Interference Patters: analysis of interacting feedbacks in *hollow*

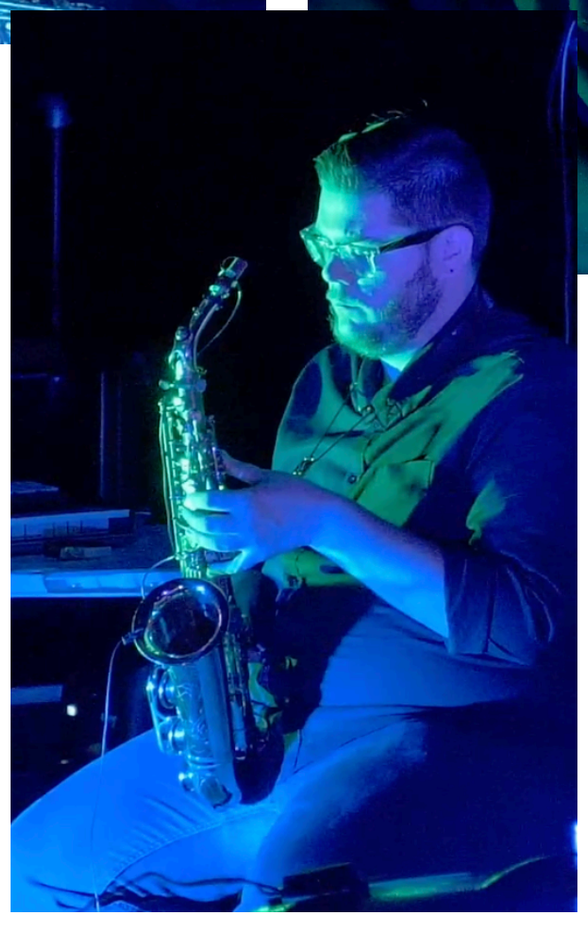
Ted Moore, University of Chicago
CHIMEFest 2020: CIRCULATIONS

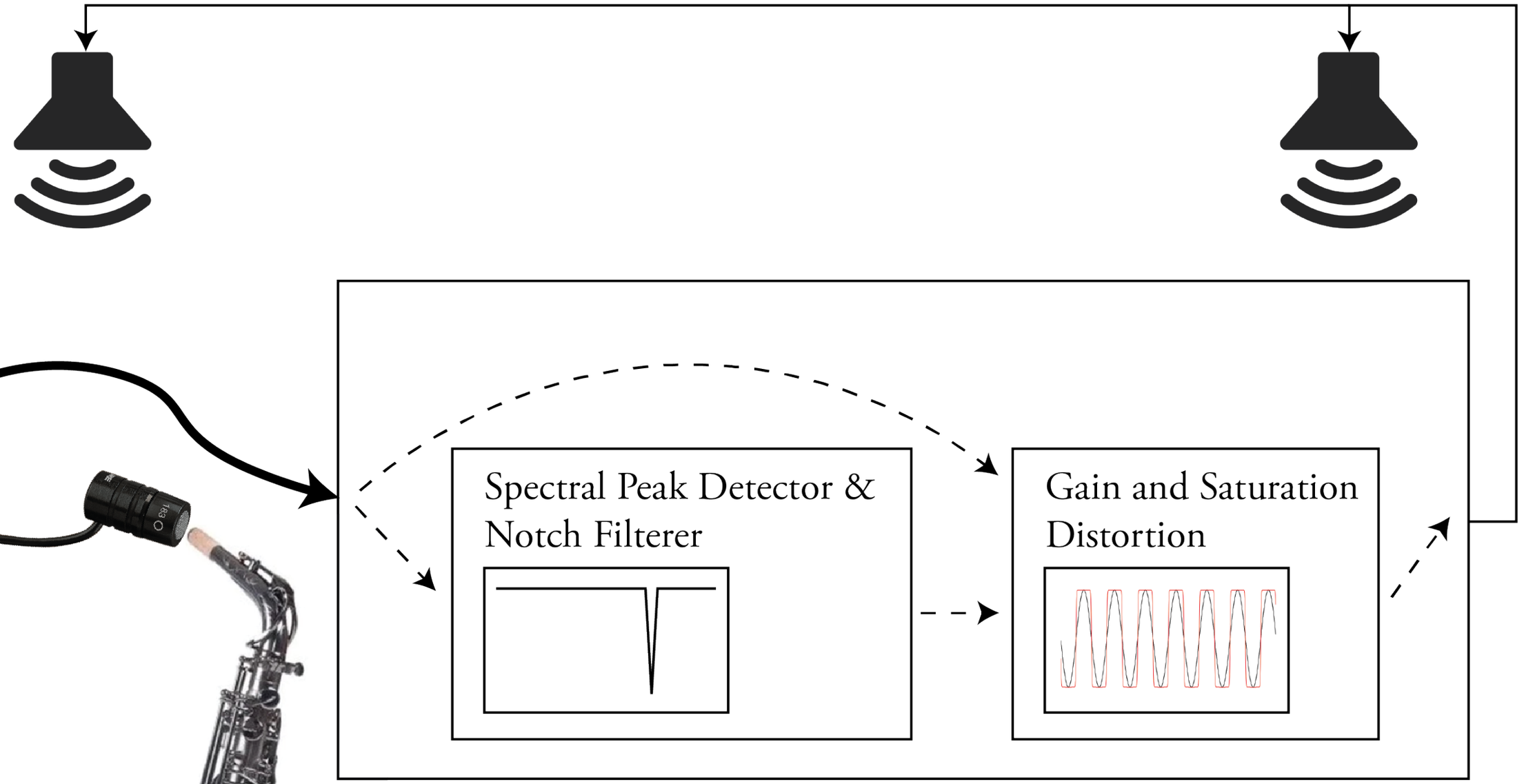
hollow

- feedback saxophone
- feedback PVC tubes
- no-input mixer

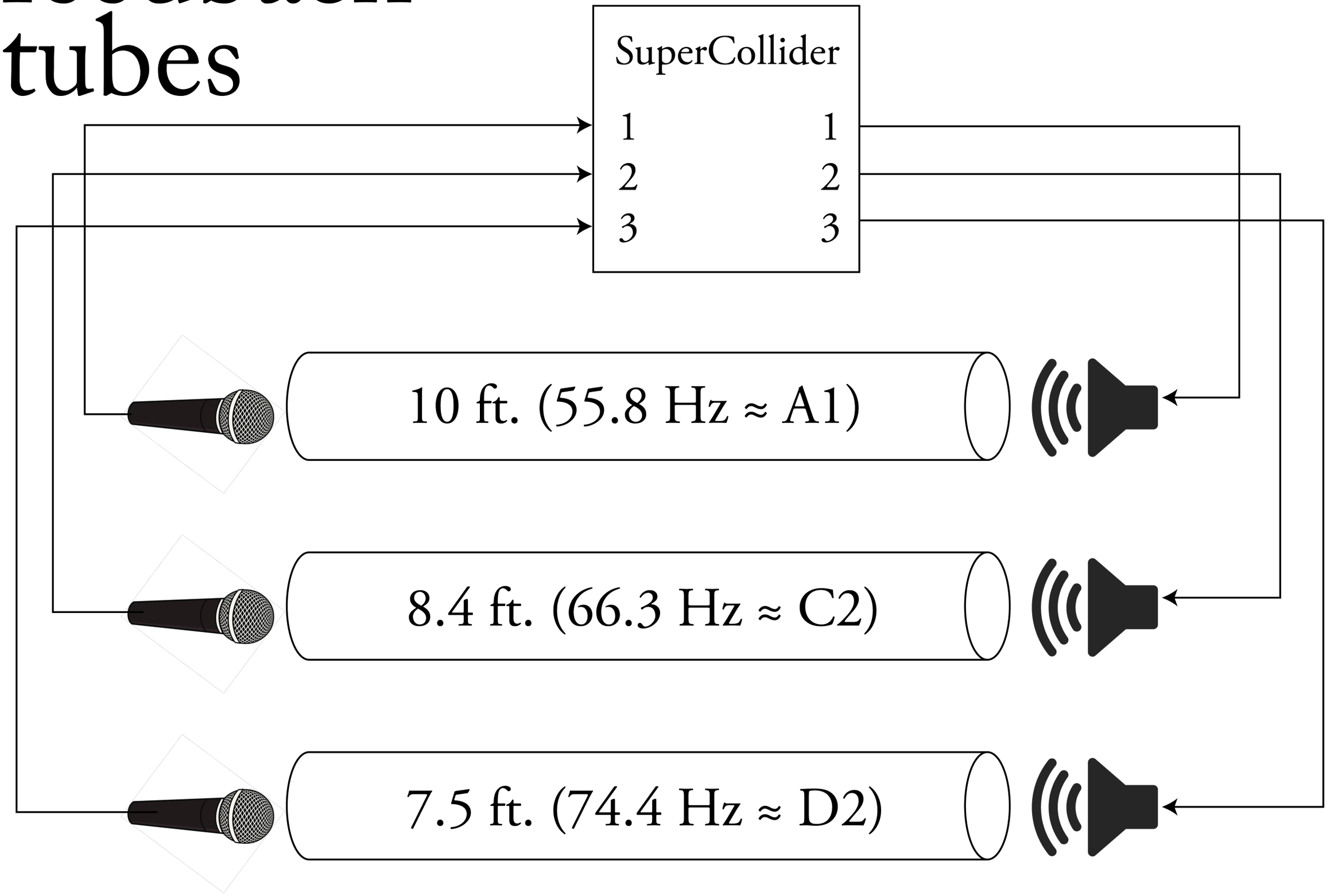
feedback saxophone

- mouthpiece
- neck
- body

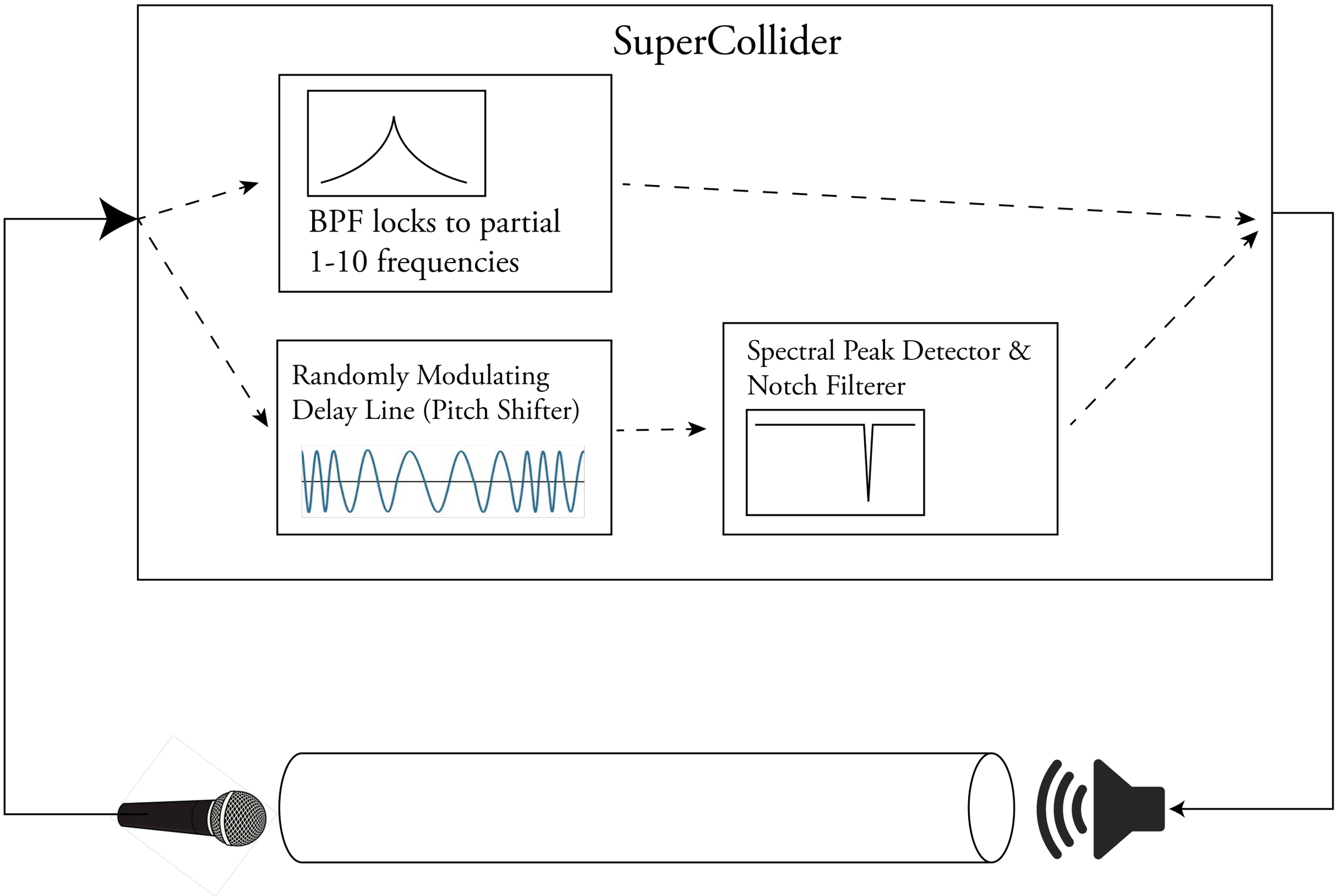



Spectral Peak Detector &
Notch Filterer
Gain and Saturation
Distortion

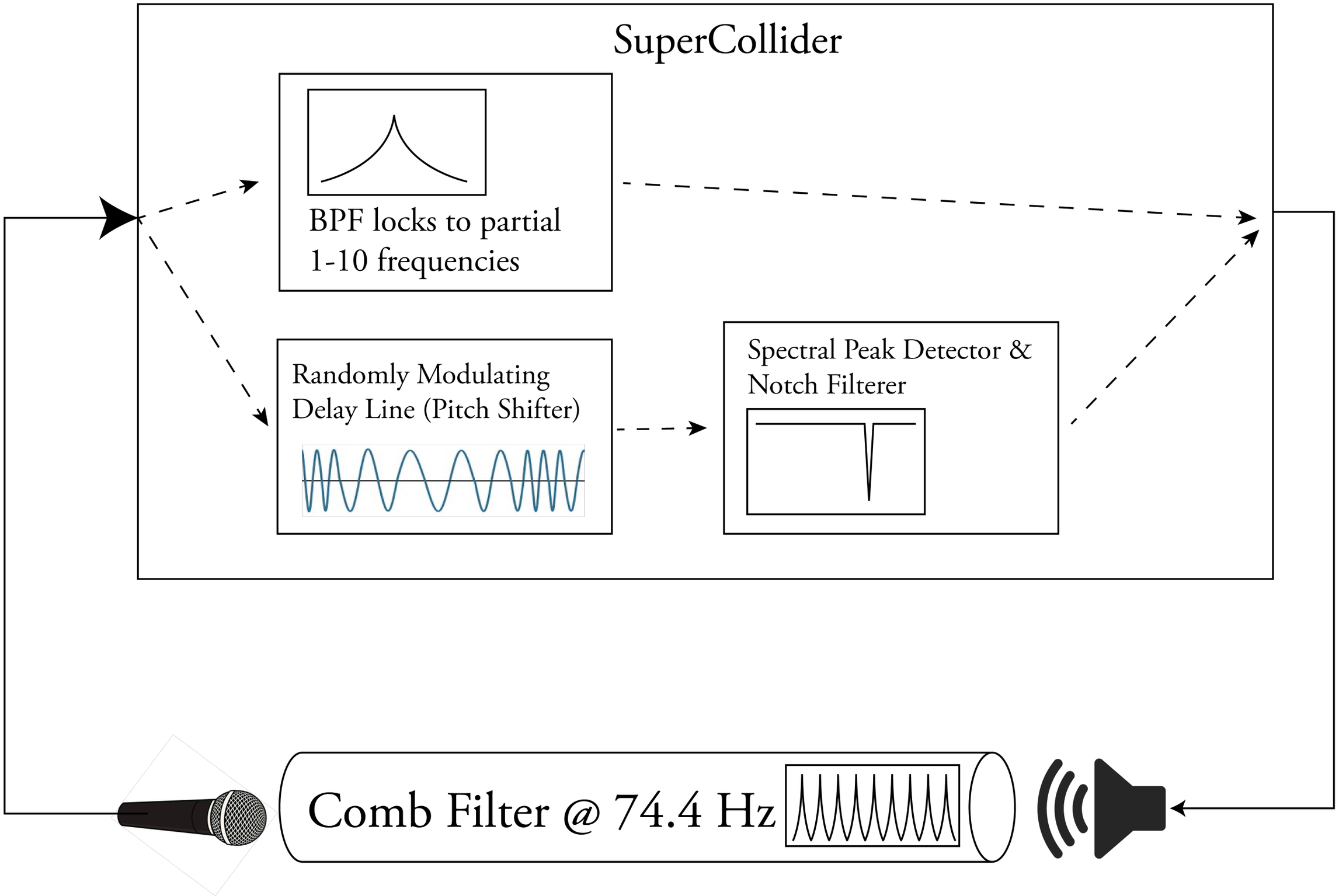
feedback tubes

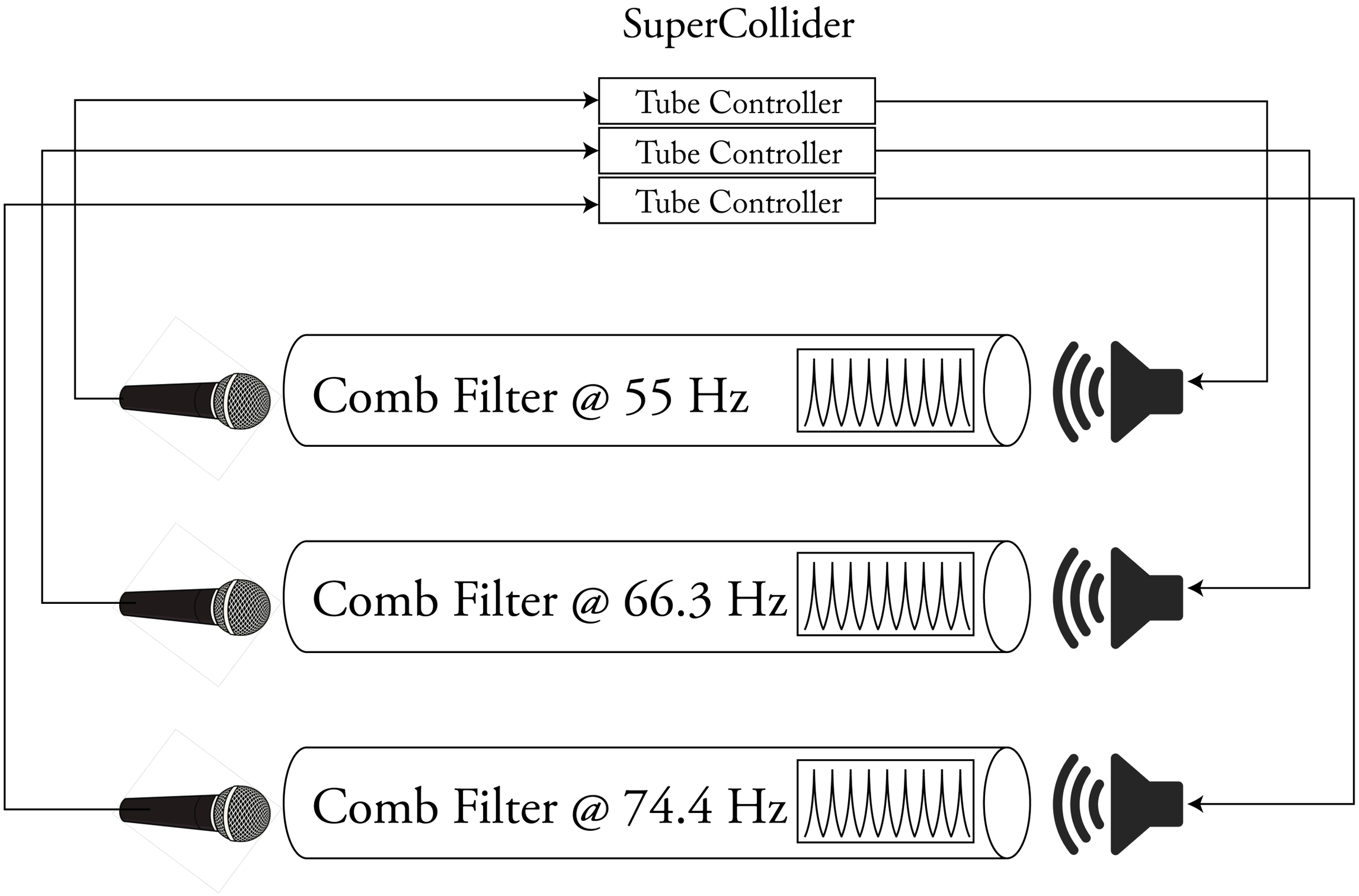


“Tube Controller”

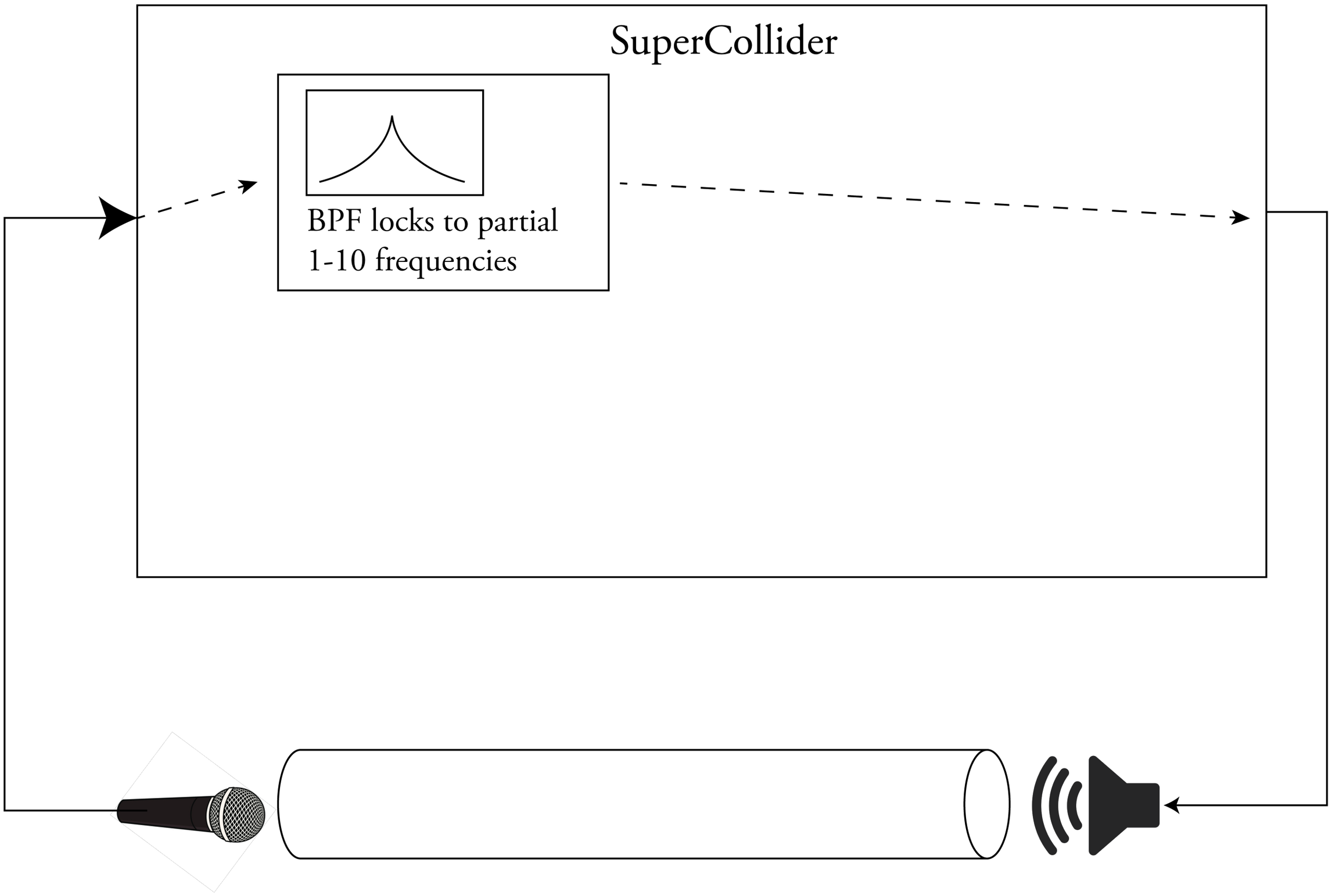


“Tube Controller”

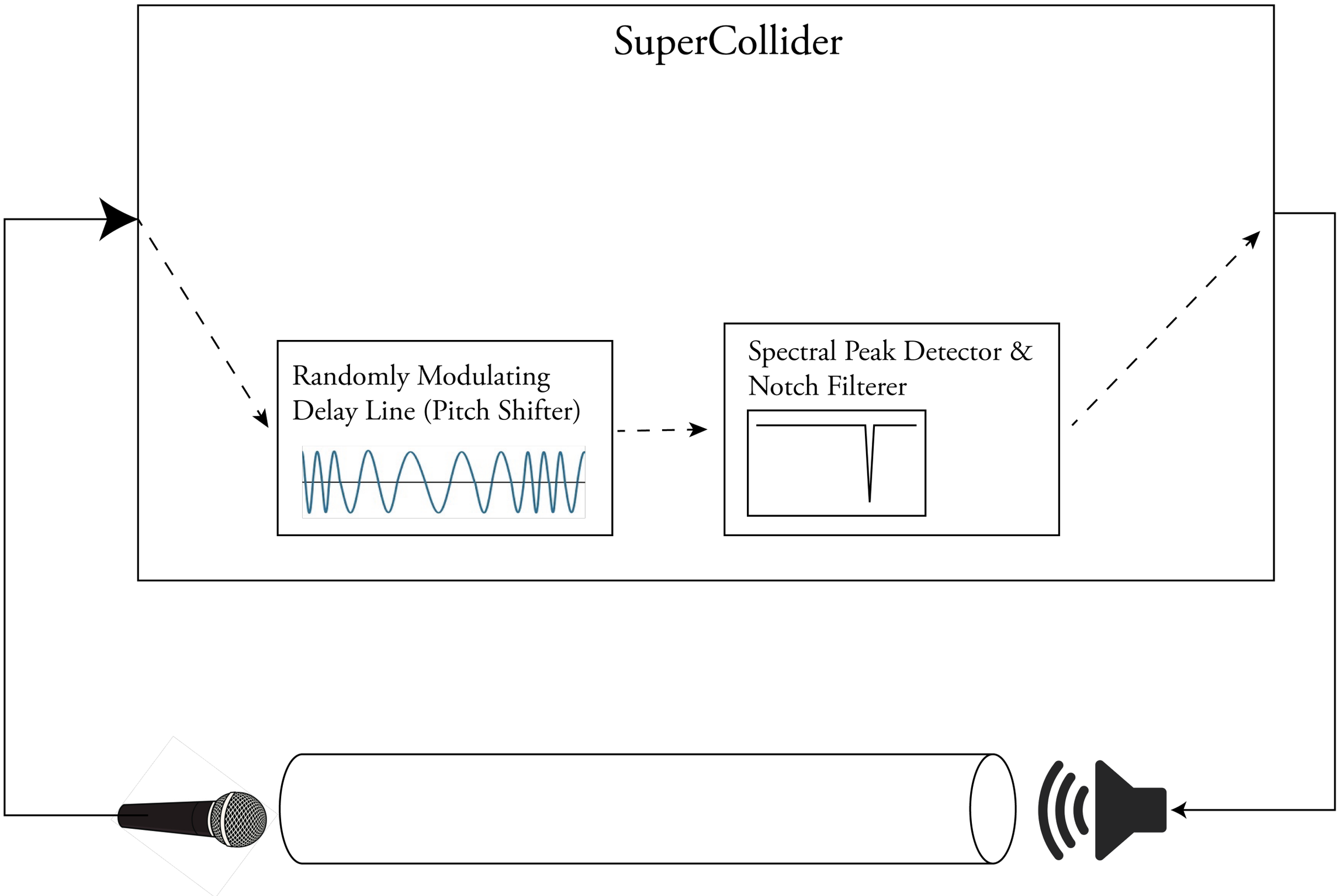


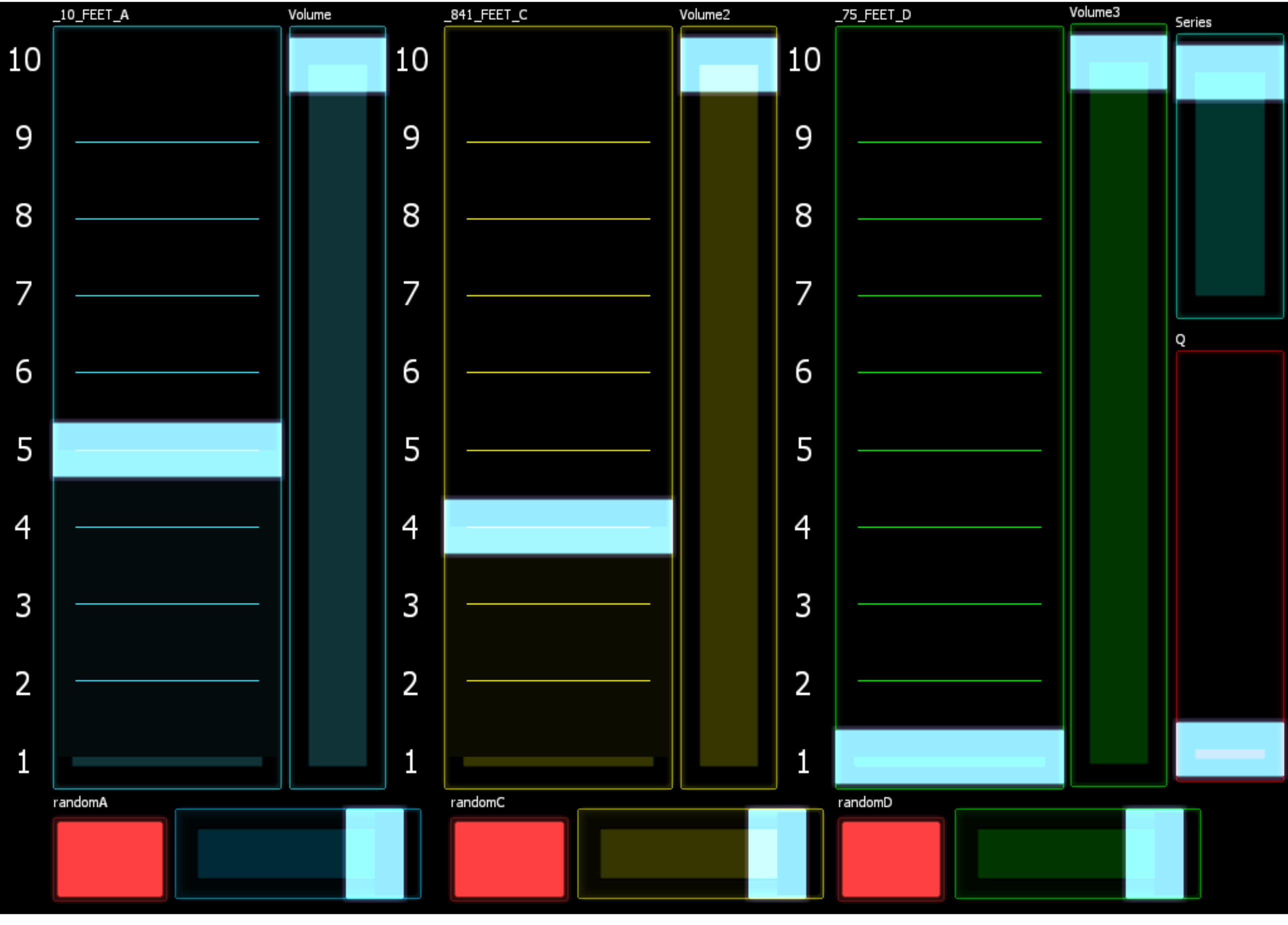

SuperCollider
Tube Controller
Tube Controller
Tube Controller
Comb Filter @ 55 Hz
Comb Filter @ 66.3 Hz
Comb Filter @ 74.4 Hz

“Tube Controller”



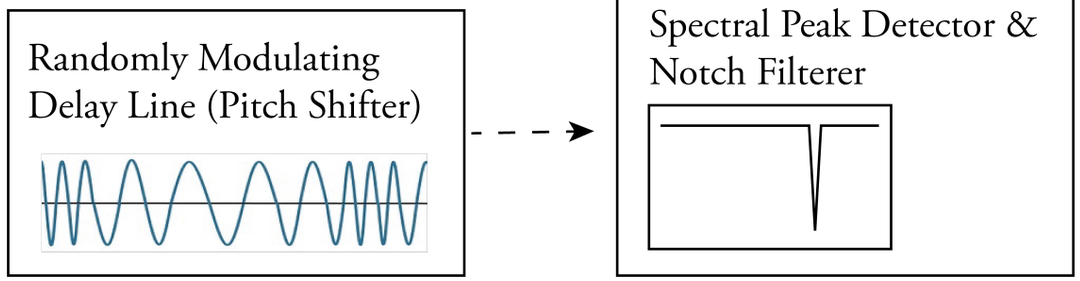
“Tube Controller”

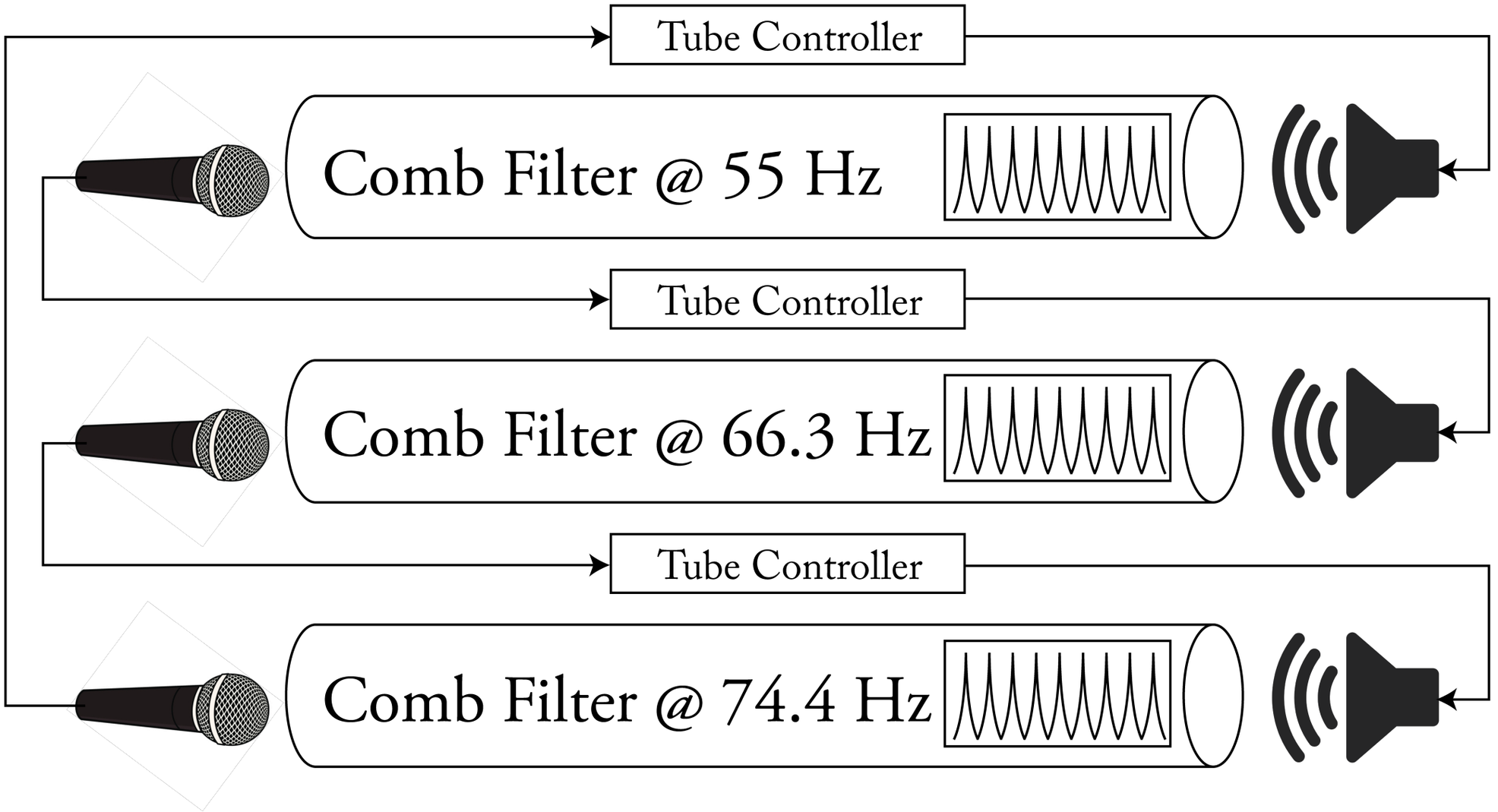



_10_FEET_A
Volume
_841_FEET_C
Volume2
_75_FEET_D
Volume3
Series
Q
10
9
8
7
6
5
4
3
2
1
randomA
randomC
randomD

Tubes in Series

All using this processing:





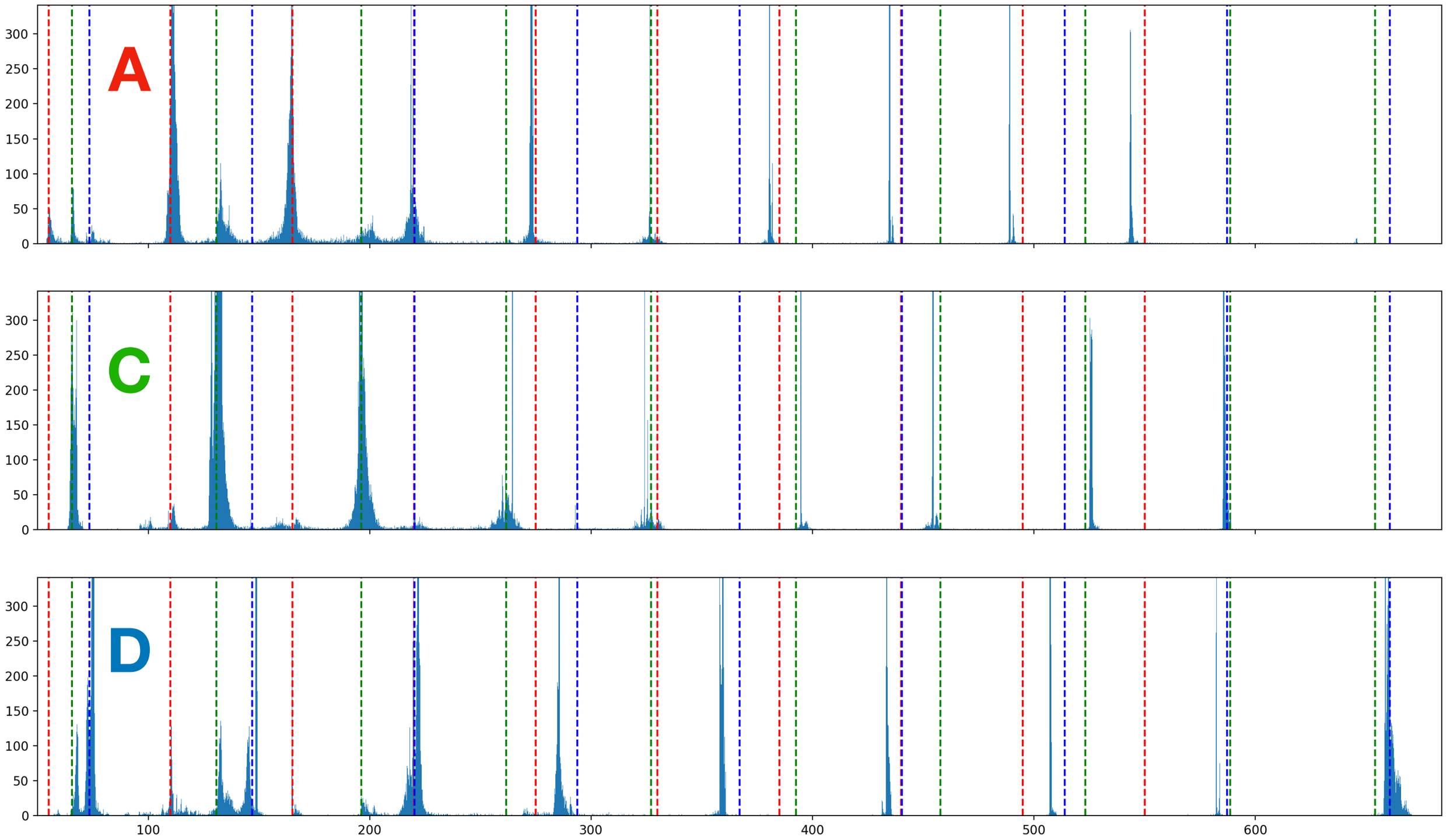
Analysis

Build on my knowledge of the system, and aural experience to develop an intuition about how the system behaves…

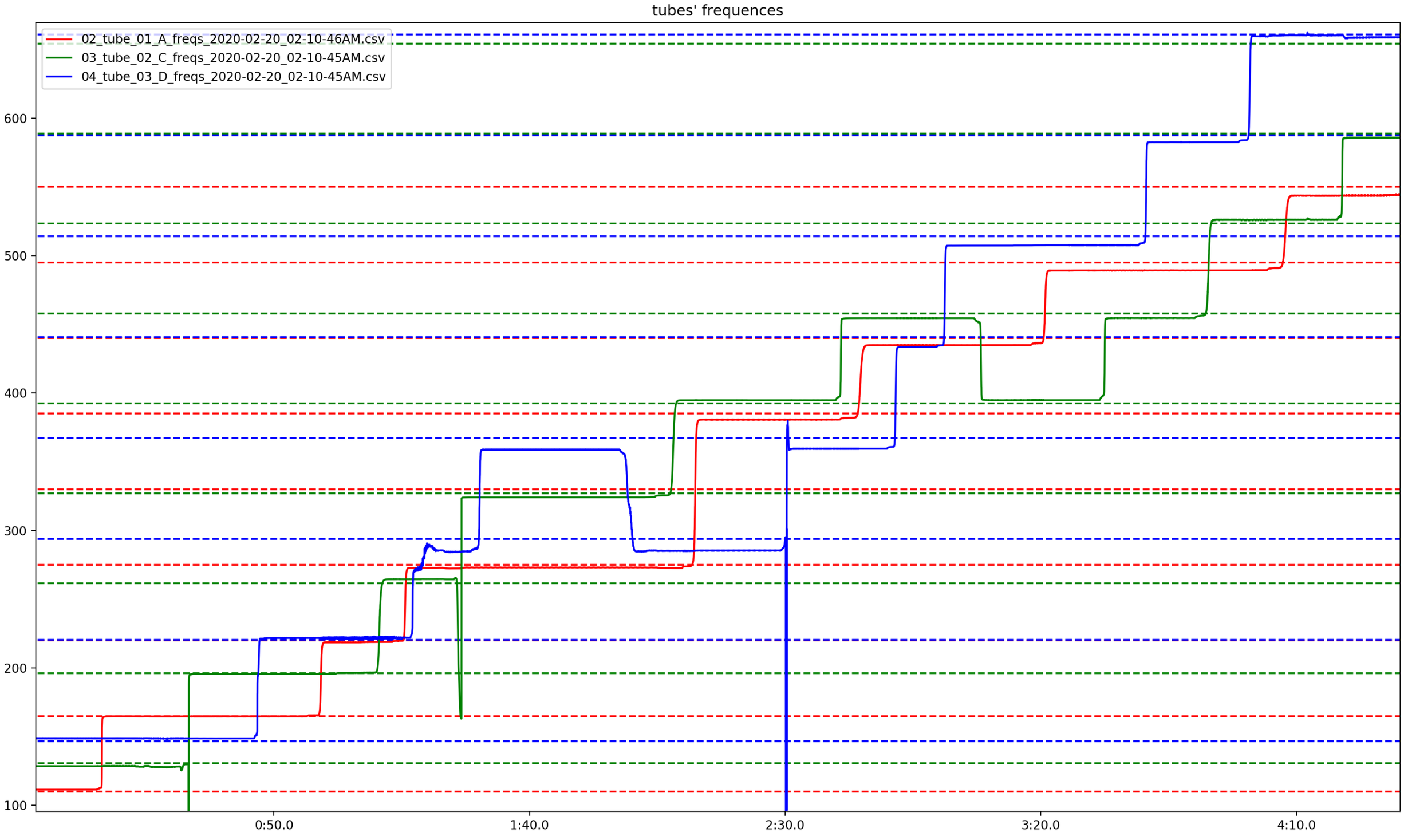
Goal:

More control, more variability, other directions.

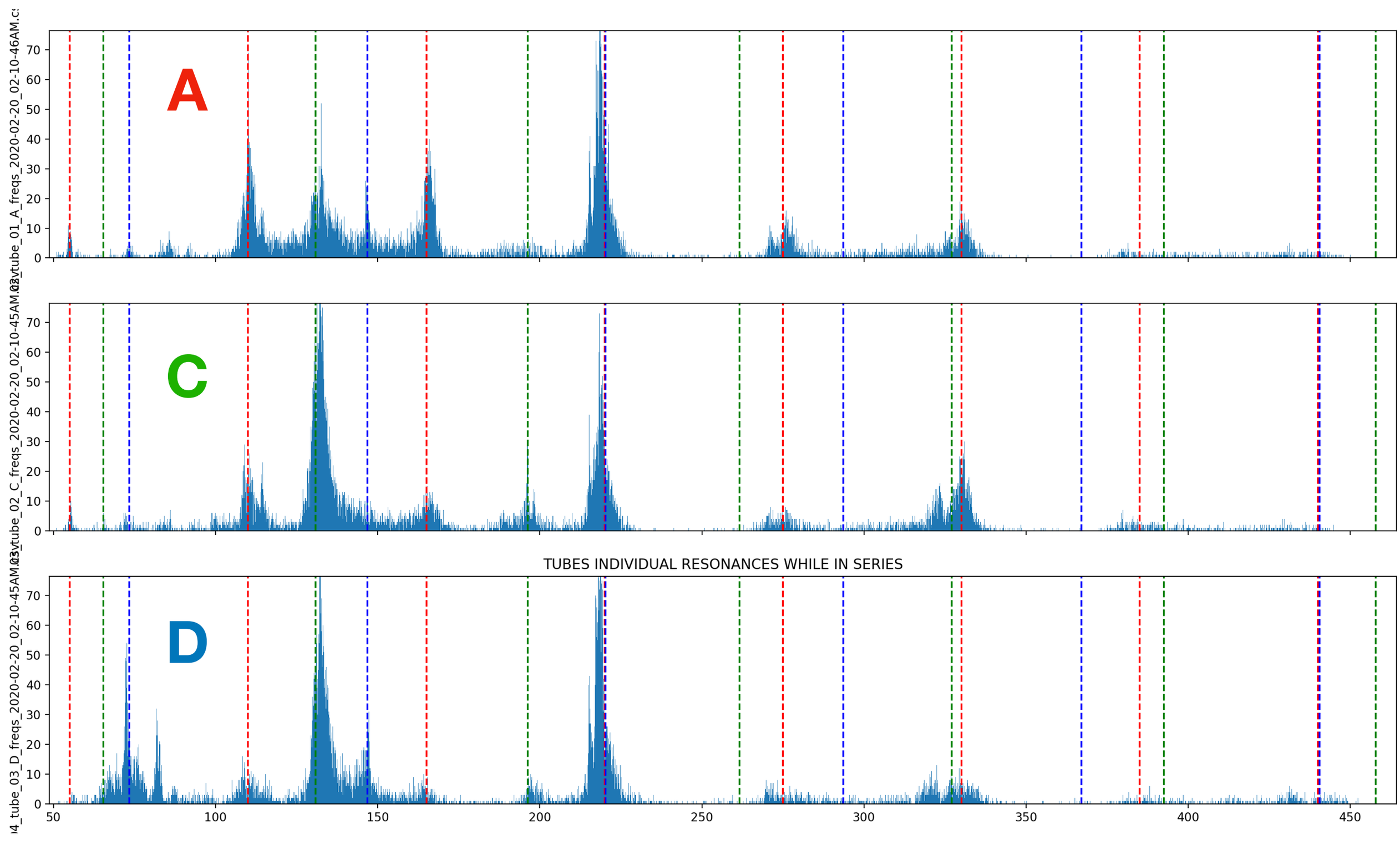
tube resonances while independent



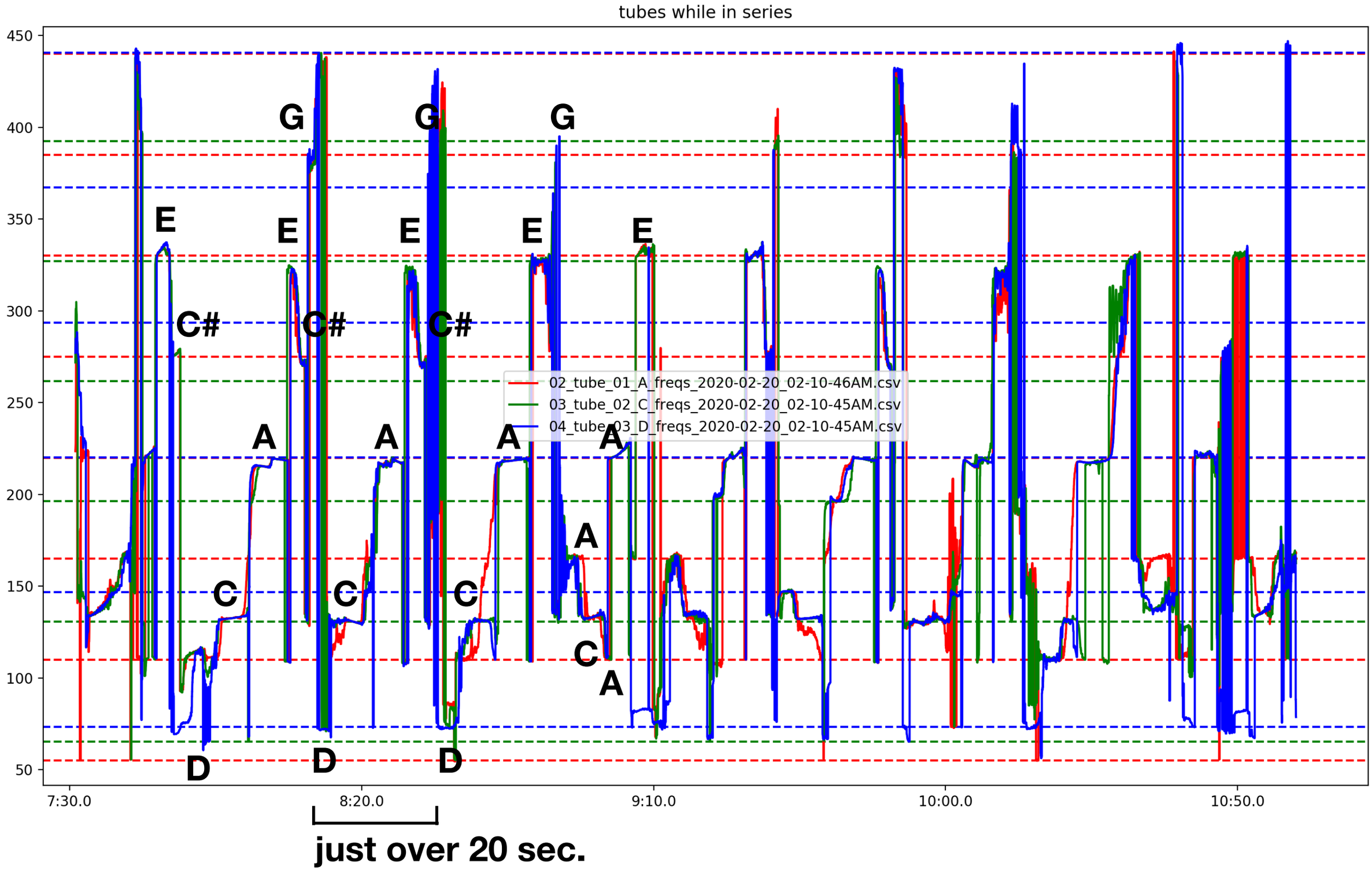
tube freqs., opening 4 min.



tube resonances while in series



tube freqs., while in series



peak detector filter time

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this.addSlider("waitMin",ControlSpec(1,50),{
    arg sl;
    waitMin = sl.value;
},12,true,true,true);

this.addSlider("waitMax",ControlSpec(1,50),{
    arg sl;
    waitMax = sl.value;
},15,true,true,true);
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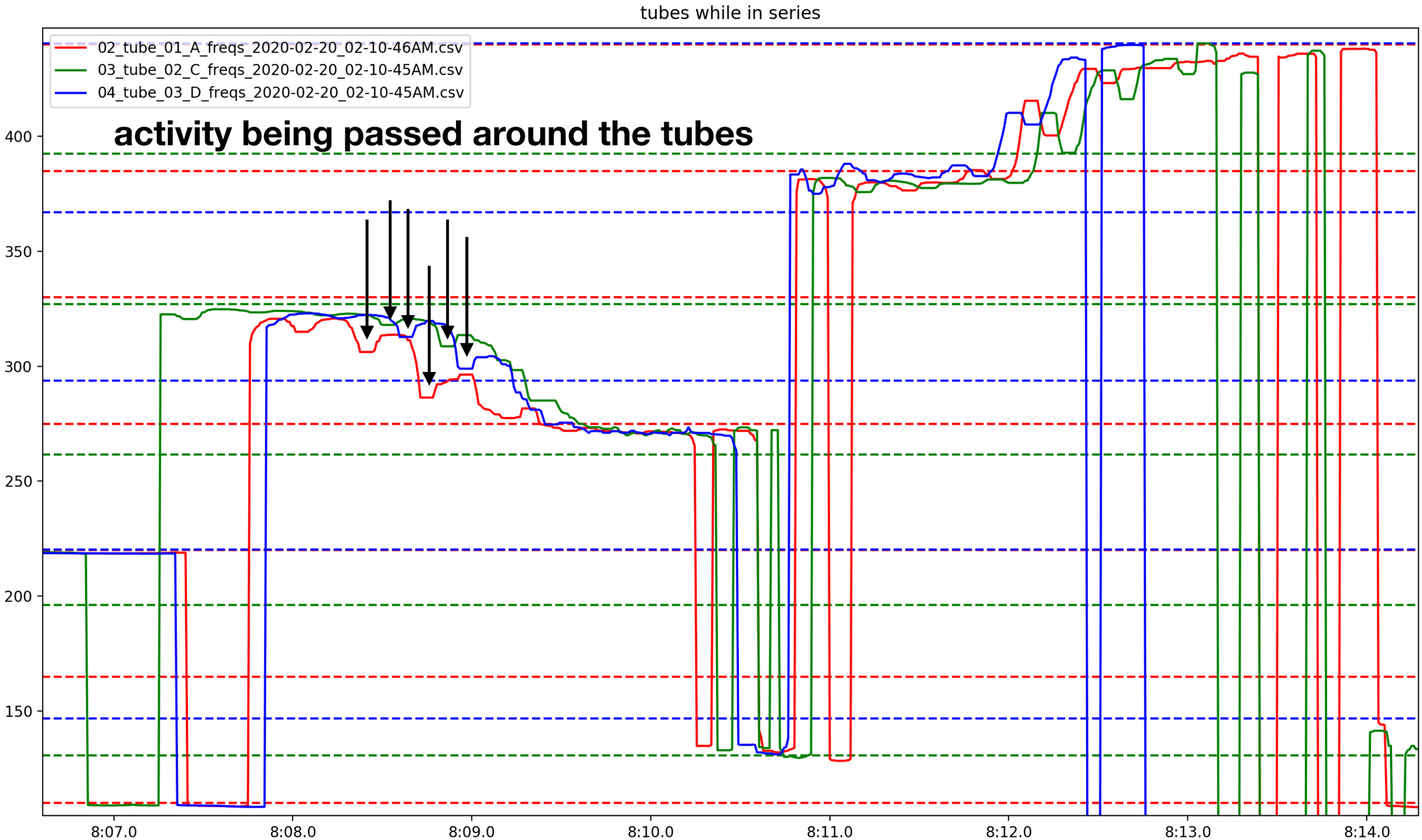
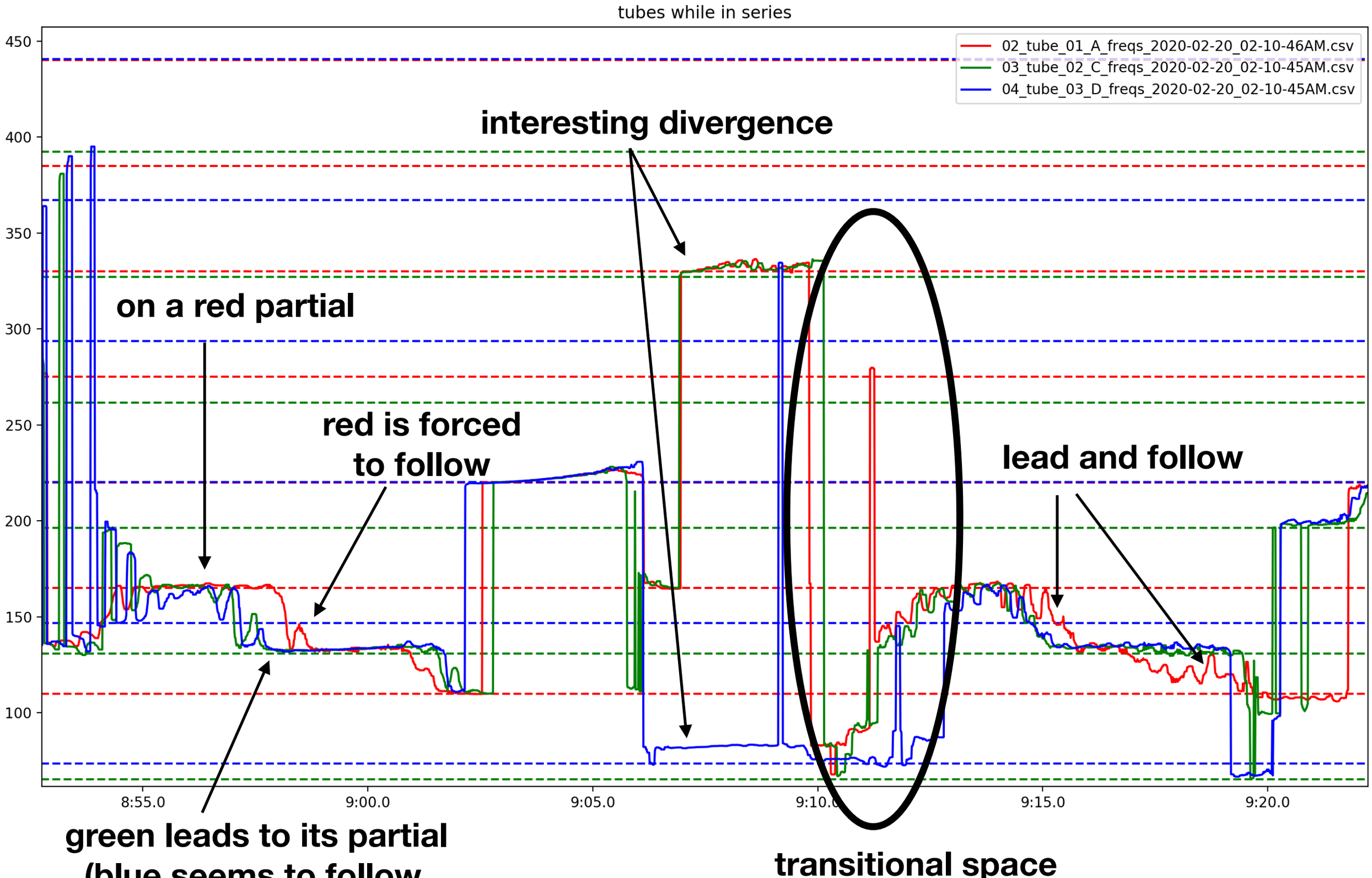
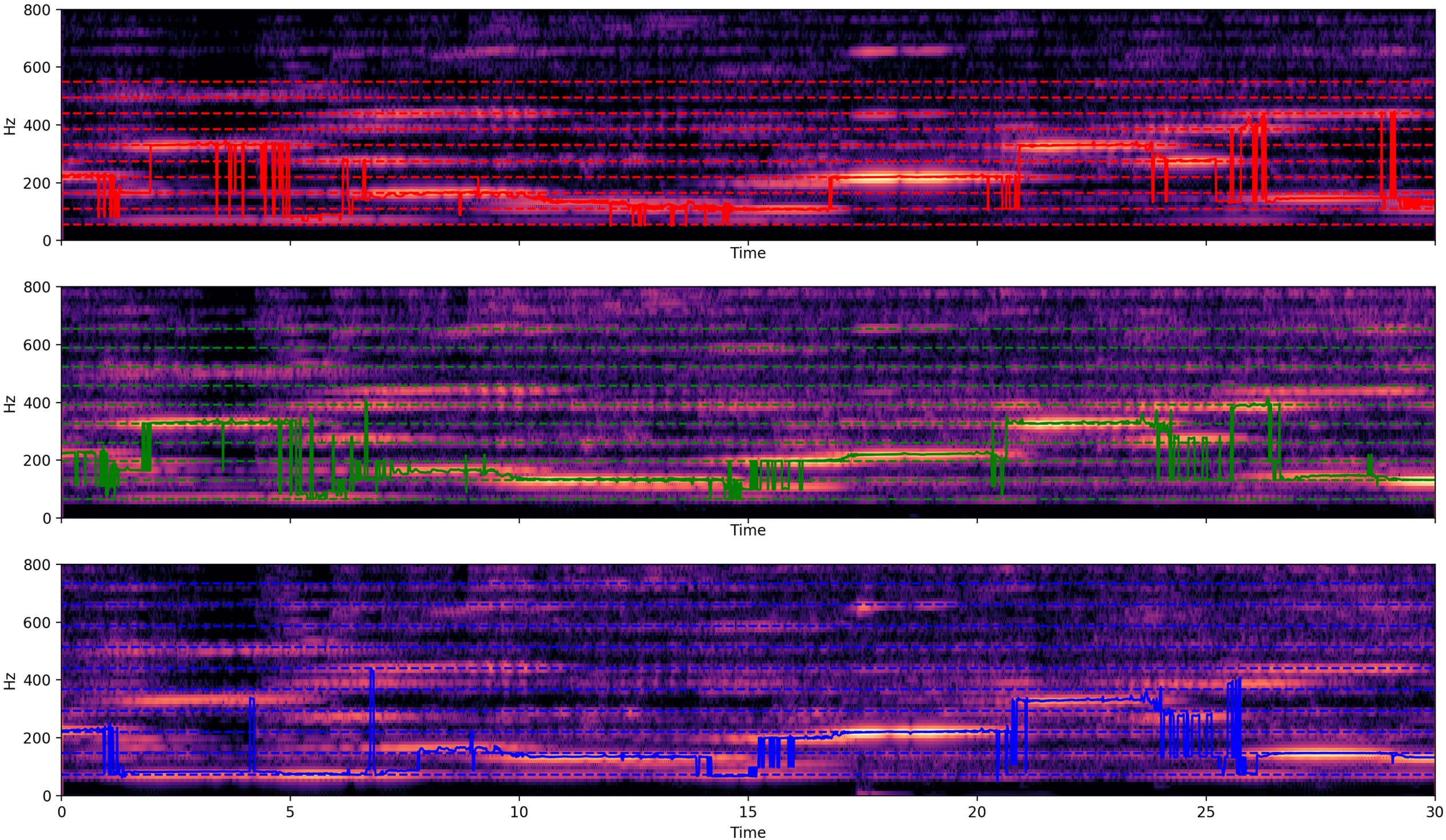
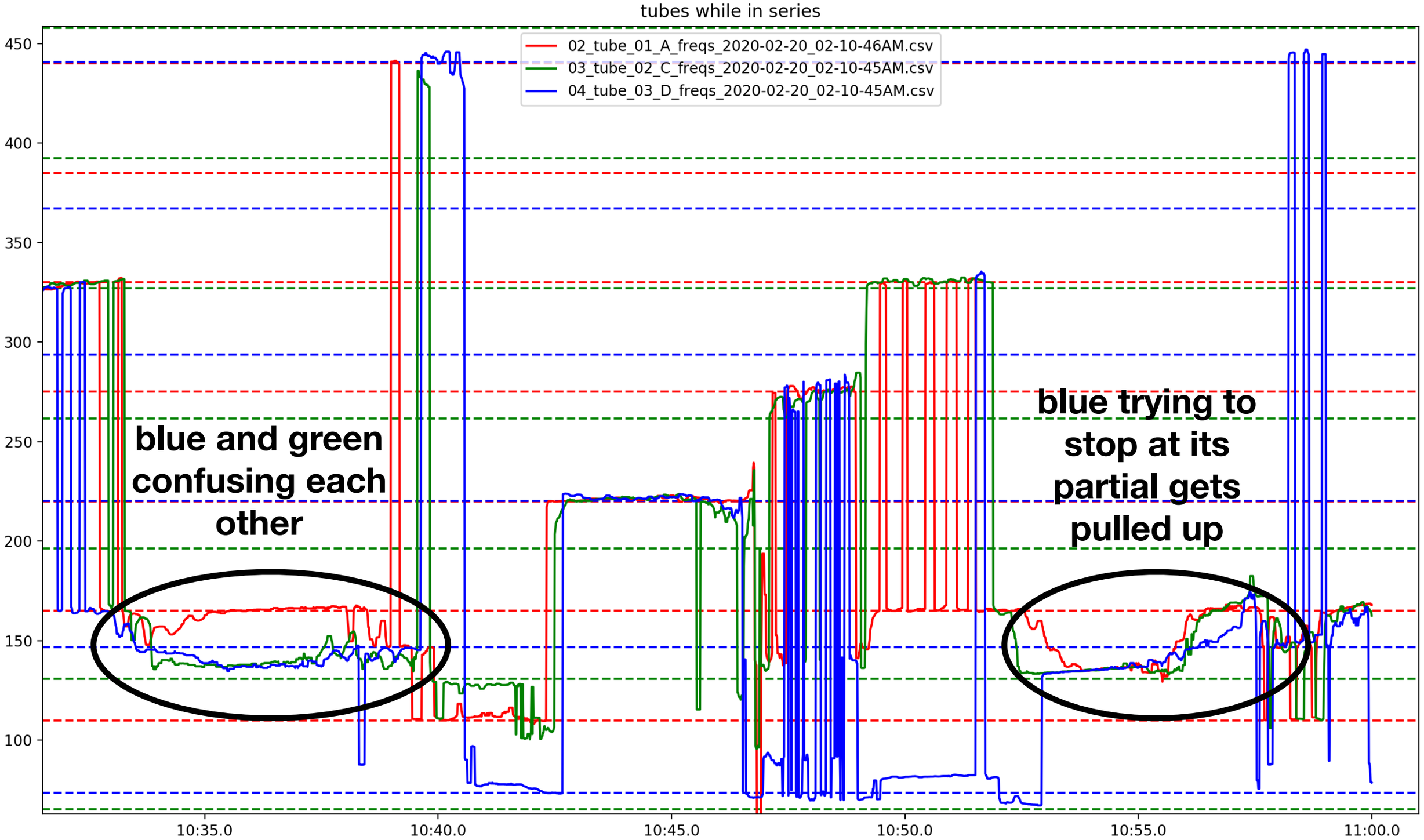
tube freqs., while in series



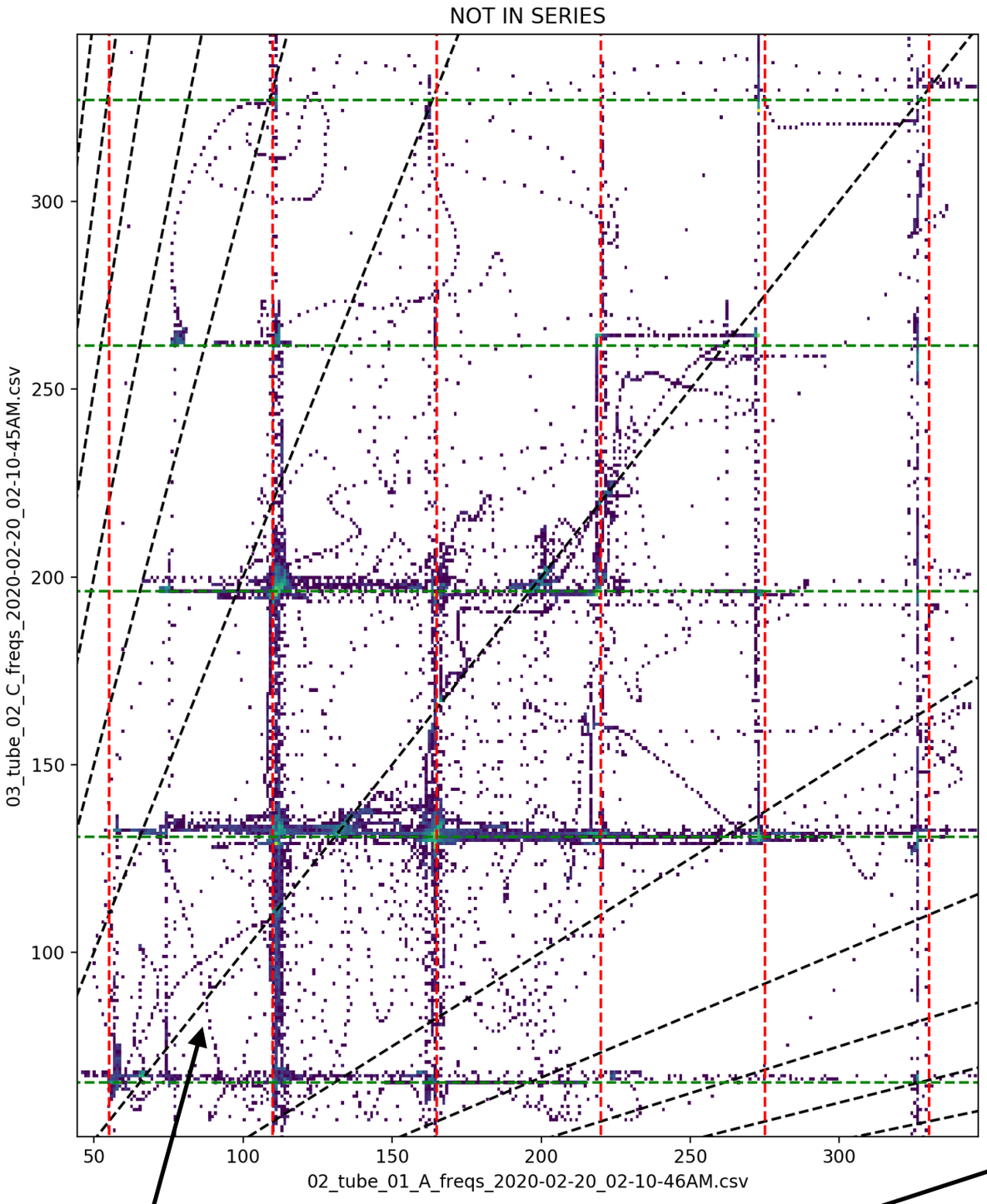

tubes while in series
02_tube_01_A_freqs_2020-02-20_02-10-46AM.csv
03_tube_02_C_freqs_2020-02-20_02-10-45AM.csv
04_tube_03_D_freqs_2020-02-20_02-10-45AM.csv
interesting divergence
on a red partial
red is forced
to follow
lead and follow
green leads to its partial
(blue seems to follow,
it doesn't care about red,
tries to stop at blue?)
transitional space
450
400
350
300
250
200
150
100
8:55.0
9:00.0
9:05.0
9:10.0
9:15.0
9:20.0

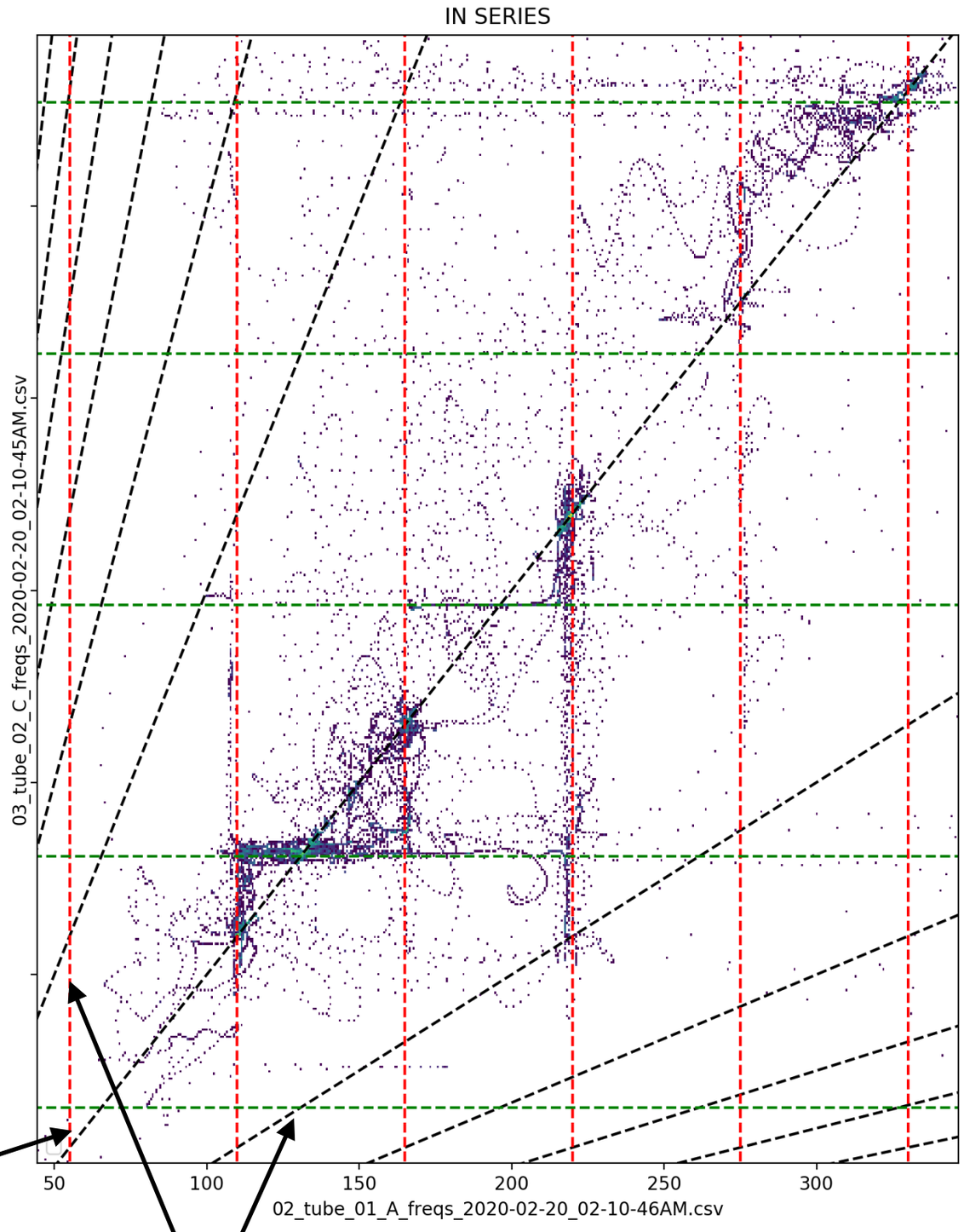
polyphony in files, monophonic pitch tracker




tubes while in series
02_tube_01_A_freqs_2020-02-20_02-10-46AM.csv
03_tube_02_C_freqs_2020-02-20_02-10-45AM.csv
04_tube_03_D_freqs_2020-02-20_02-10-45AM.csv
450
400
350
300
250
200
150
100
10:35.0
10:40.0
10:45.0
10:50.0
10:55.0
11:00.0
blue and green confusing each other
blue trying to stop at its partial gets pulled up

Tubes A & C

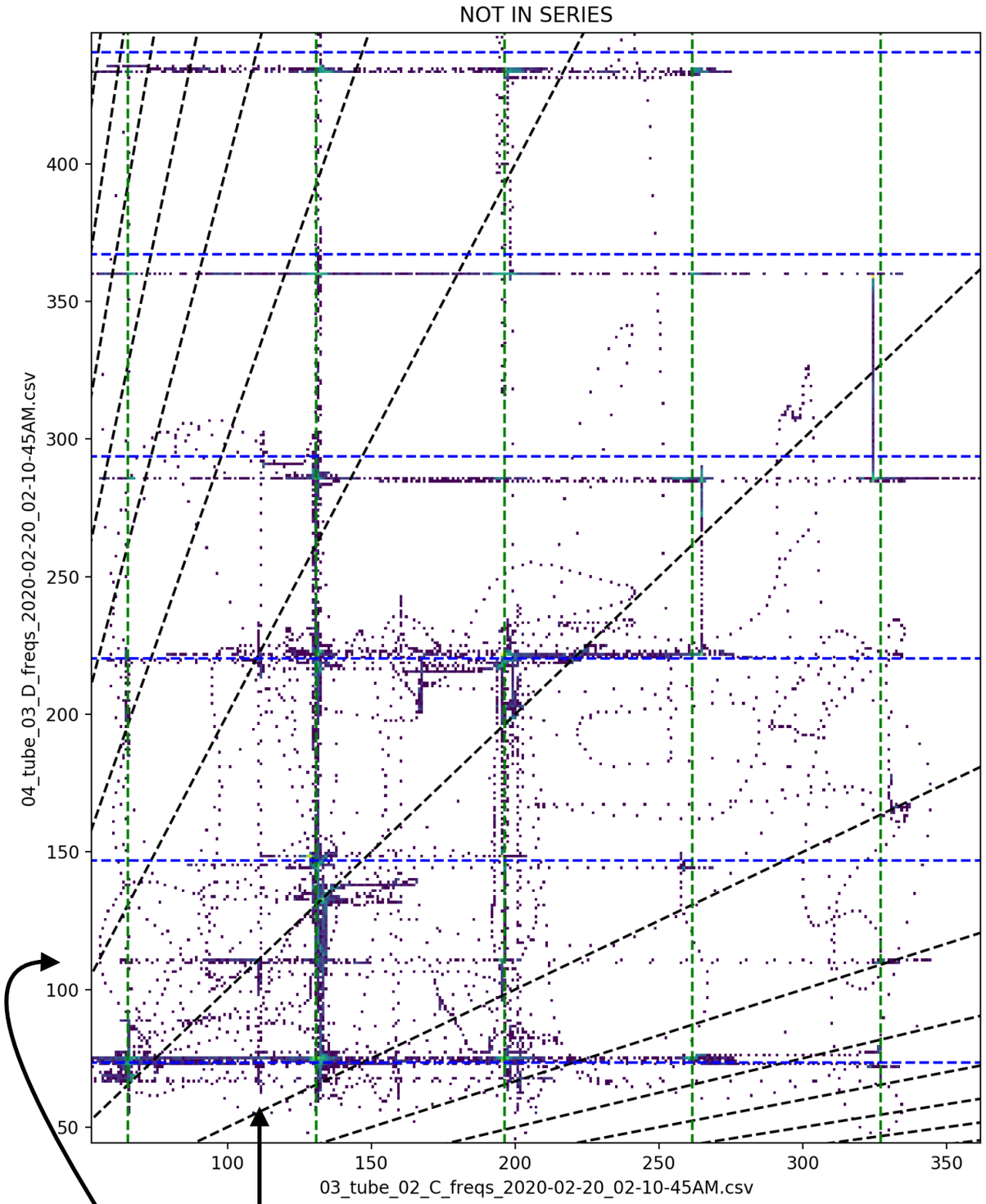


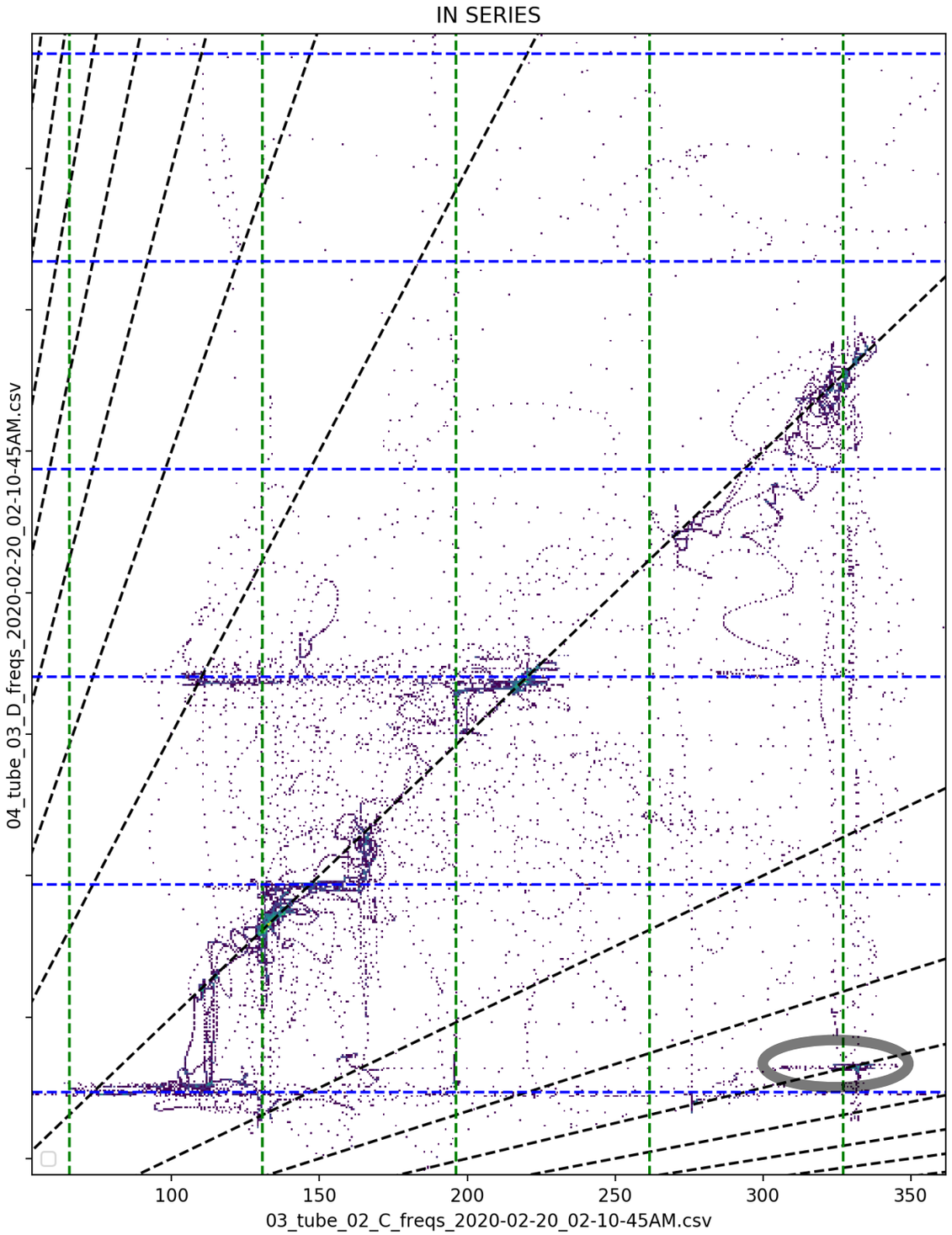


diagonal unison line

diagonal integer multiples lines

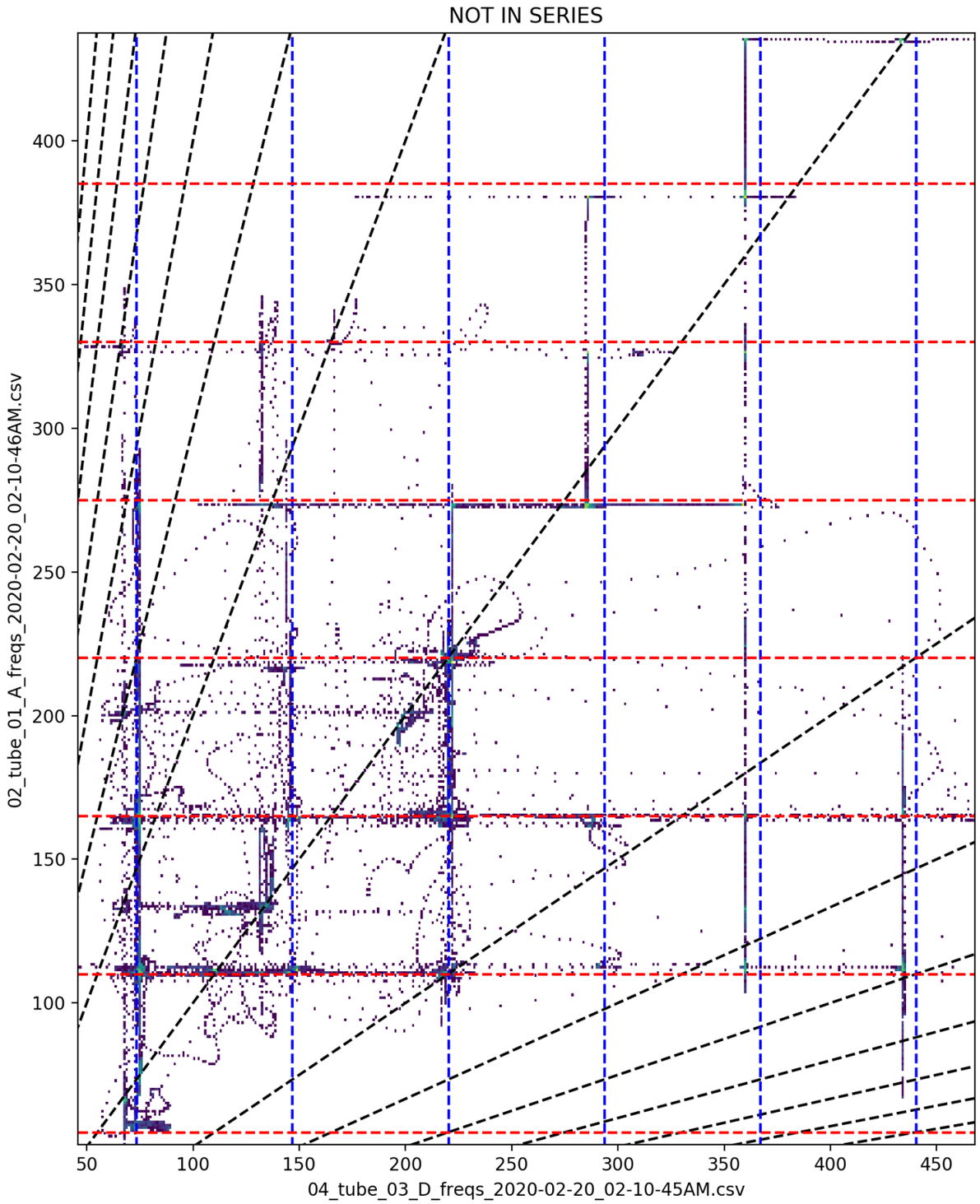
Tubes C & D

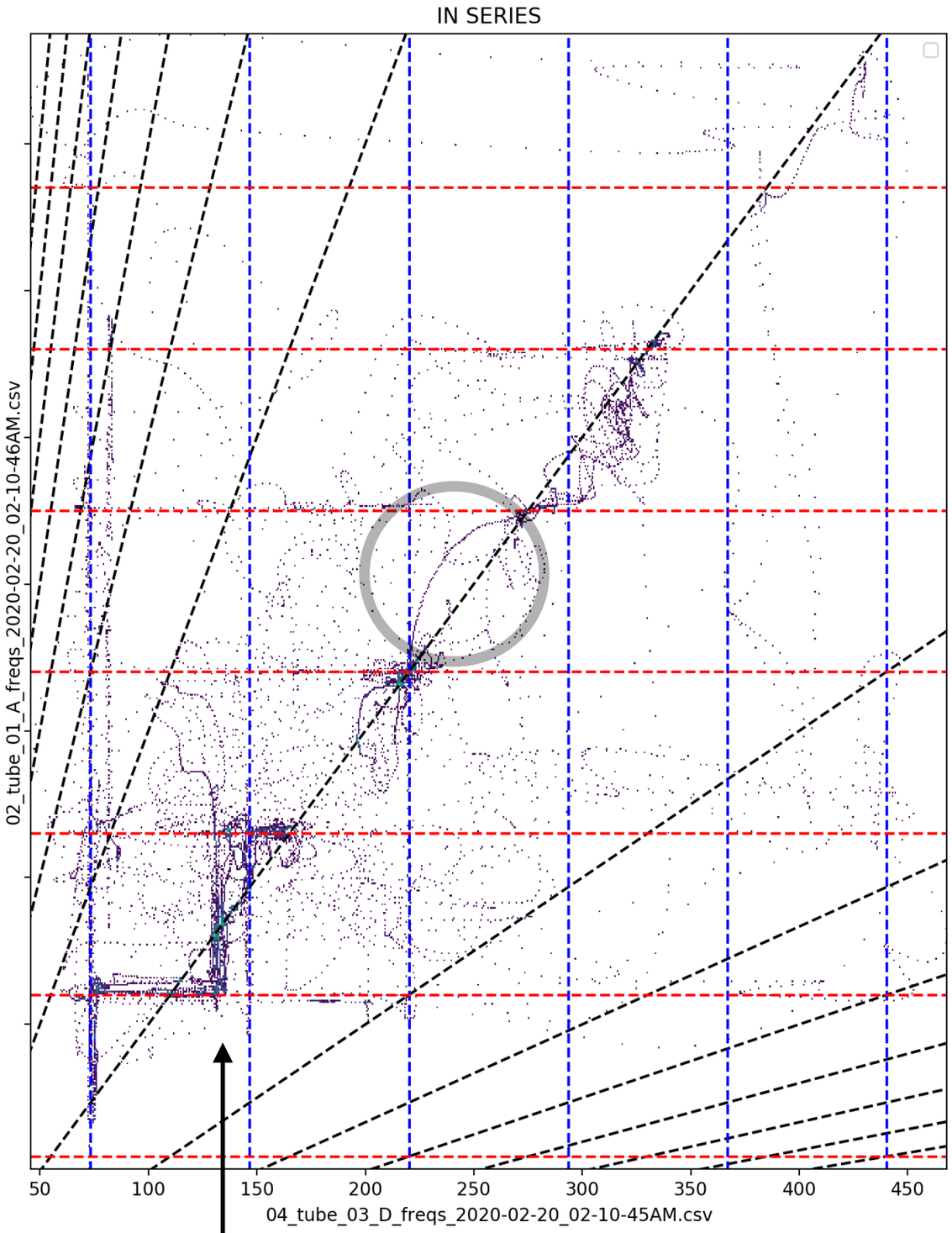




A 2nd partial

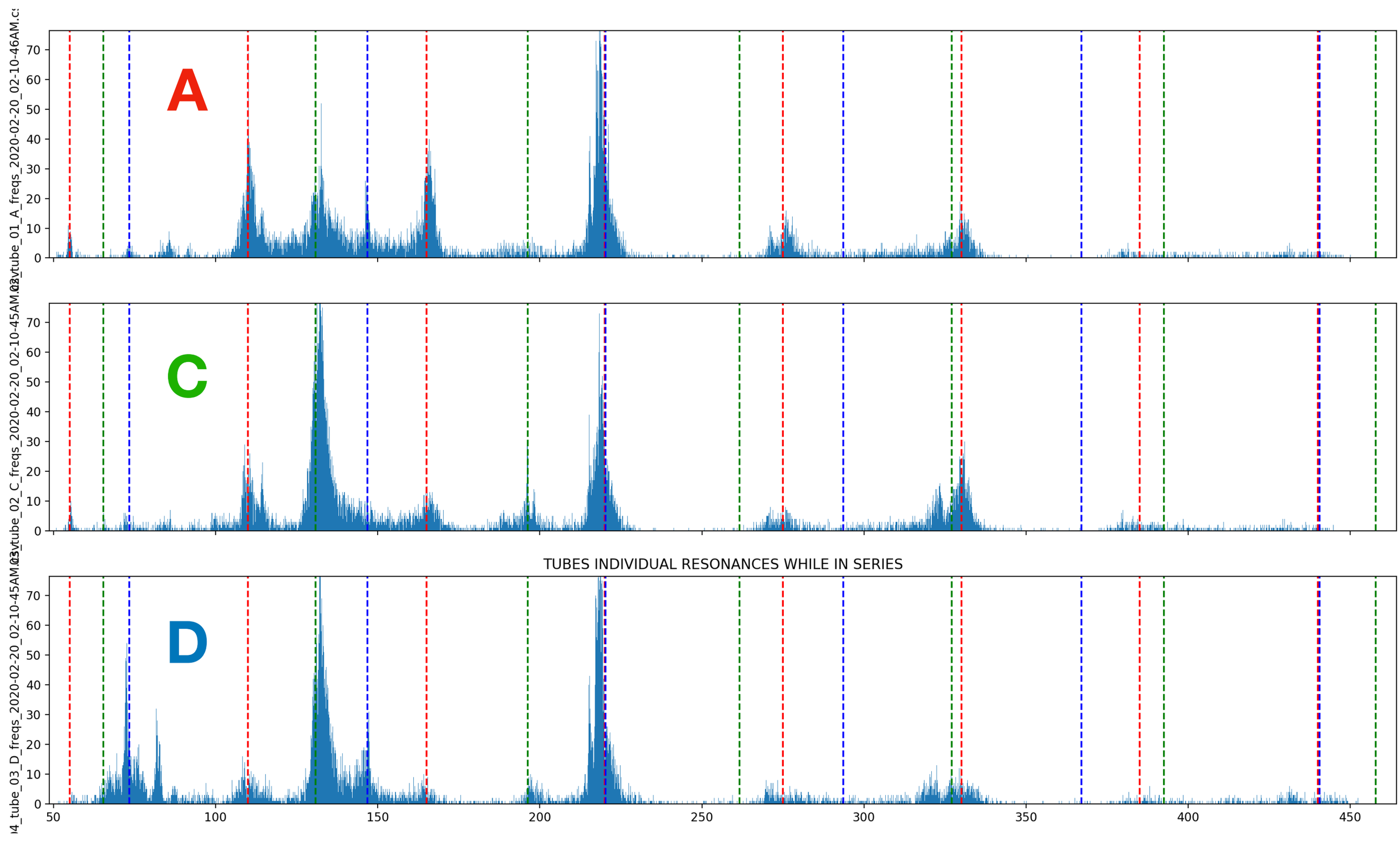
Tubes D & A



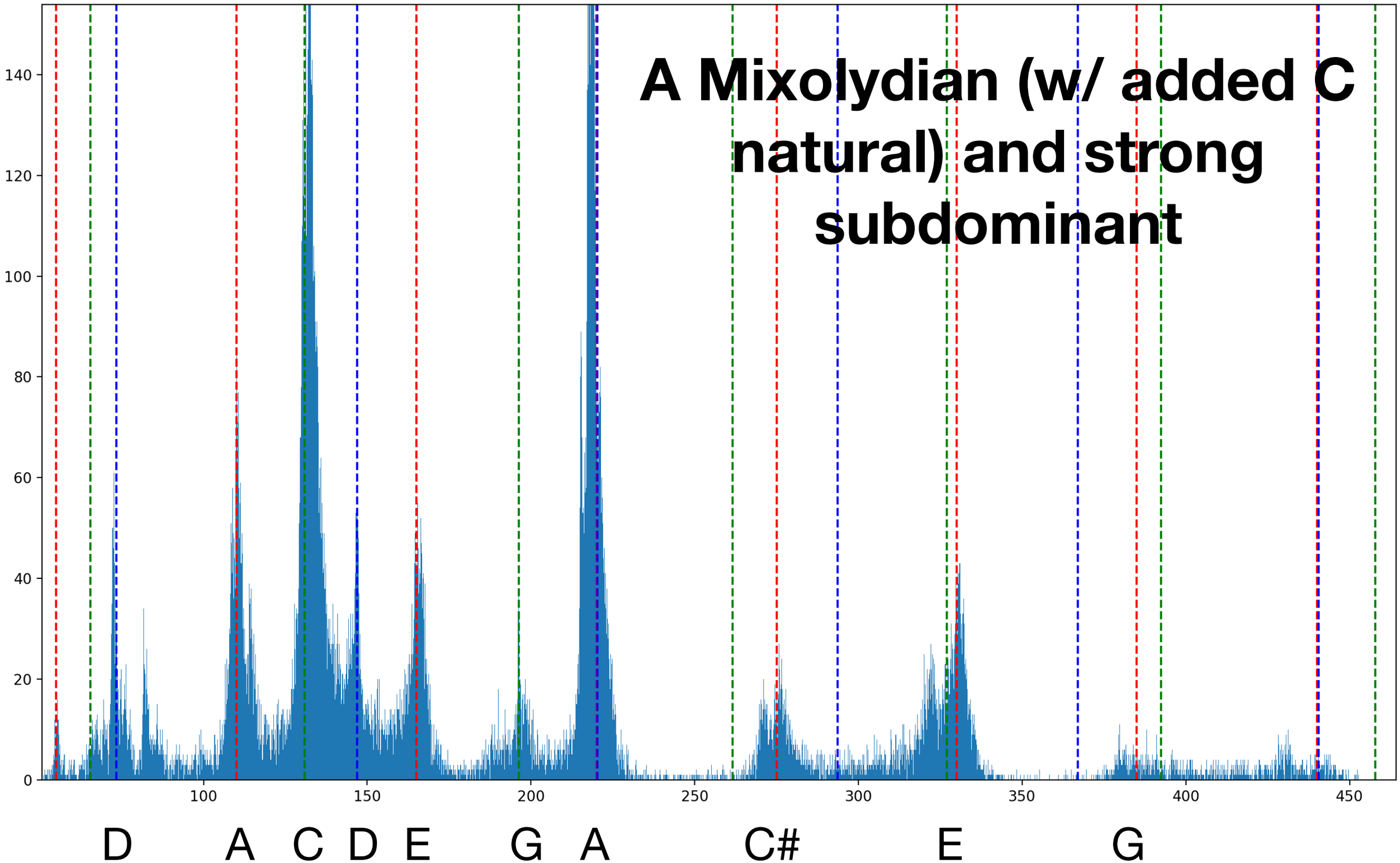


C 2nd partial

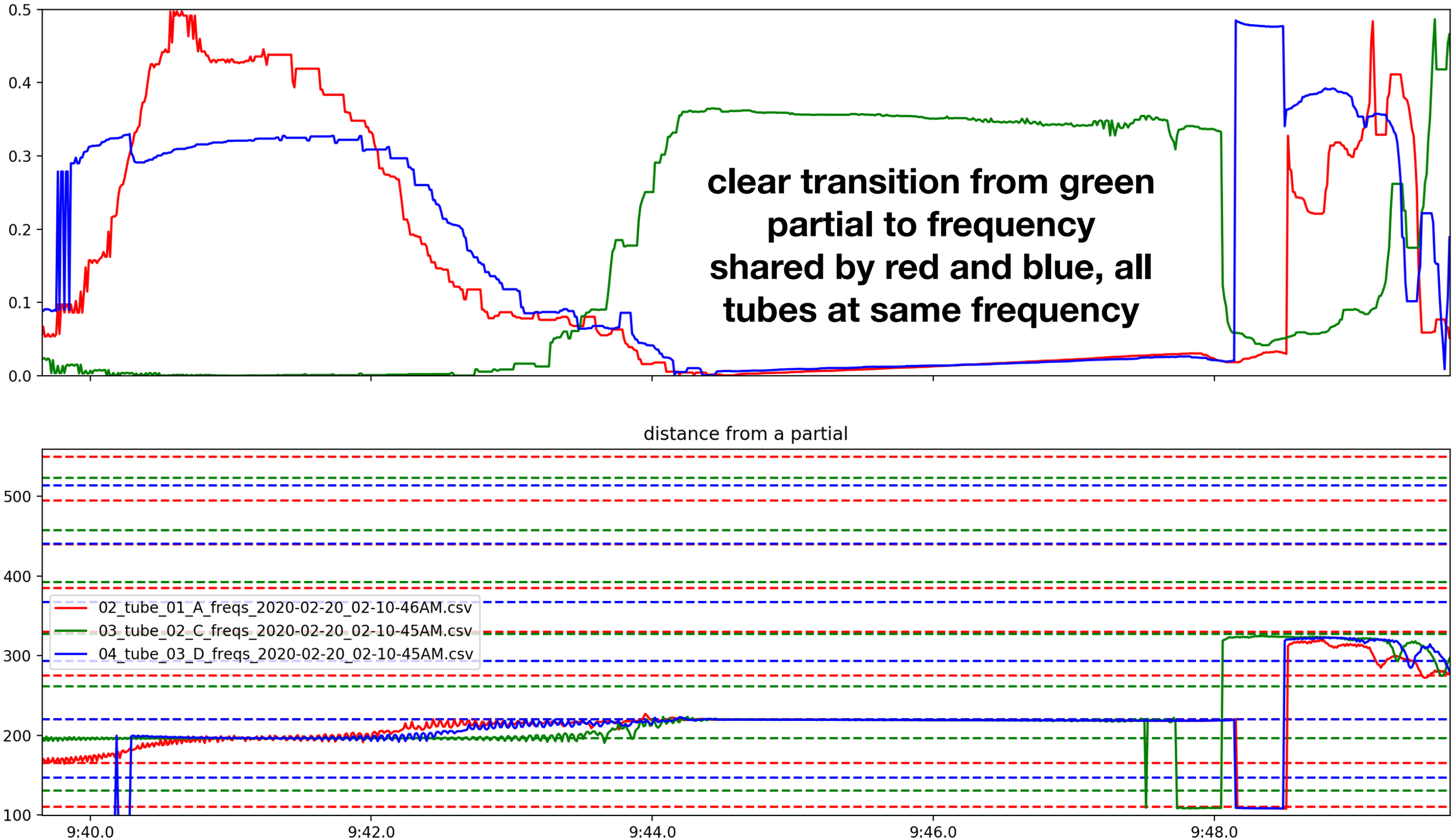
tube resonances while in series



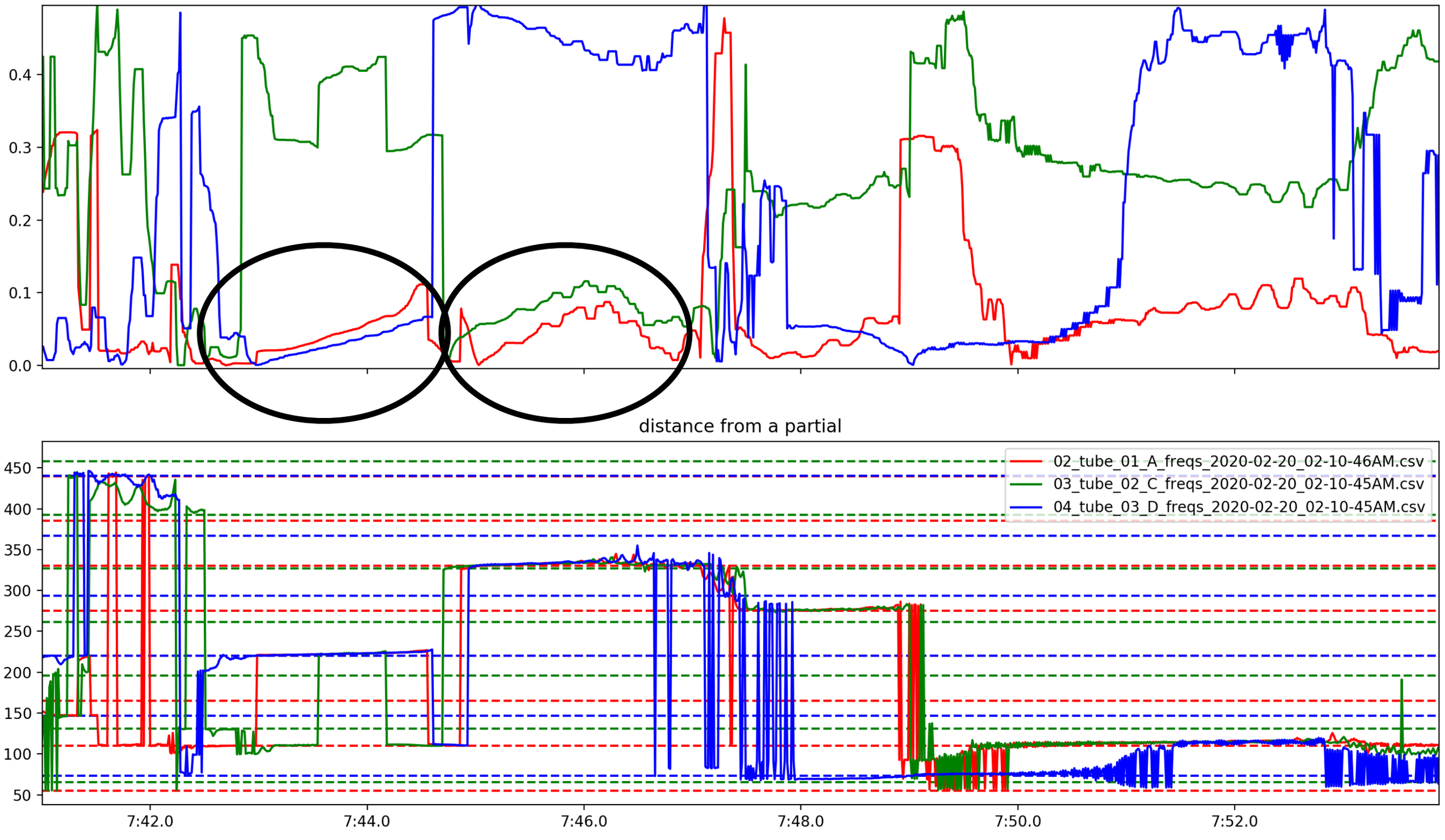
combined tubes resonance



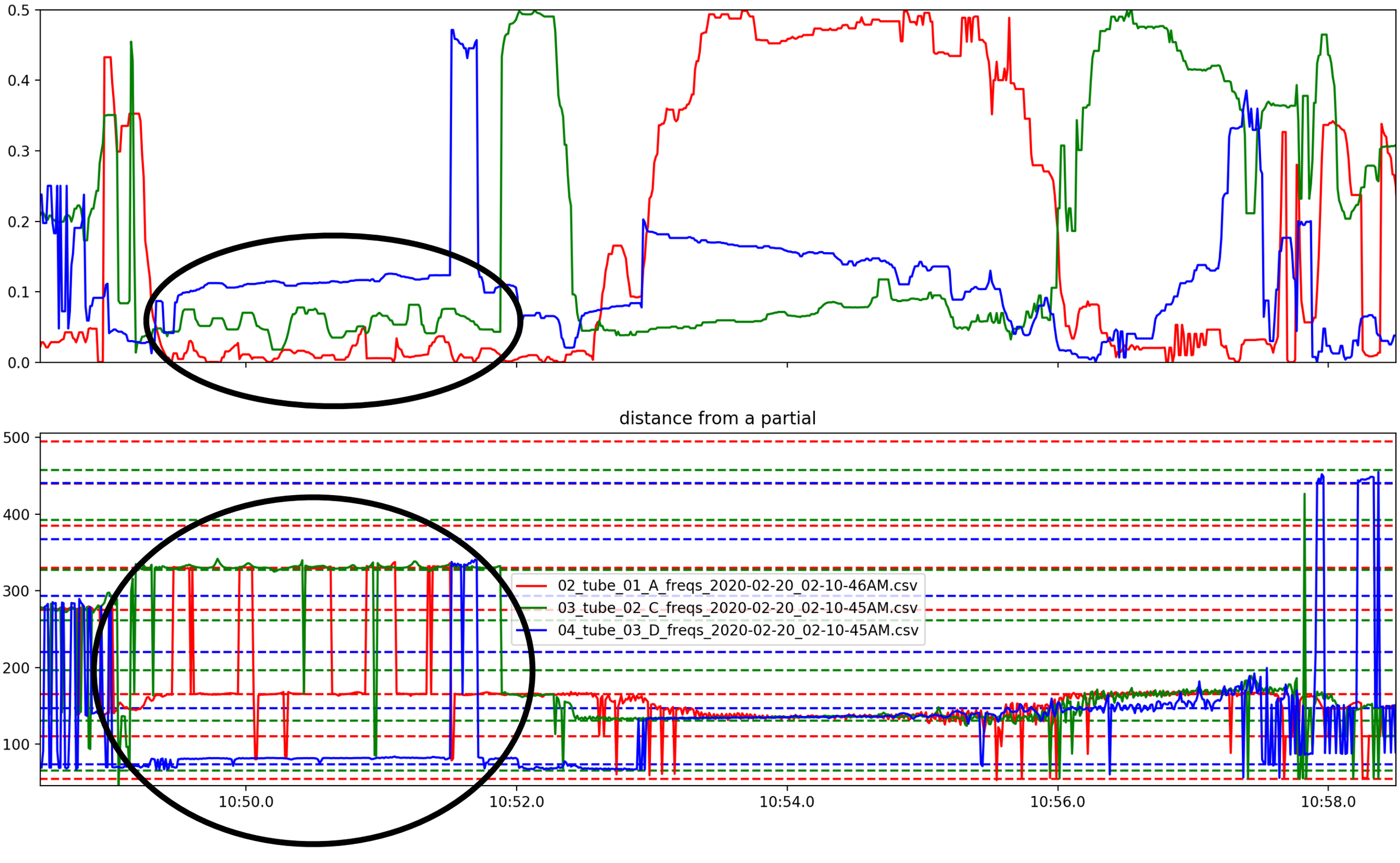
plotting each tube's distance from its own partials



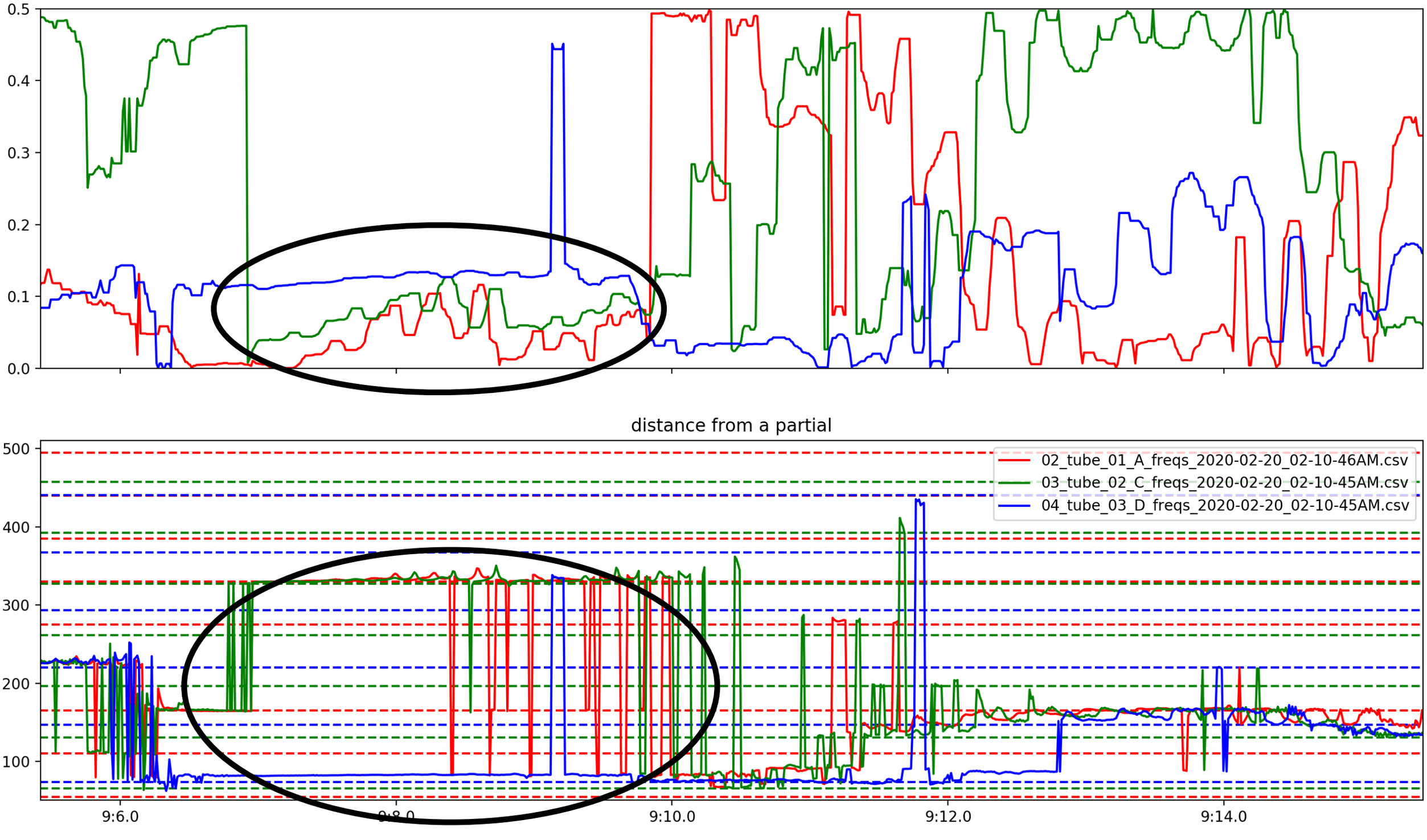
two tubes near own partial



all tubes near own partial

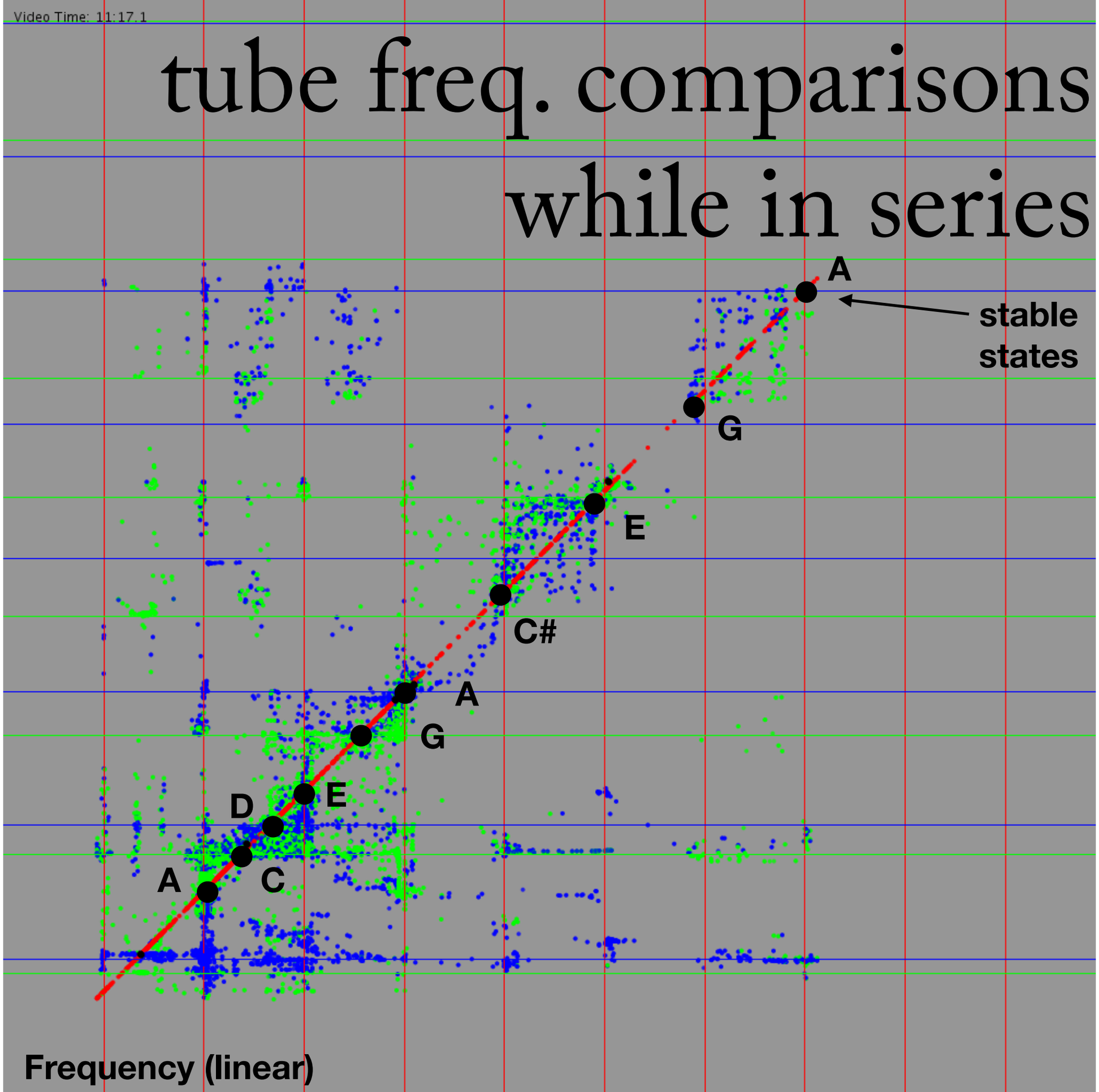


different moment, similar stable solution

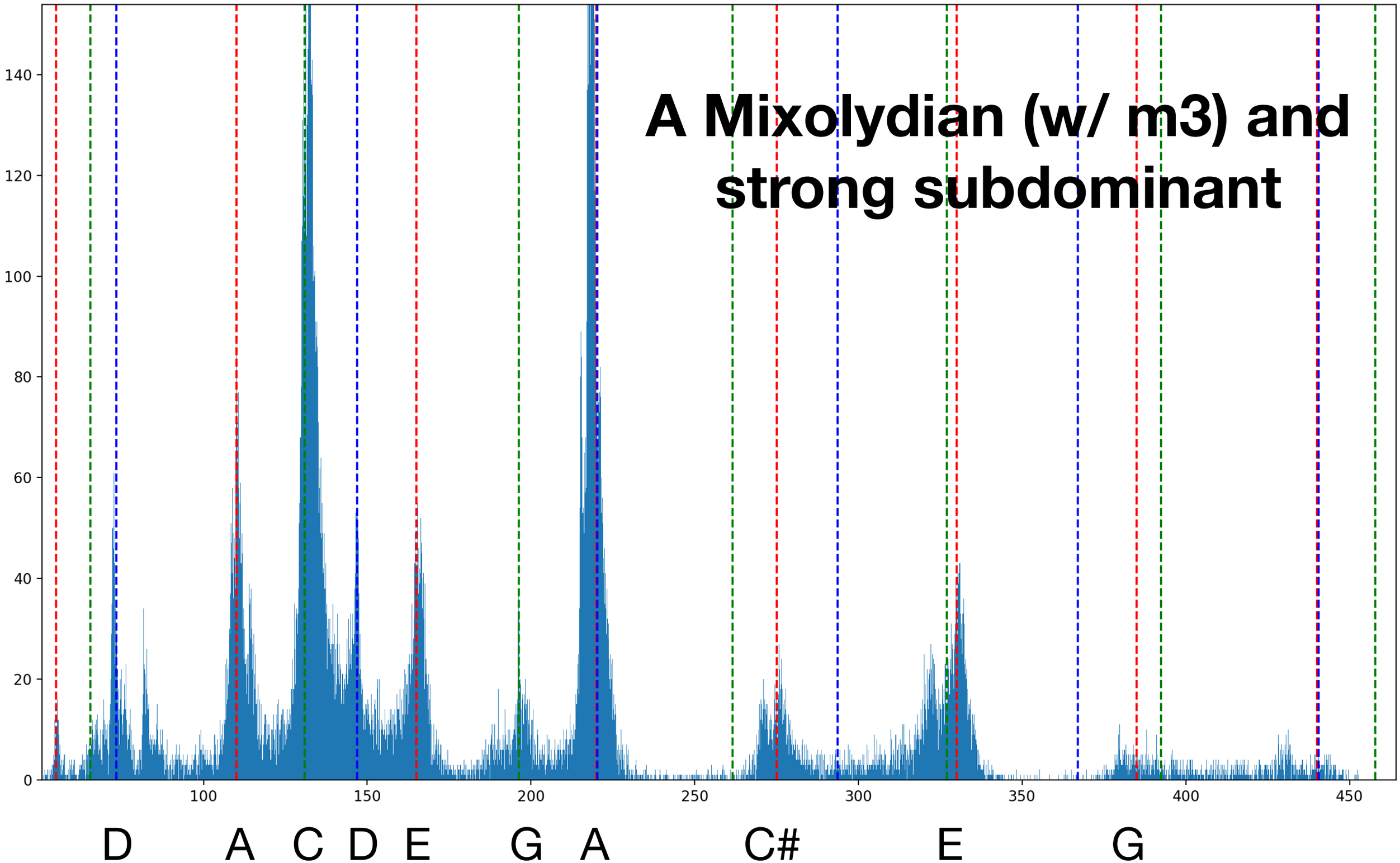


Video Time: 11:17.1

tube freq. comparisons while in series

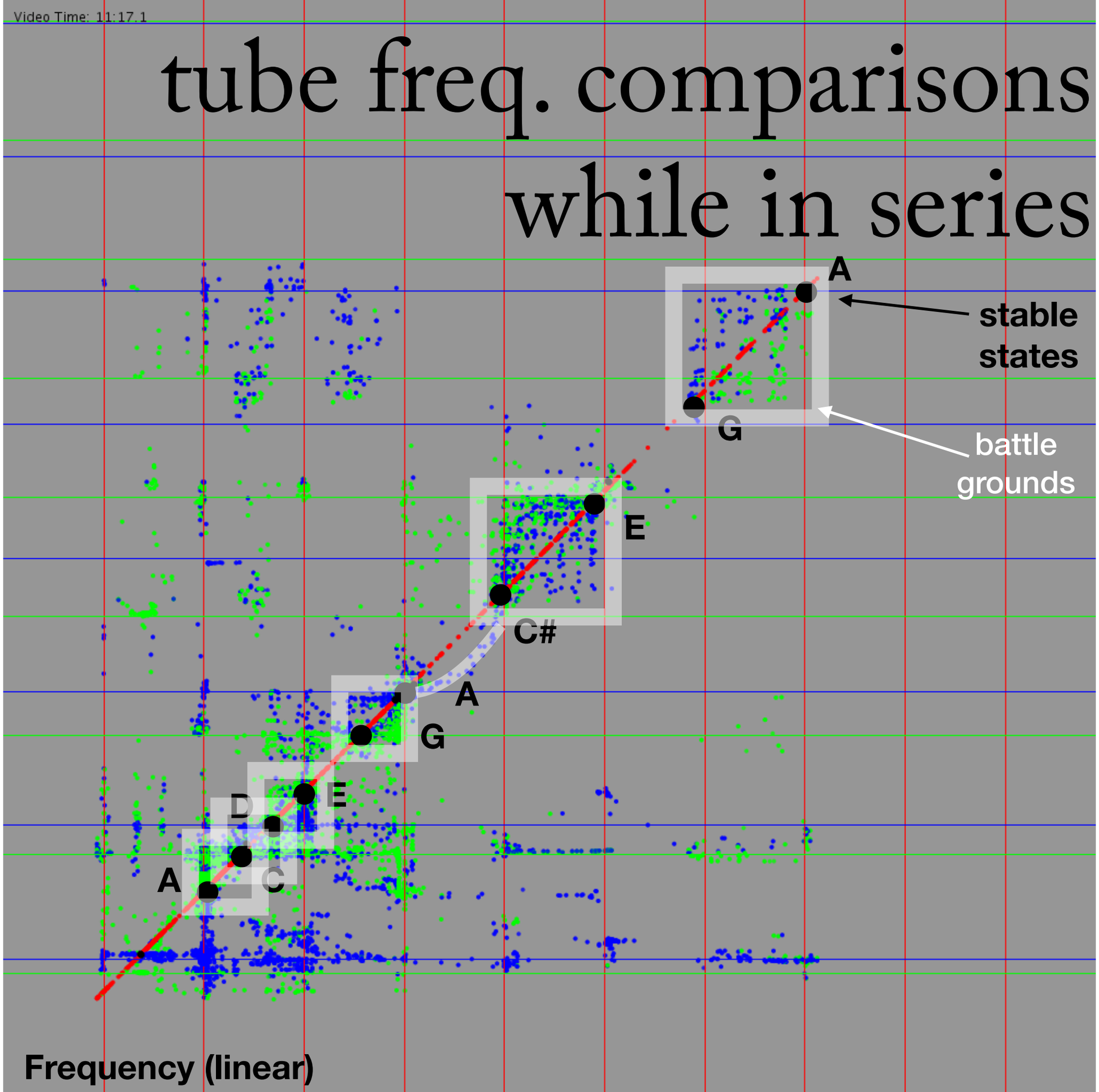


combined tubes resonance



Video Time: 11:17.1

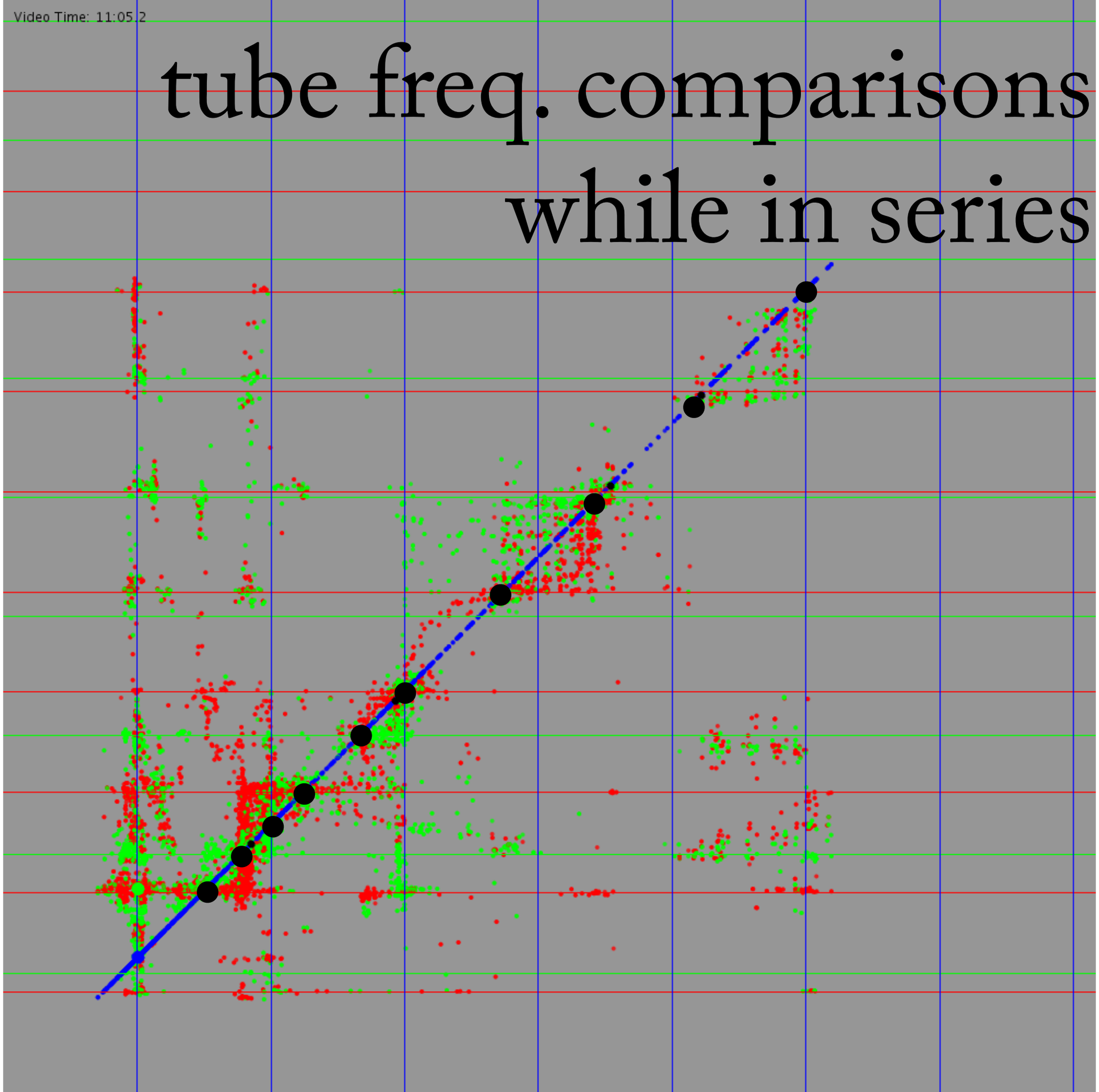
tube freq. comparisons while in series



C#
A
G
E
D
C

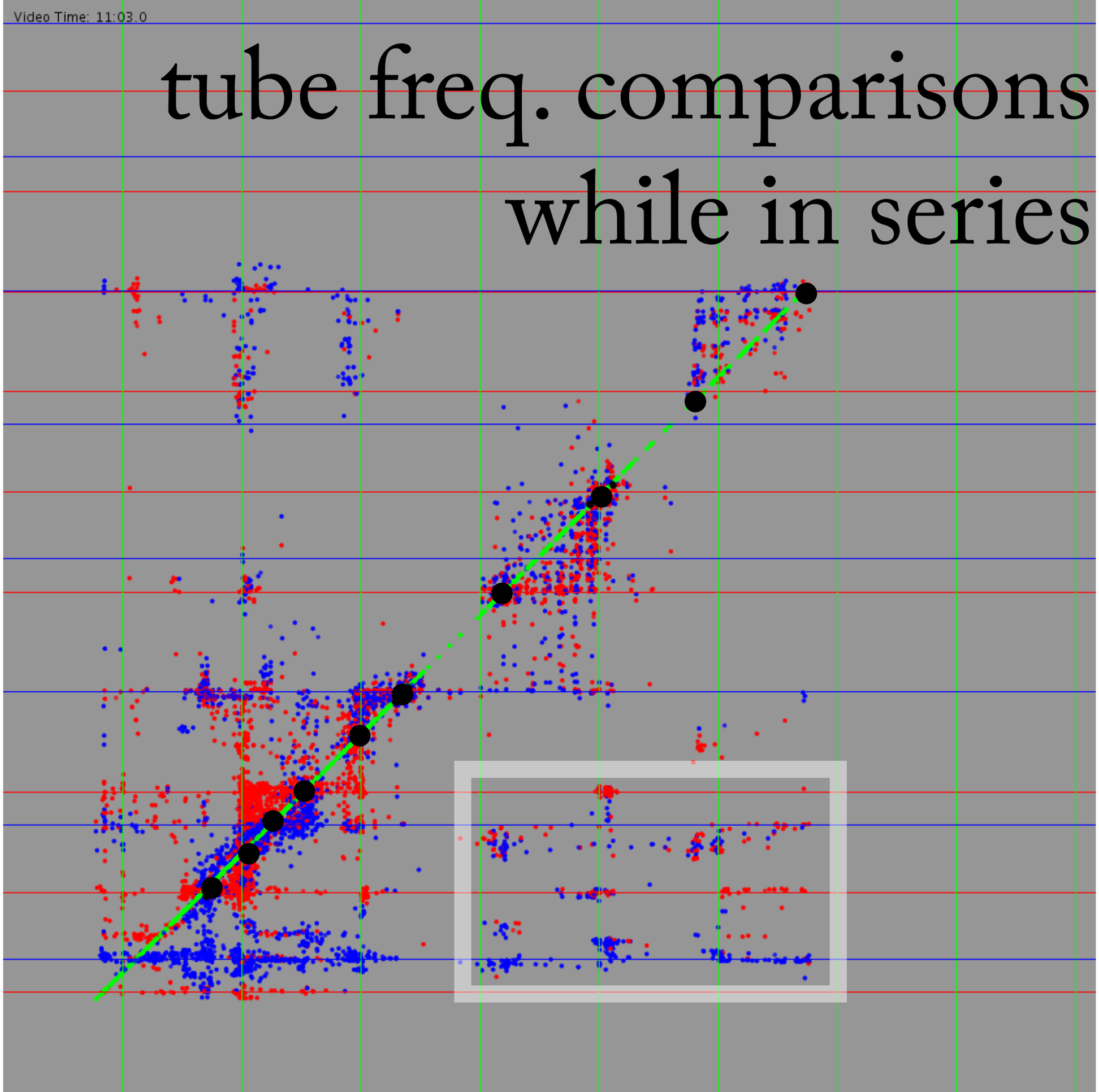
Video Time: 11:05.2

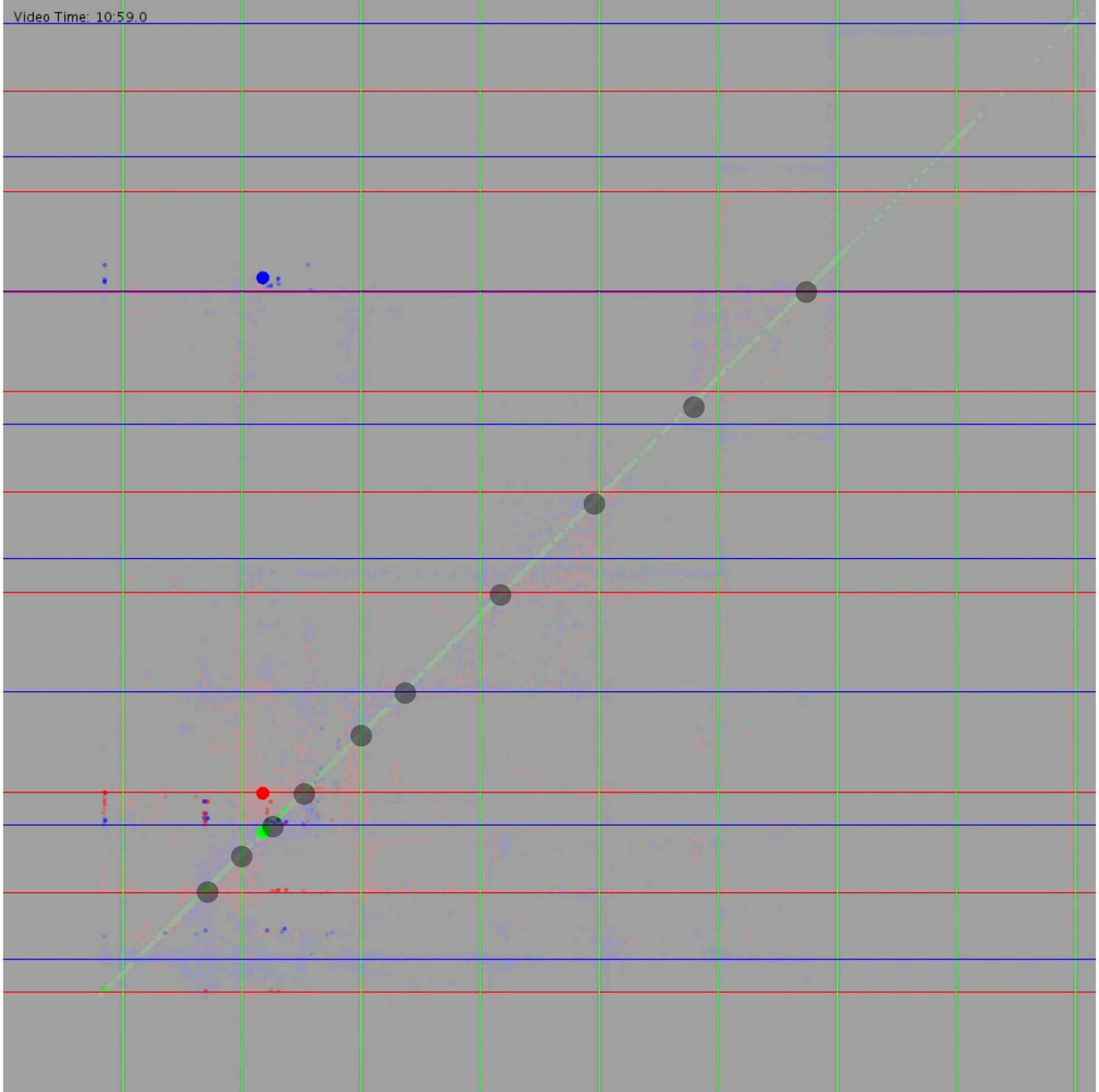
tube freq. comparisons while in series

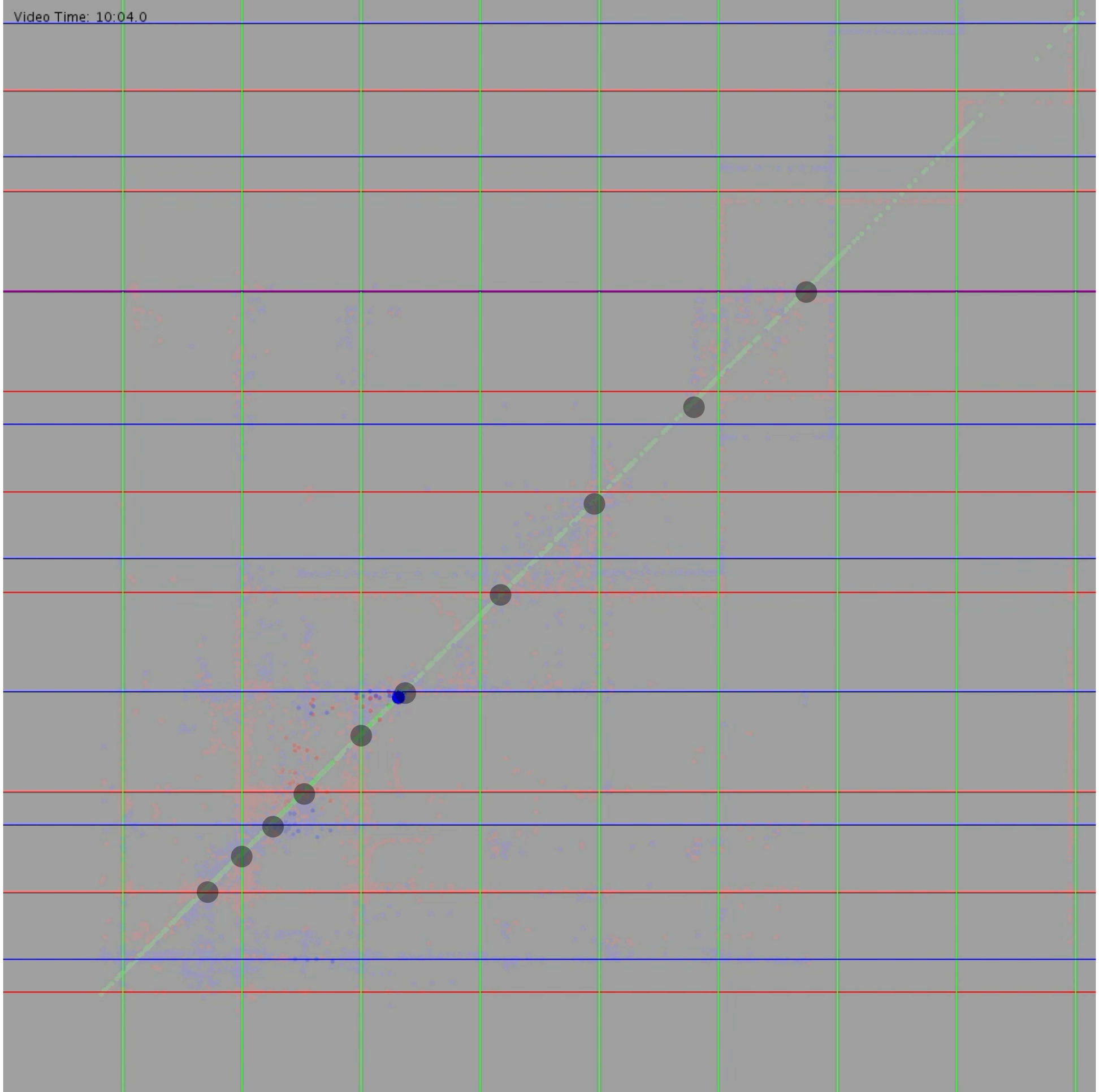


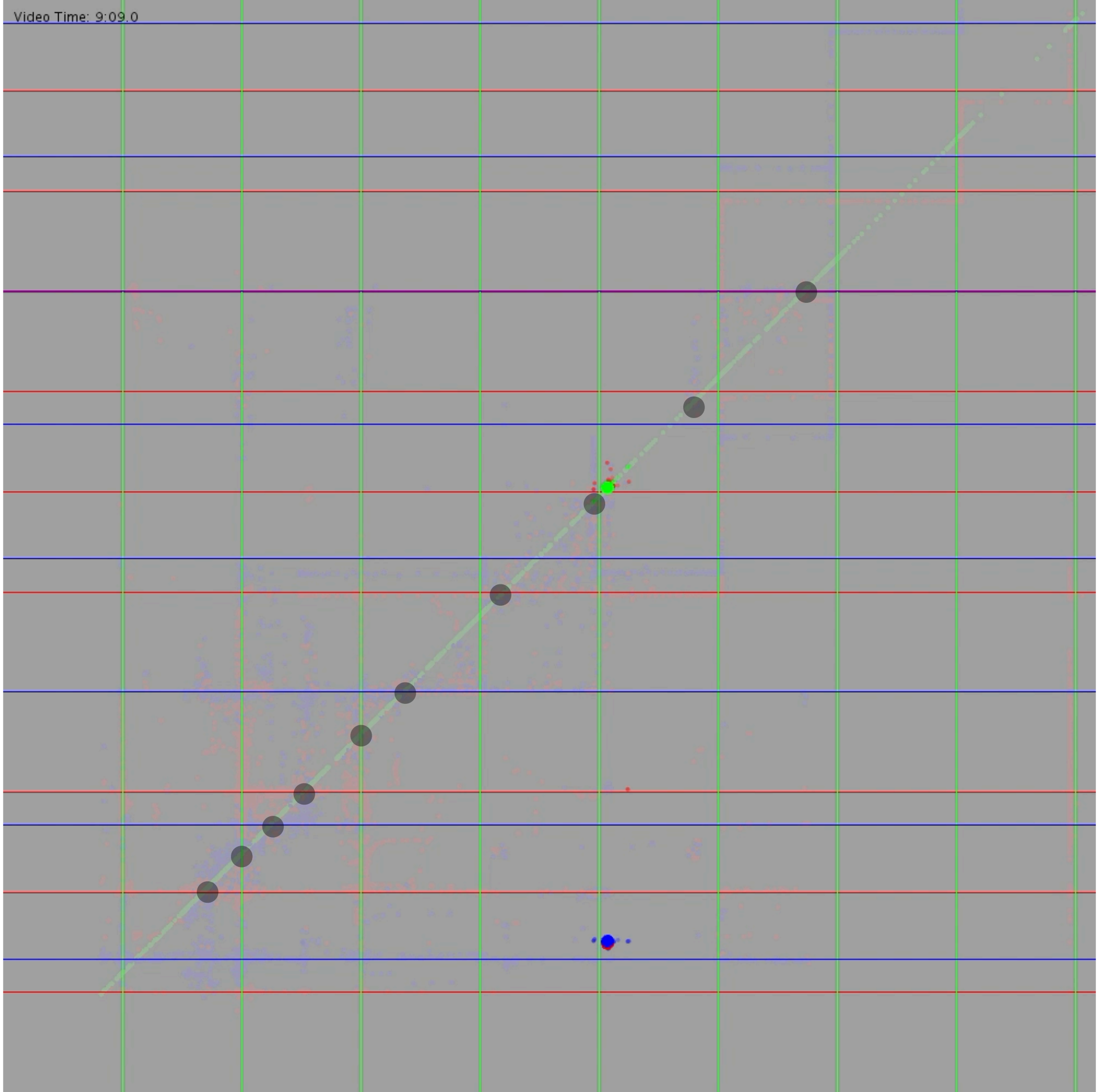
Video Time: 11:03.0

tube freq. comparisons while in series

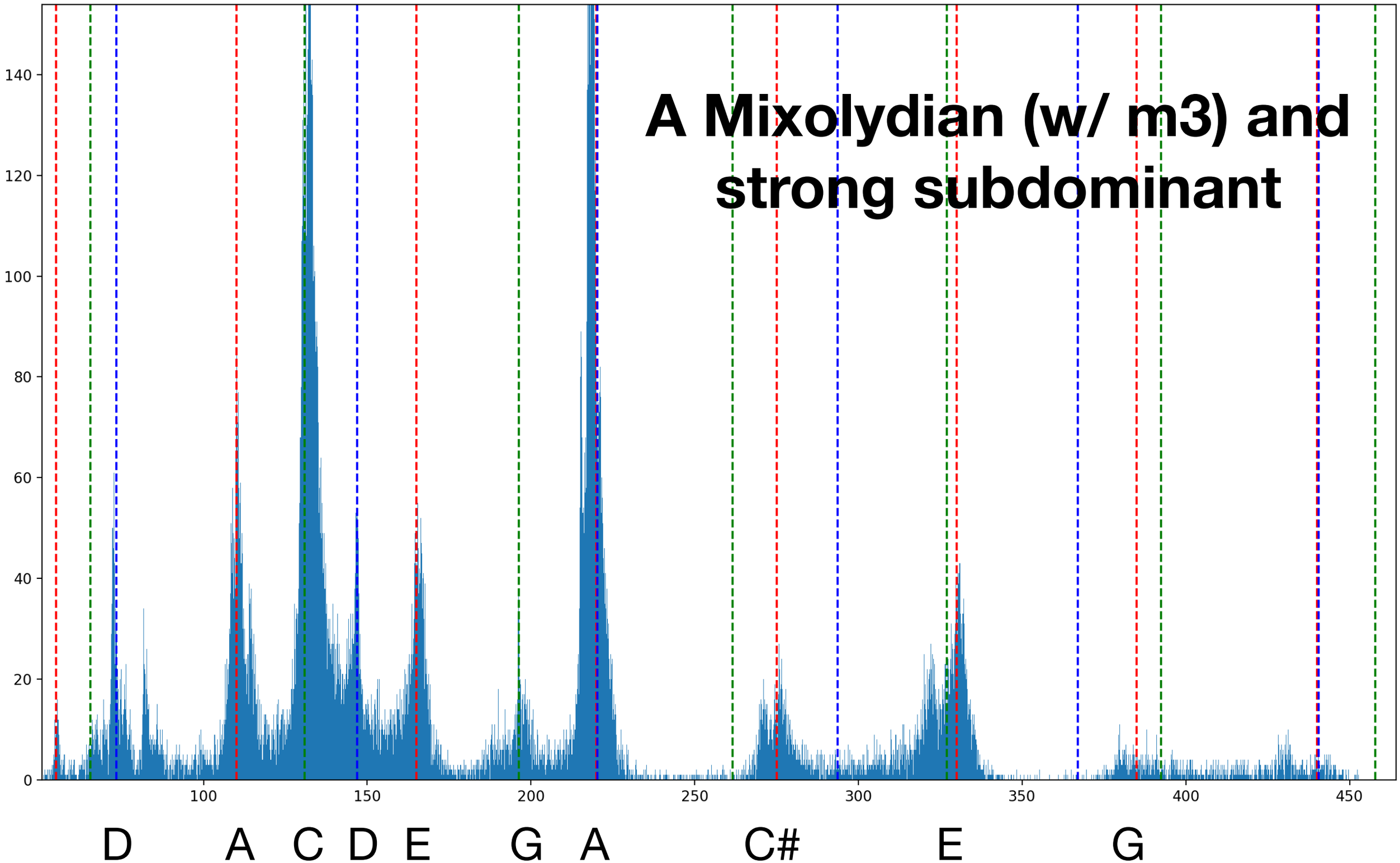



Video Time: 10:59.0

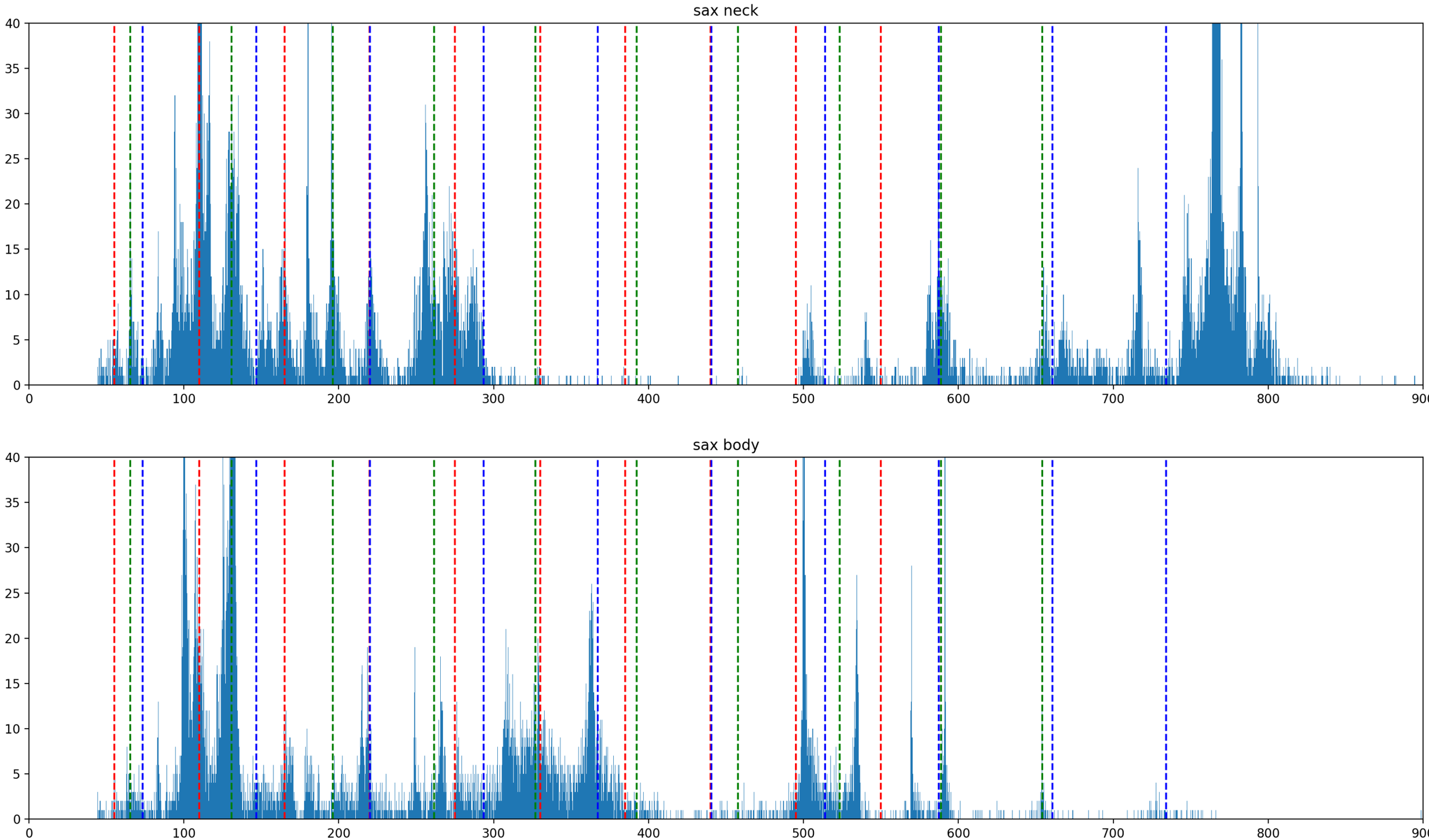

Video Time: 10:04.0


Video Time: 9:09.0

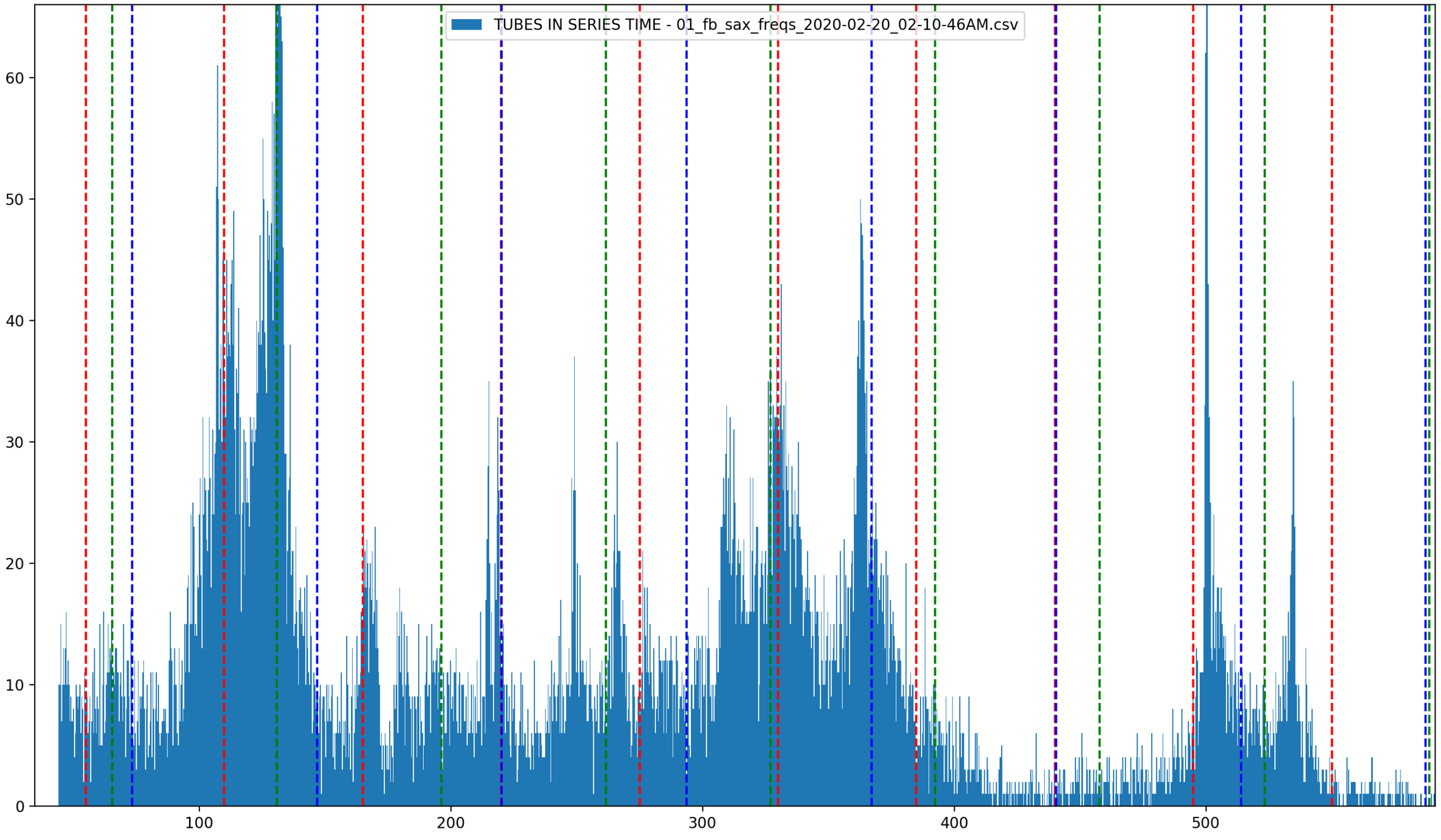
combined tubes resonance



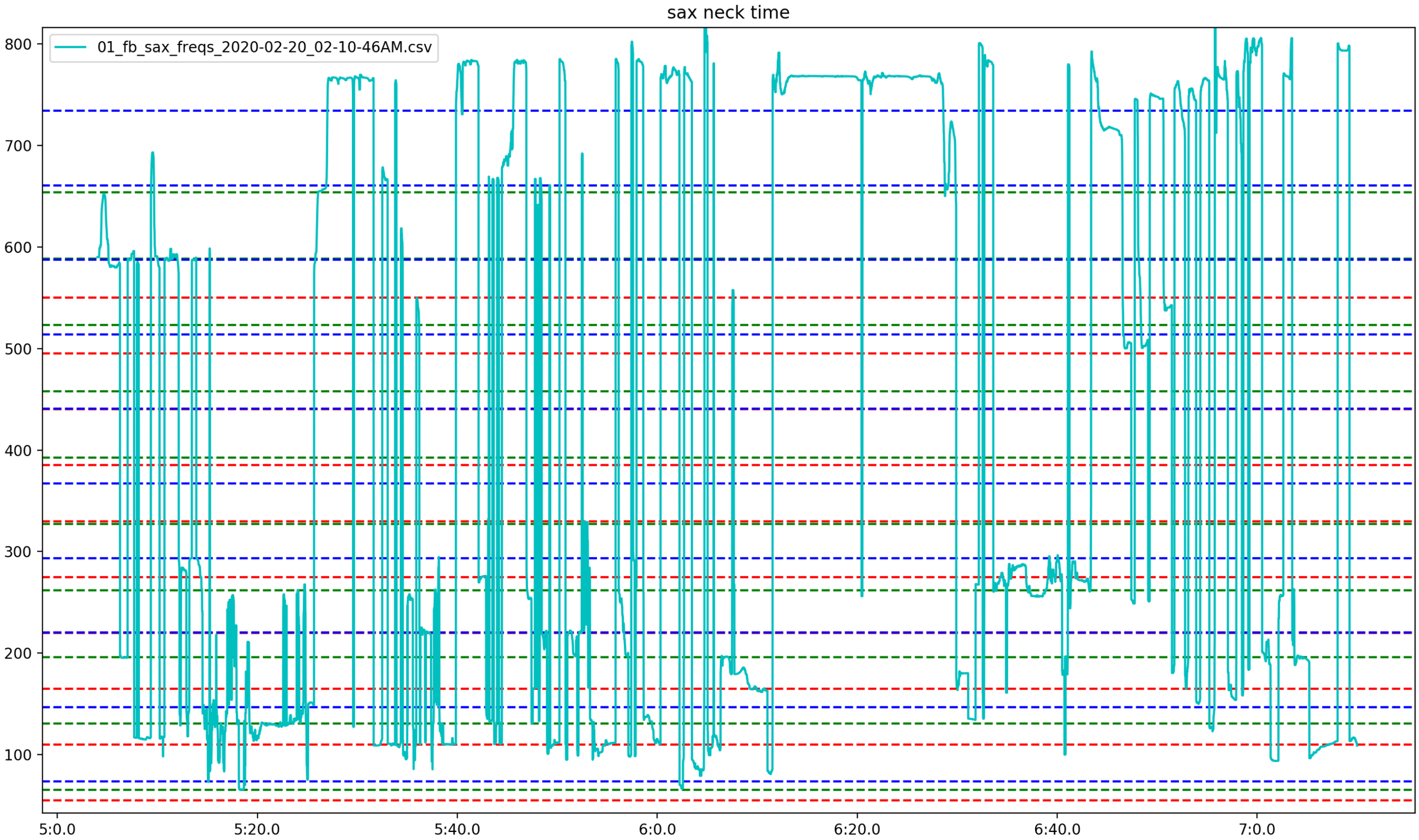
Histogram of sax neck and sax body

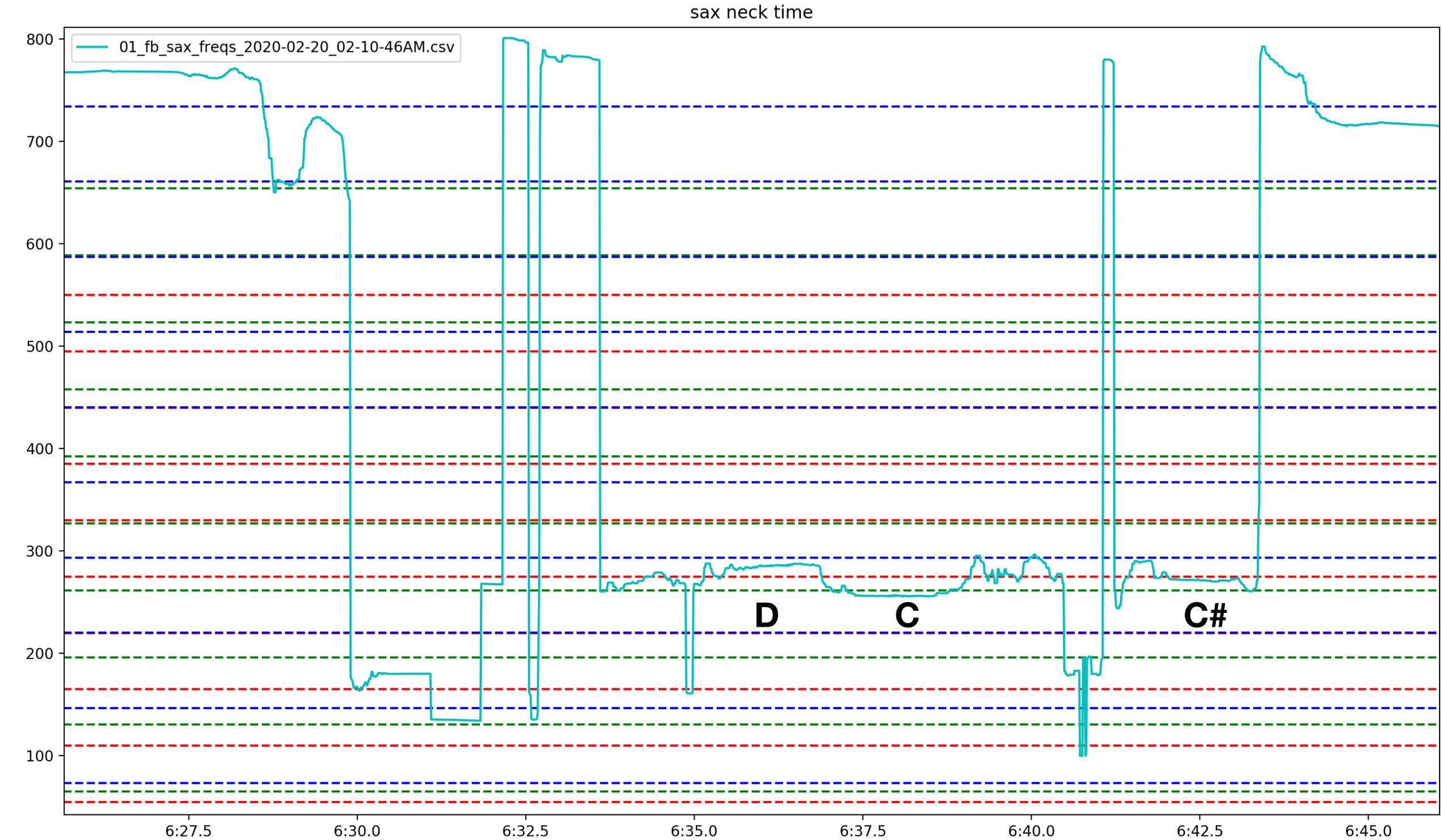


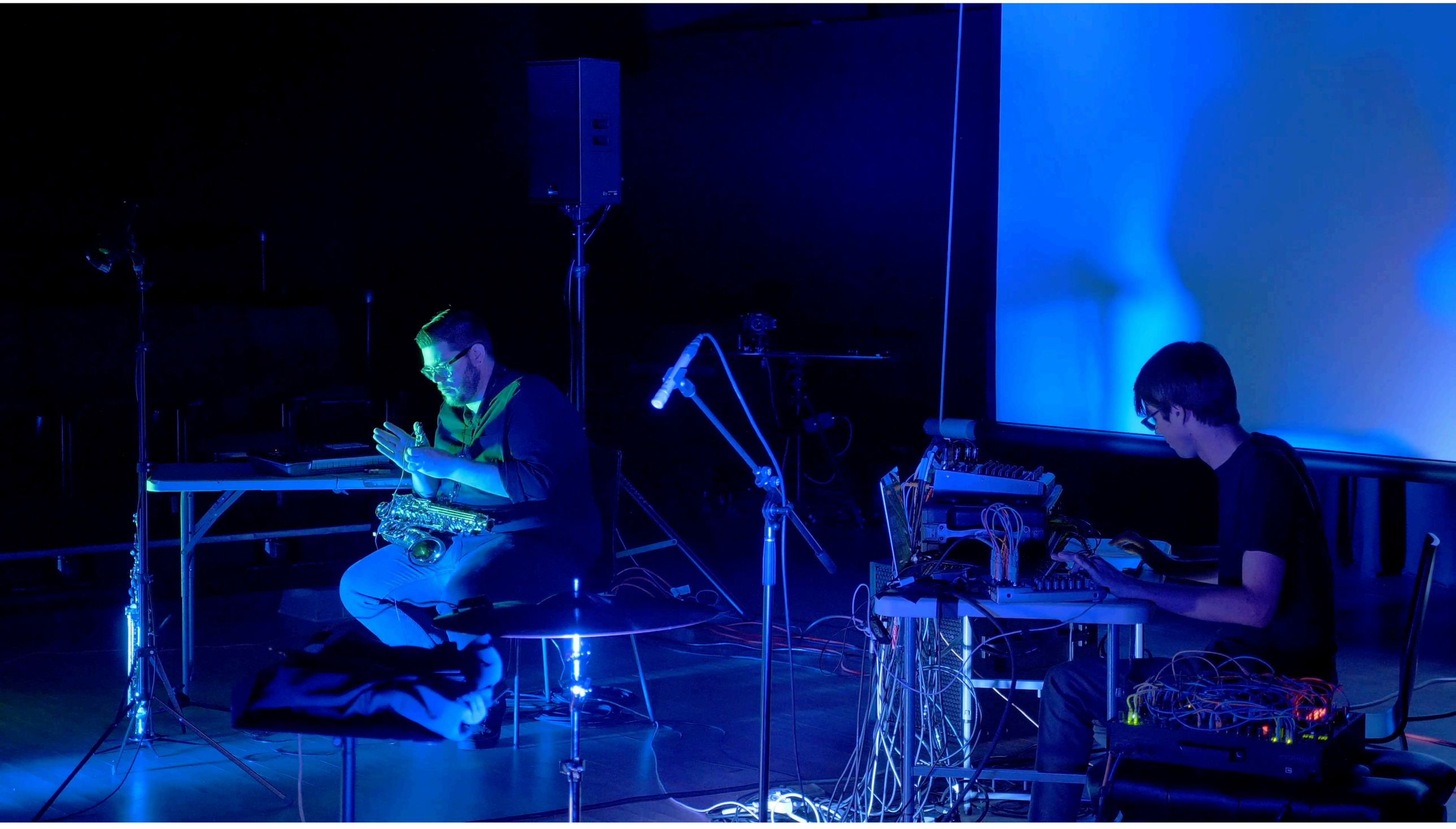
saxophone (body) resonances



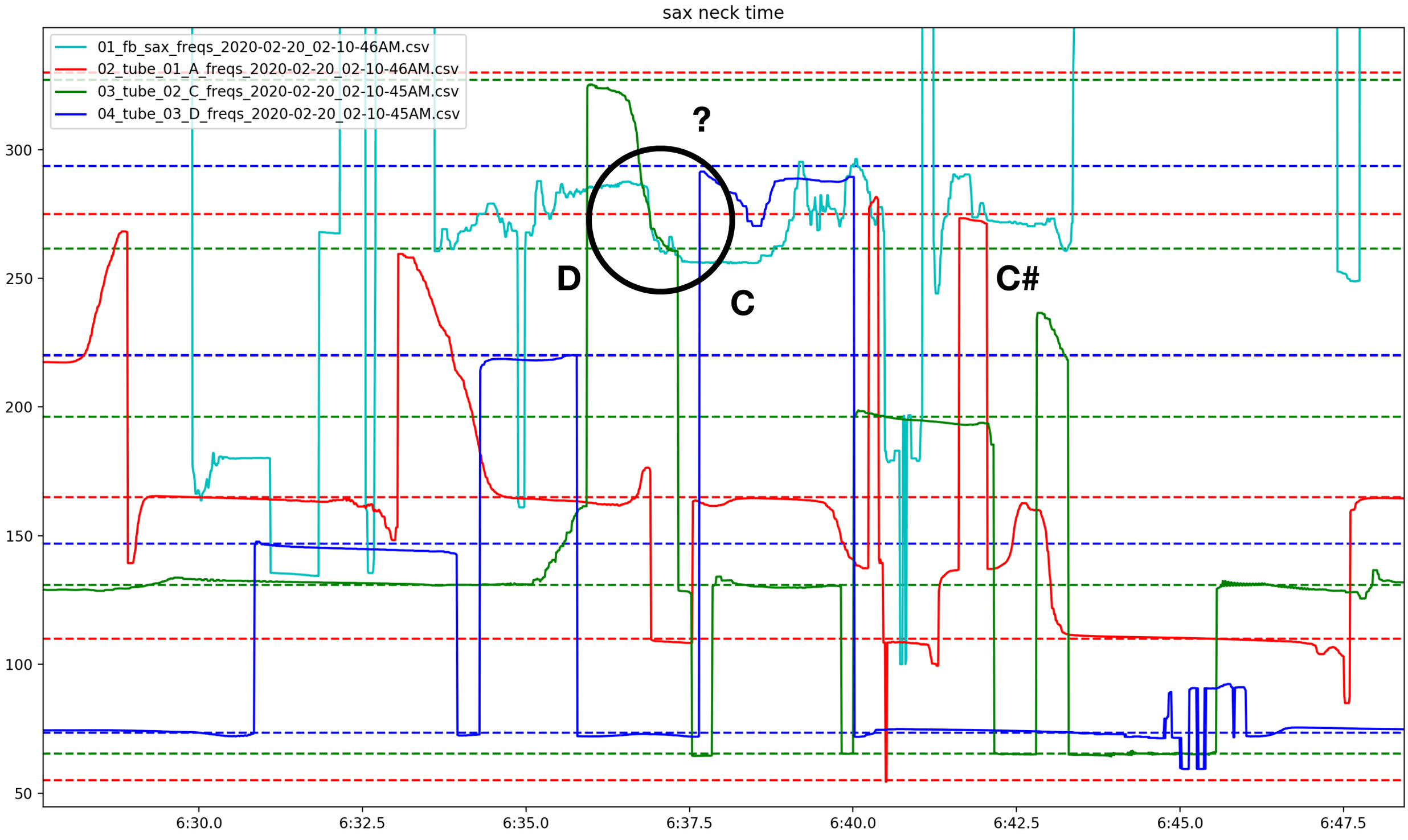
saxophone (neck) frequencies

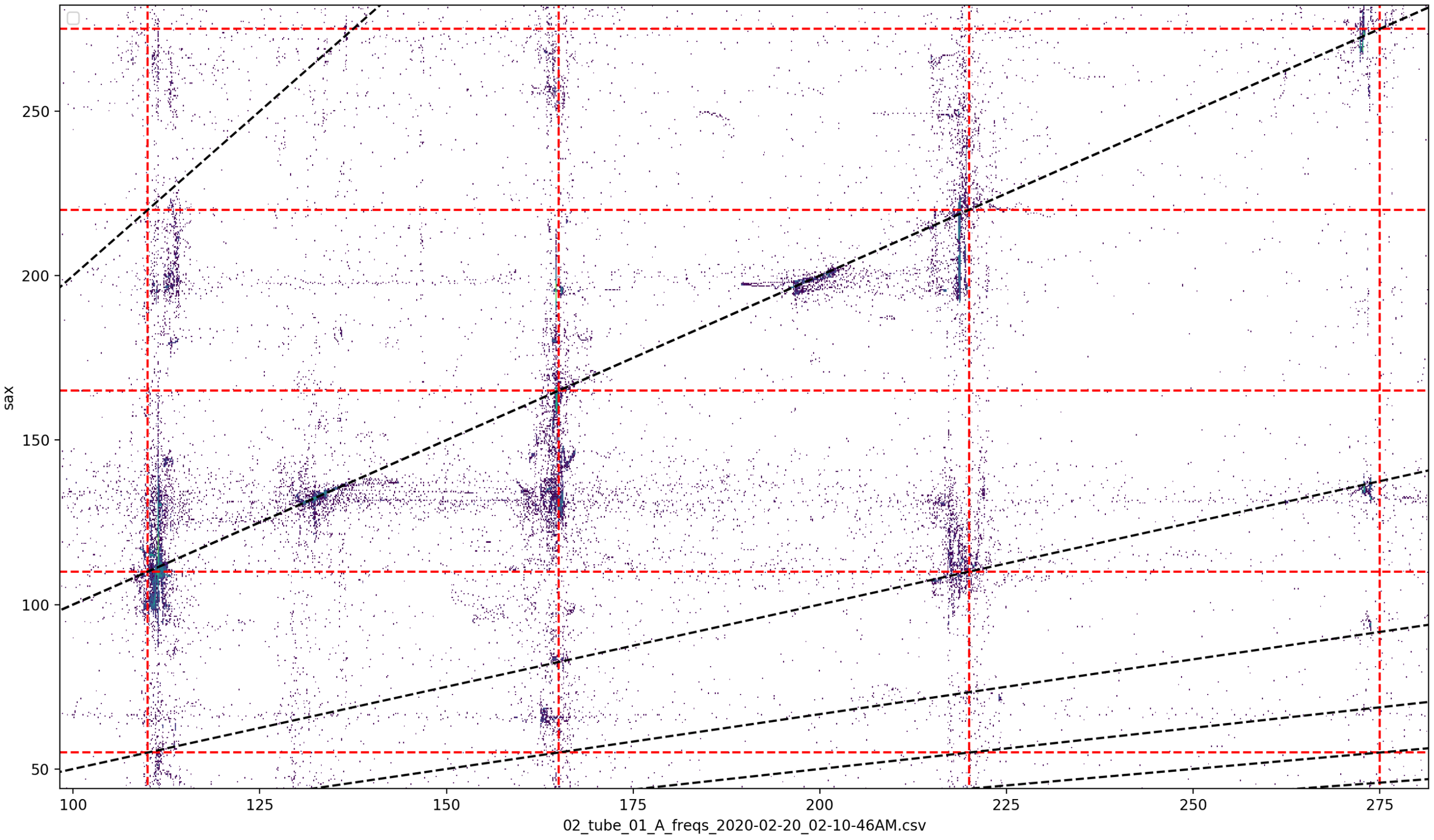


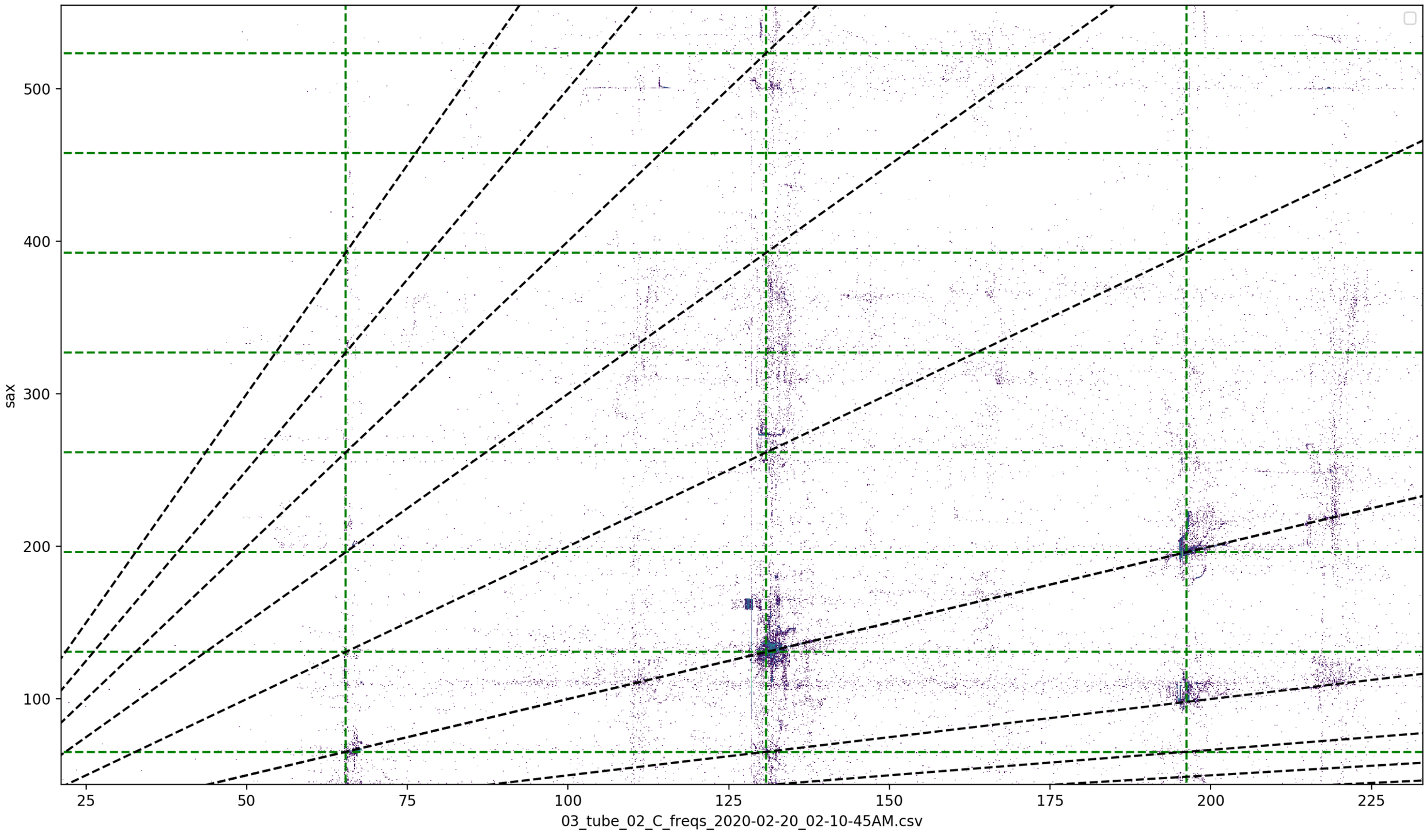

sax neck time
01_fb_sax_freqs_2020-02-20_02-10-46AM.csv
800
700
600
500
400
300
200
100
D
C
C#
6:27.5
6:30.0
6:32.5
6:35.0
6:37.5
6:40.0
6:42.5
6:45.0

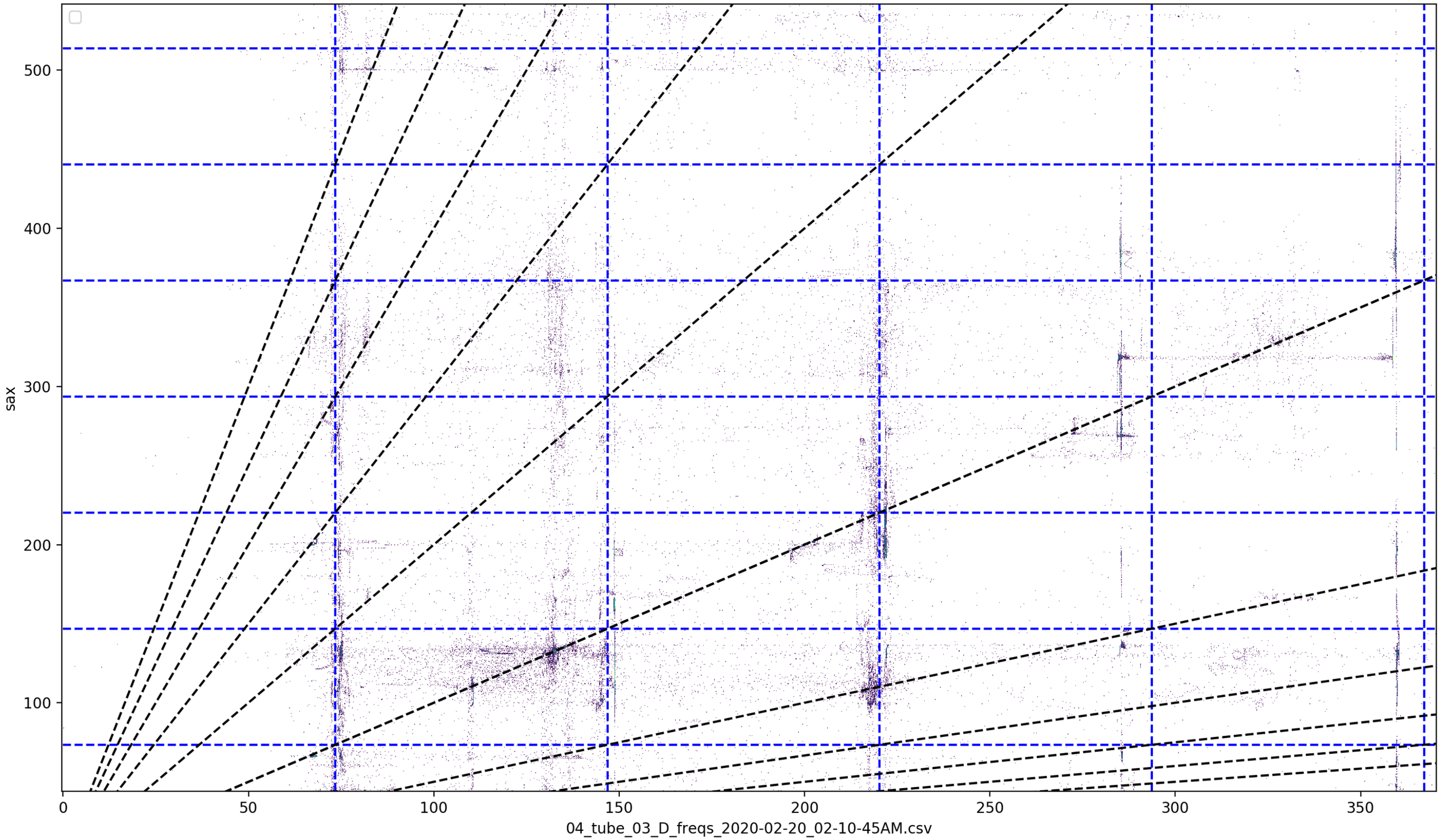


same moment, with tubes




sax
250
200
150
100
50
100
125
150
175
200
225
250
275
02_tube_01_A_freqs_2020-02-20_02-10-46AM.csv


500
400
300
200
100
sax
25
50
75
100
125
150
175
200
225
03_tube_02_C_freqs_2020-02-20_02-10-45AM.csv


sax
500
400
300
200
100
0
50
100
150
200
250
300
350
04_tube_03_D_freqs_2020-02-20_02-10-45AM.csv

Conclusion

- Tubes in series act as one system that has a particular harmonic palate.
- Hints at predicting paths of motion between stable unisons.
- Analytic approach seems to reveal structure. Could be applied to other feedback systems.
- Stochastic elements in signal processing may create or obscure certain behaviors.
    - (Probably) causes frequency cycling.
    - Causes other properties that remain a mystery? (why some unison nodes are not visited?)

Future Questions

- Why are some nodes on “unison line” not used?
- More exploration of stability that includes multiple frequencies (not all tubes on the same frequency).
- Access different harmonic palates.
- Insert saxophone body into system (as control interface?).
- Use components other than PVC tubes.
    - Bassoon?
    - Cymbal?
    - Brass?
    - Sax Quartet?

Questions