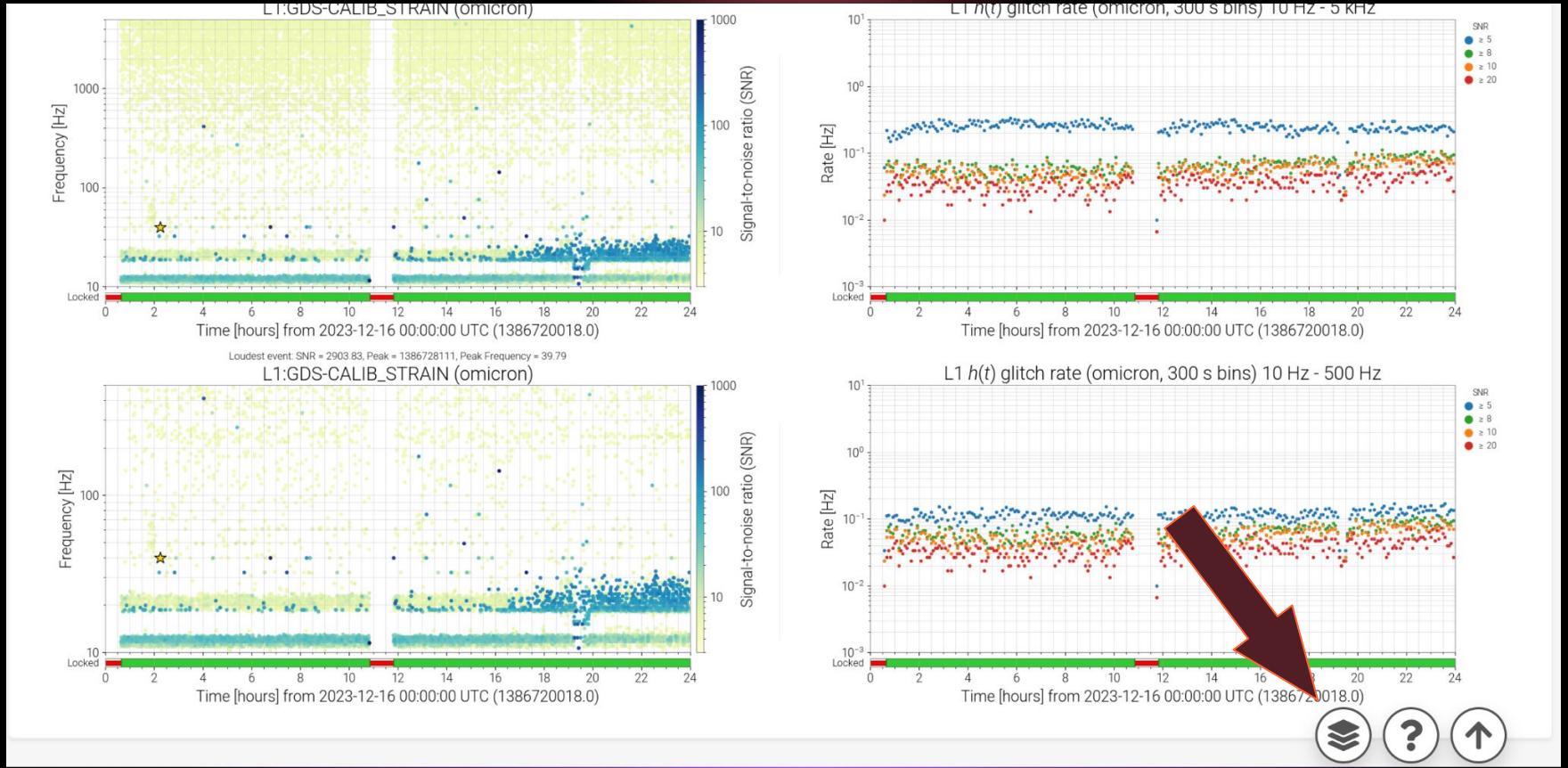




TOOLS - SUMMARY PAGES



TOOLS - SUMMARY PAGES



TOO

Overlay figures

Overlay figures for easy comparison

Instructions

This tool is designed to help visually correlate multiple types of data by laying transparent figures atop one another. To use it, follow these steps:

- From the main page(s), drag-and-drop figures onto the button with this icon:
- Expand this dialog box and use the `Overlay` button (to the right) to render a new figure by overlaying the ones selected
- Add more figures using the steps above, click `Overlay` to re-render, and use the `Download` button to save to a local file
- Use the `Clear` button to clear all figure selections

Note: figures are remembered across tabs, so multiple times and subsystems can be compared at once.

Overlay | Download | Clear

Summary and Conclusions

- Noise can couple into the strain channel through different pathways, and understanding these mechanisms is essential for improving detector performance.
- Auxiliary channels provide crucial information to identify where noise originates and how it propagates into DARM.
- Tools such as Fscan, Omicron, HVeto, Omega Scan, Gravity Spy, and the DetChar summary pages help reveal noise features, transient behavior, and potential coupling mechanisms.
- Together, these tools support DetChar efforts to diagnose, track, and mitigate noise, ultimately improving the sensitivity..
- Many other tools also deserve attention, such as iDQ, UPV, BRUCO, LASSO, and STOCHMON.
- In addition, DetChar continuously develops and explores custom tools and analysis methods, incorporating new techniques as needed.

THANK YOU!

Any questions?