



Frequency Hunting Application for Beam Noise Detection

DEELS'18

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ALBA Synchrotron

The Problem

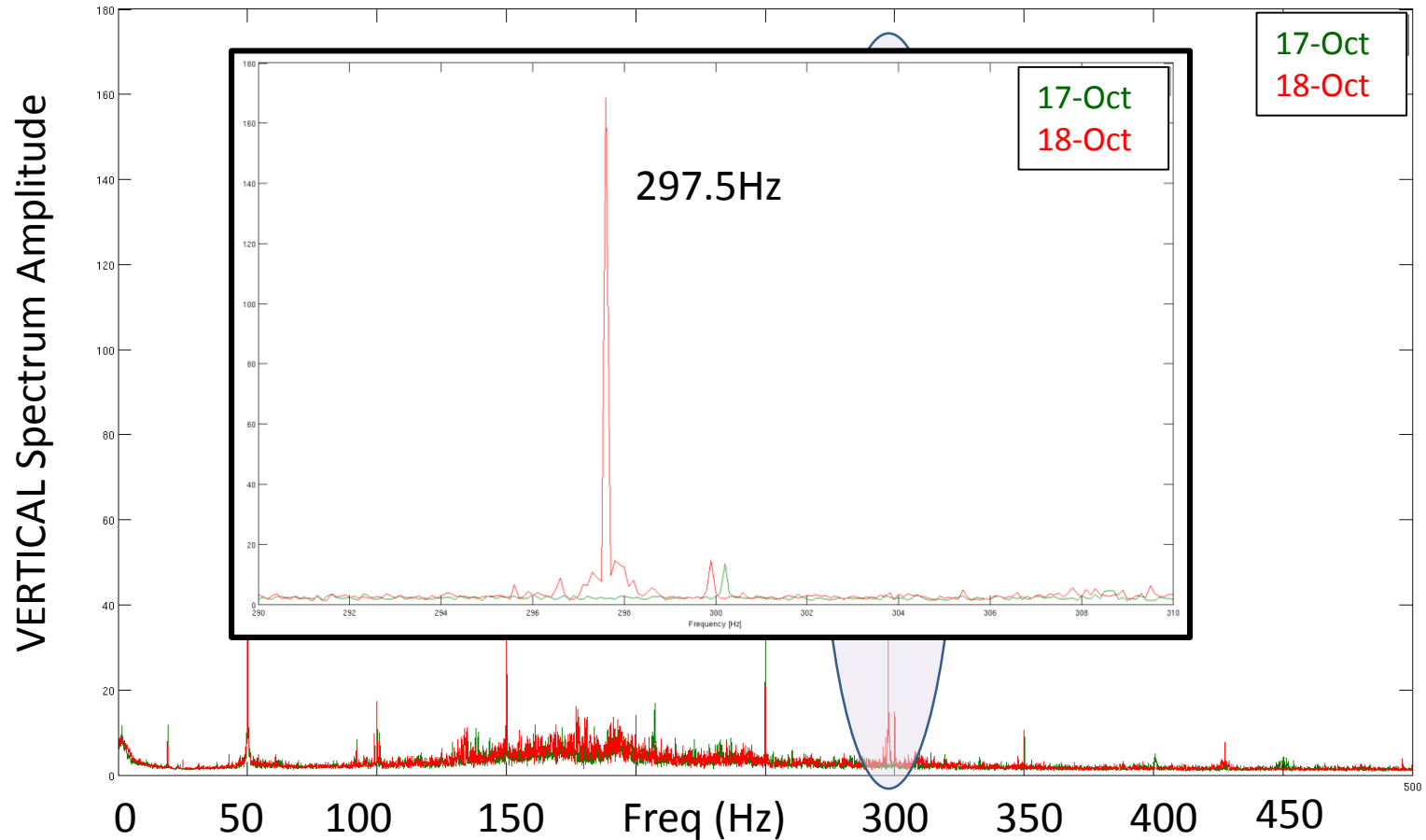
Frequencies
tracking app

Tracked
events

What's next?

The Problem

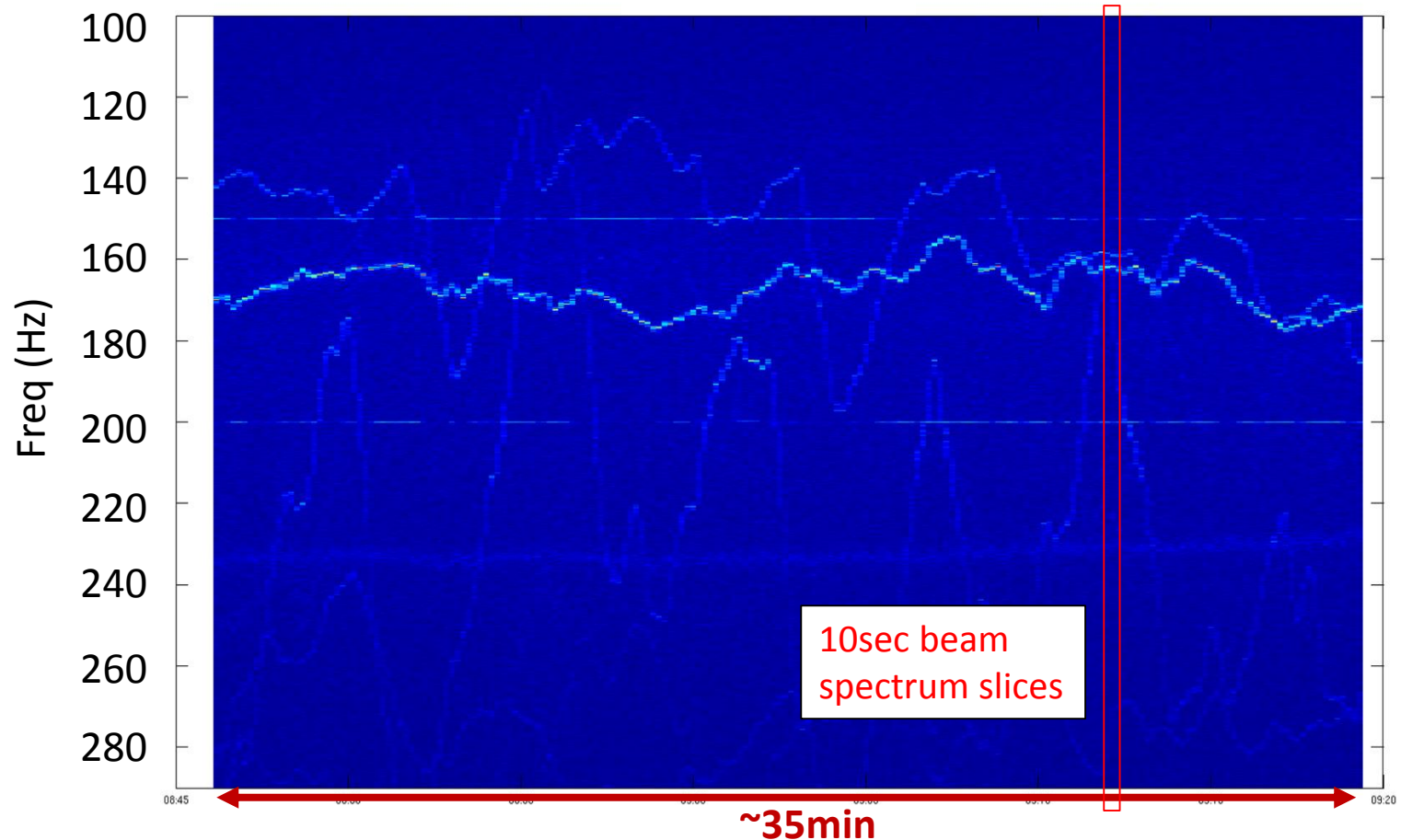
- Weird orbit distortions showing up and vanishing
- We ca not correlate these perturbations directly with its source, because they appear at random times



The Problem

- They do not have frequencies easily identifiable with a subsystem
- We need a reliable way to keep track of this unusual frequencies

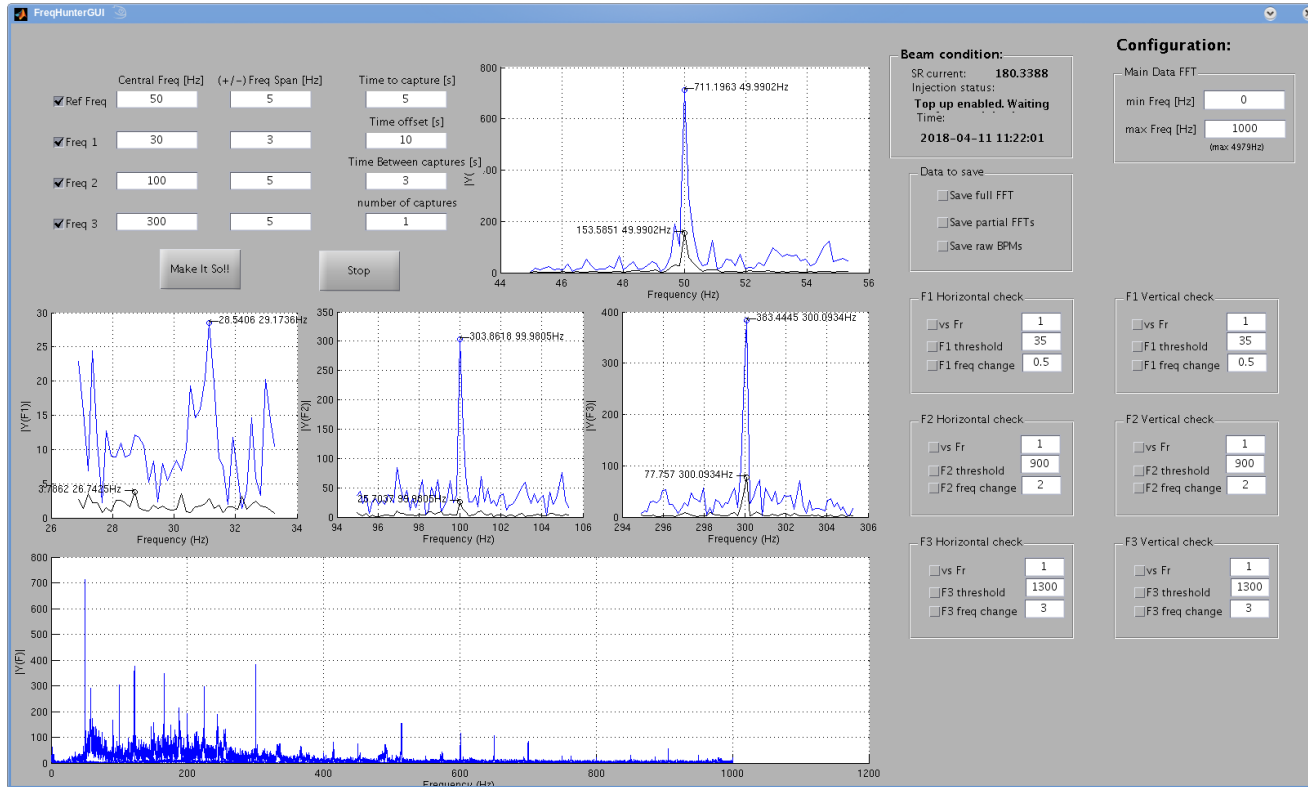
24-November



Frequencies tracking app

1st attempt

Matlab GUI to keep track of up to 3 frequencies using the data from the Fast Archiver

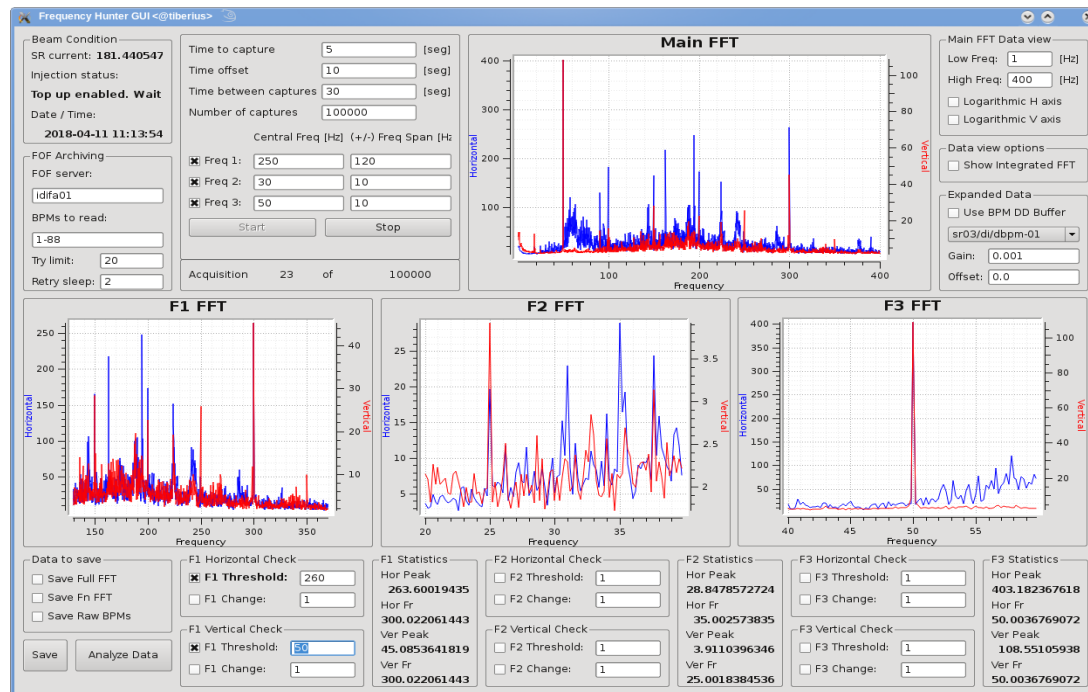


Not very reliable, uses a lot of computing power and needs a dedicated Matlab license (quite coveted at ALBA)

Frequencies tracking app

2nd attempt: “Frequencies Hunter”

- Made in python → free
- Memory handling under control
- Stable → more that 3 months working without any problem
- Keep track of 3 frequencies at the same time, together with many machine parameters (beam current, FOFB status, Injector status, ...)



Frequencies tracking app

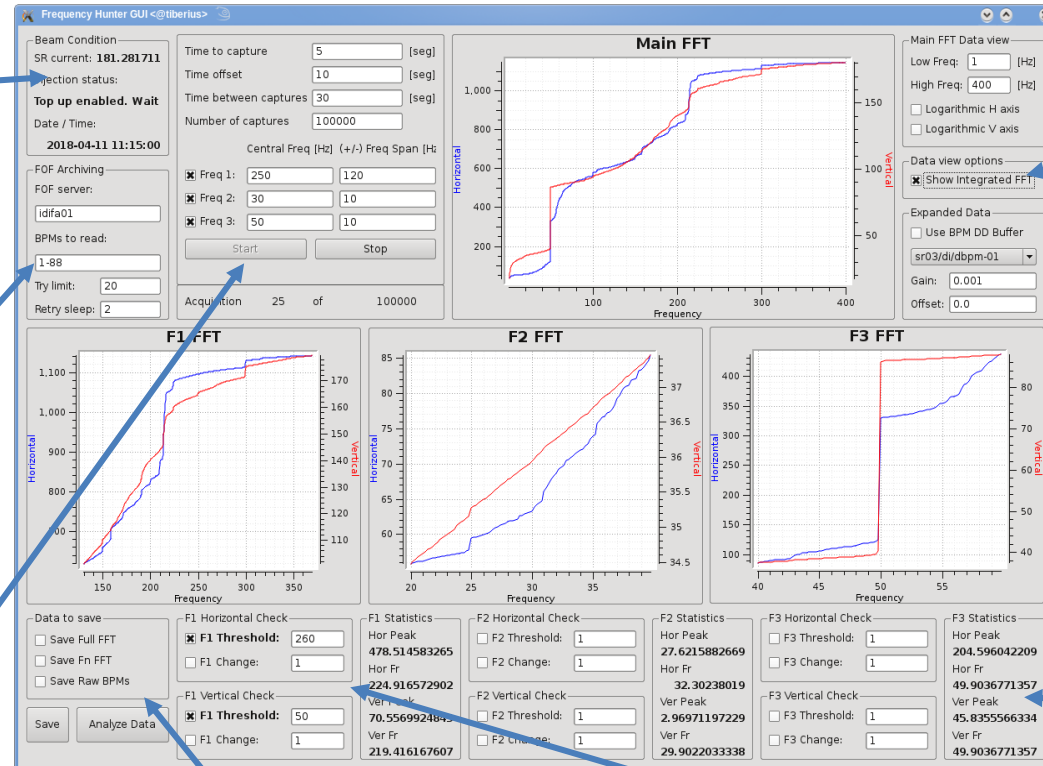
2nd attempt: "Frequencies Hunter"

Machine Status:

- SR current
- Working mode
- Date - Time

- BPMs to check
- Number of tries before error
- Sleep time between retries

- Time span to analyze
- Time between captures
- Number of captures
- Central frequency and side bands to monitor



Data view options

Tracked frequencies Stats

Data to save:

- Full FFT
- Partial FFT
- Full BPMs raw data

Save data conditions:

- Frequency peak value
- Absolute frequency movement



Frequencies tracking app

Log File

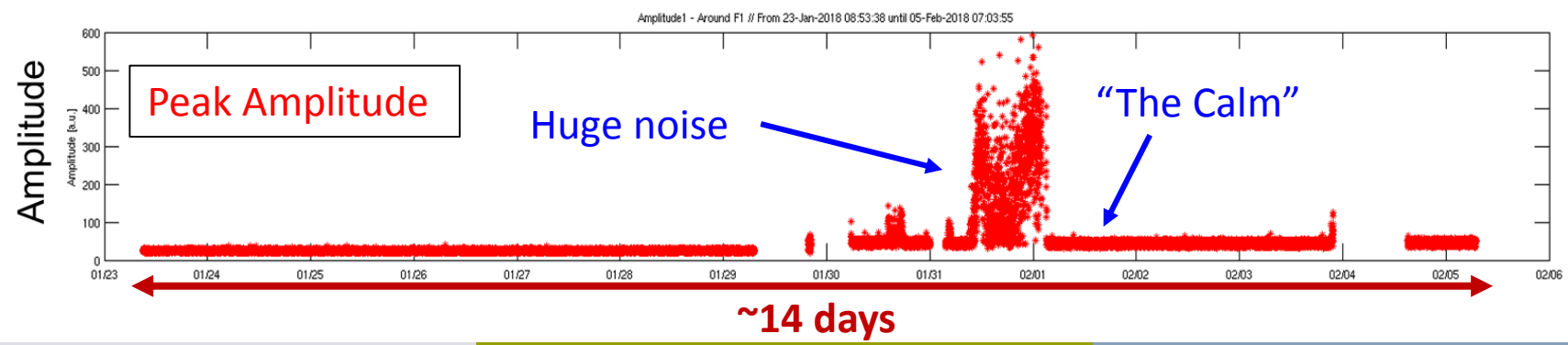
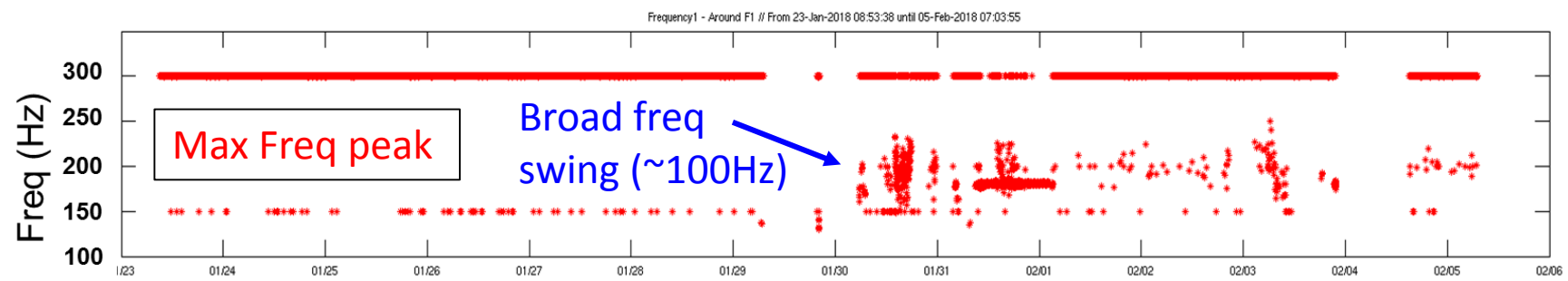
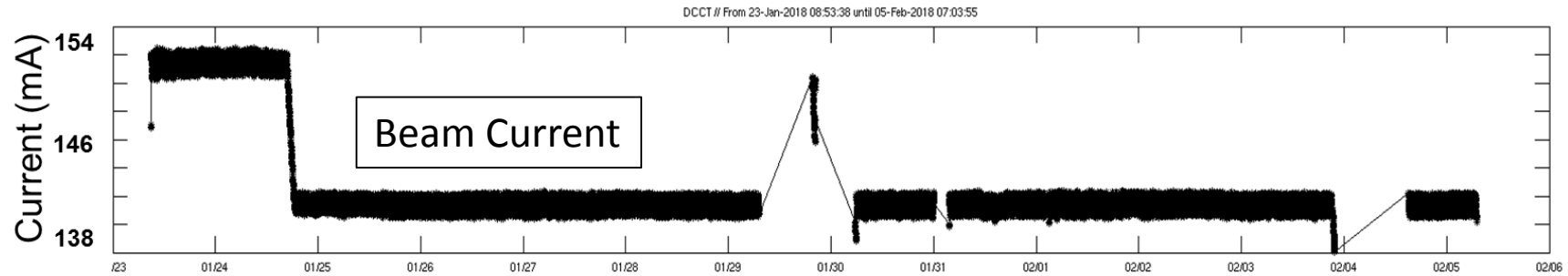
- FFT values of the tracked frequencies saved in a log file
- Log is updated on every acquisition loop, even if the save data conditions are not met
- Off-line analysis of the file allow us to identify freq peaks vs. time and machine status

TimeTx	TimeNum	SRcurrent	F1AH	F1FH	F1AV	F1FV	F2AH	F2FH	F2AV	F2FV	F3AH	F3FH	F3AV	F3FV	F1Saved	F2Saved	F3Saved	FFTSaved	RawSaved	InjStatus	FOFB
20180411110147	737161.46	180.37	259.13	300.01	42.94	300.01	22.23	39.4	4.31	25	408.96	50	110.37	50	FALSE	FALSE	TRUE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110221	737161.46	180.29	275.14	299.82	48.74	299.82	26.39	31	4.33	25	420.17	50	106.26	50	FALSE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110254	737161.46	180.22	326.75	240.81	60.88	217.91	28.75	31.8	2.93	29.9	189.98	49.9	44.67	49.9	TRUE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110327	737161.46	180.13	301.87	224.91	59.84	222.31	28.01	32.3	3.06	29.9	186.94	49.9	45.02	49.9	TRUE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110401	737161.46	180.06	308.36	224.91	60.51	219.01	26.78	31.9	3.08	29.9	202.92	49.9	46.59	49.9	TRUE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110434	737161.46	179.98	304.93	299.82	50.59	299.82	25.04	31	3.59	25	420.76	50	106.15	50	TRUE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110507	737161.46	179.9	267.53	299.81	45.61	299.81	19.92	35.2	3.96	25	436.17	50	106.15	50	FALSE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411110540	737161.46	179.82	257.09	299.81	44.54	299.81	22.04	39.4	4.19	25	407.58	50	108.46	50	FALSE	FALSE	FALSE	FALSE	FALSE	Warming up	ON
20180411110613	737161.46	179.75	242.44	299.81	44.21	299.81	20.38	39.4	4.12	25	393.47	50	108.31	50	FALSE	FALSE	FALSE	FALSE	FALSE	Warming up	ON
20180411110646	737161.46	179.67	275.14	300.01	46.74	300.01	24.64	31	3.55	25	416.64	50	109.19	50	FALSE	FALSE	FALSE	FALSE	FALSE	Warming up	ON
20180411110719	737161.46	179.59	268.62	300.01	47.74	300.01	21.38	38.6	4.24	25	430.12	50	110.68	50	FALSE	FALSE	TRUE	FALSE	FALSE	Warming up	ON
20180411110752	737161.46	179.52	196.84	300.01	34.28	300.01	23.33	38	4.02	25	397.7	50	111.65	50	FALSE	FALSE	TRUE	FALSE	FALSE	Warming up	ON
20180411110825	737161.46	179.44	272.17	300.01	46.55	300.01	23.81	39.6	4.13	25	415.43	50	111.36	50	FALSE	FALSE	TRUE	FALSE	FALSE	Warming up	ON
20180411110858	737161.46	180.39	282.4	300.01	48.7	300.01	21.34	25	4.2	25	407.1	50	110.04	50	FALSE	FALSE	TRUE	FALSE	FALSE	Top up enabled. Injecting.	ON
20180411111036	737161.47	181.91	254.24	300.02	44.62	300.02	23.41	38.6	4.2	25	439.8	50	107.02	50	FALSE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411111109	737161.47	181.84	292.79	300.21	50.66	300.21	22.35	35	3.82	25	406.23	50	102.82	50	FALSE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON
20180411111142	737161.47	181.75	218.85	223.62	38.79	300.02	20.94	39.2	4.27	25	418.37	50	108.79	50	FALSE	FALSE	FALSE	FALSE	FALSE	Top up enabled. Waiting for next injection.	ON

Tracked events – Case1

Swinging 150-250Hz

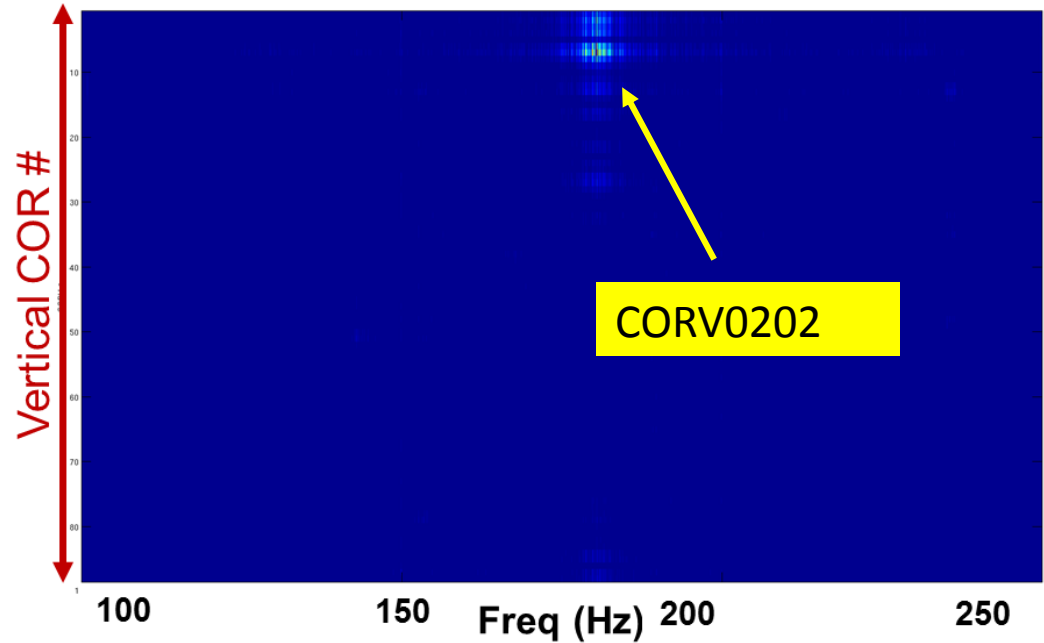
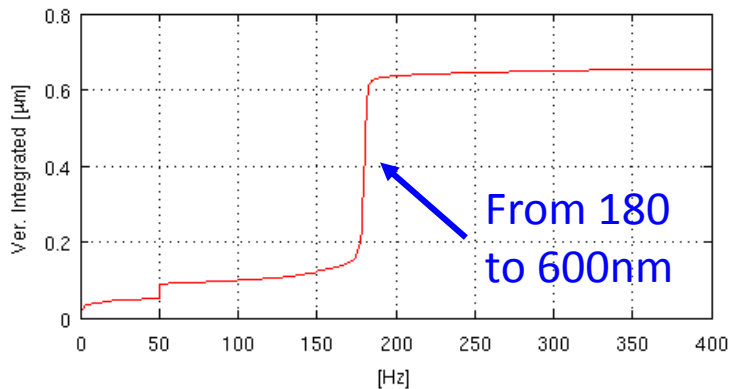
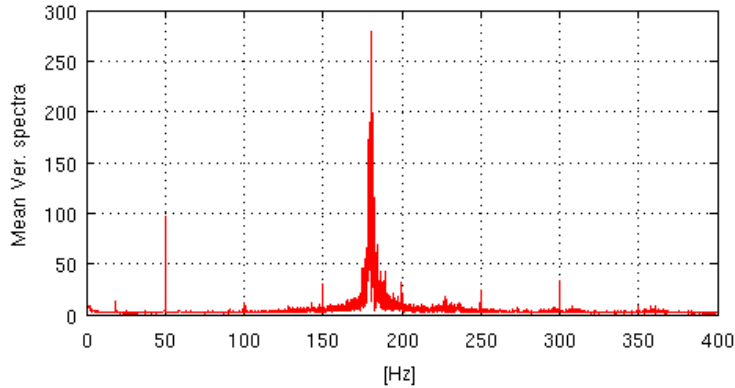
23-Jan until 05-Feb



Tracked events – Case1

Swinging 150-250Hz

Retrieved data from the “noisy day”

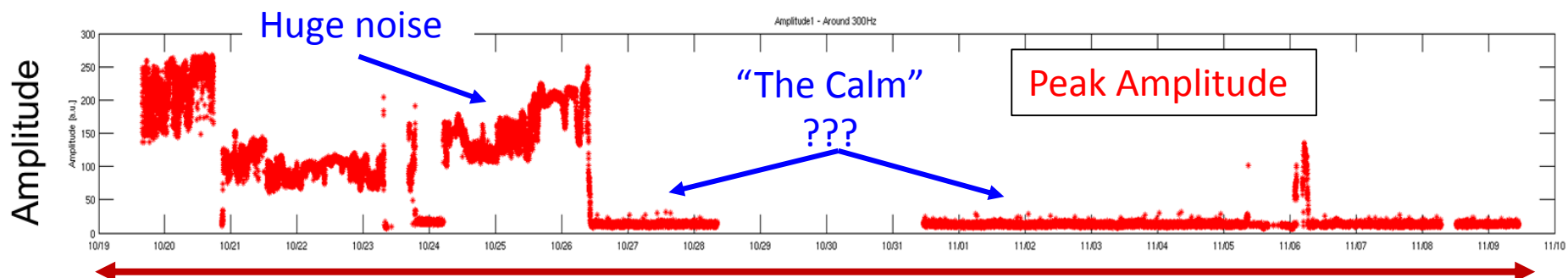
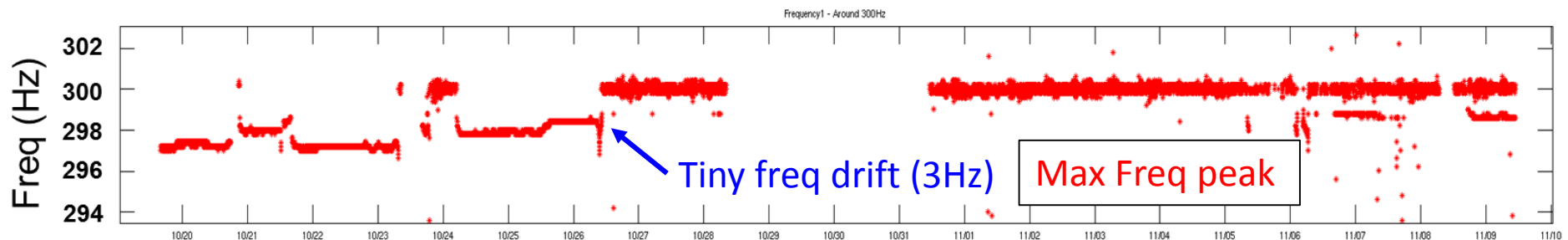
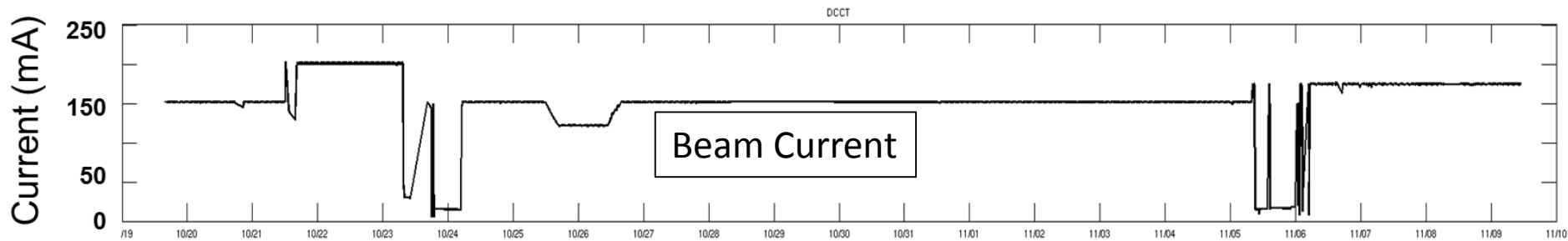


CORV0202 replaced on the 5th of February → **Swinging peak gone since then**

Tracked events – Case2

297Hz vertical noise

19-Oct until 11-Nov



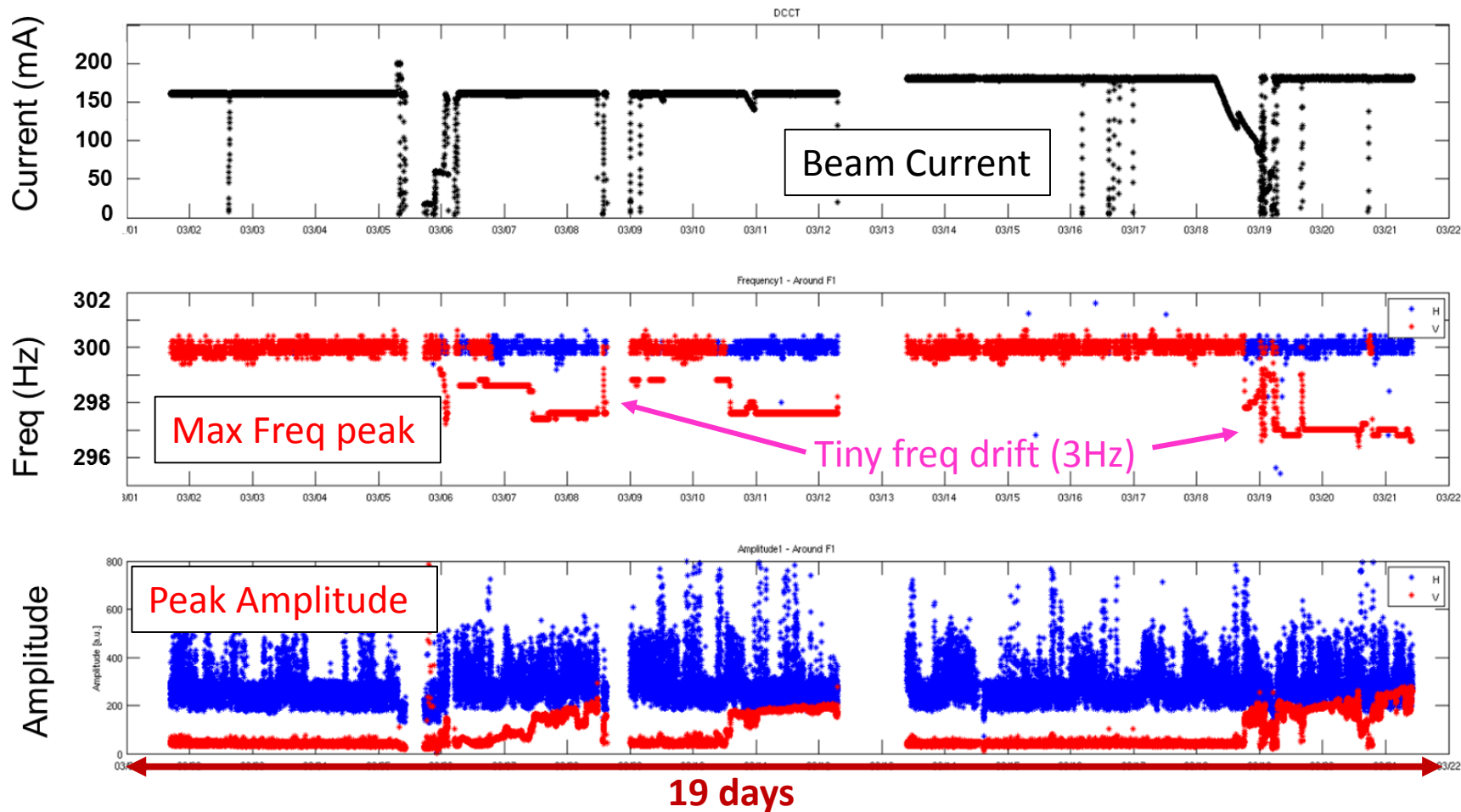
~20 days

Tracked events – Case2

297Hz vertical noise

01-Mar until 21-Mar

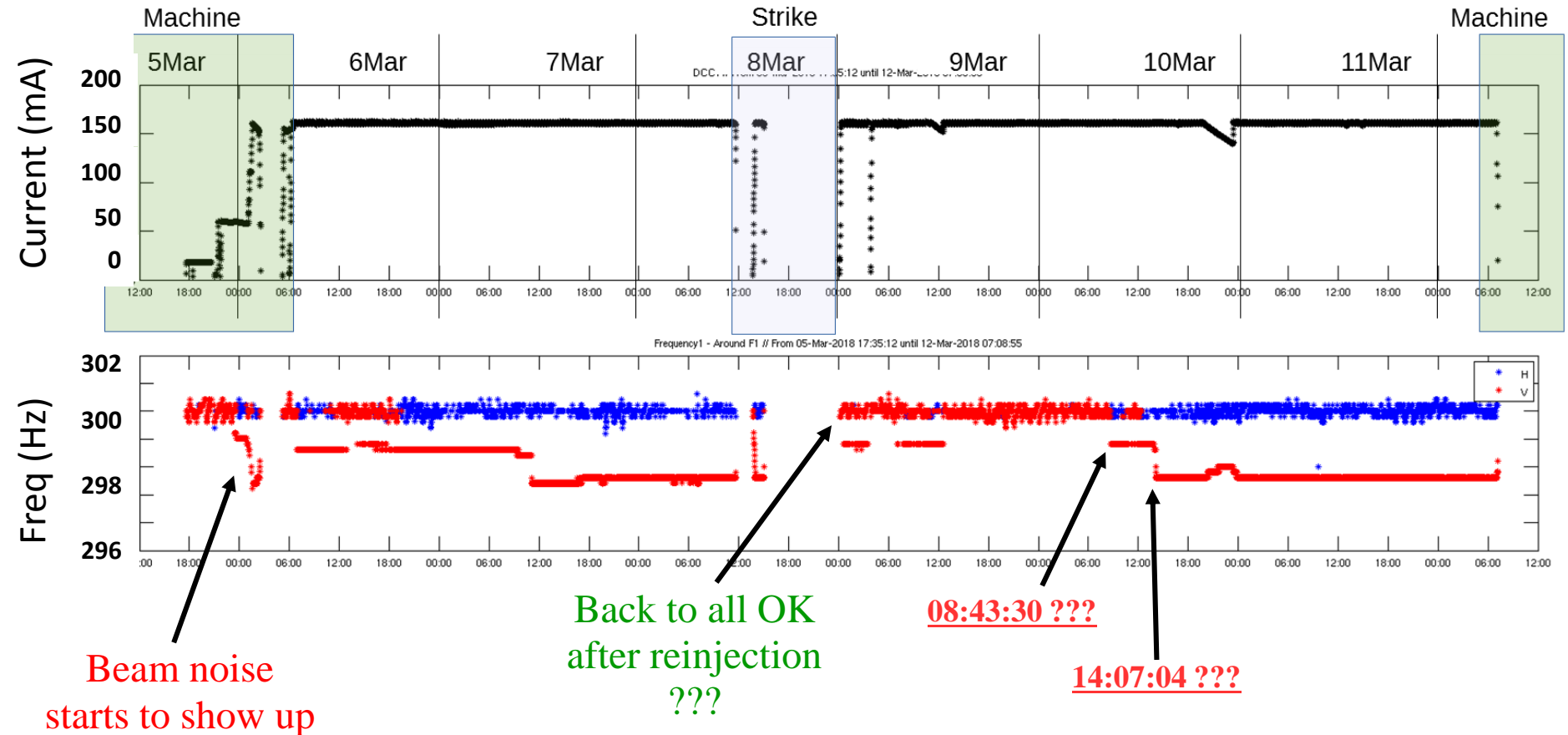
~ 297Hz vertical noise showing up again from time to time



Tracked events – Case2

297Hz vertical noise

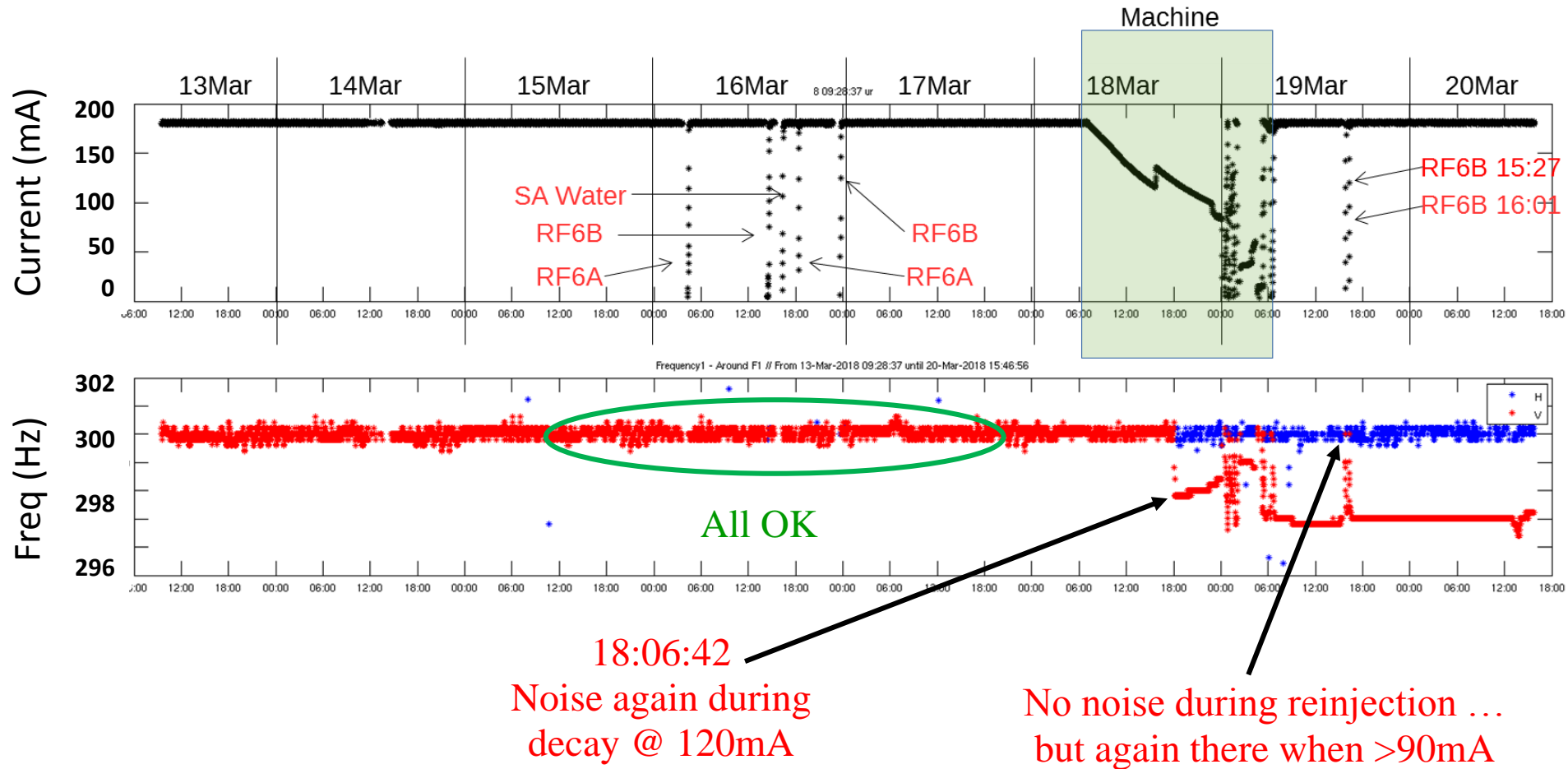
~ 297Hz vertical noise showing up from time to time



Tracked events – Case2

297Hz vertical noise

~ 297Hz vertical noise showing up again from time to time

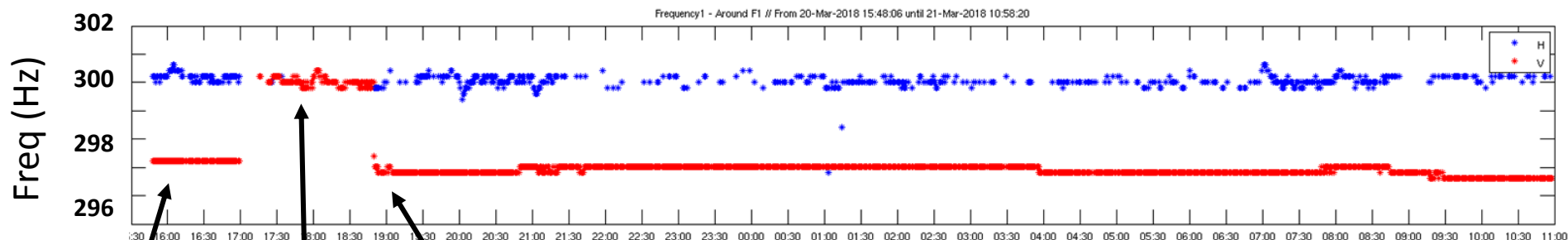
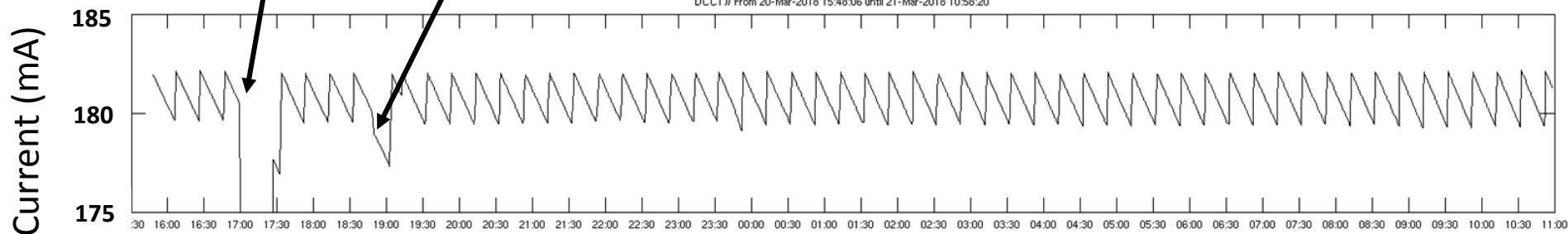


Tracked events – Case2

297Hz vertical noise

SCW quench +
beam down

SCW quench +
1mA loss



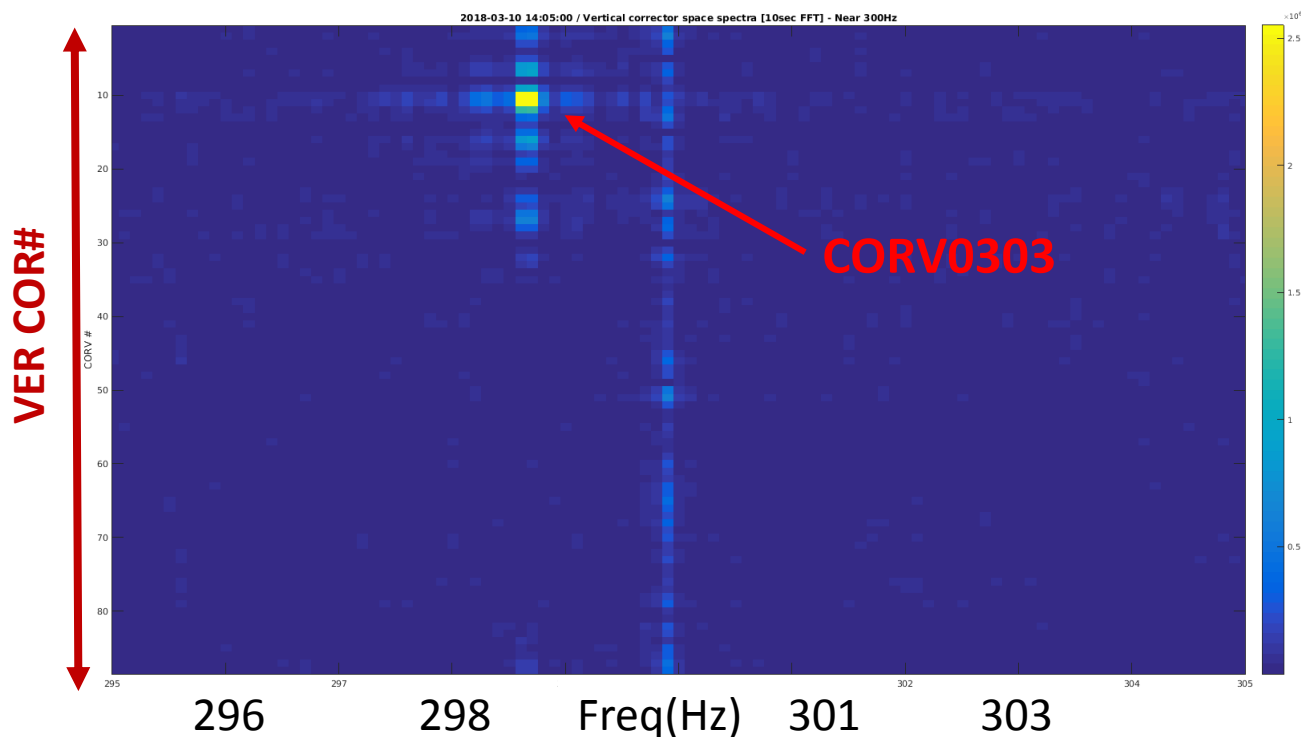
Noise
present

All OK

Noise
back

Tracked events – Case2

297Hz vertical noise



CORV0303 replaced on the 5th of April → Noise gone since then

But why related with beam reinjections, decaying beams, SCW quenches, RF cavities trips ... and also when none of these happens?



What's next?

- Multiple (infinite) frequencies tracking
- Frequencies self-detection and tracking
- Save not only mean FFT data but all BPMs FFT info
- Create a TANGO Device Server to integrate it into Control System
- Save data into ALBA archiving instead of logfile for easier events correlation
- ...

Thanks for your attention!!!