

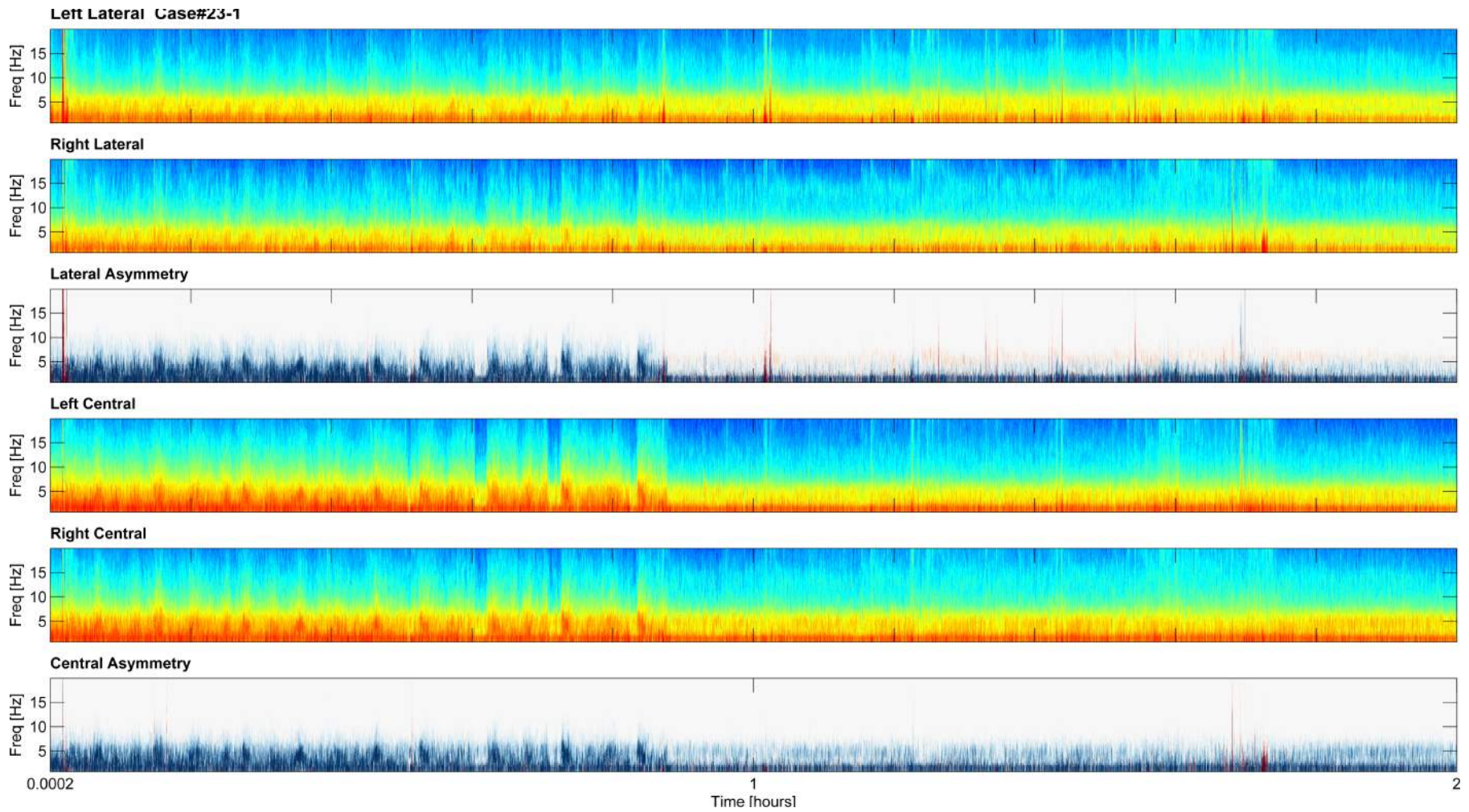
# An introduction to quantitative EEG and compressed spectral arrays

# Goals

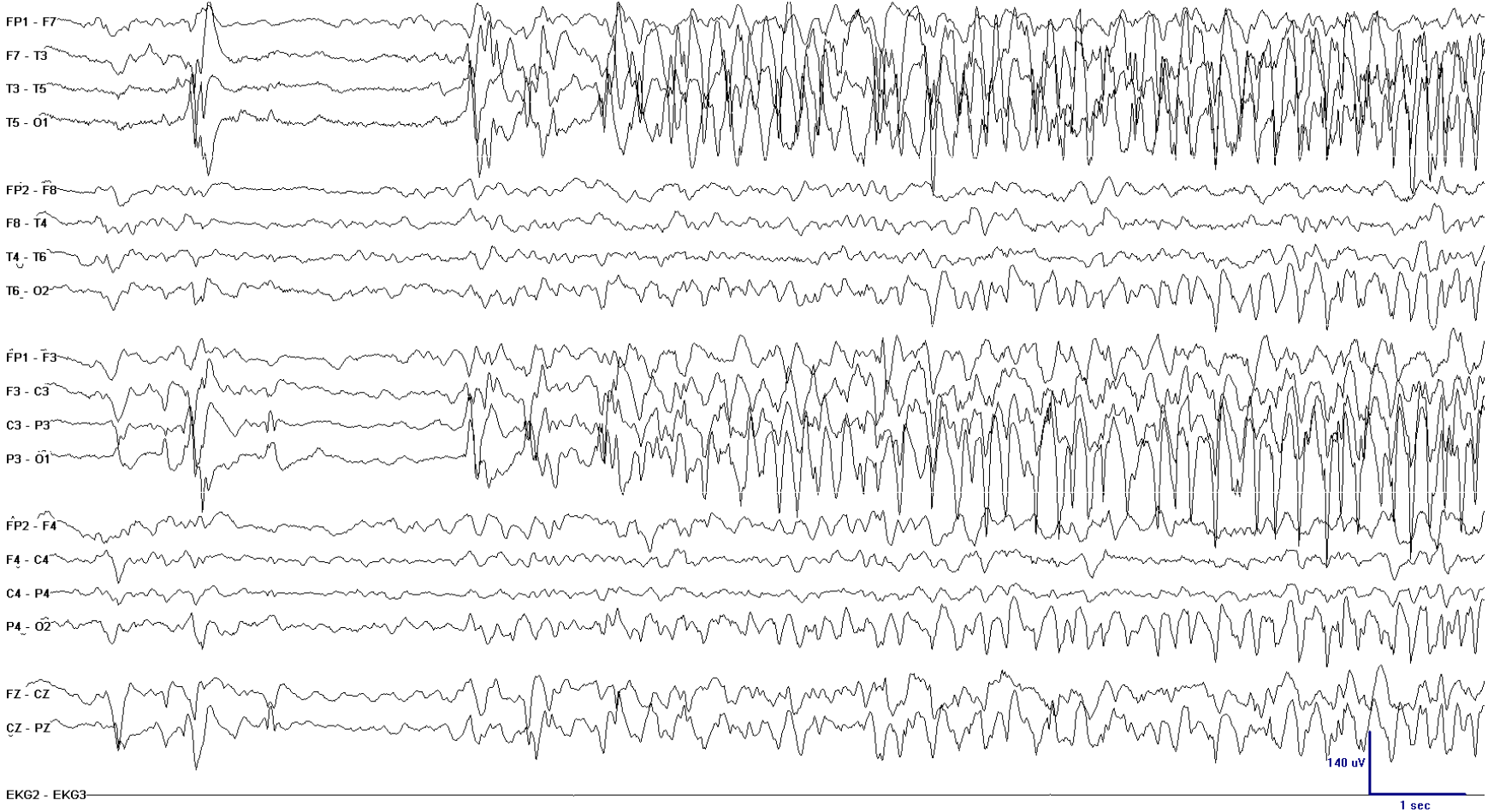
- Understand the role of quantitative EEG analysis
- Introduction to compressed spectral array (CSA)
- Identify seizures using CSA
- Differentiate artifacts from seizures using CSA

# Examples

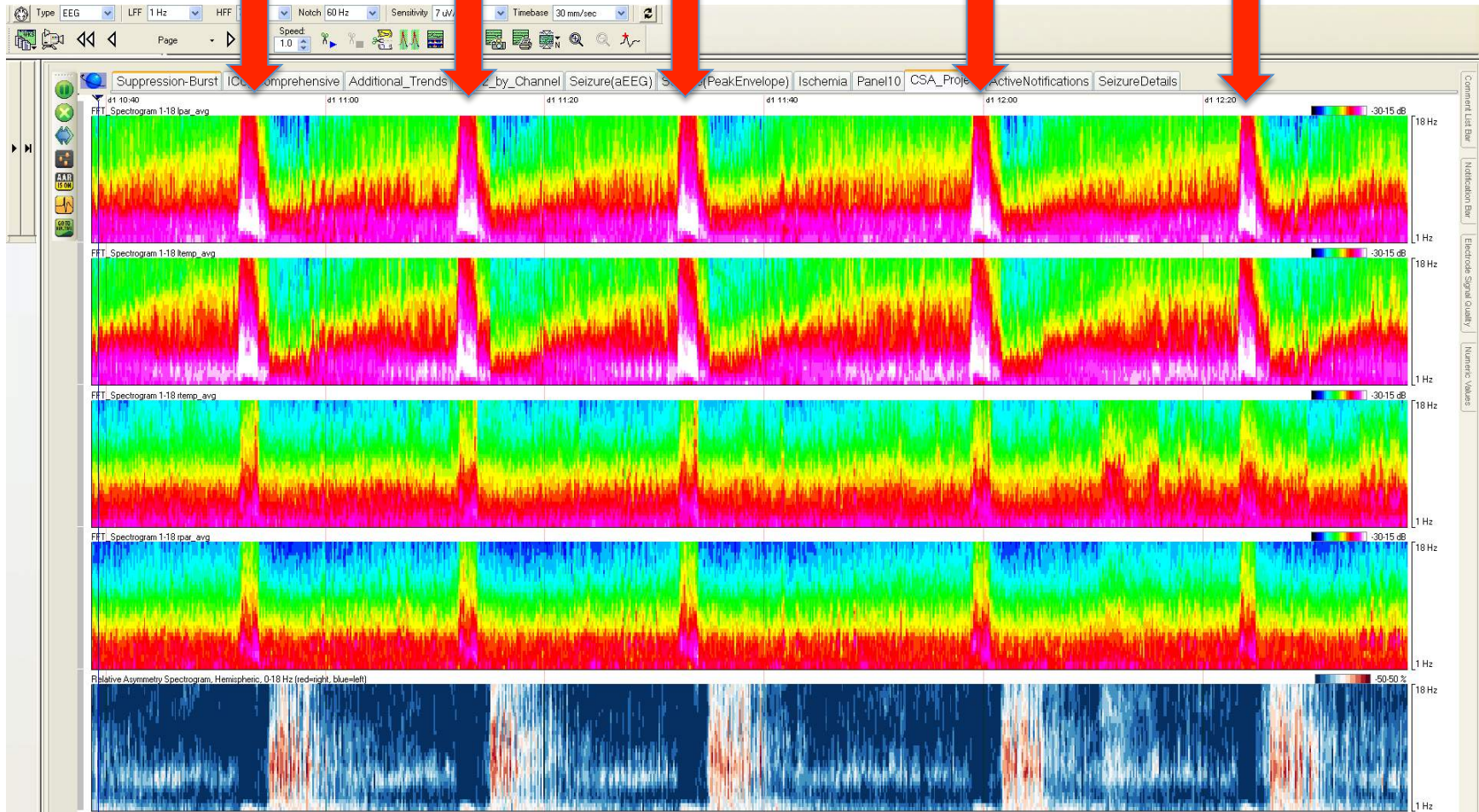
# CSA example



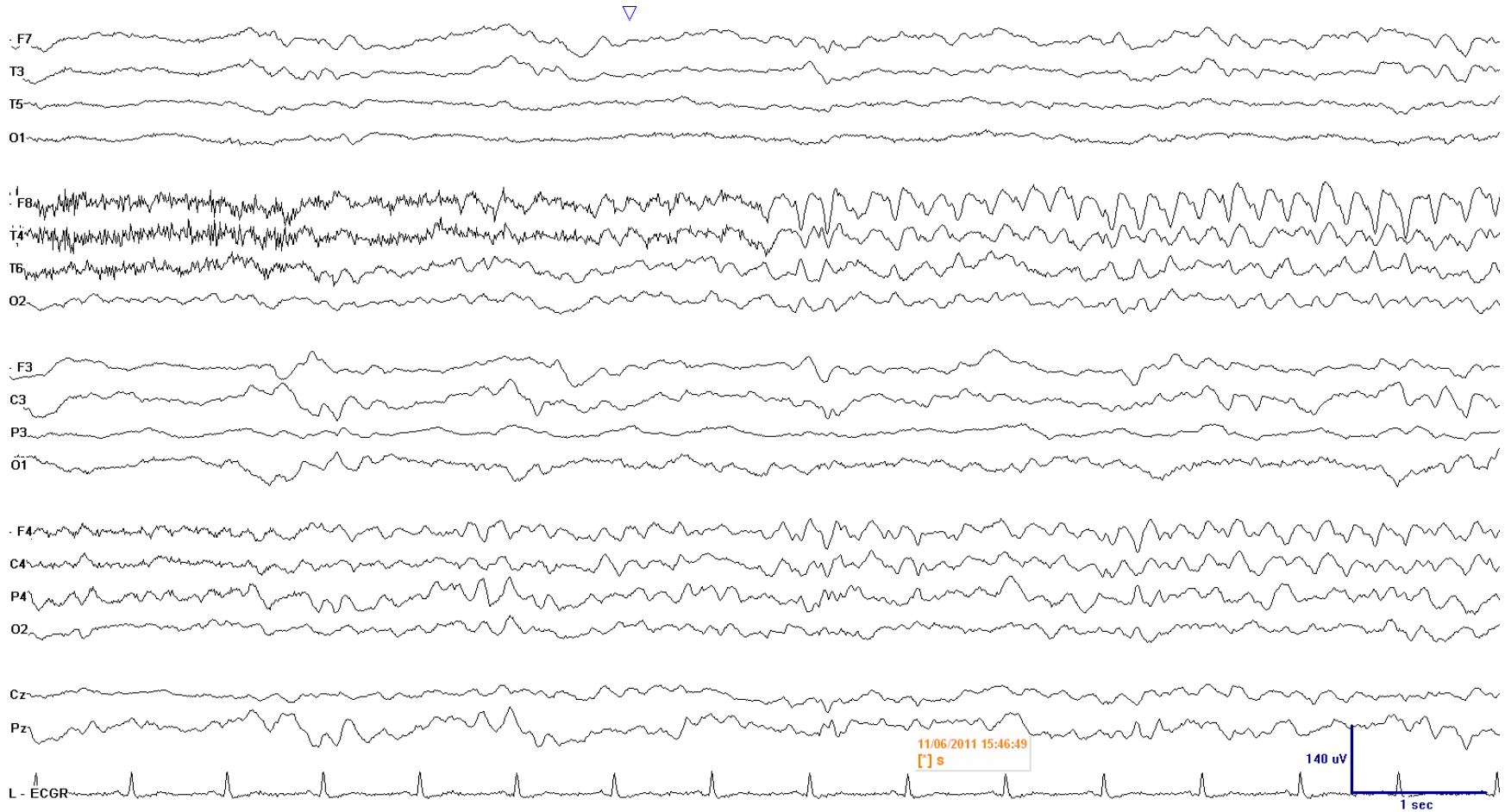
# Seizure example



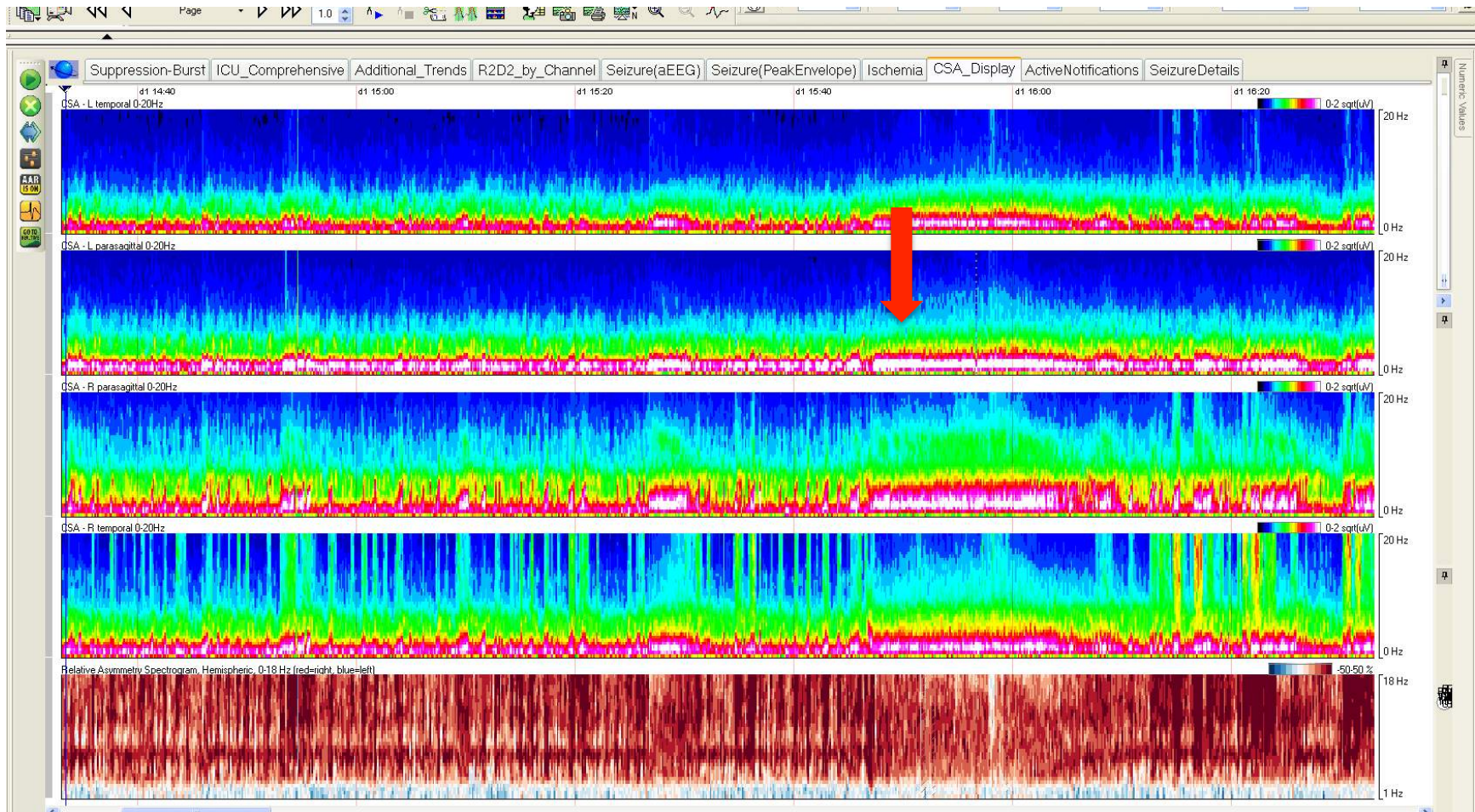
# Corresponding CSA



# A focal seizure

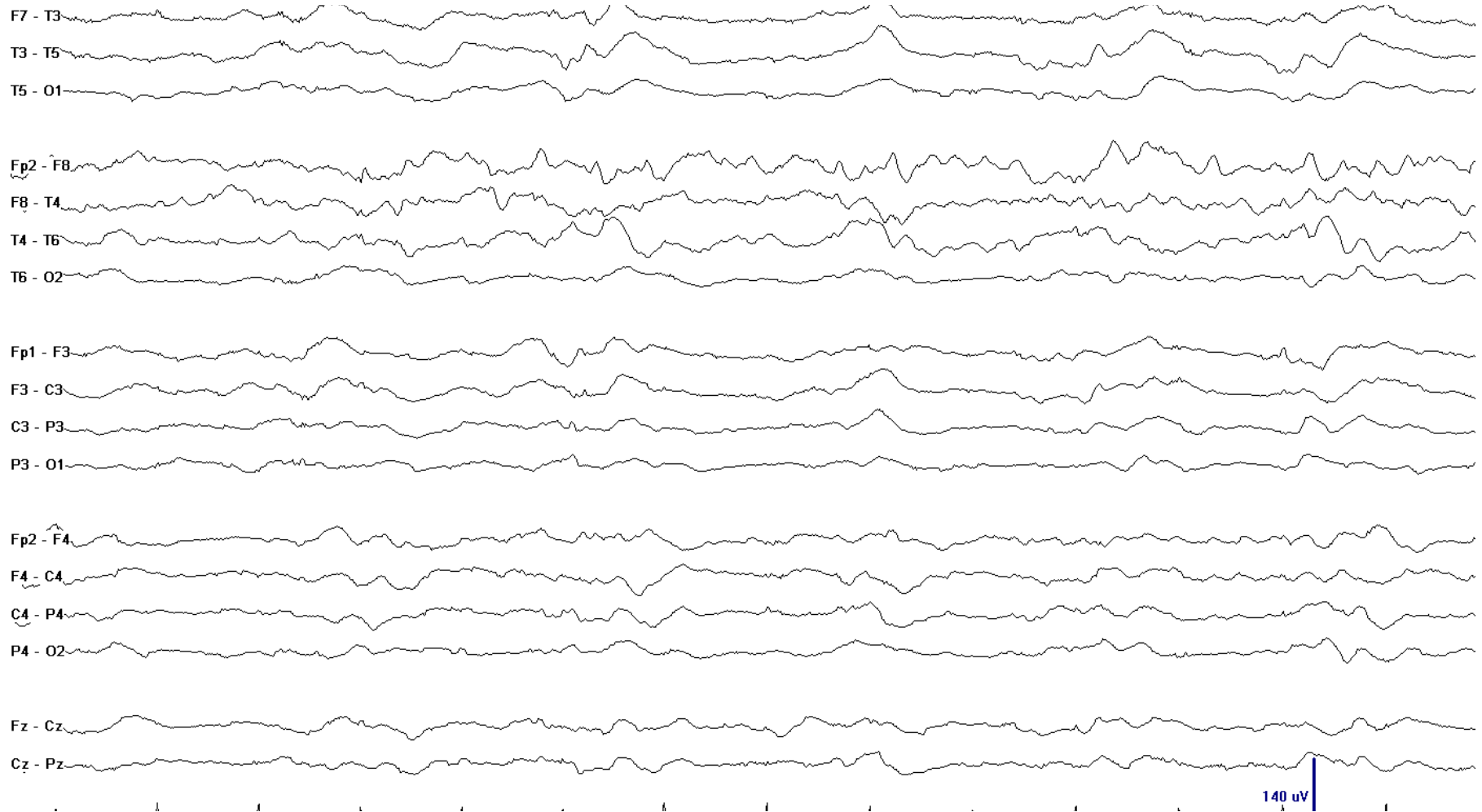


# Corresponding CSA

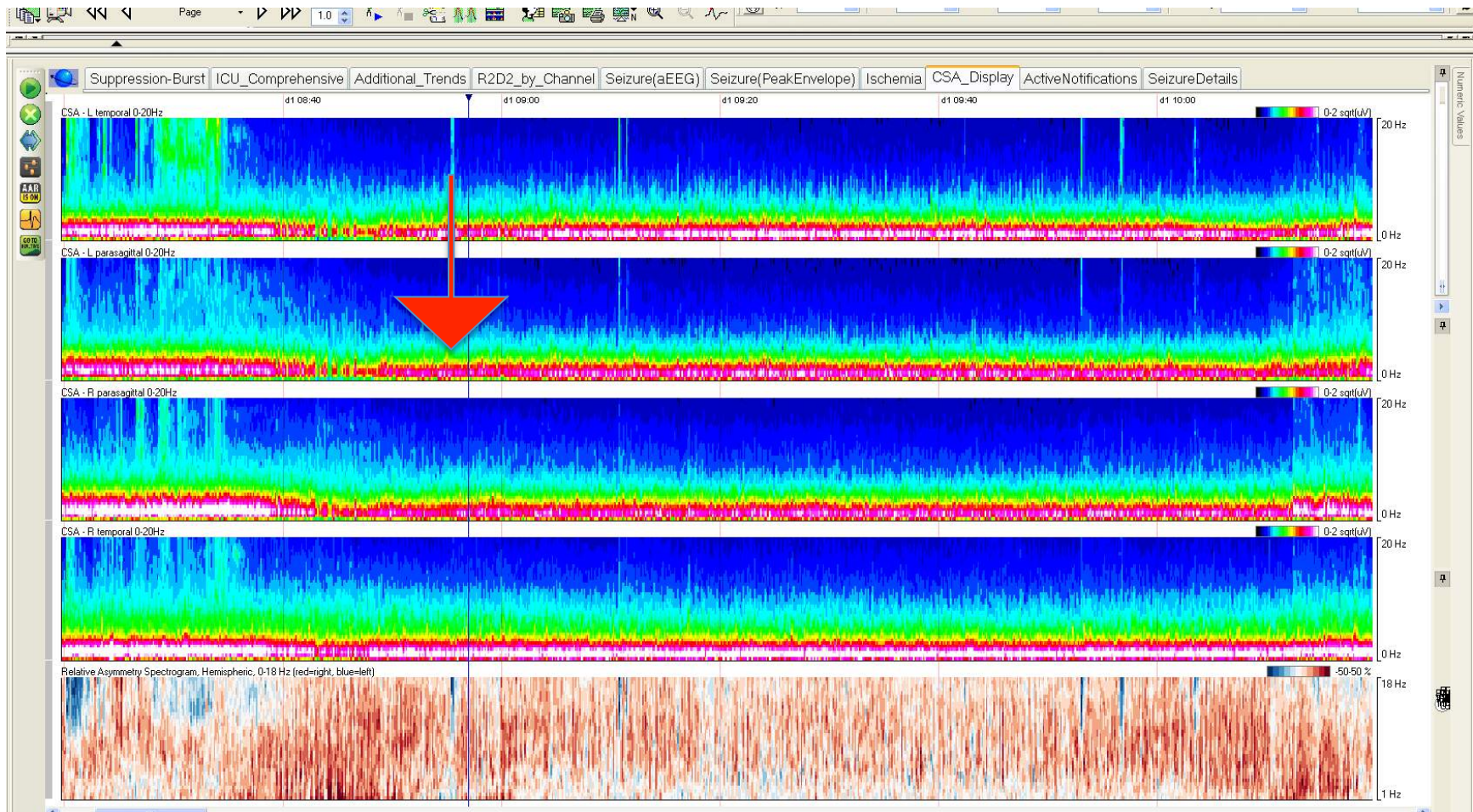




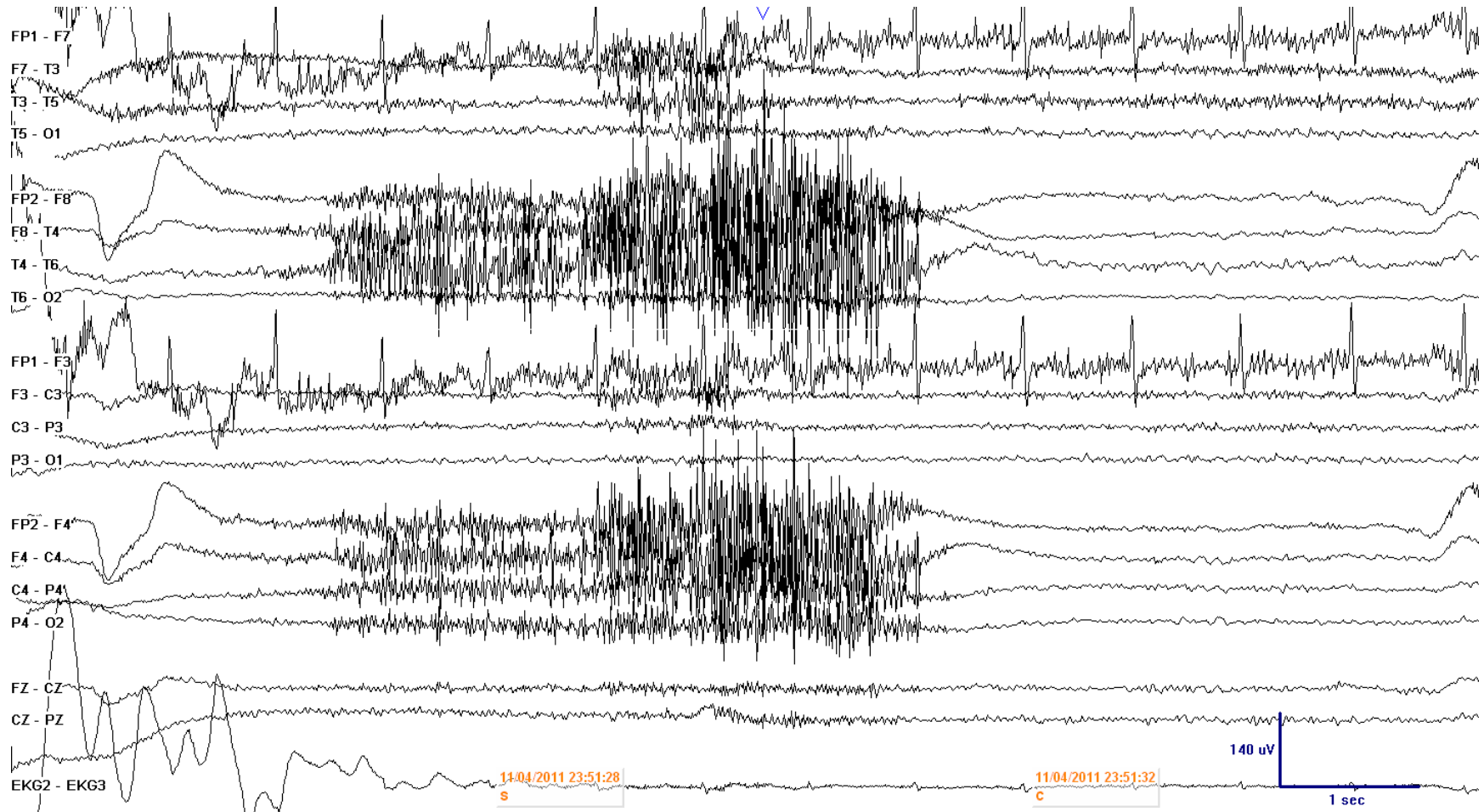
# Very small, focal szs can be undetectable



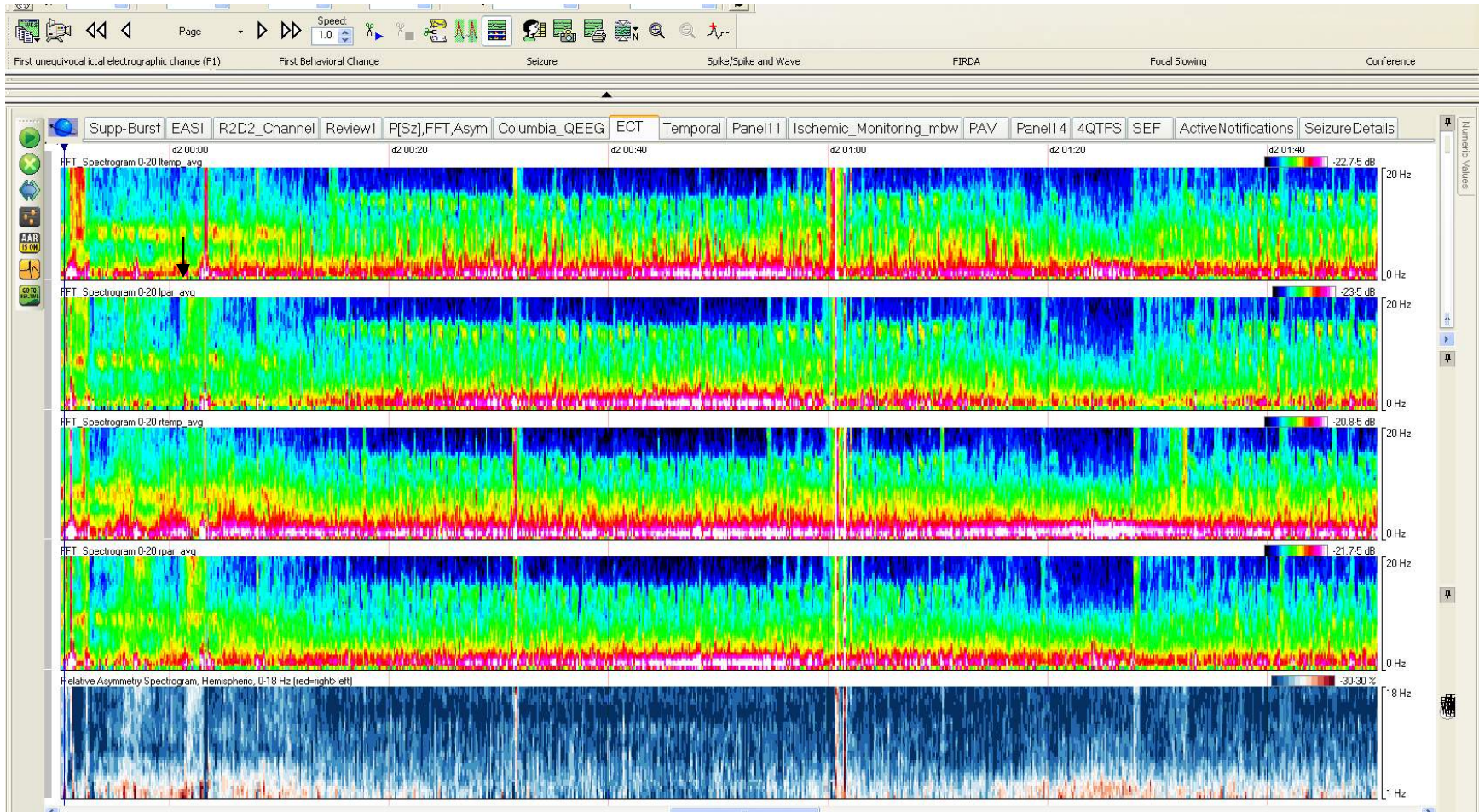
# No change in small, focal seizures



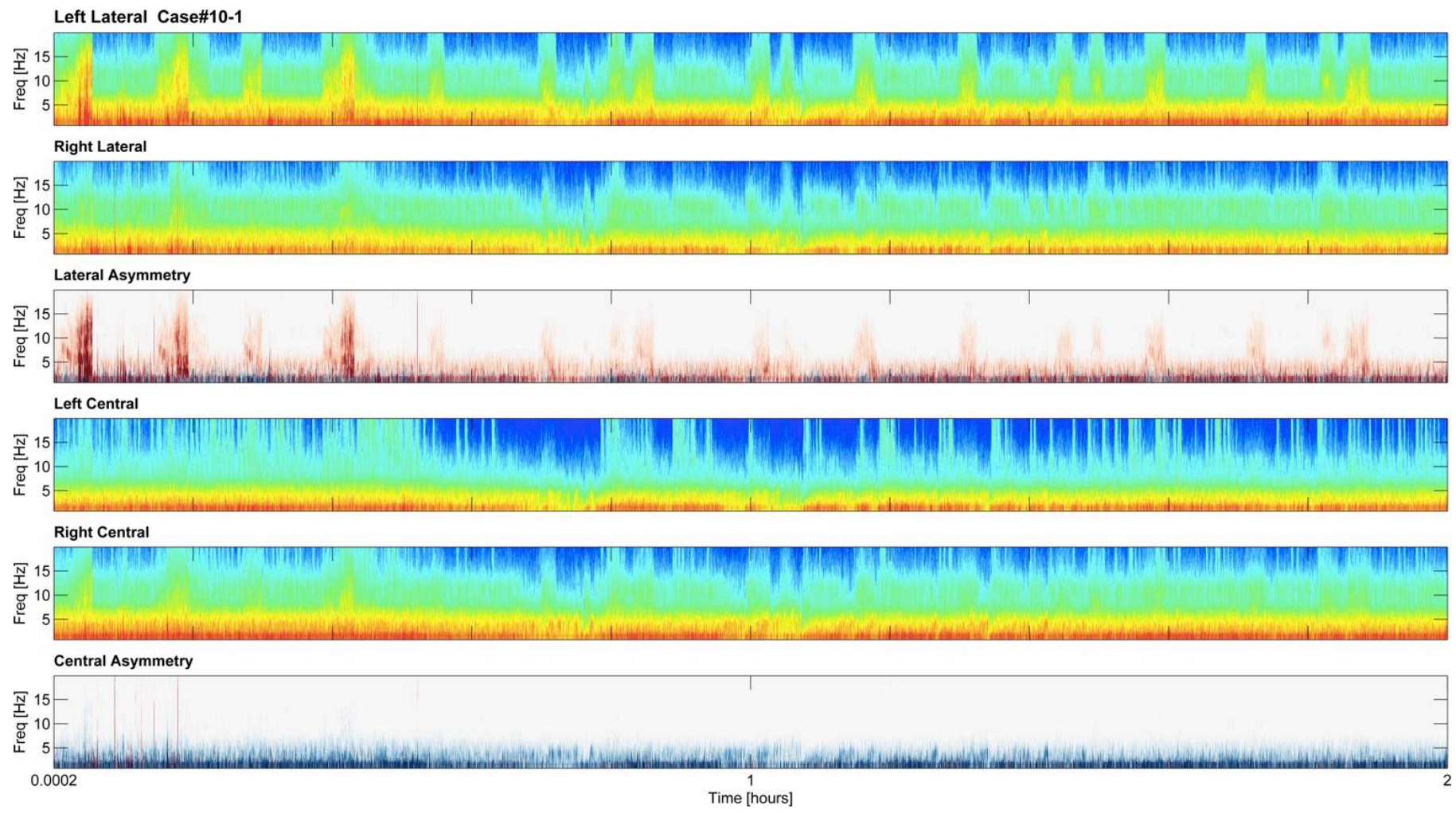
# Muscle artifact can lead to false-positives



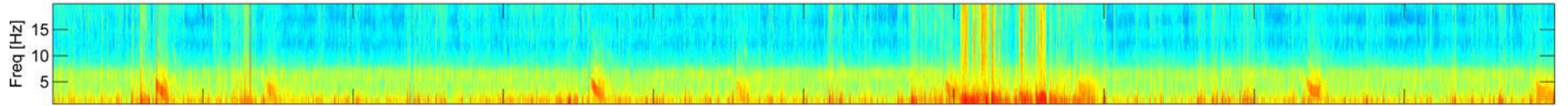
# Marked muscle artifact



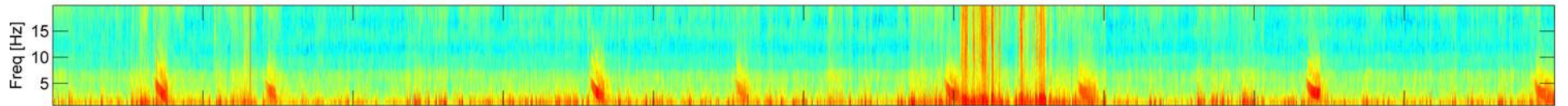
CSA: more examples



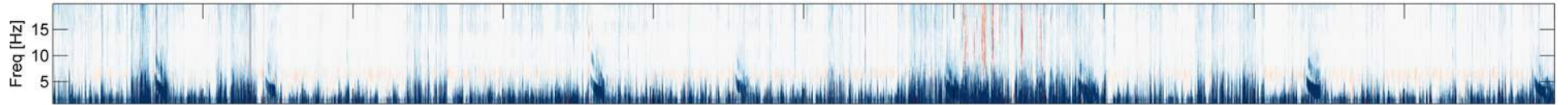
**Left Lateral Case#2-1**



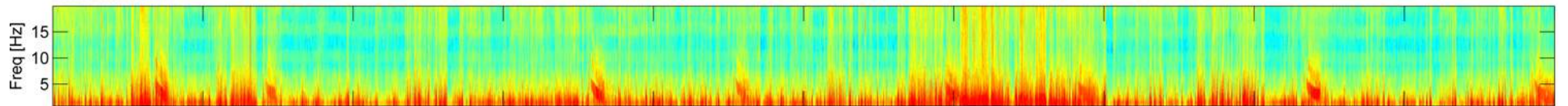
**Right Lateral**



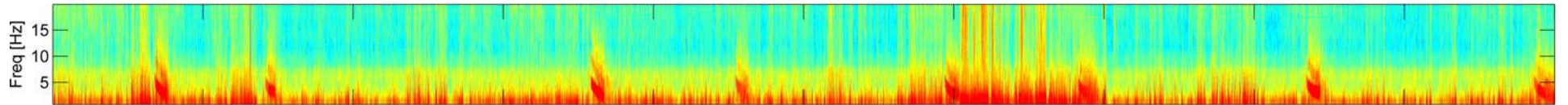
**Lateral Asymmetry**



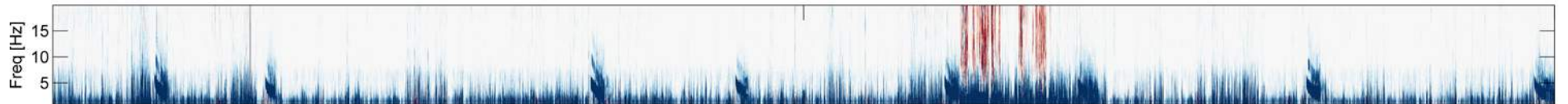
**Left Central**



**Right Central**



**Central Asymmetry**

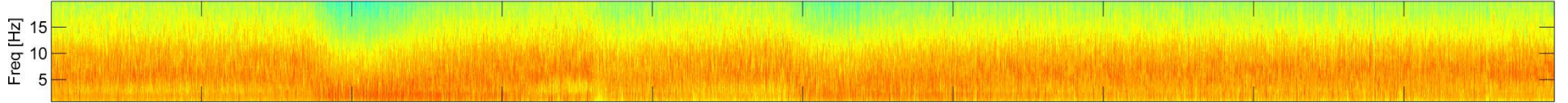


0.0002

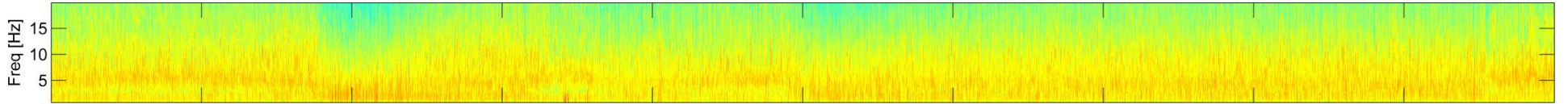
1  
Time [hours]

2

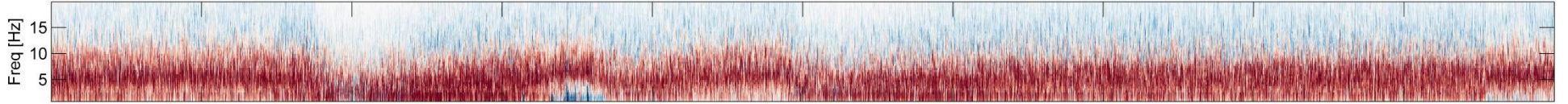
**Left Lateral Case#79-3**



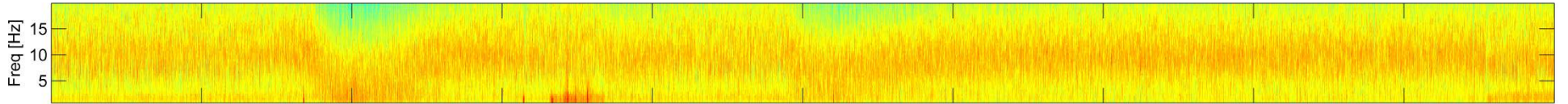
**Right Lateral**



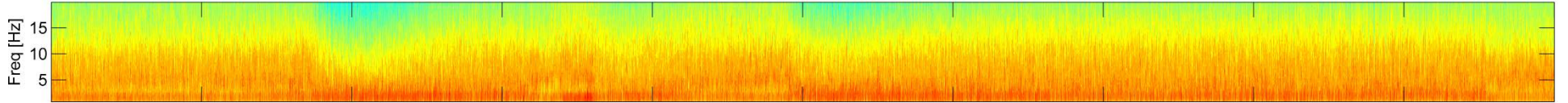
**Lateral Asymmetry**



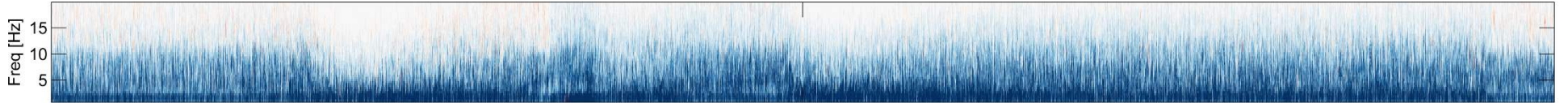
**Left Central**



**Right Central**



**Central Asymmetry**



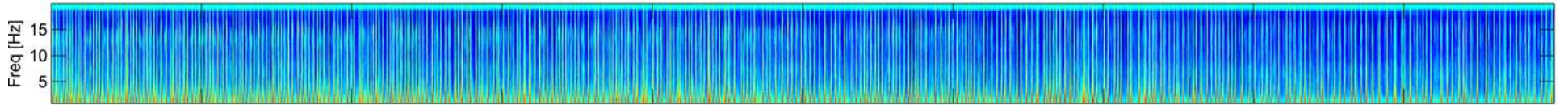
4

5  
Time [hours]

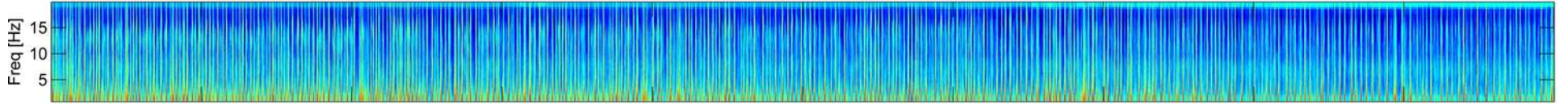
6



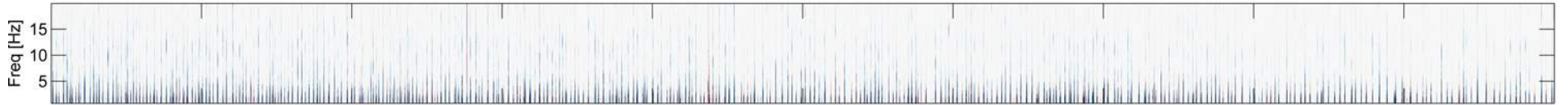
**Left Lateral Case#61-3**



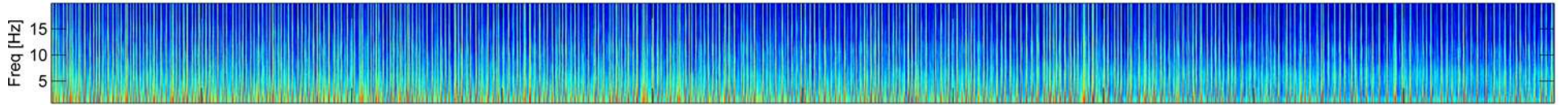
**Right Lateral**



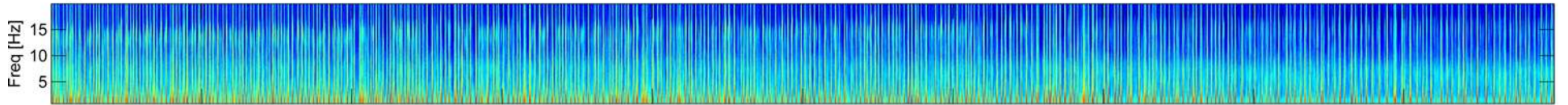
**Lateral Asymmetry**



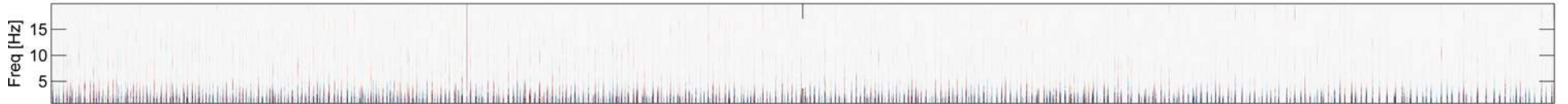
**Left Central**



**Right Central**



**Central Asymmetry**



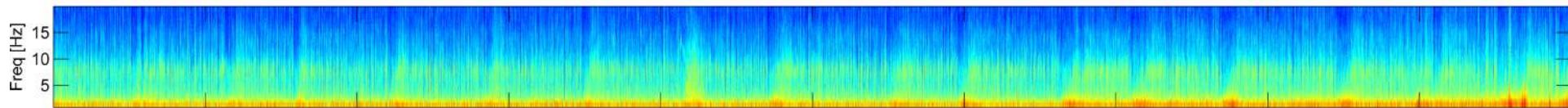
4

5

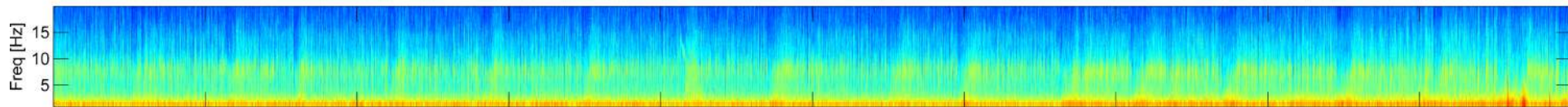
6

Time [hours]

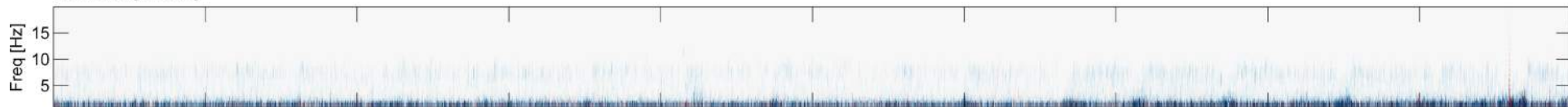
**Left Lateral Case#46-4**



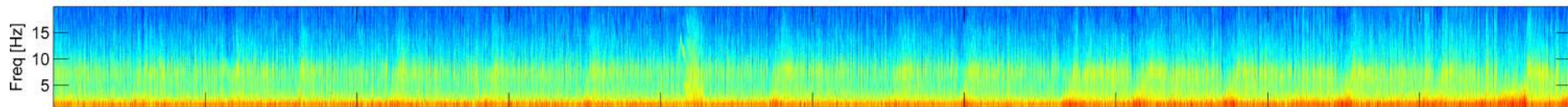
**Right Lateral**



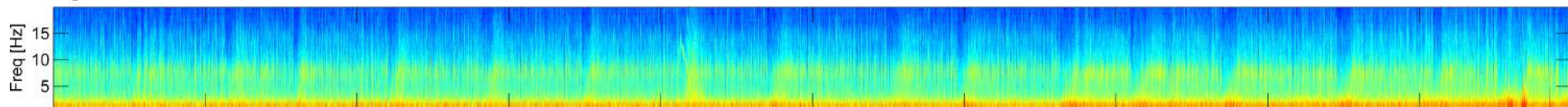
**Lateral Asymmetry**



**Left Central**



**Right Central**

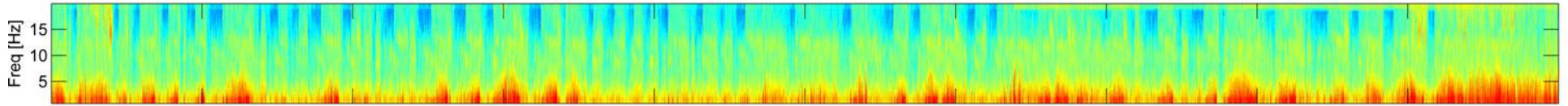


**Central Asymmetry**

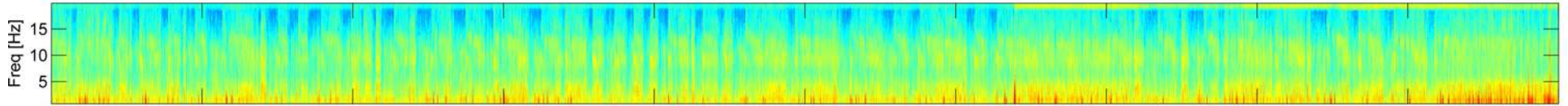


6 7 8  
Time [hours]

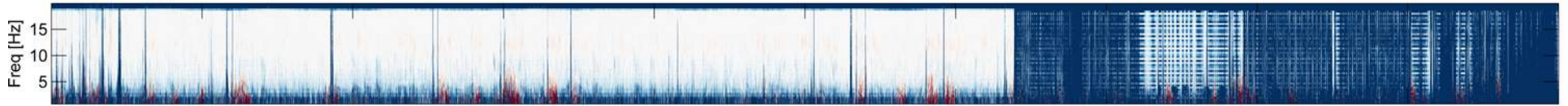
Left Lateral Case#50-8



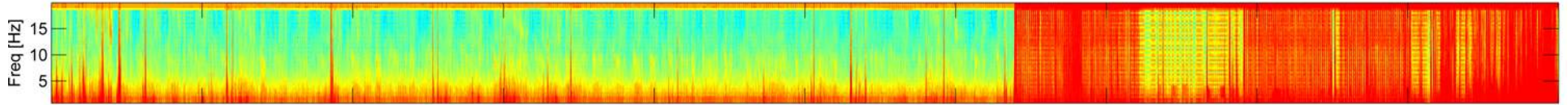
Right Lateral



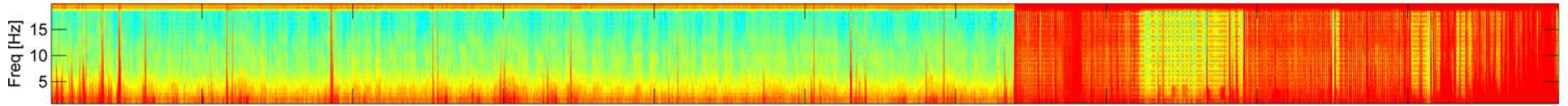
Lateral Asymmetry



Left Central



Right Central



Central Asymmetry

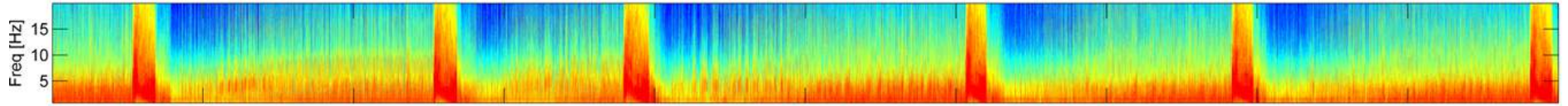


14

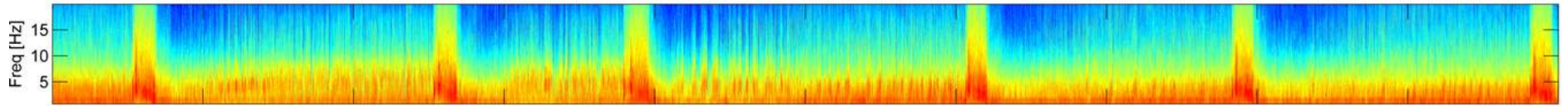
15  
Time [hours]

16

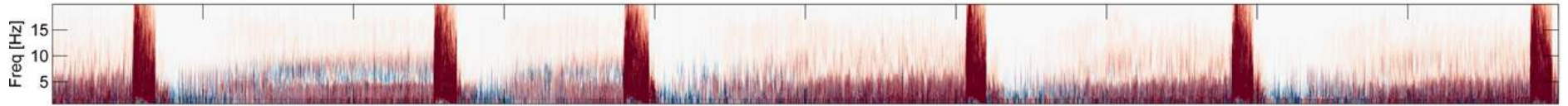
**Left Lateral Case#5/-1**



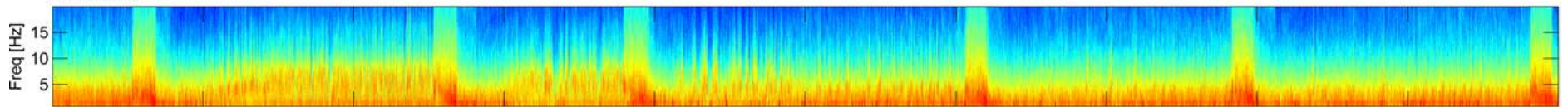
**Right Lateral**



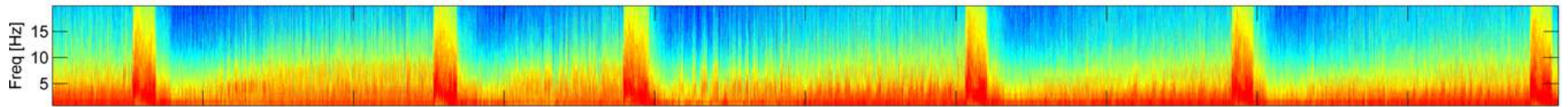
**Lateral Asymmetry**



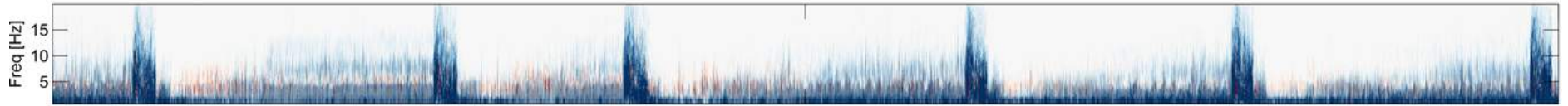
**Left Central**



**Right Central**



**Central Asymmetry**



0.0002

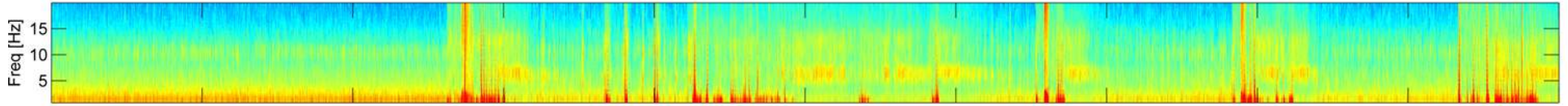
1  
Time [hours]

2

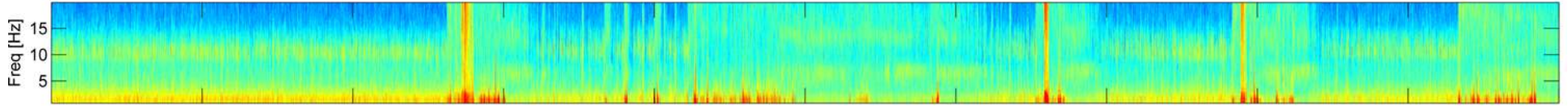
# Pre-test questions

Some of the following slides contain seizures. Based on the information we have discussed, decide if you think seizures are present. If seizures are present, note how many you think that there are.

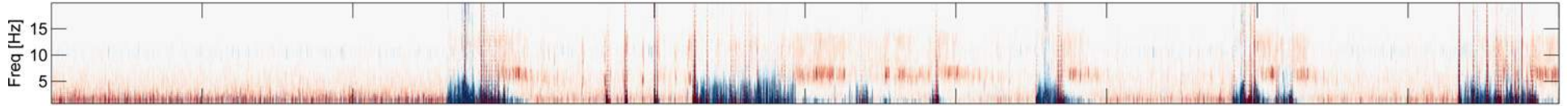
**Left Lateral Case#67-16**



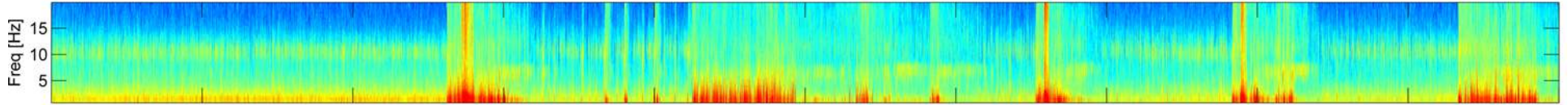
**Right Lateral**



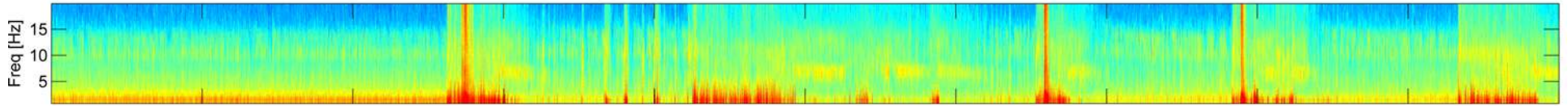
**Lateral Asymmetry**



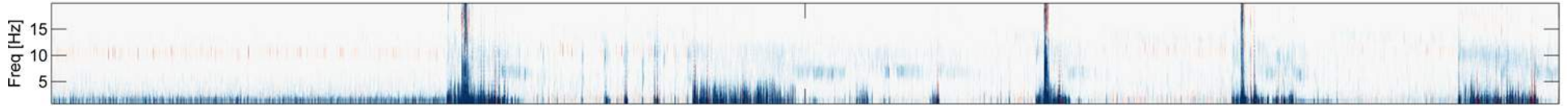
**Left Central**



**Right Central**



**Central Asymmetry**

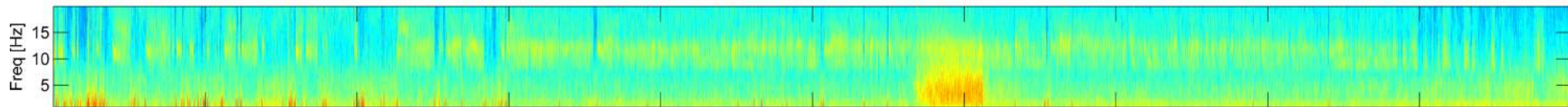


30

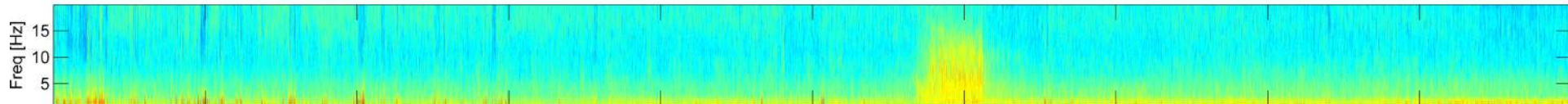
31  
Time [hours]

32

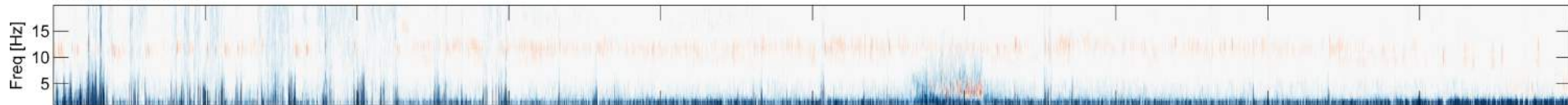
**Left Lateral Case#13-2**



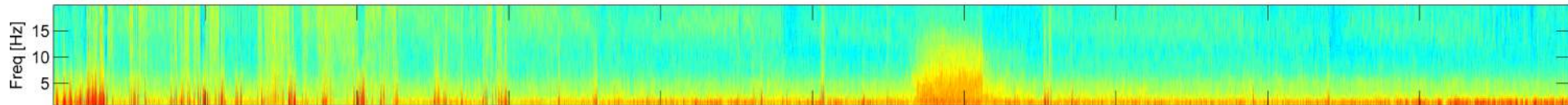
**Right Lateral**



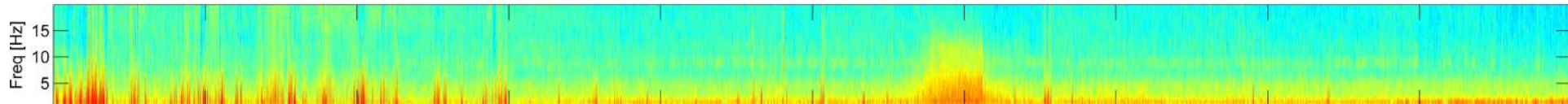
**Lateral Asymmetry**



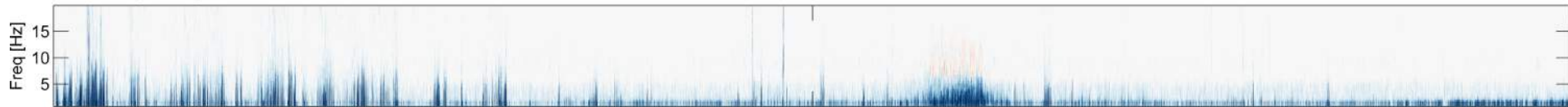
**Left Central**



**Right Central**

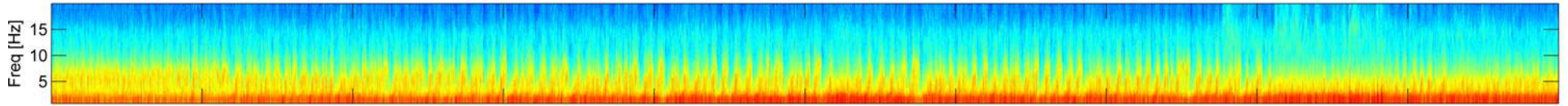


**Central Asymmetry**

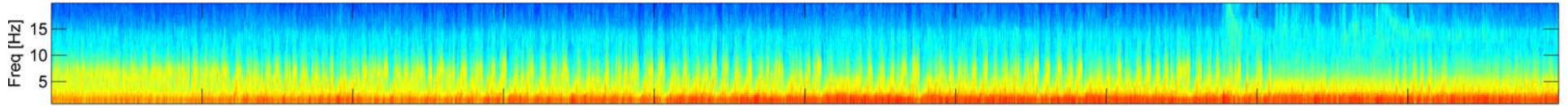


2 3 4  
Time [hours]

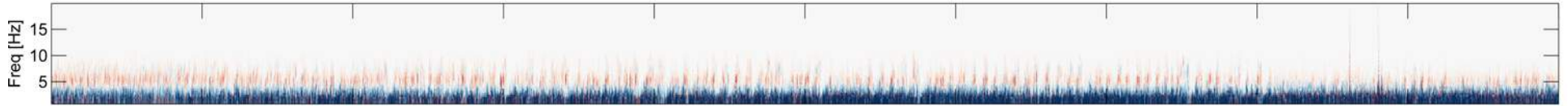
**Left Lateral Case#73-12**



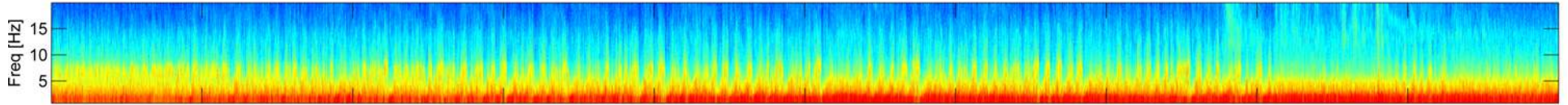
**Right Lateral**



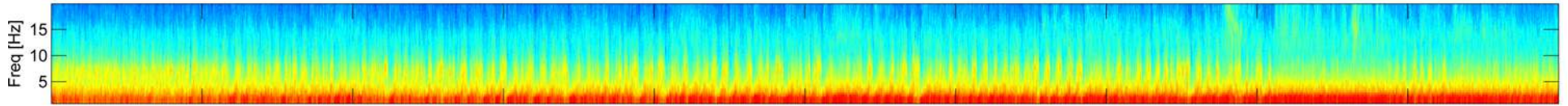
**Lateral Asymmetry**



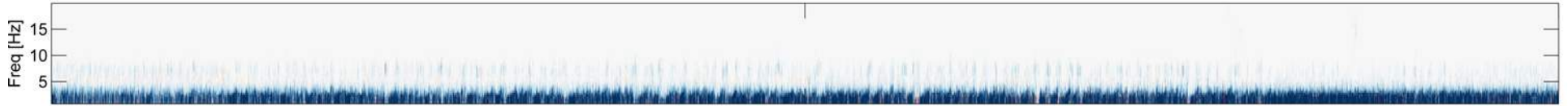
**Left Central**



**Right Central**



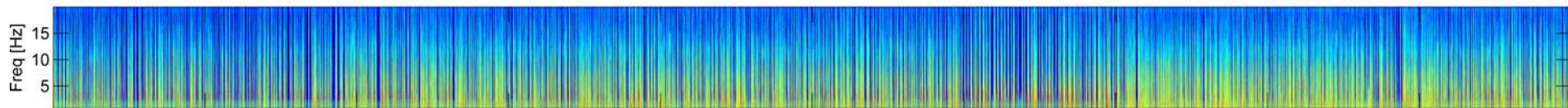
**Central Asymmetry**



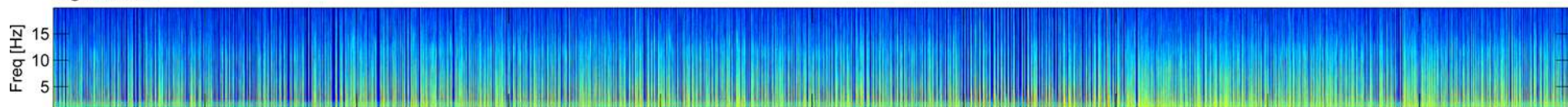
22 23 24  
Time [hours]



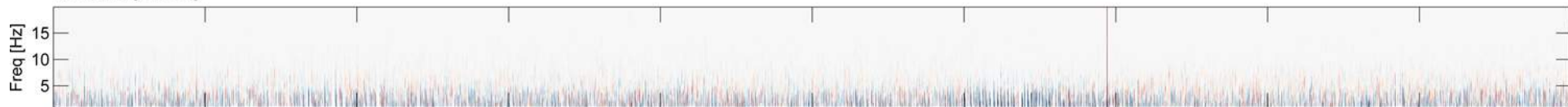
**Left Lateral Case#65-2**



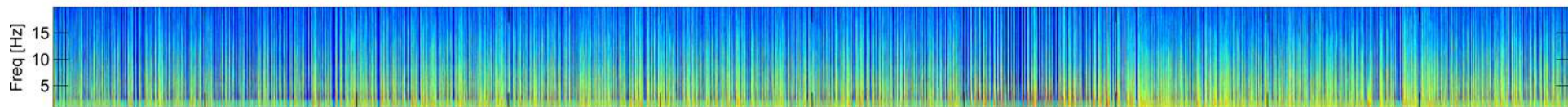
**Right Lateral**



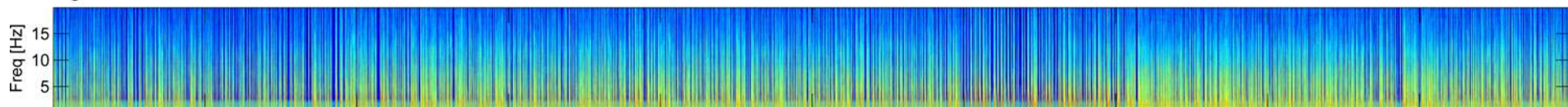
**Lateral Asymmetry**



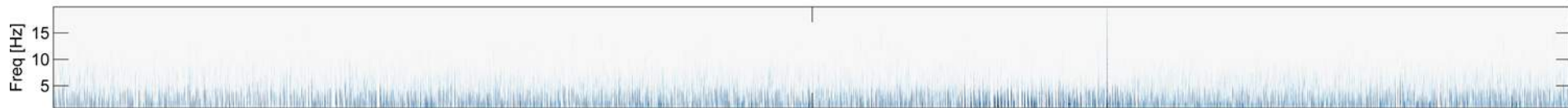
**Left Central**



**Right Central**

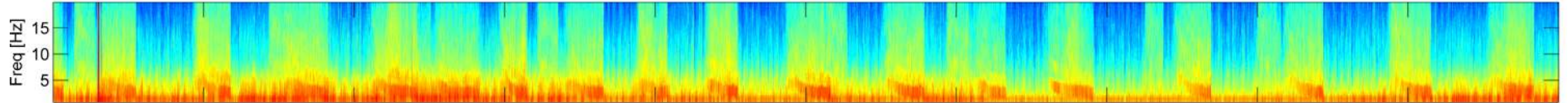


**Central Asymmetry**

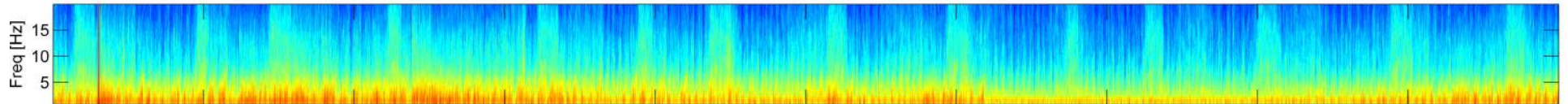


2 3 4  
Time [hours]

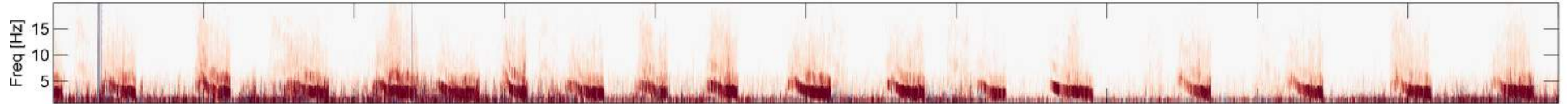
**Left Lateral Case#10-13**



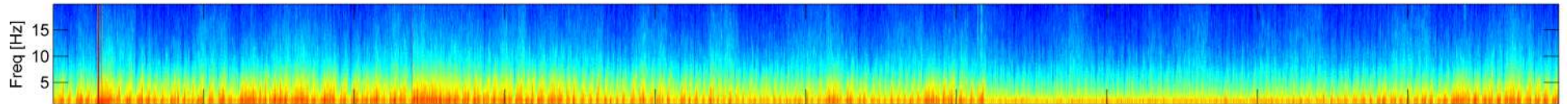
**Right Lateral**



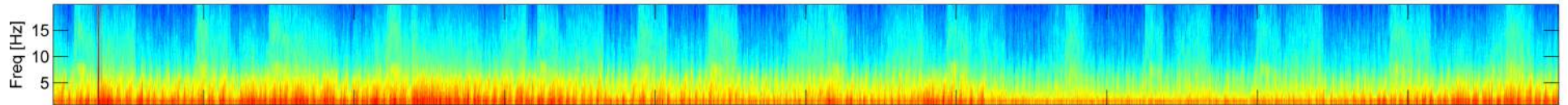
**Lateral Asymmetry**



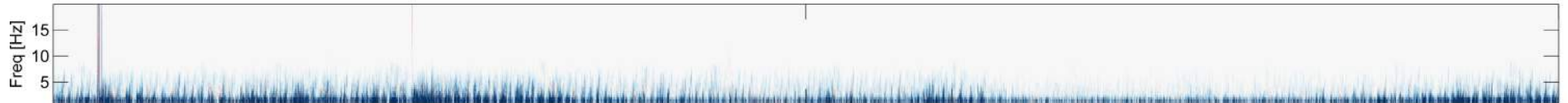
**Left Central**



**Right Central**

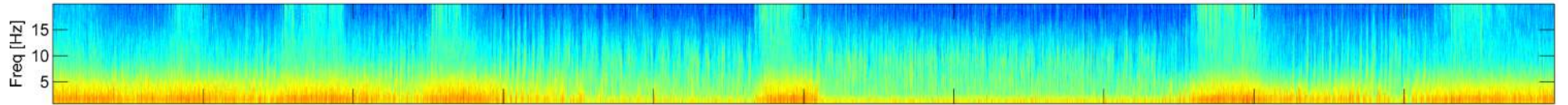


**Central Asymmetry**

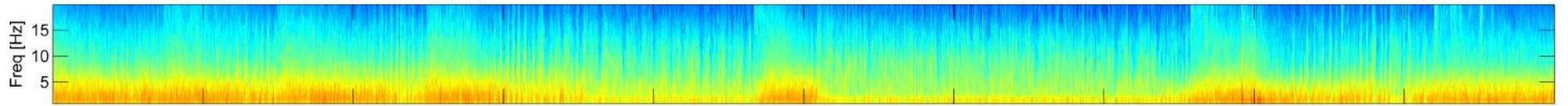


24 25 26  
Time [hours]

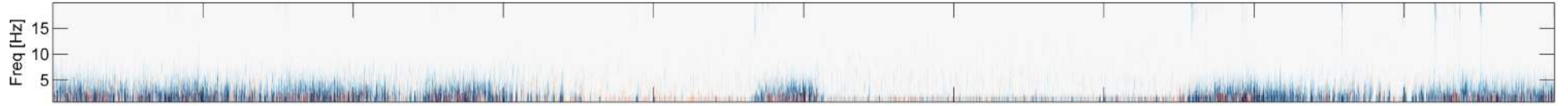
**Left Lateral Case#6-4**



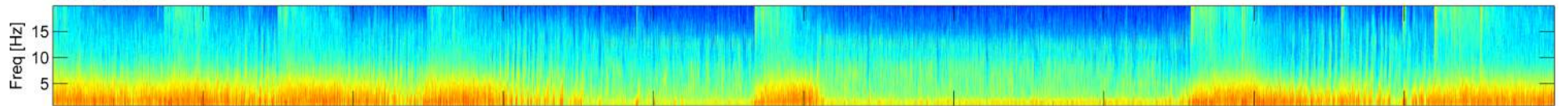
**Right Lateral**



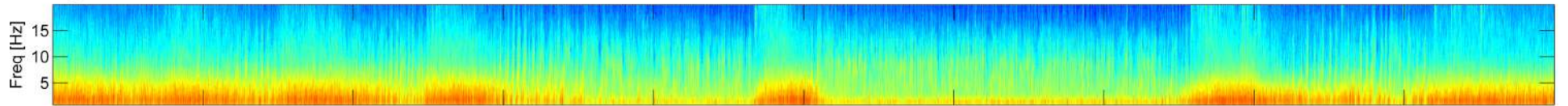
**Lateral Asymmetry**



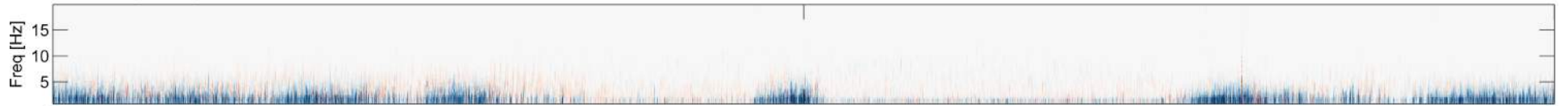
**Left Central**



**Right Central**

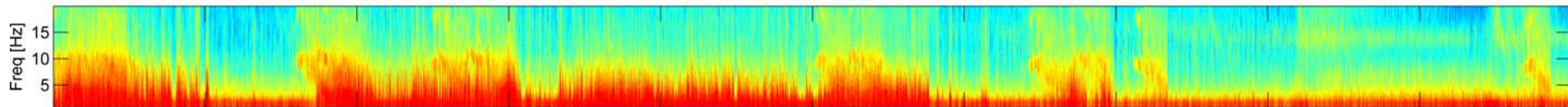


**Central Asymmetry**

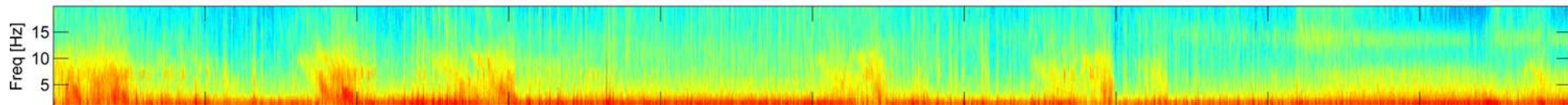


6 7 8  
Time [hours]

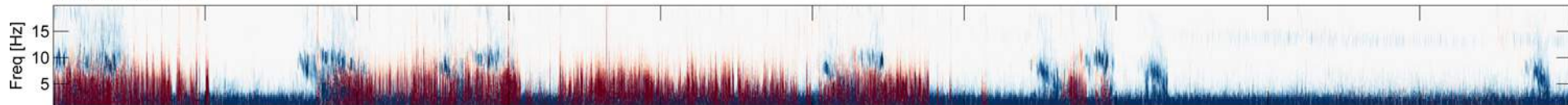
**Left Lateral Case#86-1**



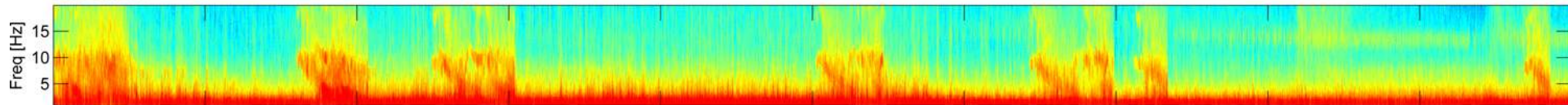
**Right Lateral**



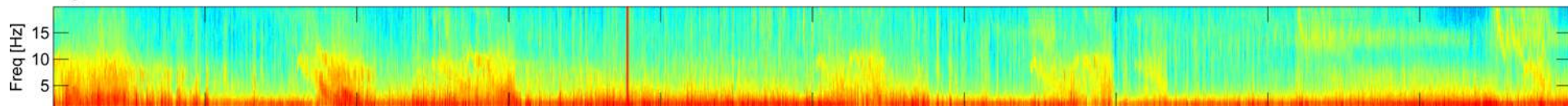
**Lateral Asymmetry**



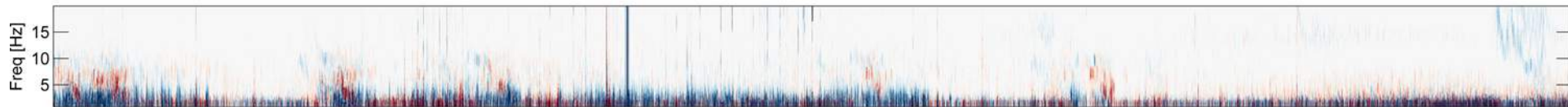
**Left Central**



**Right Central**



**Central Asymmetry**

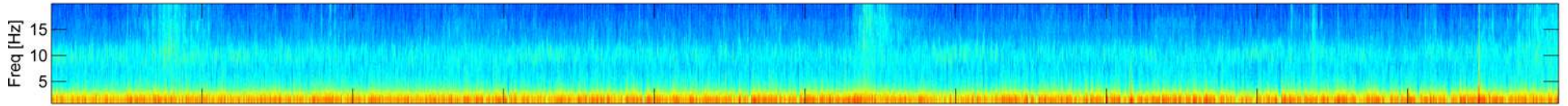


0.0002

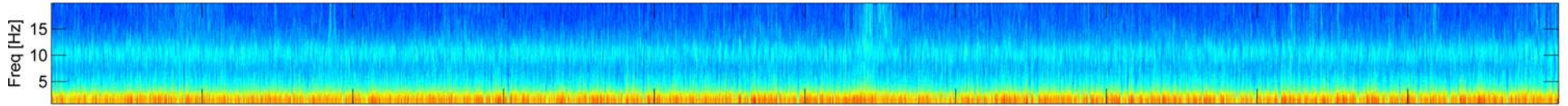
1  
Time [hours]

2

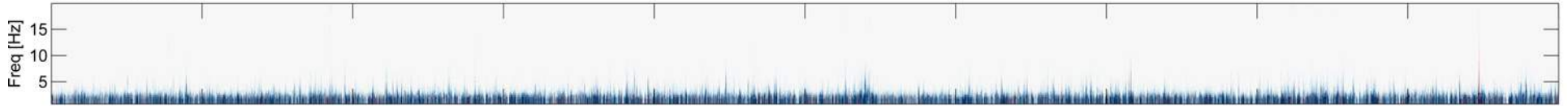
**Left Lateral Case#69-5**



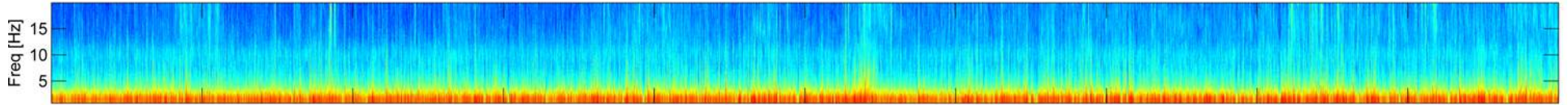
**Right Lateral**



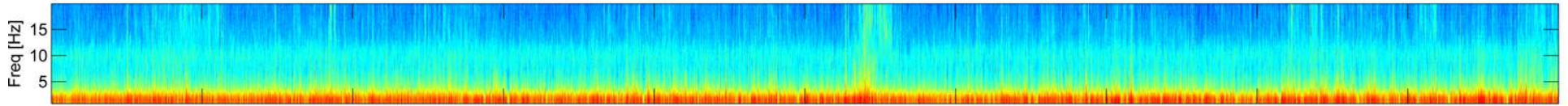
**Lateral Asymmetry**



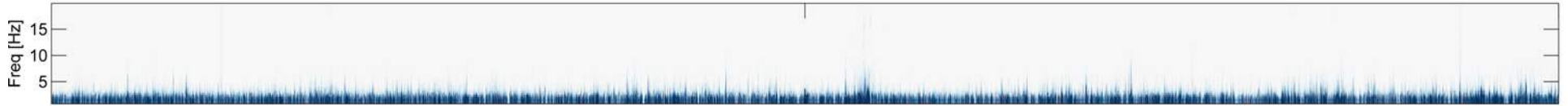
**Left Central**



**Right Central**

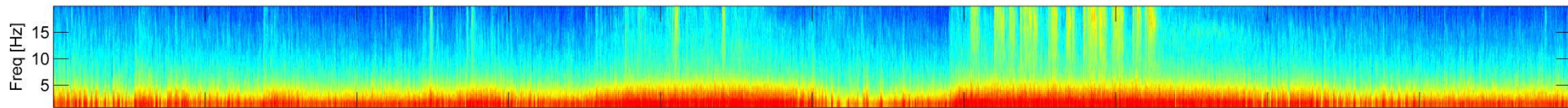


**Central Asymmetry**

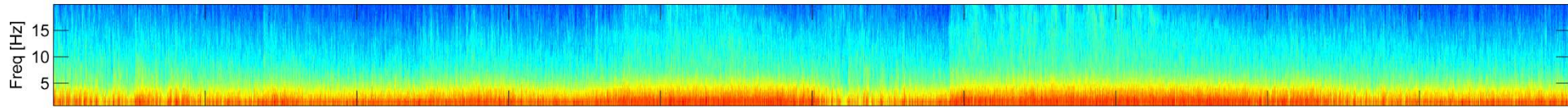


8 9 10  
Time [hours]

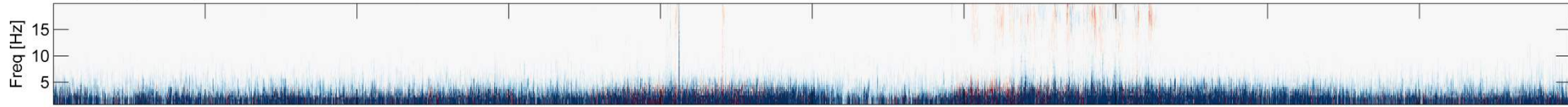
**Left Lateral Case#111-4**



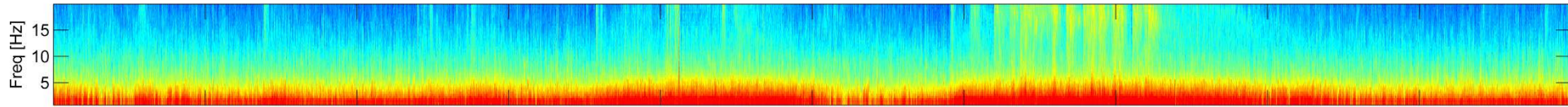
**Right Lateral**



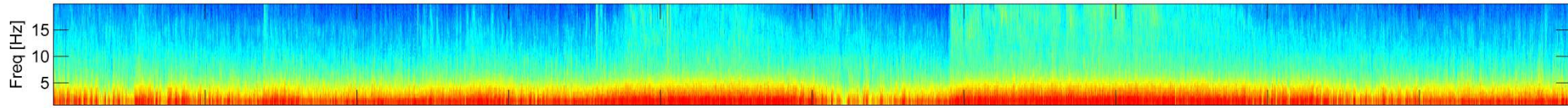
**Lateral Asymmetry**



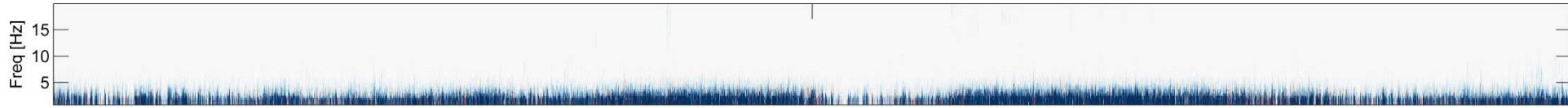
**Left Central**



**Right Central**



**Central Asymmetry**

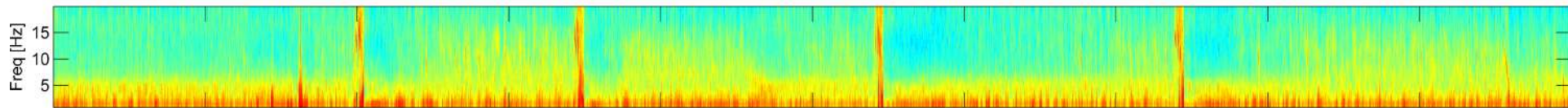


6

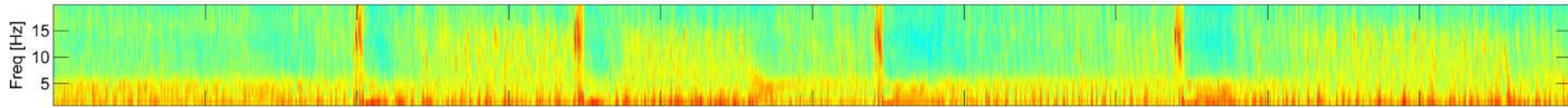
7  
Time [hours]

8

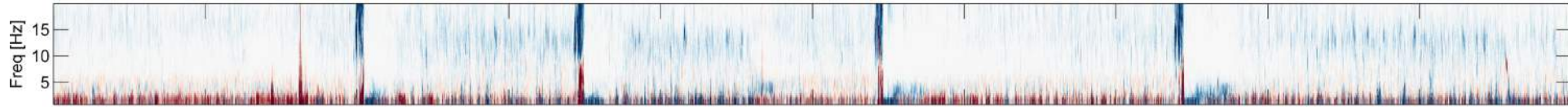
**Left Lateral Case#84-3**



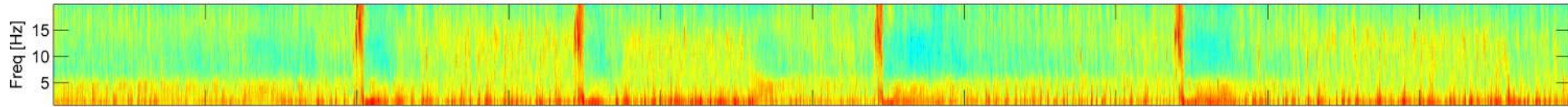
**Right Lateral**



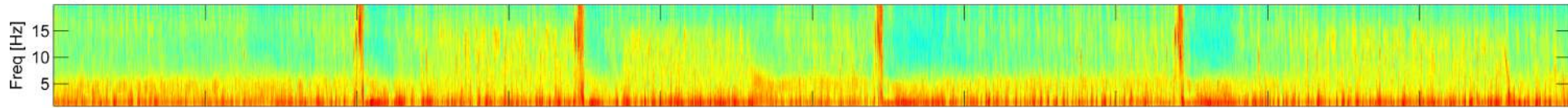
**Lateral Asymmetry**



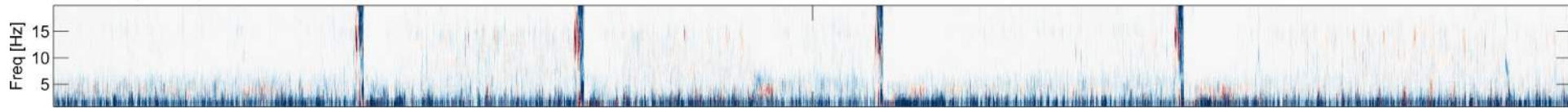
**Left Central**



**Right Central**



**Central Asymmetry**

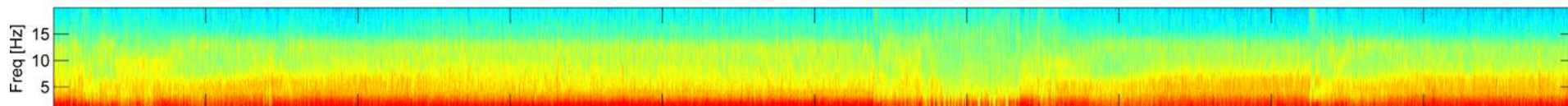


4 5 6  
Time [hours]

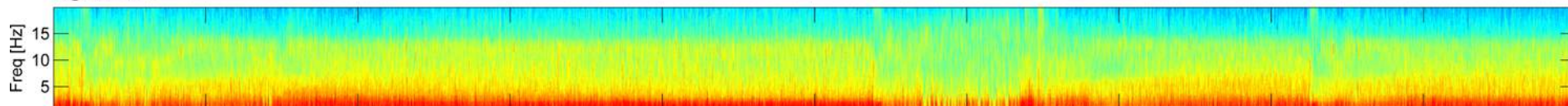
CSA test



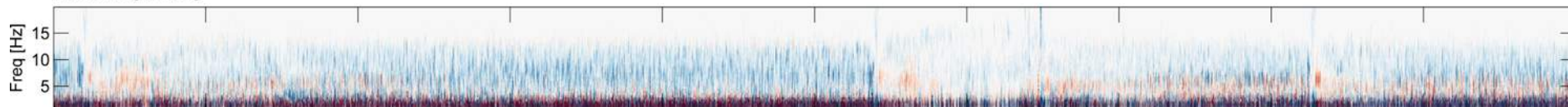
**Left Lateral Case#77-9**



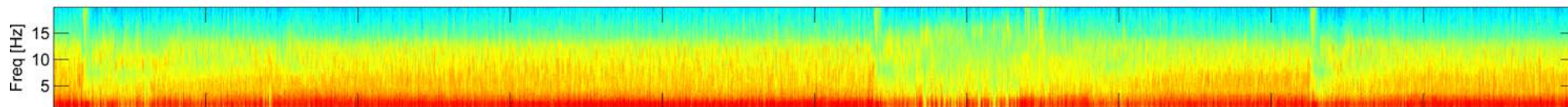
**Right Lateral**



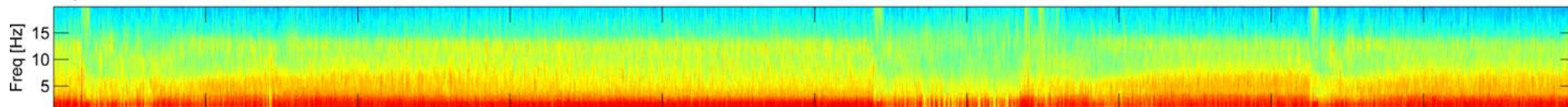
**Lateral Asymmetry**



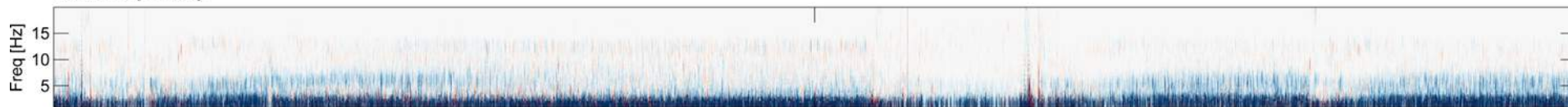
**Left Central**



**Right Central**

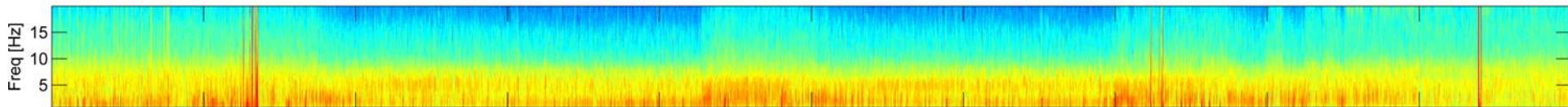


**Central Asymmetry**

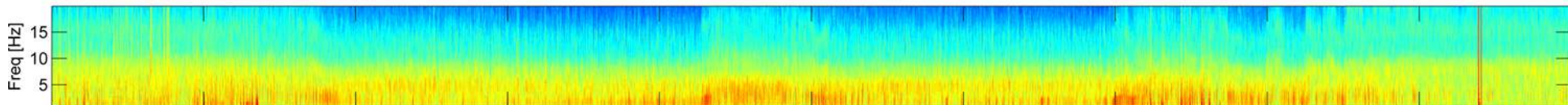


16 17 18  
Time [hours]

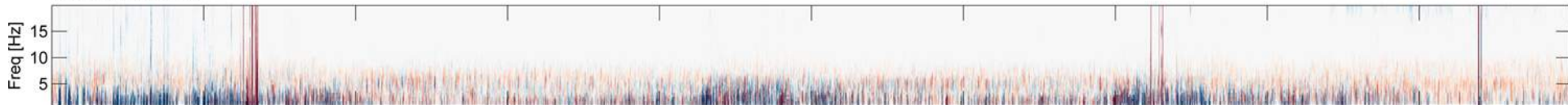
**Left Lateral Case#74-2**



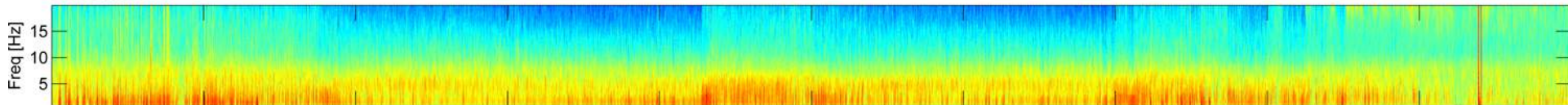
**Right Lateral**



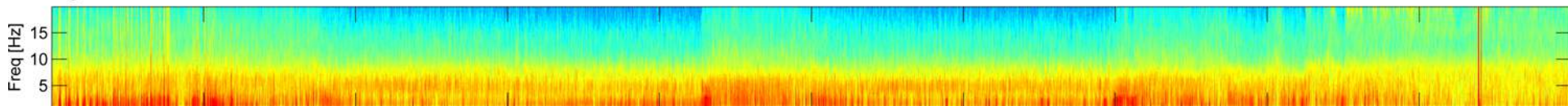
**Lateral Asymmetry**



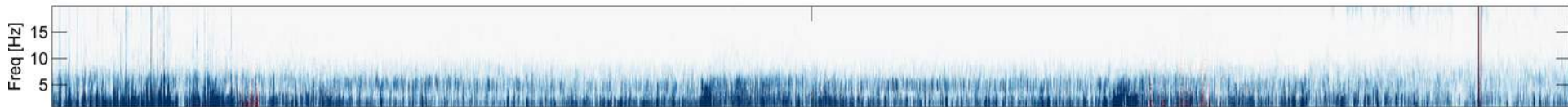
**Left Central**



**Right Central**



**Central Asymmetry**

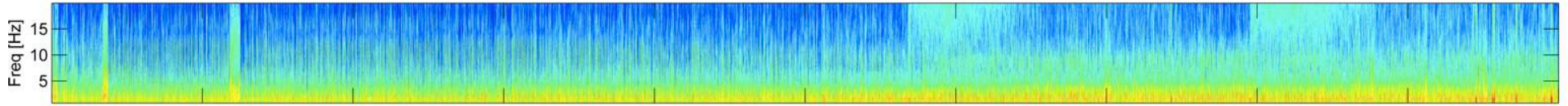


2

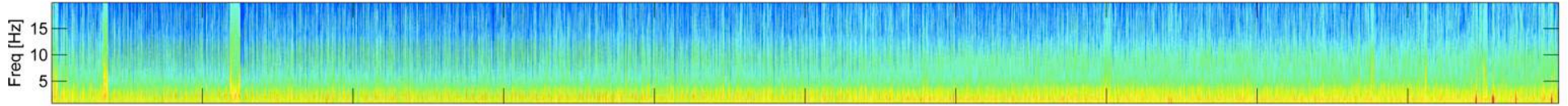
3  
Time [hours]

4

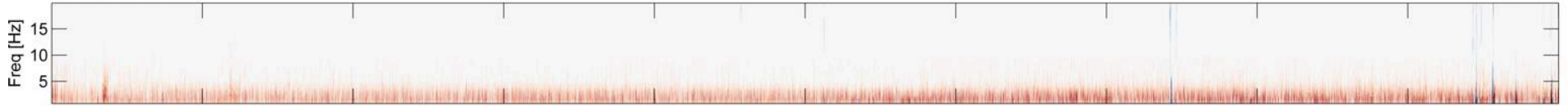
**Left Lateral Case#71-6**



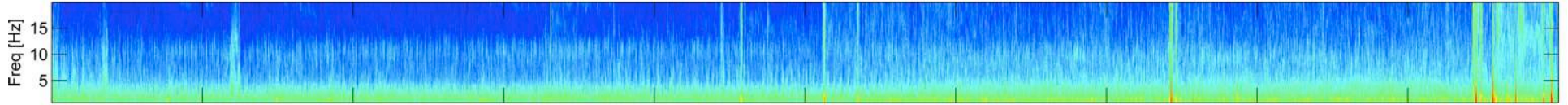
**Right Lateral**



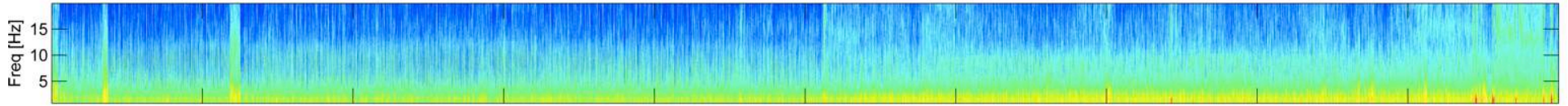
**Lateral Asymmetry**



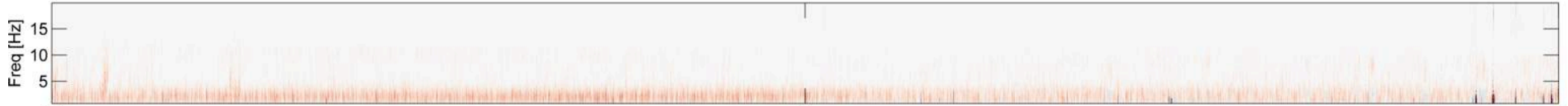
**Left Central**



**Right Central**

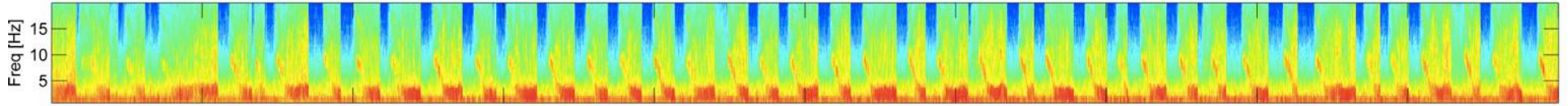


**Central Asymmetry**

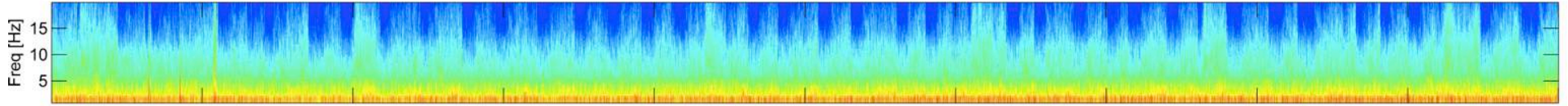


10 11 12  
Time [hours]

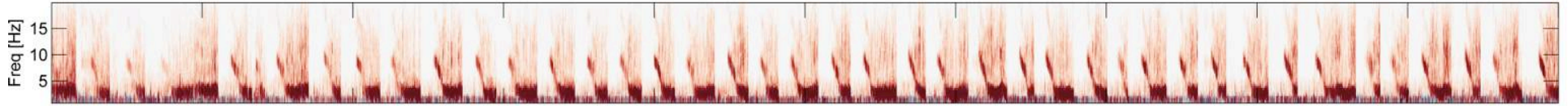
**Left Lateral Case#10-7**



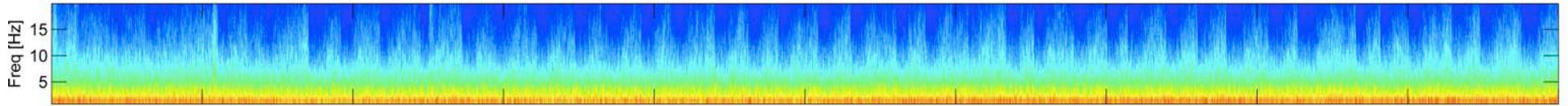
**Right Lateral**



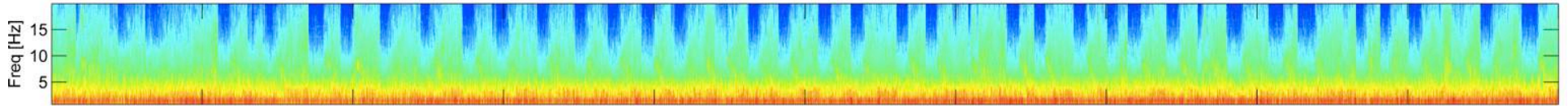
**Lateral Asymmetry**



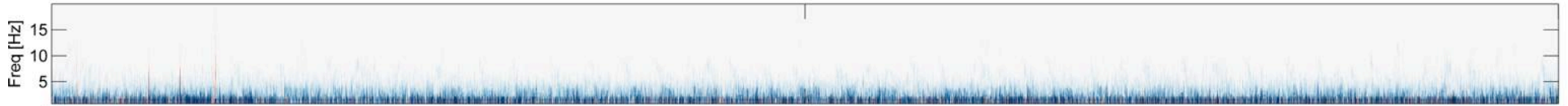
**Left Central**



**Right Central**

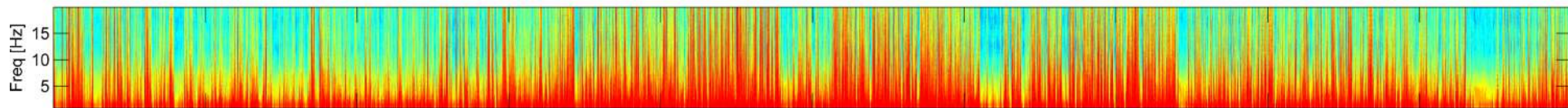


**Central Asymmetry**

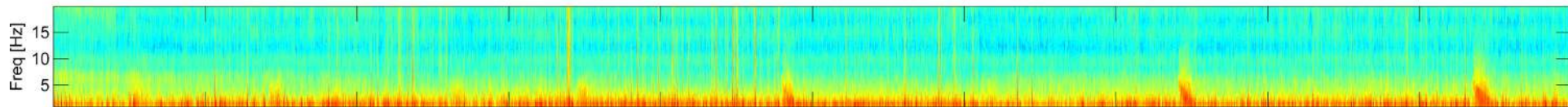


12 13 14  
Time [hours]

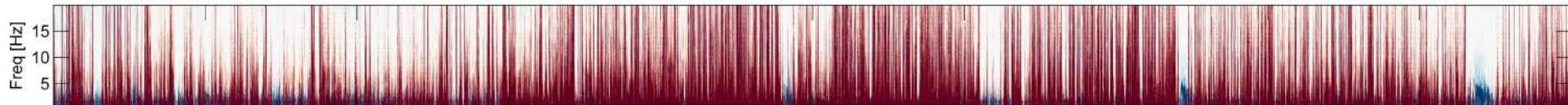
**Left Lateral Case#2-3**



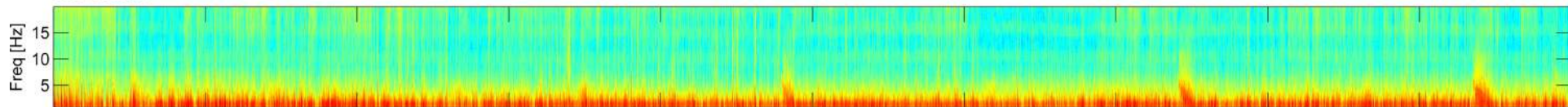
**Right Lateral**



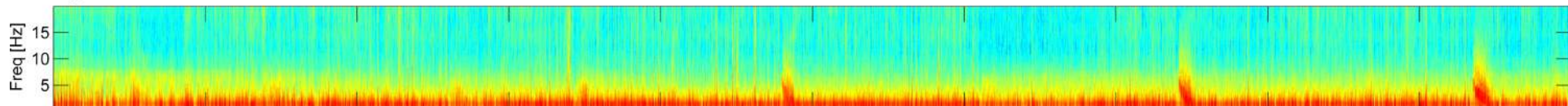
**Lateral Asymmetry**



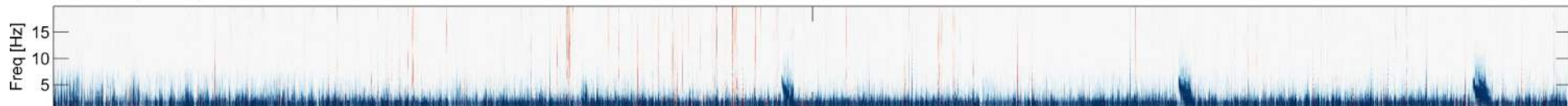
**Left Central**



**Right Central**

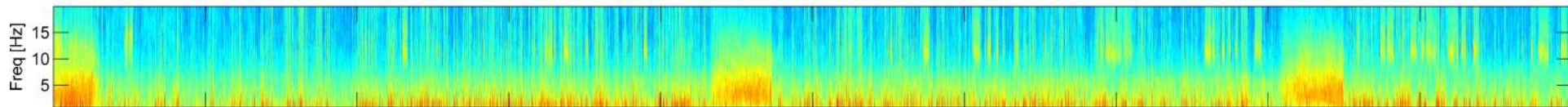


**Central Asymmetry**

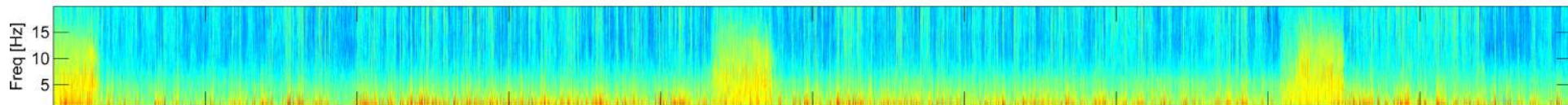


4 5 6  
Time [hours]

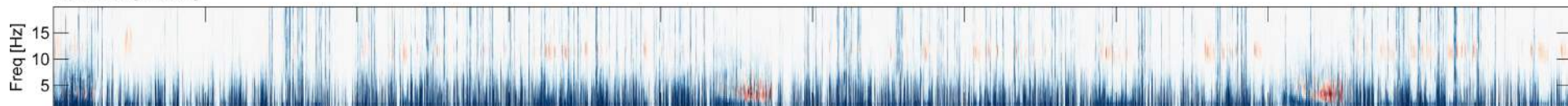
**Left Lateral Case#13-1**



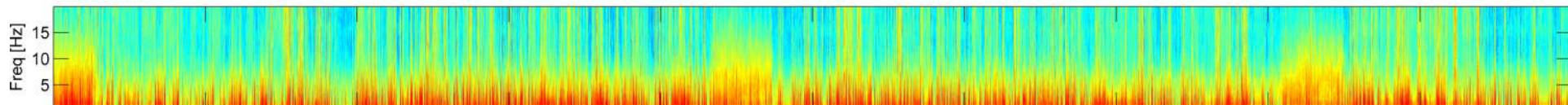
**Right Lateral**



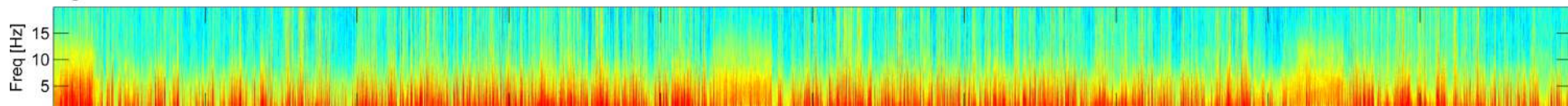
**Lateral Asymmetry**



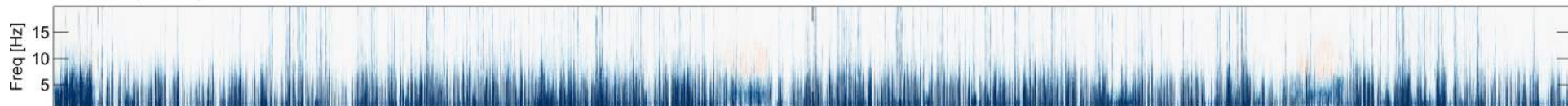
**Left Central**



**Right Central**



**Central Asymmetry**

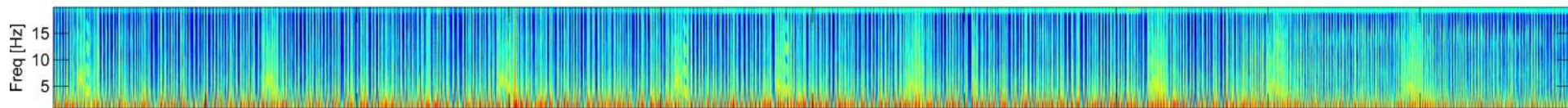


0.0002

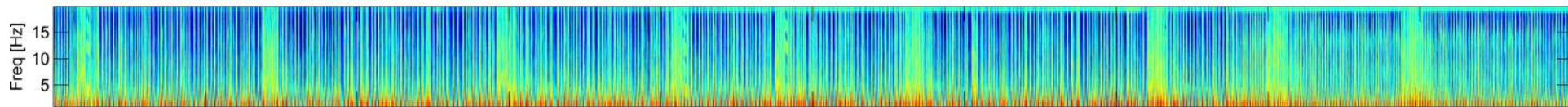
1  
Time [hours]

2

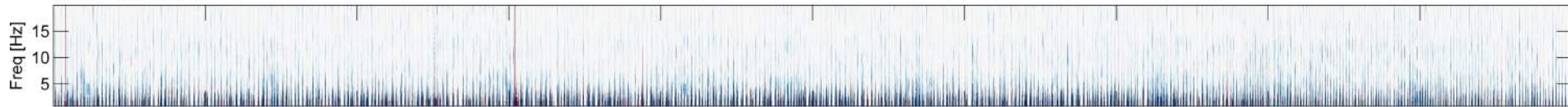
**Left Lateral Case#61-1**



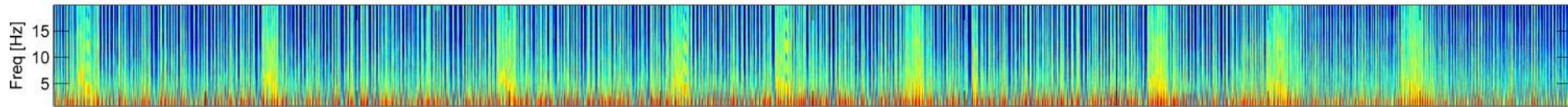
**Right Lateral**



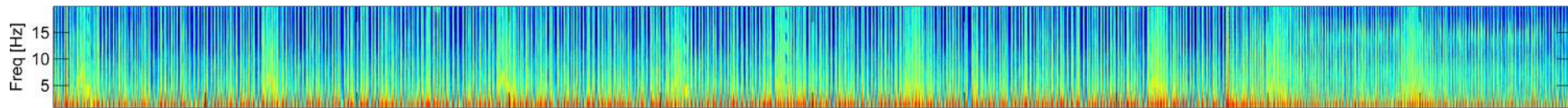
**Lateral Asymmetry**



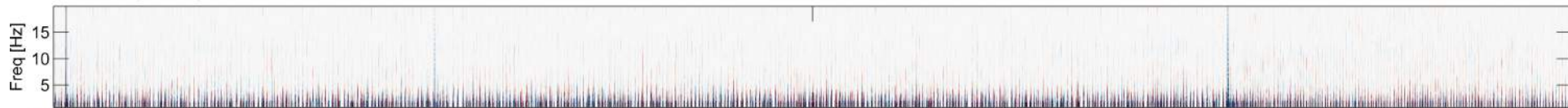
**Left Central**



**Right Central**

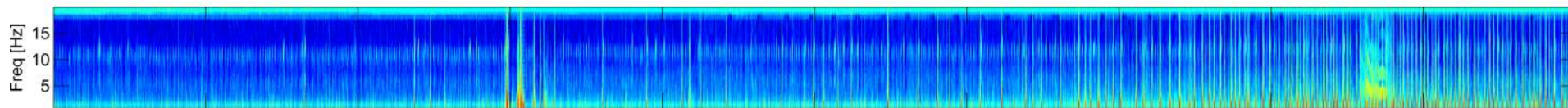


**Central Asymmetry**

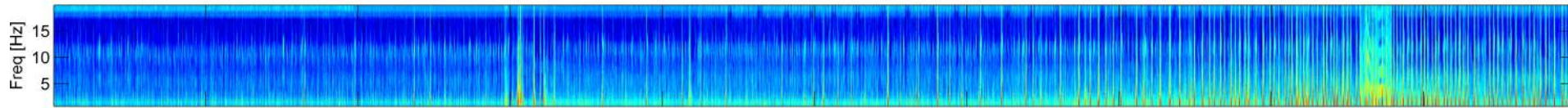


0.0002 1 2  
Time [hours]

**Left Lateral Case#61-9**



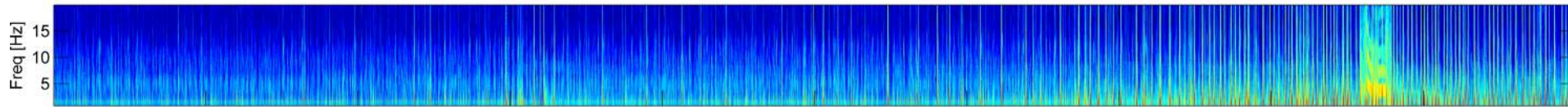
**Right Lateral**



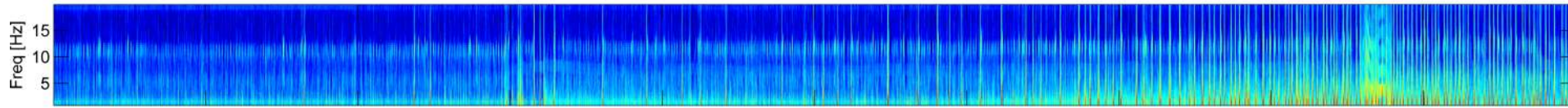
**Lateral Asymmetry**



**Left Central**



**Right Central**



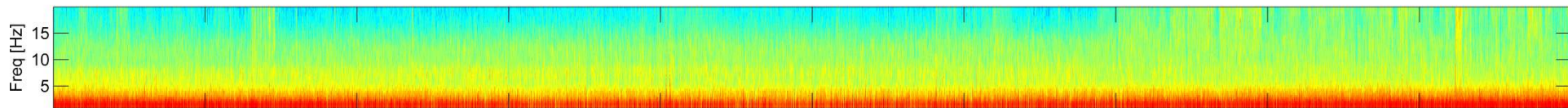
**Central Asymmetry**



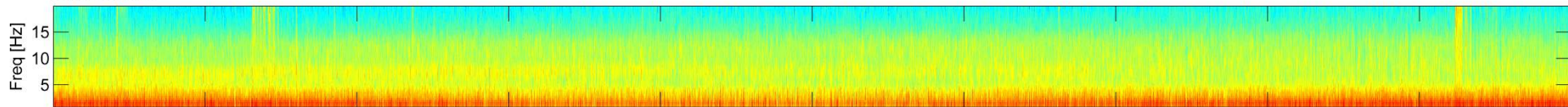
16 17 18  
Time [hours]



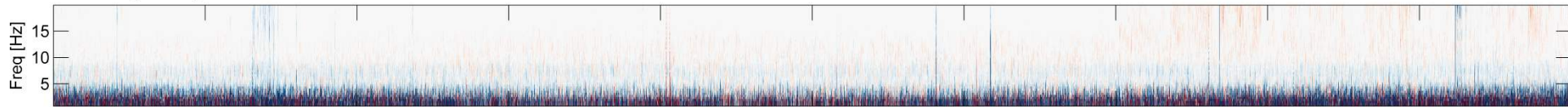
**Left Lateral Case#16-2**



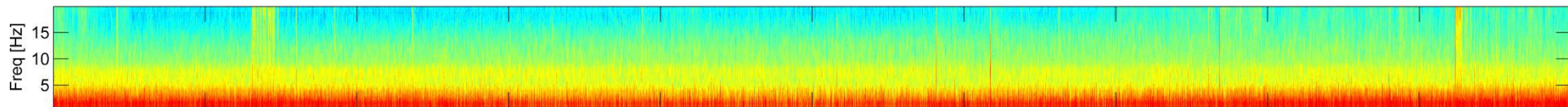
**Right Lateral**



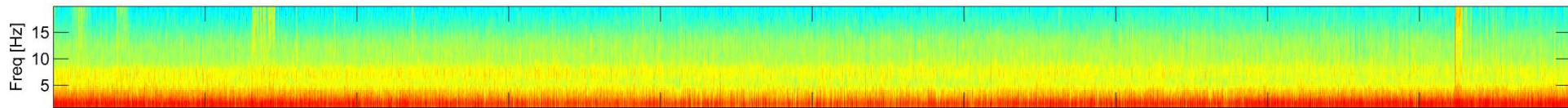
**Lateral Asymmetry**



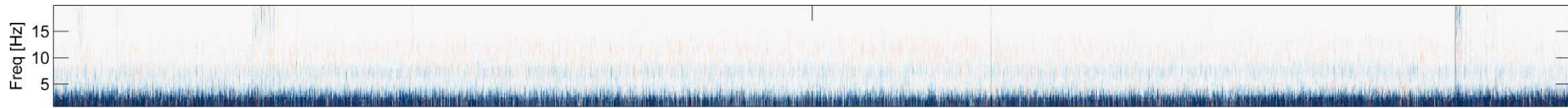
**Left Central**



**Right Central**

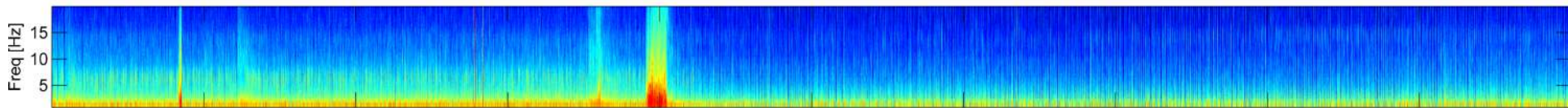


**Central Asymmetry**

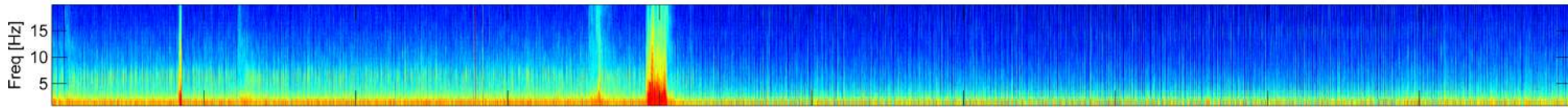


2 3 4  
Time [hours]

**Left Lateral Case#33-4**



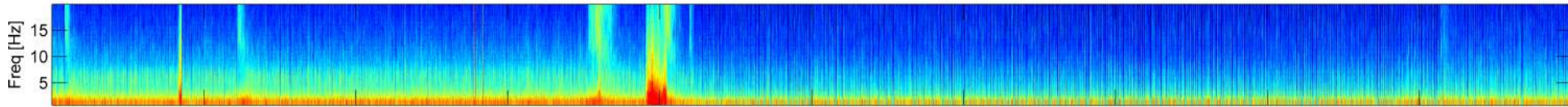
**Right Lateral**



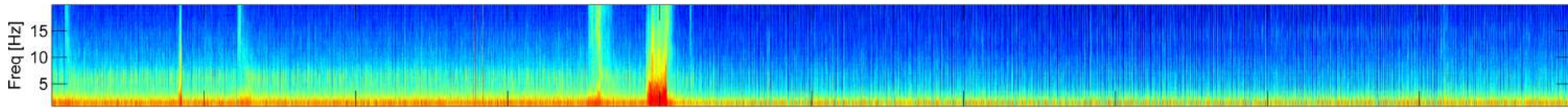
**Lateral Asymmetry**



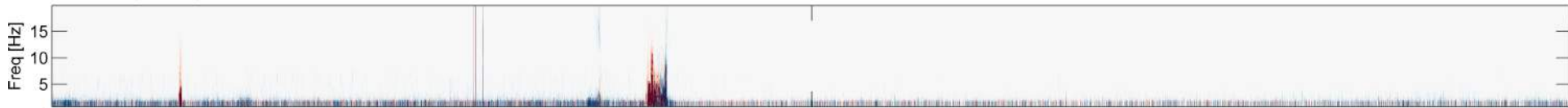
**Left Central**



**Right Central**

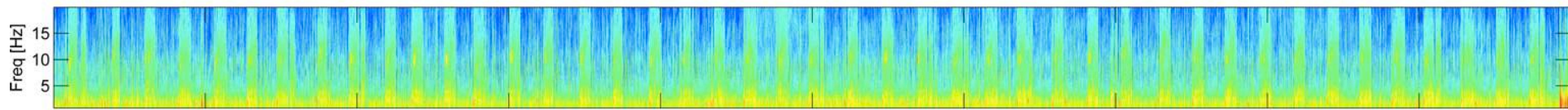


**Central Asymmetry**

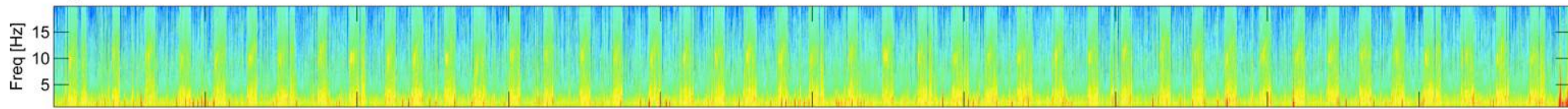


6 7 8  
Time [hours]

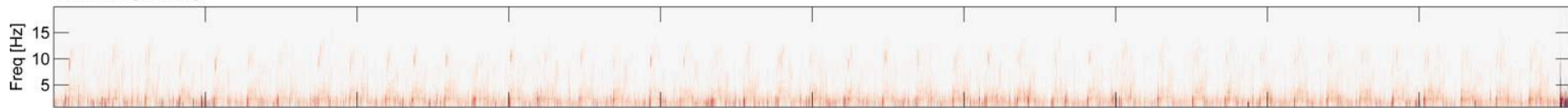
**Left Lateral Case#71-2**



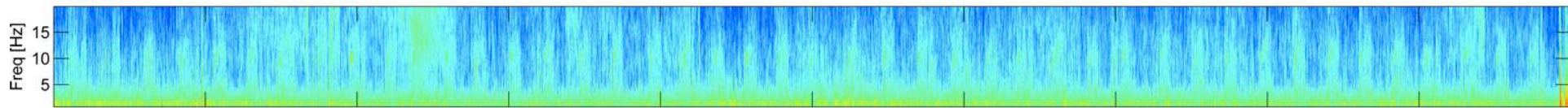
**Right Lateral**



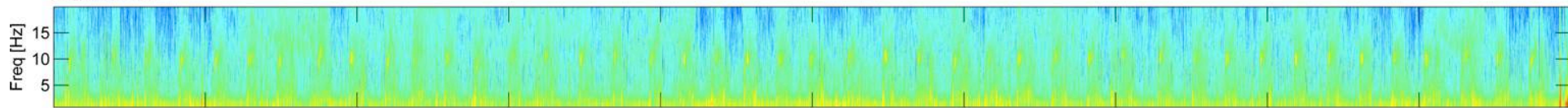
**Lateral Asymmetry**



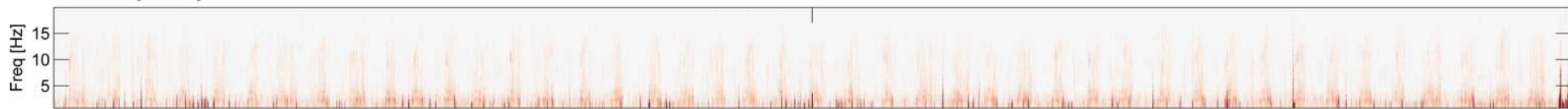
**Left Central**



**Right Central**

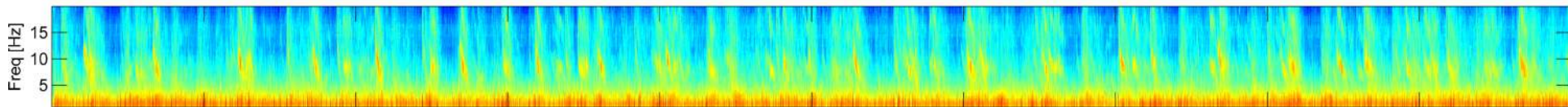


**Central Asymmetry**

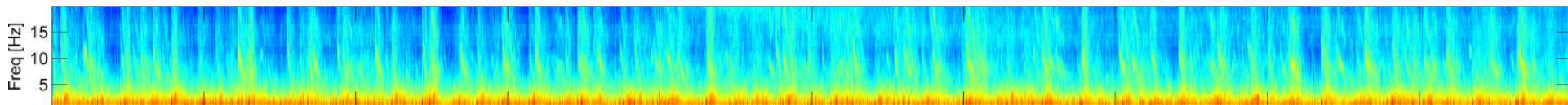


2 3 4  
Time [hours]

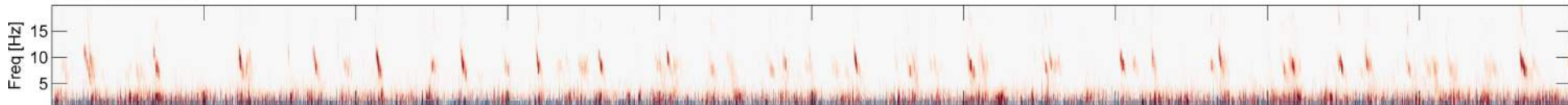
**Left Lateral Case#19-3**



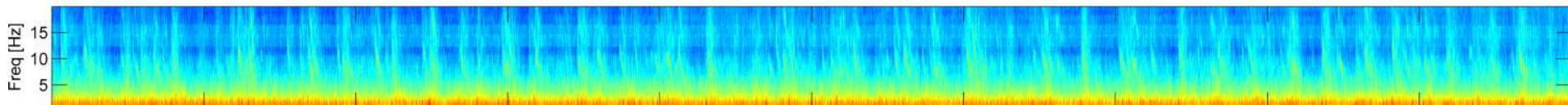
**Right Lateral**



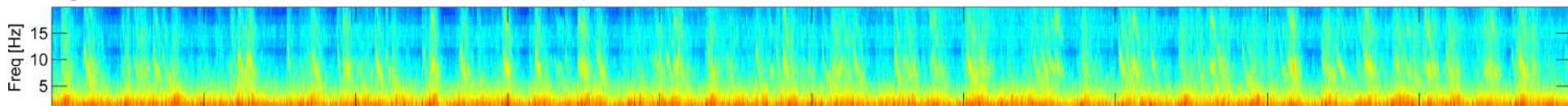
**Lateral Asymmetry**



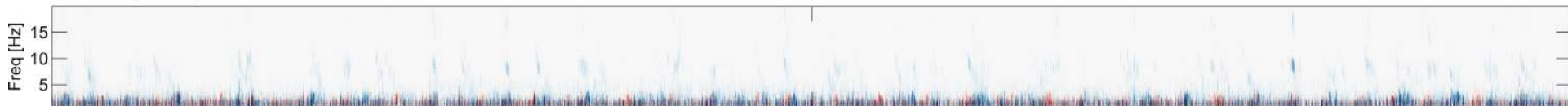
**Left Central**



**Right Central**

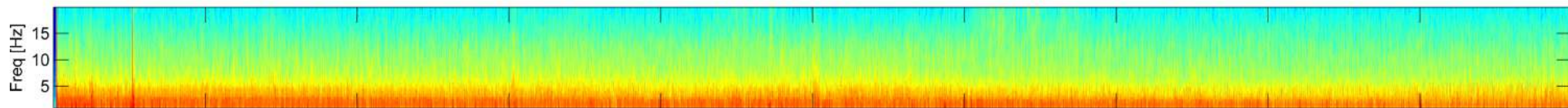


**Central Asymmetry**

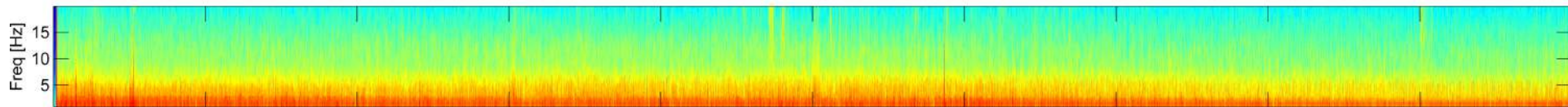


4 5 6  
Time [hours]

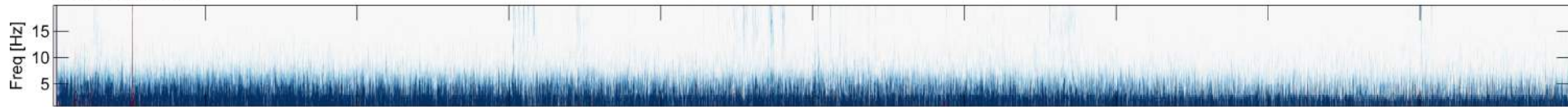
**Left Lateral Case#80-1**



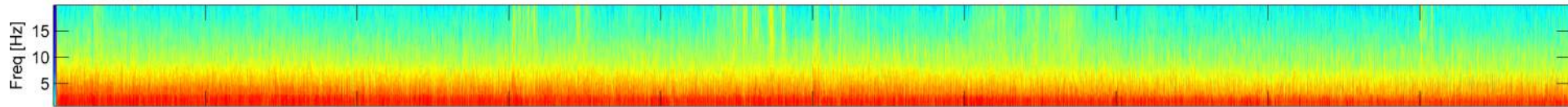
**Right Lateral**



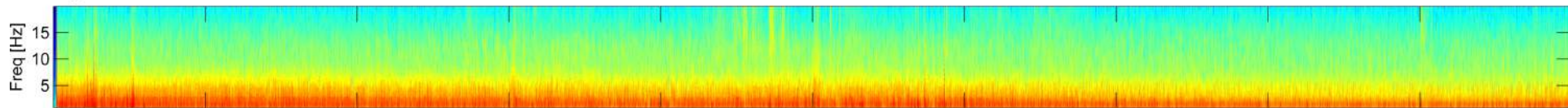
**Lateral Asymmetry**



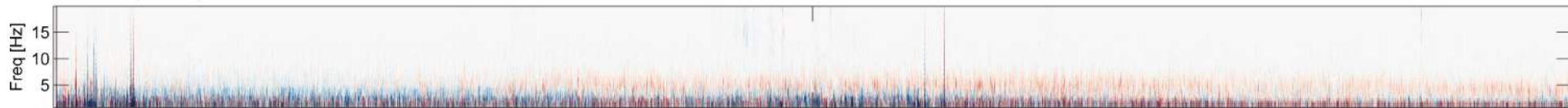
**Left Central**



**Right Central**

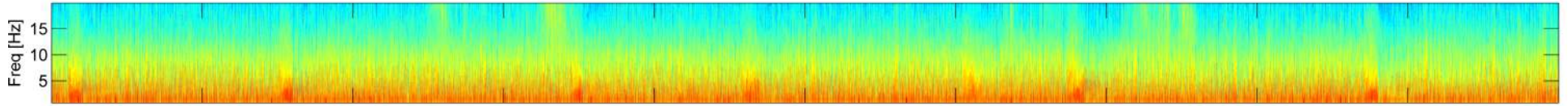


**Central Asymmetry**

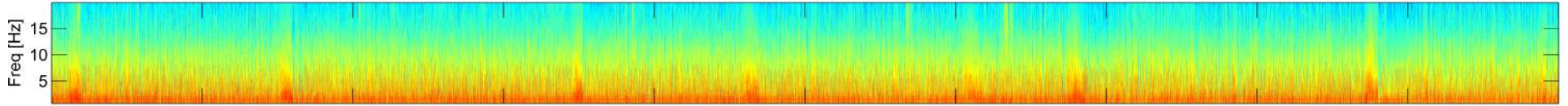


0.0002 1 2  
Time [hours]

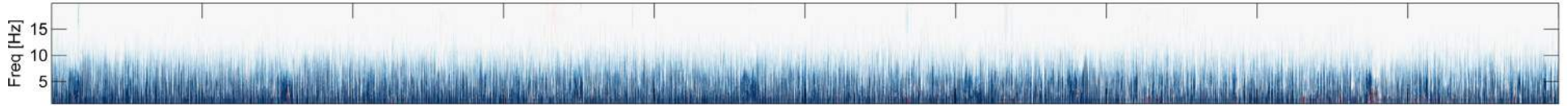
**Left Lateral Case#80-7**



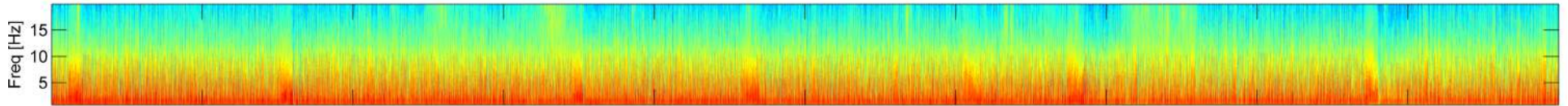
**Right Lateral**



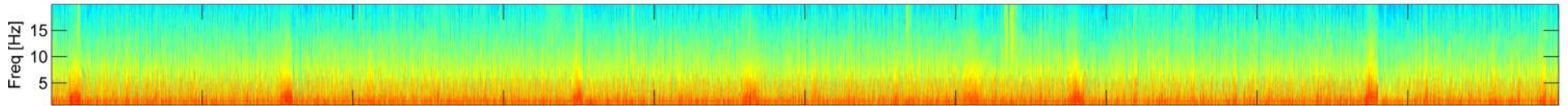
**Lateral Asymmetry**



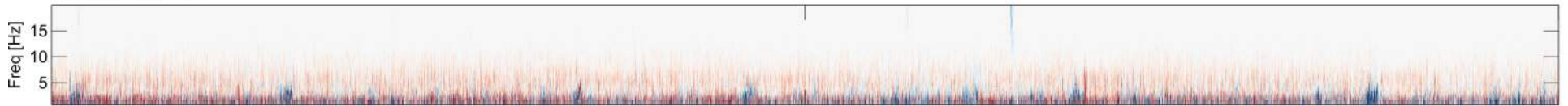
**Left Central**



**Right Central**

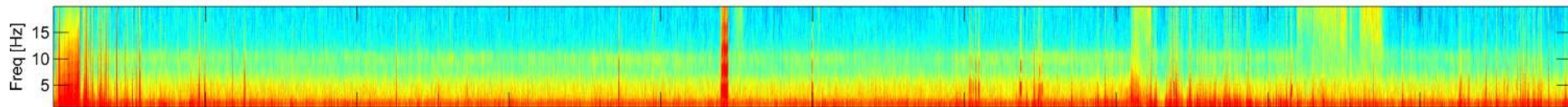


**Central Asymmetry**

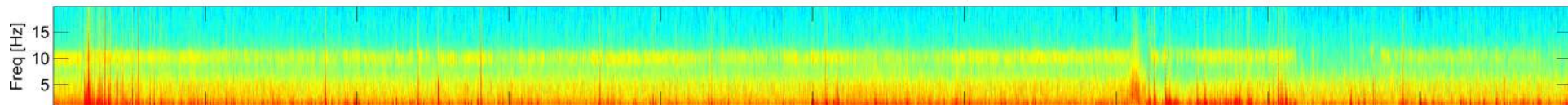


12 13 14  
Time [hours]

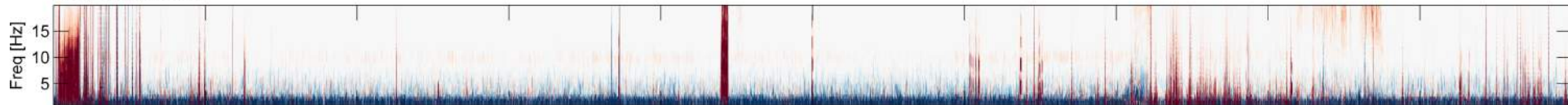
**Left Lateral Case#82-1**



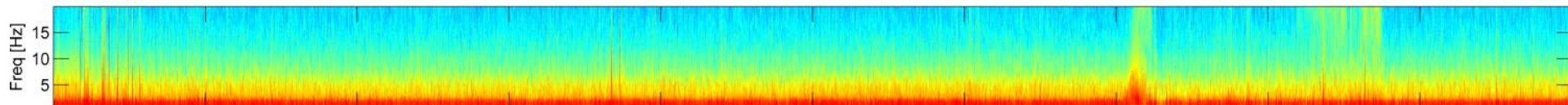
**Right Lateral**



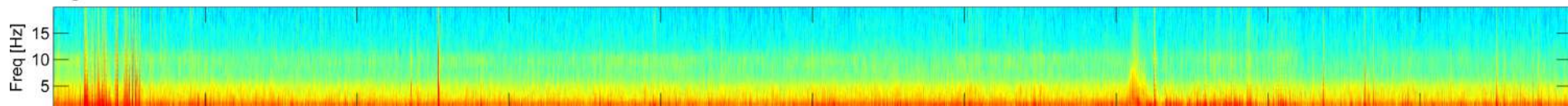
**Lateral Asymmetry**



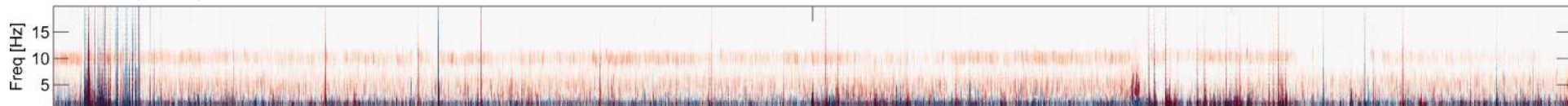
**Left Central**



**Right Central**



**Central Asymmetry**

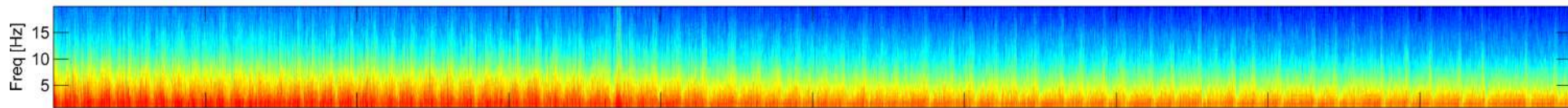


0.0002

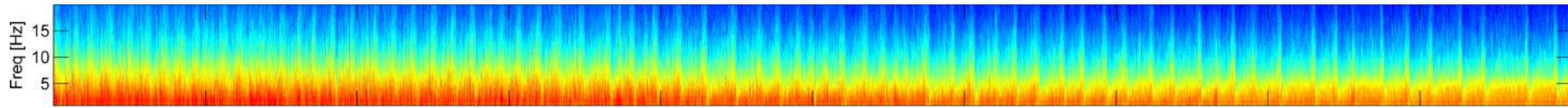
1  
Time [hours]

2

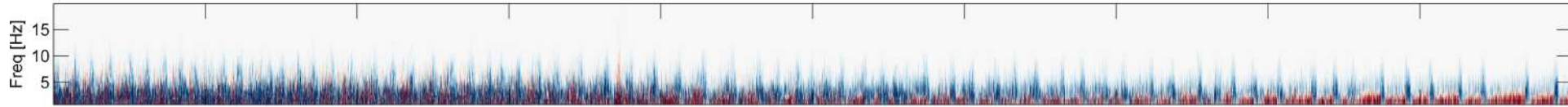
**Left Lateral Case#3-1**



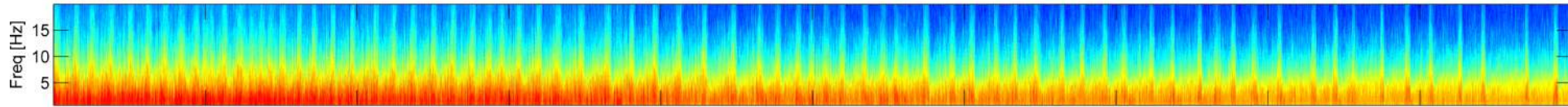
**Right Lateral**



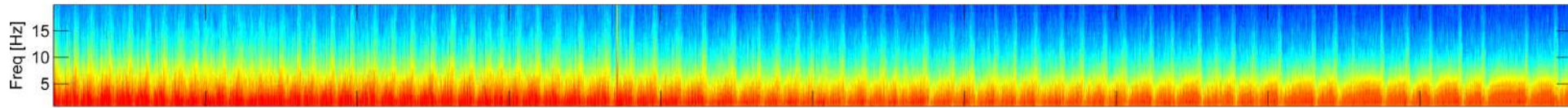
**Lateral Asymmetry**



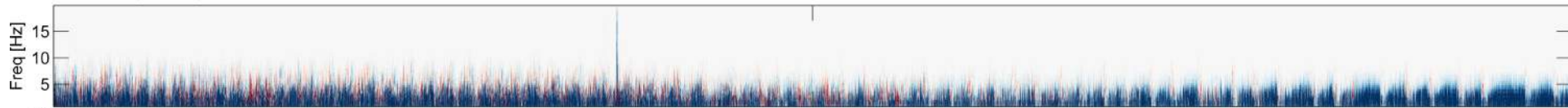
**Left Central**



**Right Central**



**Central Asymmetry**



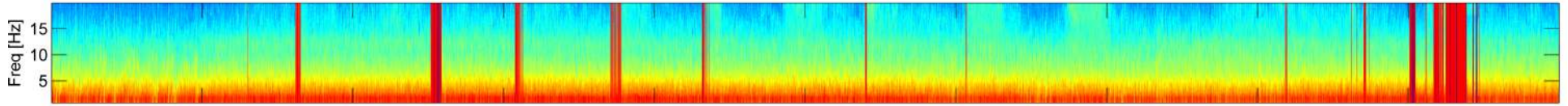
0.0002

1  
Time [hours]

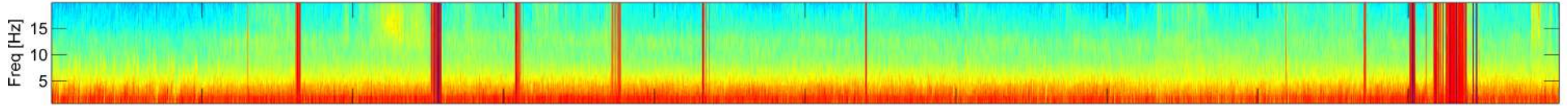
2



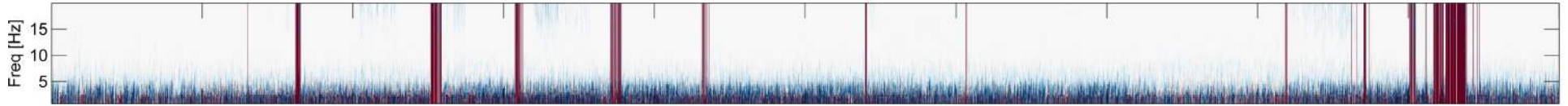
**Left Lateral Case#31-11**



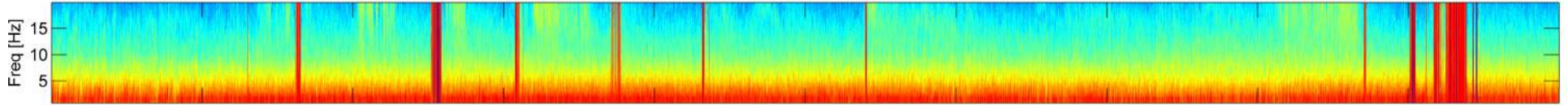
**Right Lateral**



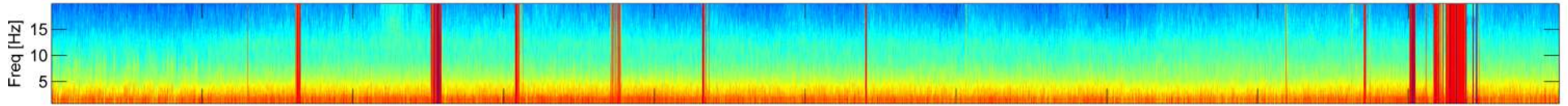
**Lateral Asymmetry**



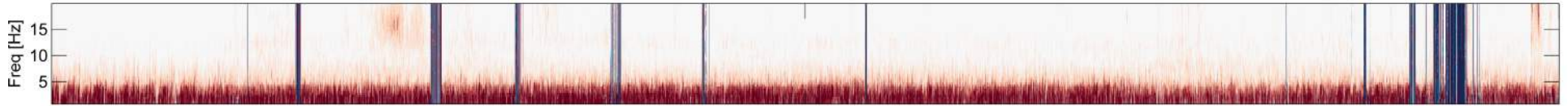
**Left Central**



**Right Central**

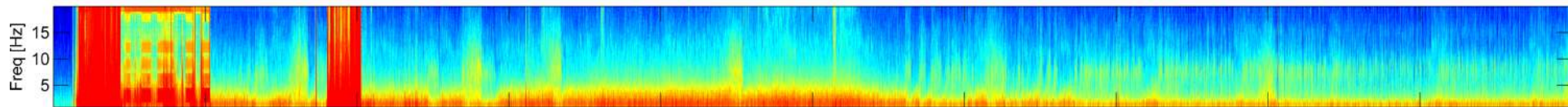


**Central Asymmetry**

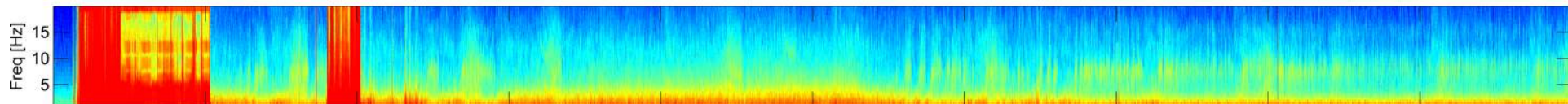


20 21 22  
Time [hours]

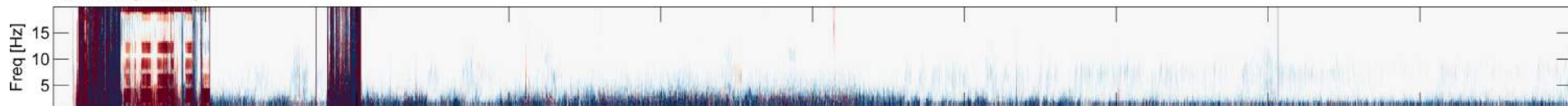
**Left Lateral Case#46-1**



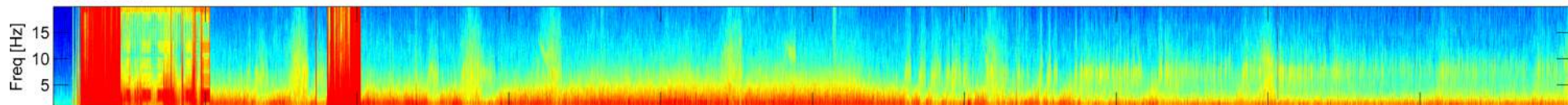
**Right Lateral**



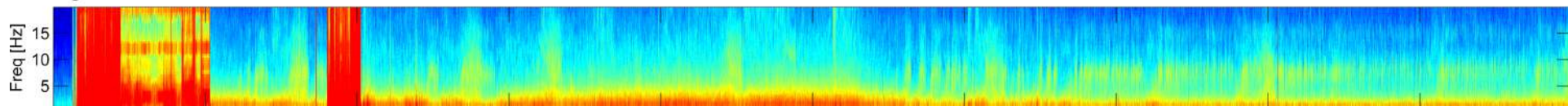
**Lateral Asymmetry**



**Left Central**



**Right Central**



**Central Asymmetry**

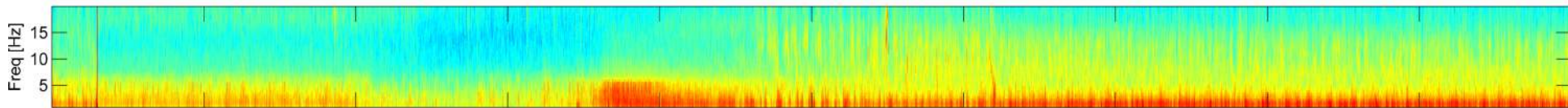


0.0002

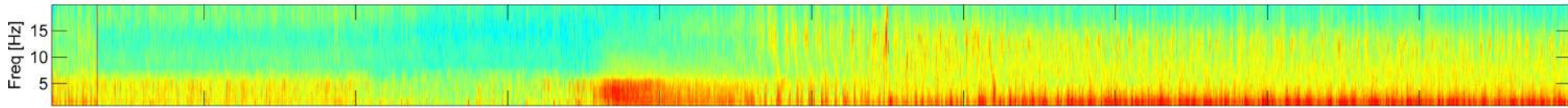
1  
Time [hours]

2

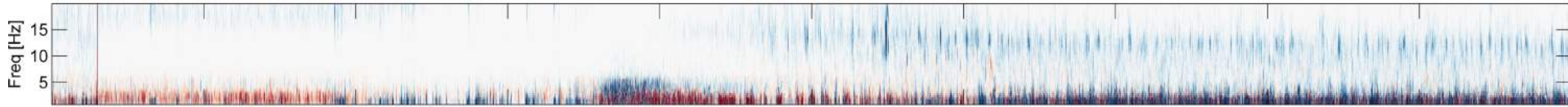
**Left Lateral Case#84-4**



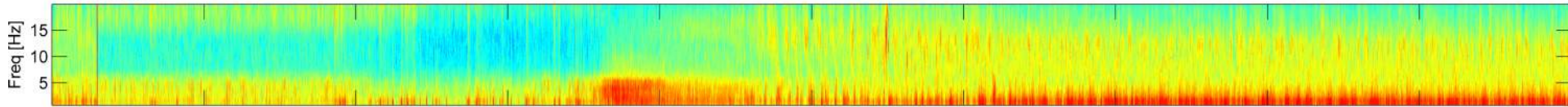
**Right Lateral**



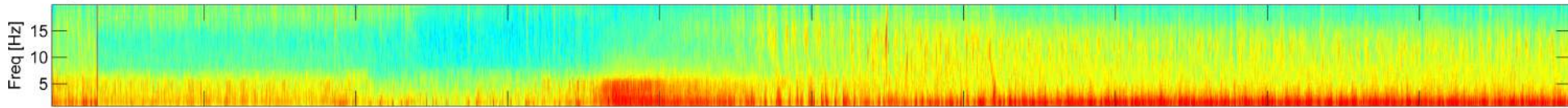
**Lateral Asymmetry**



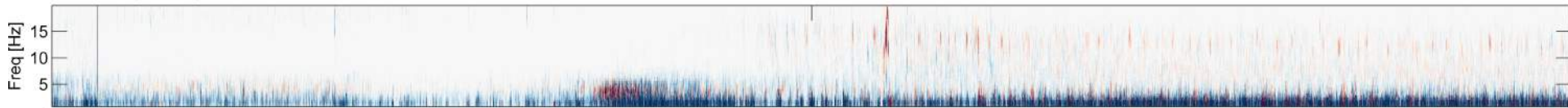
**Left Central**



**Right Central**

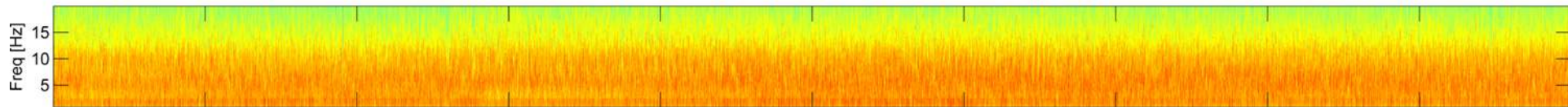


**Central Asymmetry**

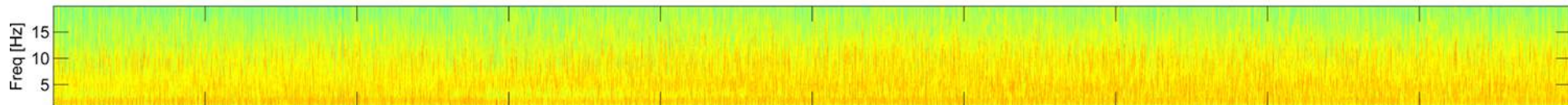


6 7 8  
Time [hours]

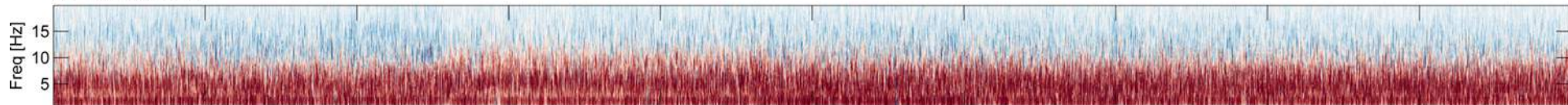
**Left Lateral Case#79-2**



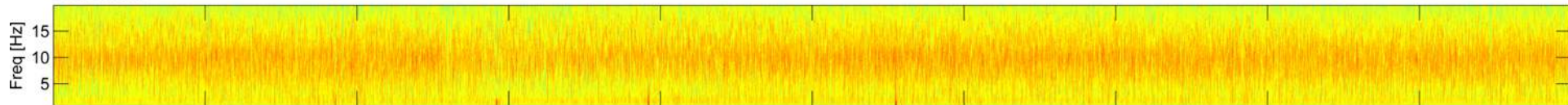
**Right Lateral**



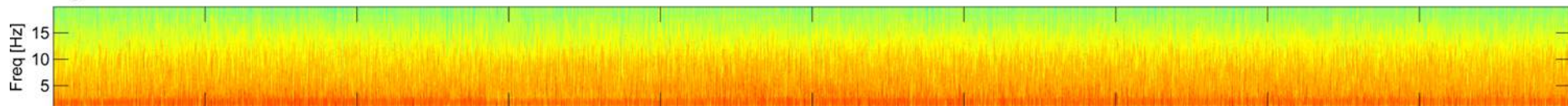
**Lateral Asymmetry**



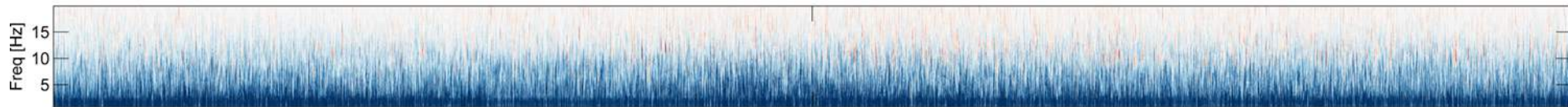
**Left Central**



**Right Central**



**Central Asymmetry**

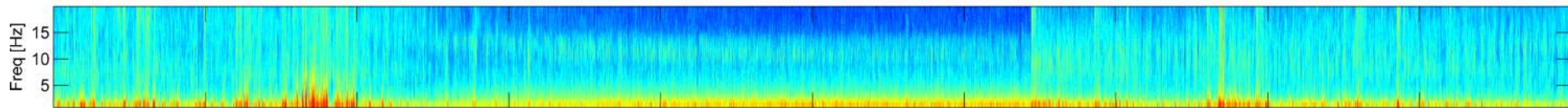


2

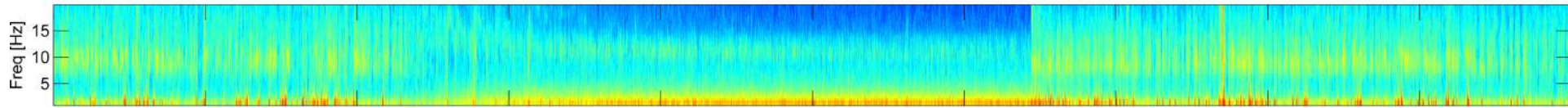
3  
Time [hours]

4

**Left Lateral Case#18-3**



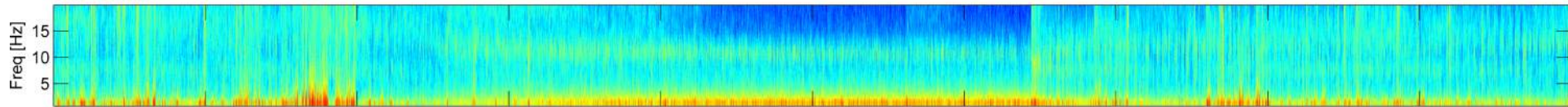
**Right Lateral**



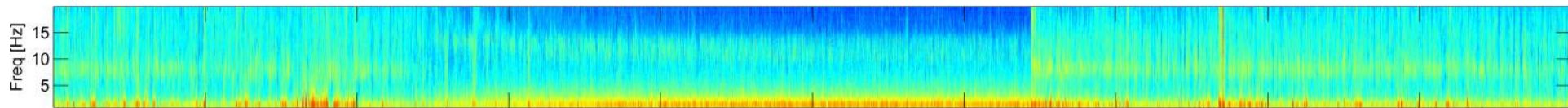
**Lateral Asymmetry**



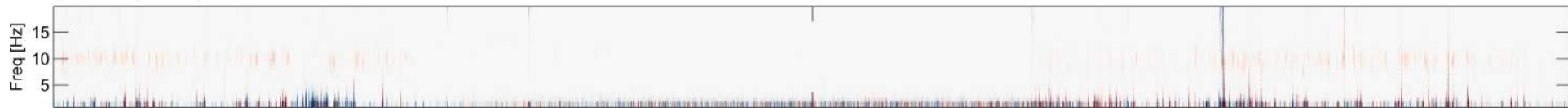
**Left Central**



**Right Central**

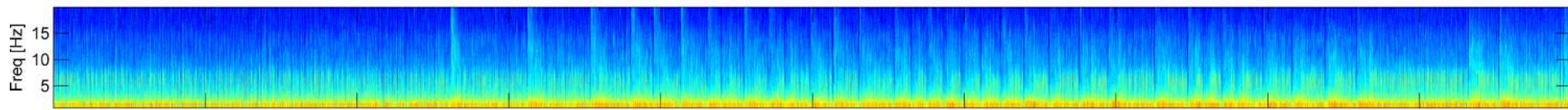


**Central Asymmetry**

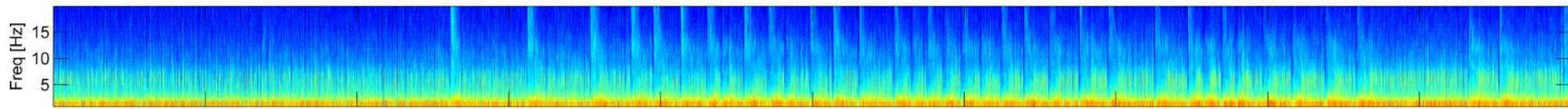


4 5 6  
Time [hours]

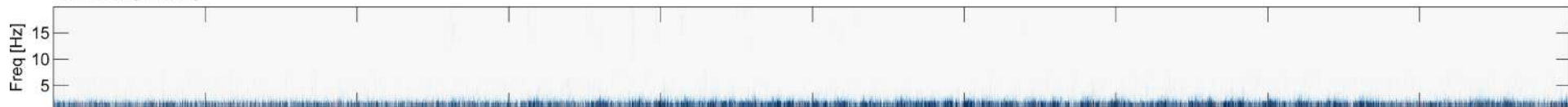
**Left Lateral Case#33-3**



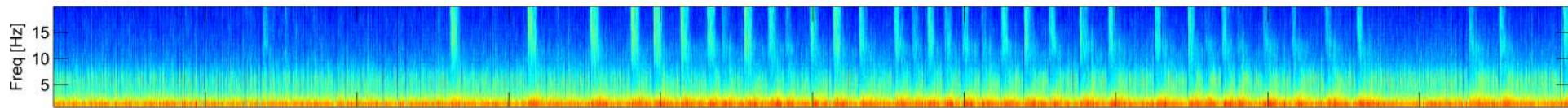
**Right Lateral**



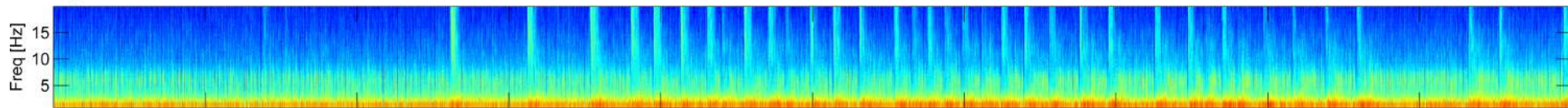
**Lateral Asymmetry**



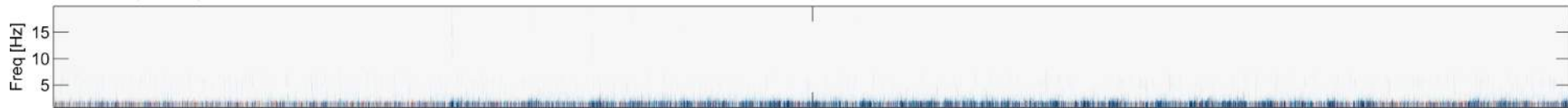
**Left Central**



**Right Central**

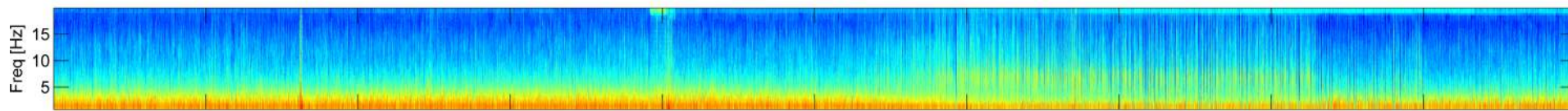


**Central Asymmetry**

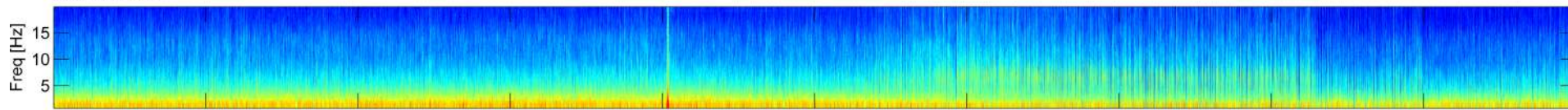


4 5 6  
Time [hours]

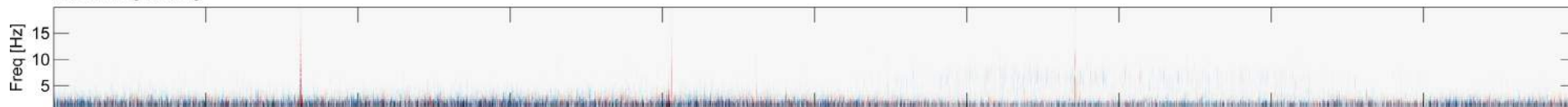
**Left Lateral Case#90-7**



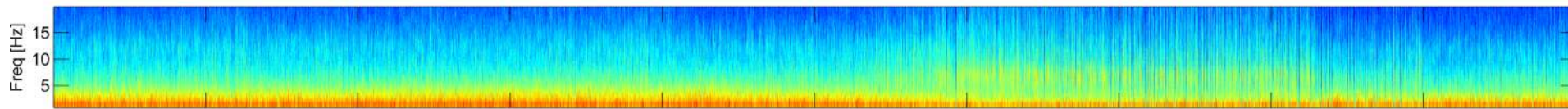
**Right Lateral**



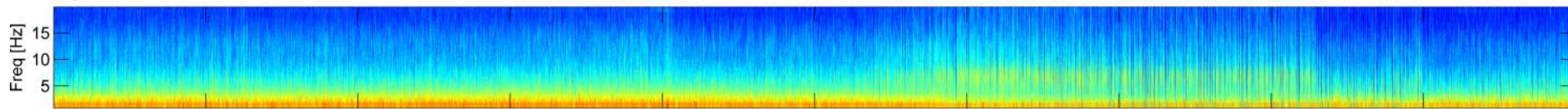
**Lateral Asymmetry**



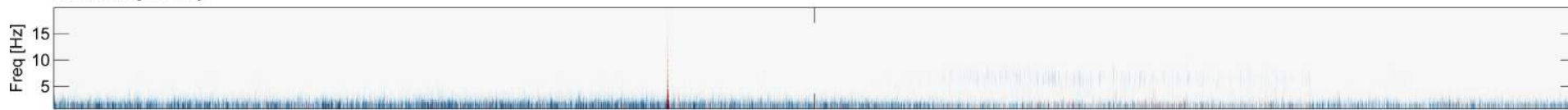
**Left Central**



**Right Central**

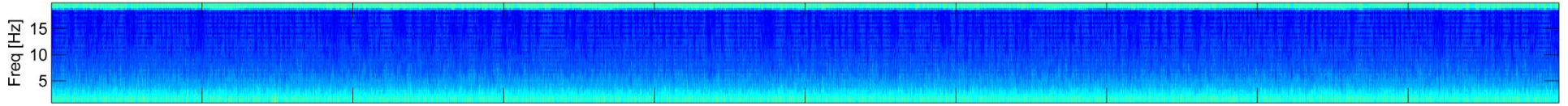


**Central Asymmetry**

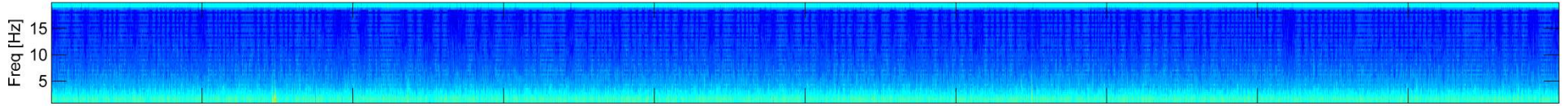


12 13 14  
Time [hours]

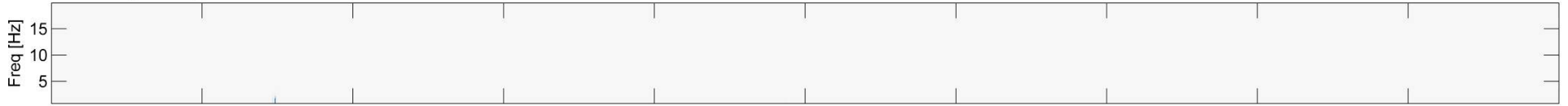
**Left Lateral Case#82-16**



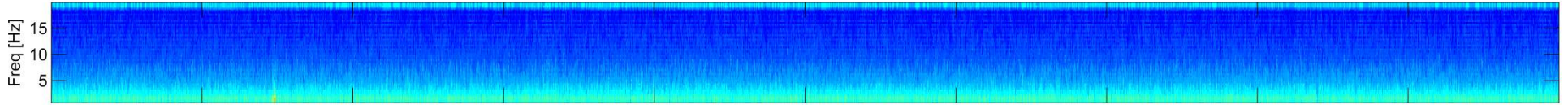
**Right Lateral**



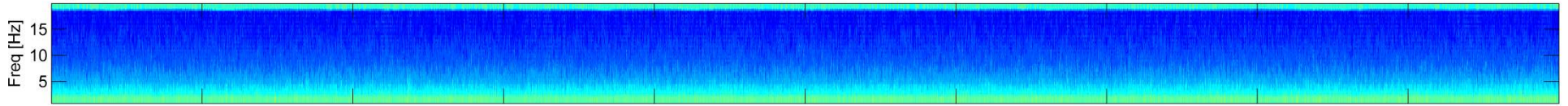
**Lateral Asymmetry**



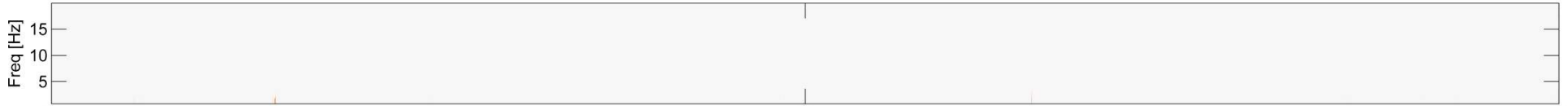
**Left Central**



**Right Central**



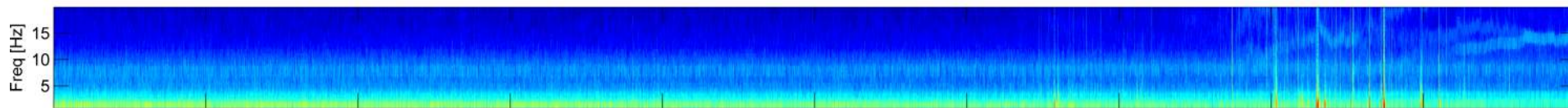
**Central Asymmetry**



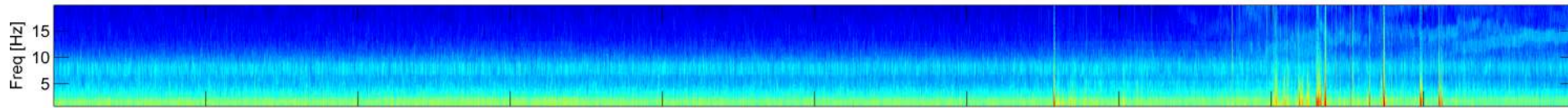
30 31 32  
Time [hours]



**Left Lateral Case#3-5**



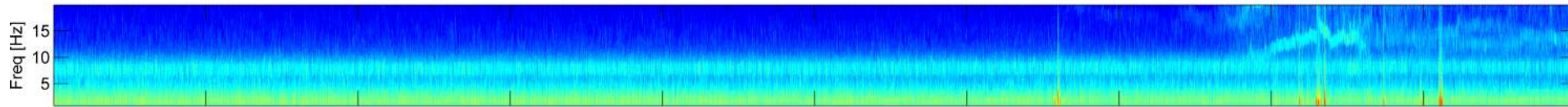
**Right Lateral**



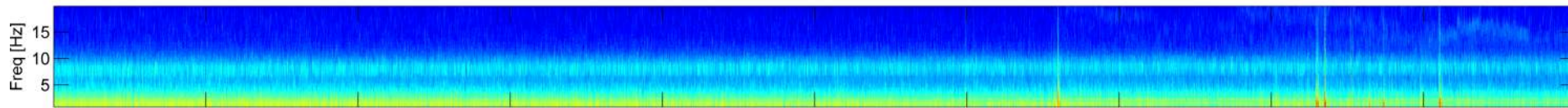
**Lateral Asymmetry**



**Left Central**



**Right Central**

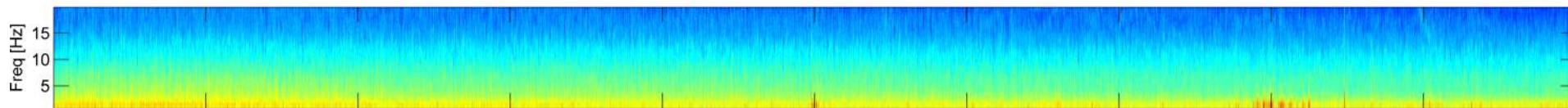


**Central Asymmetry**

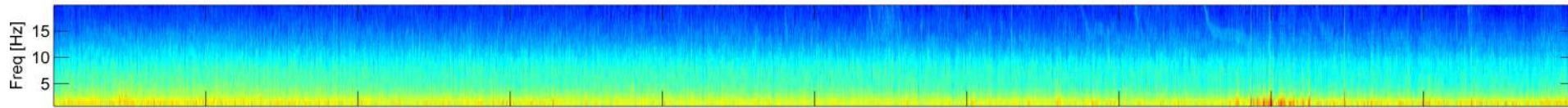


8 9 10  
Time [hours]

**Left Lateral Case#5-5**



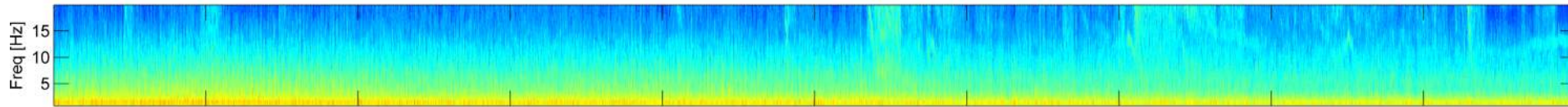
**Right Lateral**



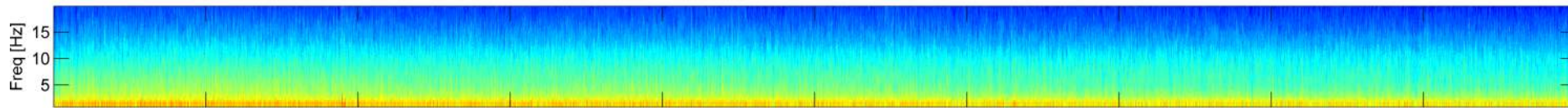
**Lateral Asymmetry**



**Left Central**



**Right Central**

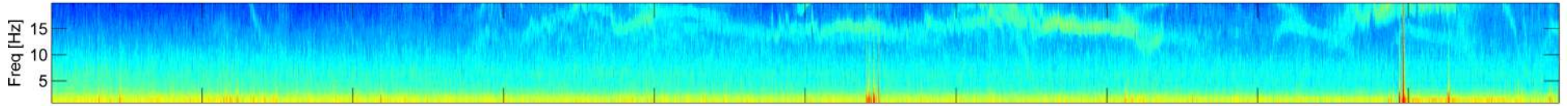


**Central Asymmetry**

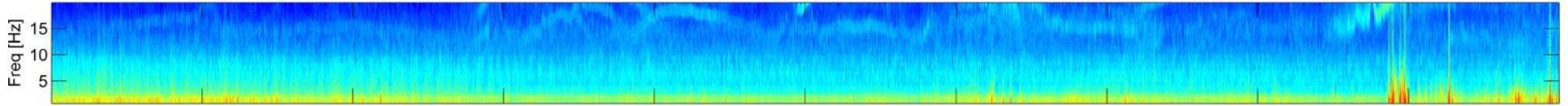


8 9 10  
Time [hours]

**Left Lateral Case#5-6**



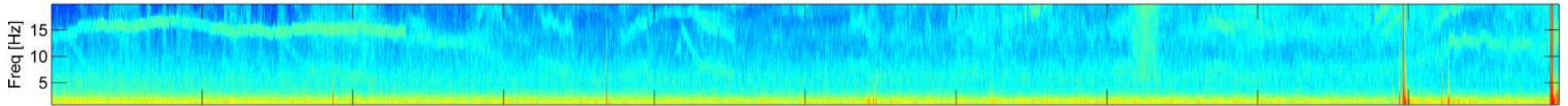
**Right Lateral**



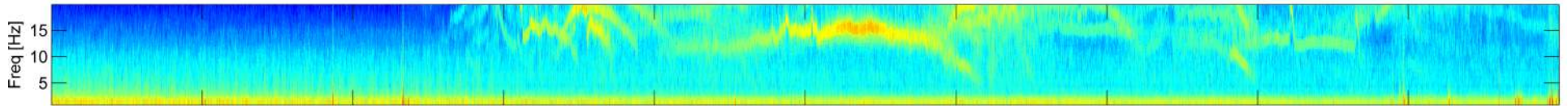
**Lateral Asymmetry**



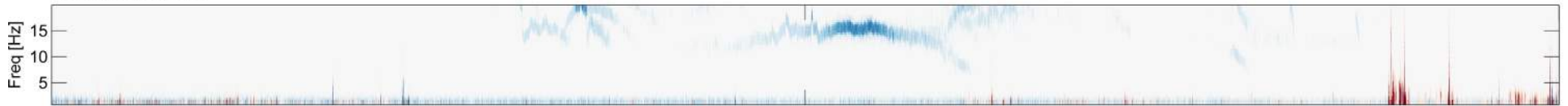
**Left Central**



**Right Central**



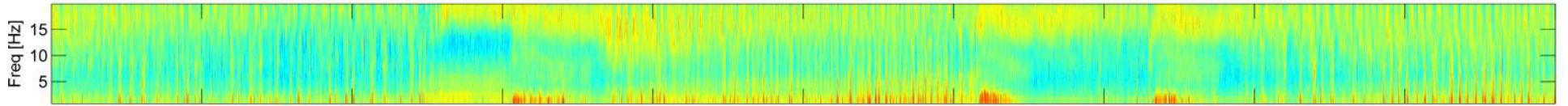
**Central Asymmetry**



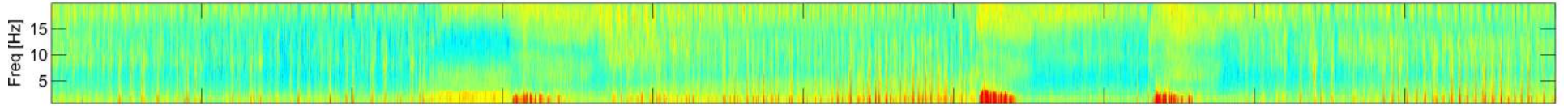
11  
Time [hours]

12

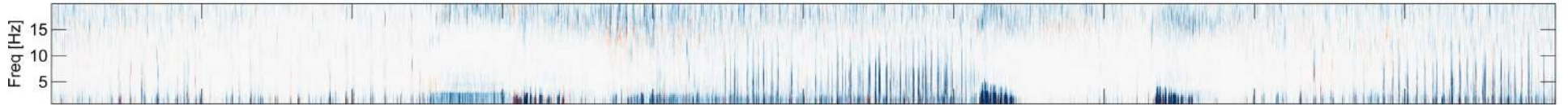
**Left Lateral Case#30-5**



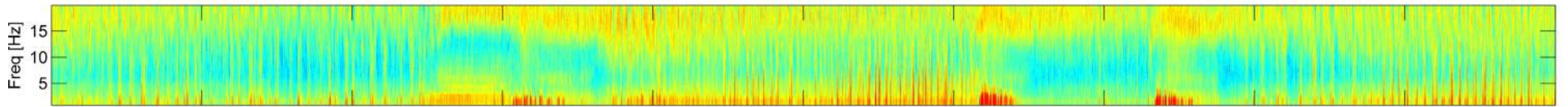
**Right Lateral**



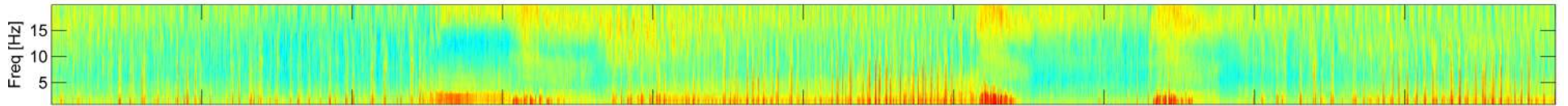
**Lateral Asymmetry**



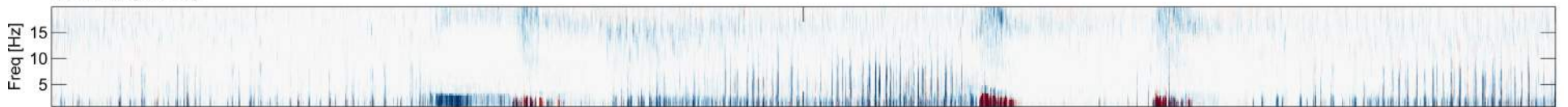
**Left Central**



**Right Central**

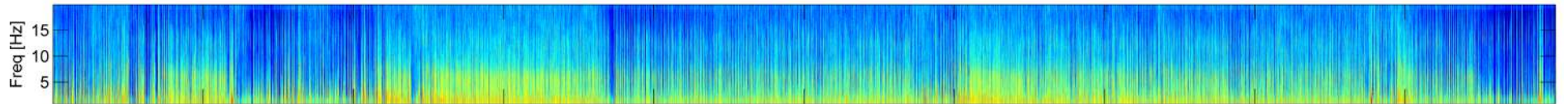


**Central Asymmetry**

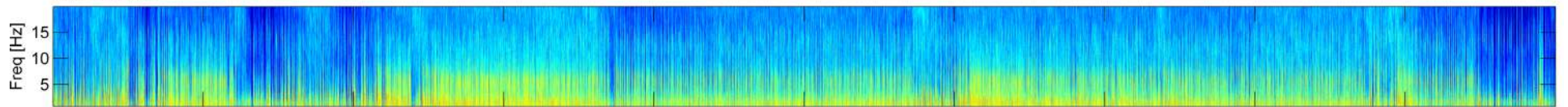


8 9 10  
Time [hours]

**Left Lateral Case#1-10**



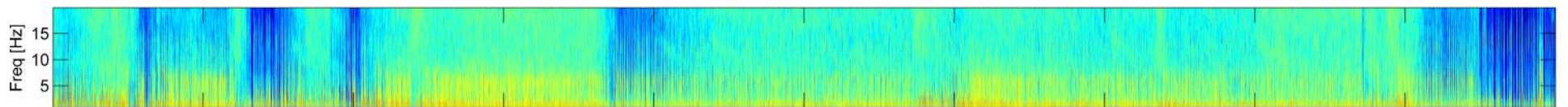
**Right Lateral**



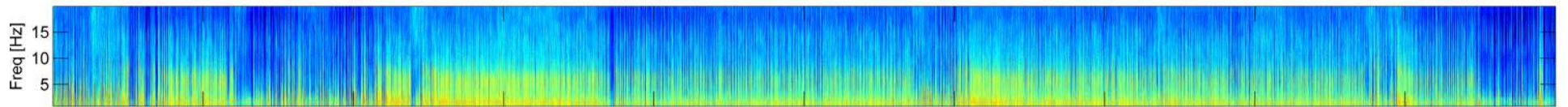
**Lateral Asymmetry**



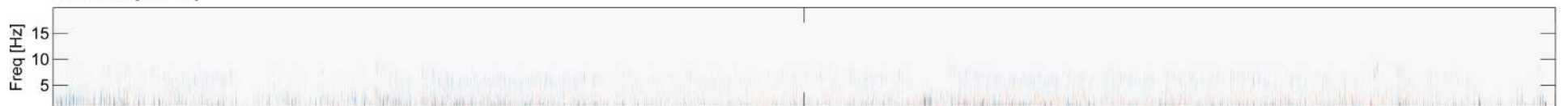
**Left Central**



**Right Central**



**Central Asymmetry**

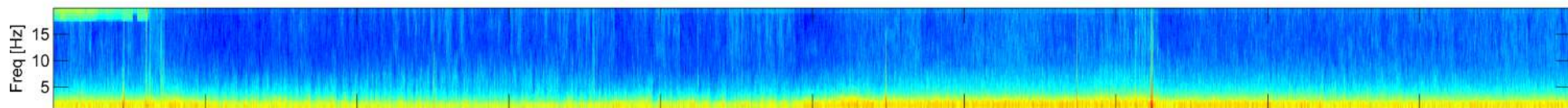


18

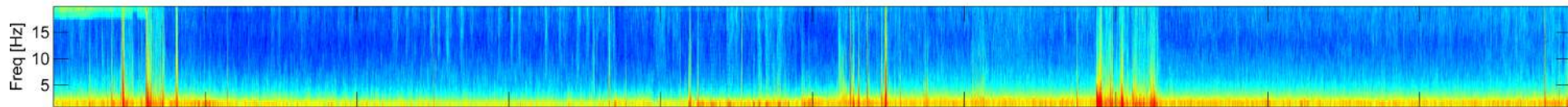
19  
Time [hours]

20

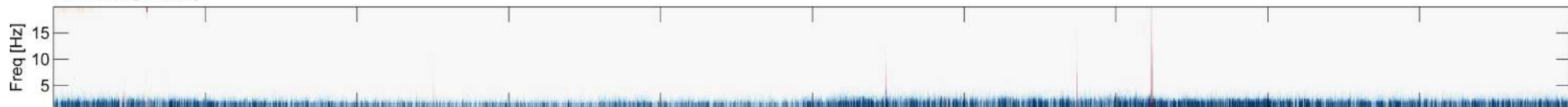
**Left Lateral Case#8-4**



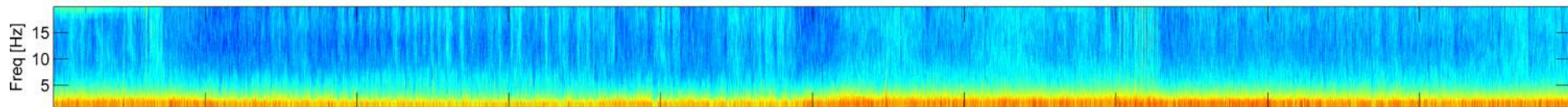
**Right Lateral**



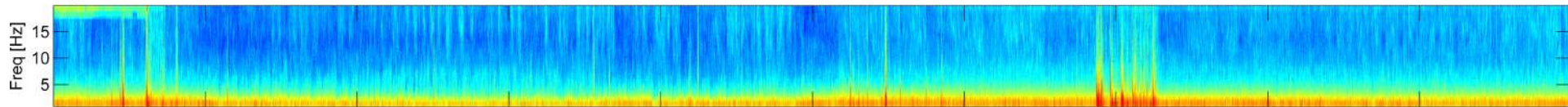
**Lateral Asymmetry**



**Left Central**



**Right Central**

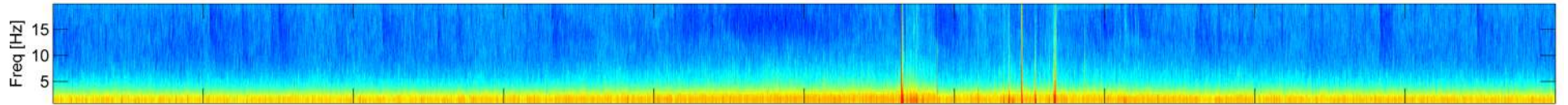


**Central Asymmetry**

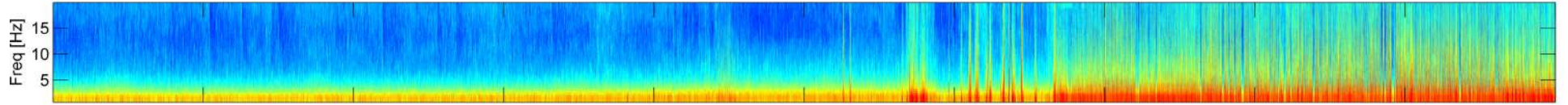


6 7 8  
Time [hours]

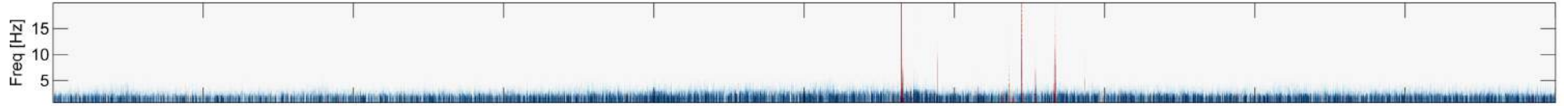
**Left Lateral Case#8-8**



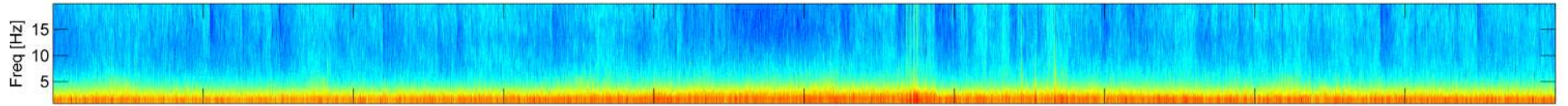
**Right Lateral**



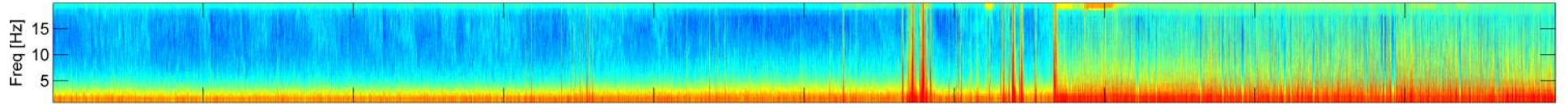
**Lateral Asymmetry**



**Left Central**



**Right Central**



**Central Asymmetry**

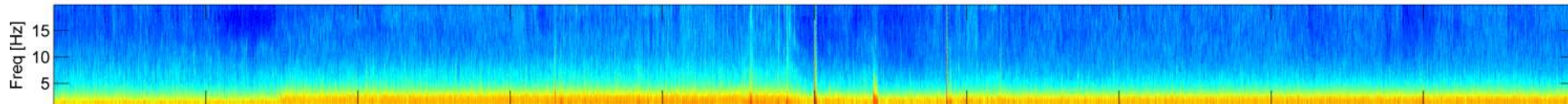


14

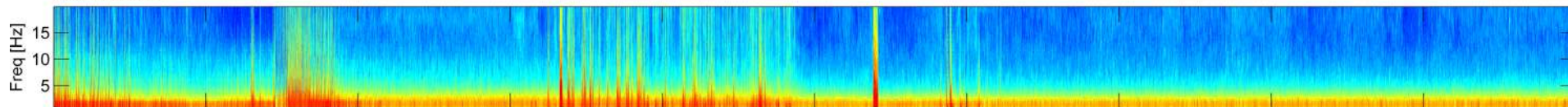
15  
Time [hours]

16

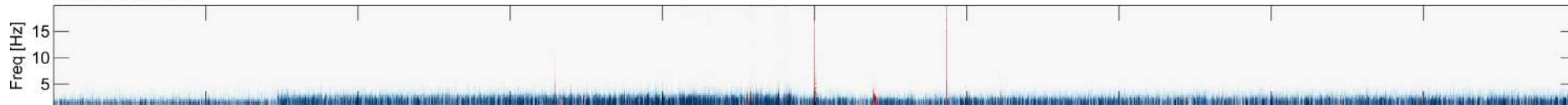
**Left Lateral Case#8-10**



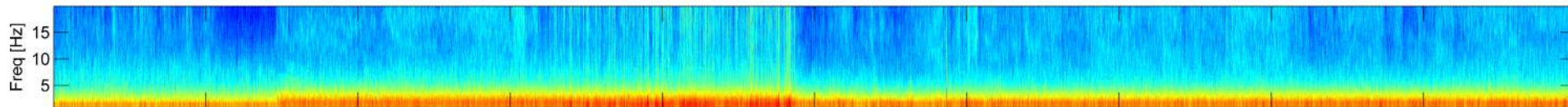
**Right Lateral**



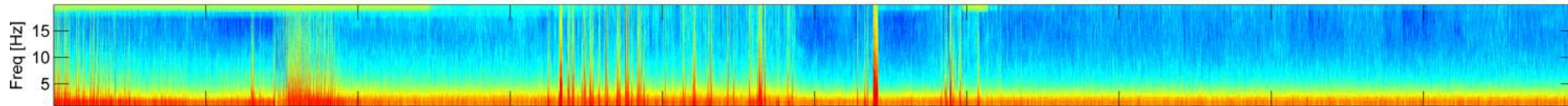
**Lateral Asymmetry**



**Left Central**



**Right Central**



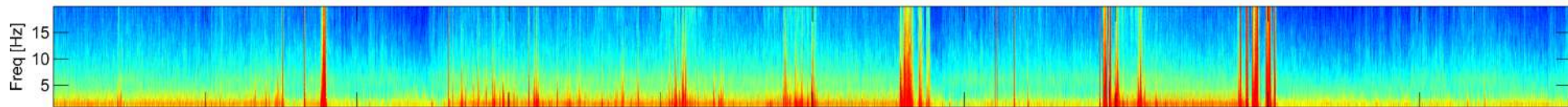
**Central Asymmetry**



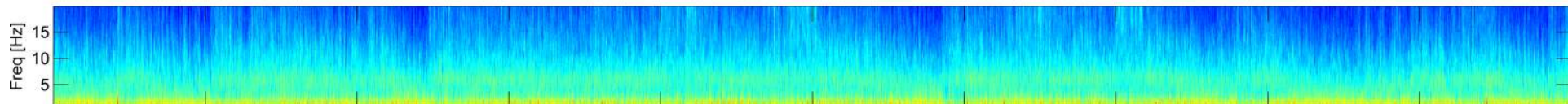
18 19 20  
Time [hours]



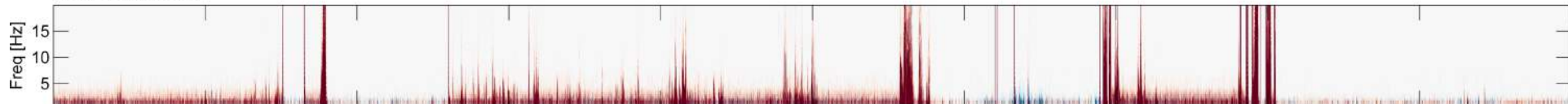
**Left Lateral Case#11-3**



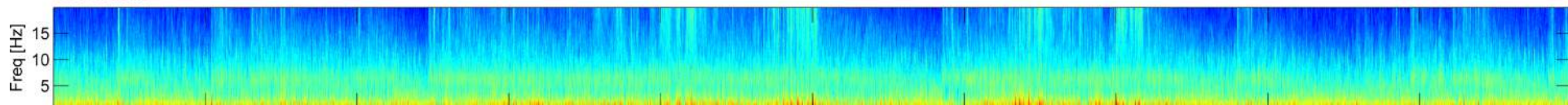
**Right Lateral**



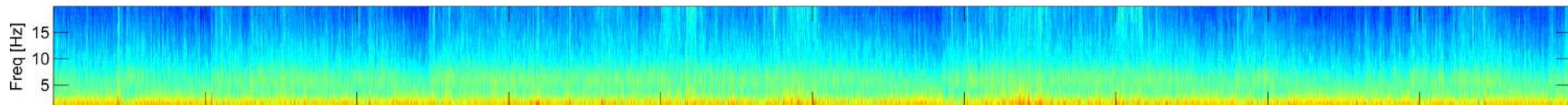
**Lateral Asymmetry**



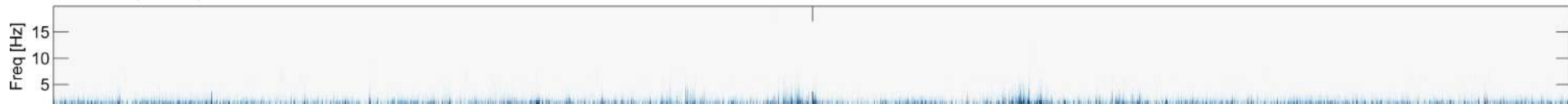
**Left Central**



**Right Central**

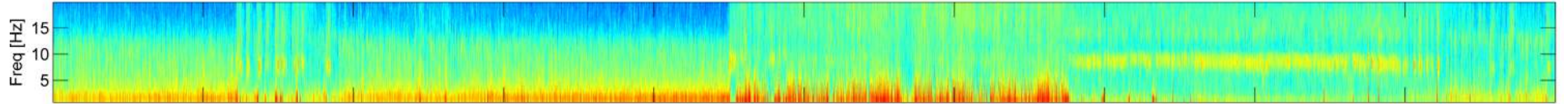


**Central Asymmetry**

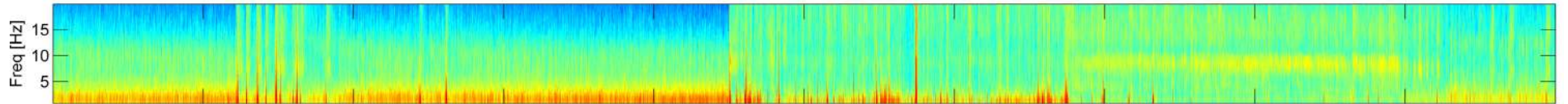


4 5 6  
Time [hours]

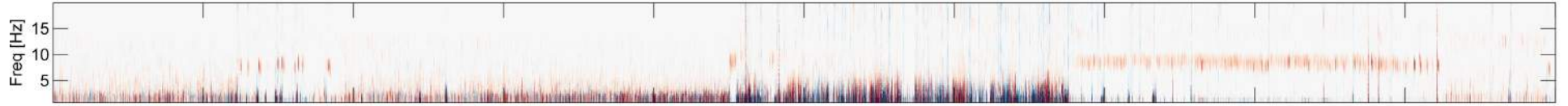
**Left Lateral Case#12-5**



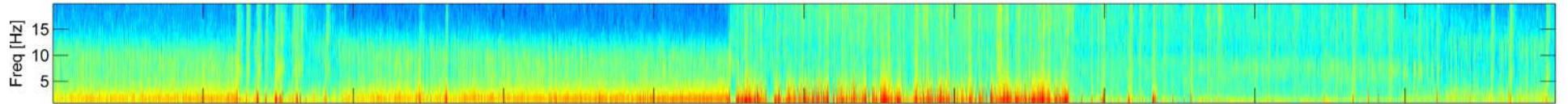
**Right Lateral**



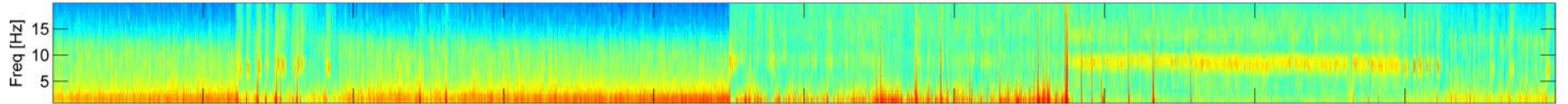
**Lateral Asymmetry**



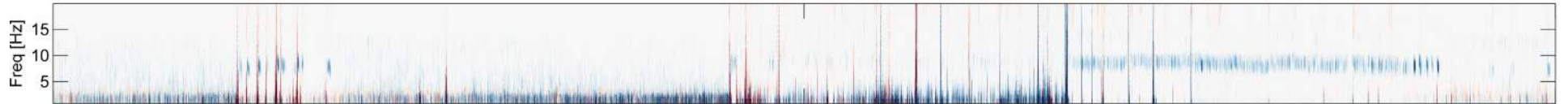
**Left Central**



**Right Central**

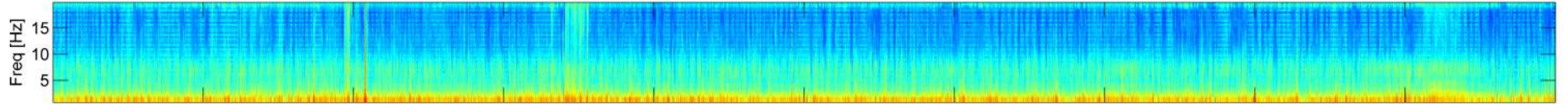


**Central Asymmetry**

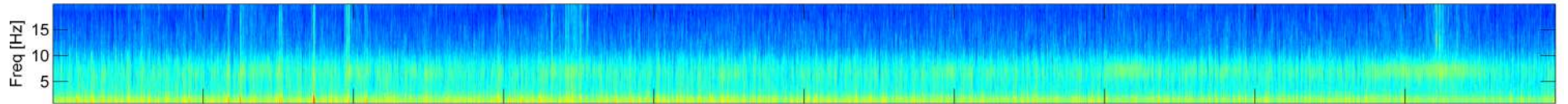


8 9 10  
Time [hours]

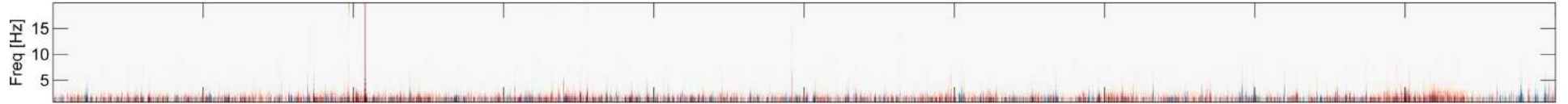
**Left Lateral Case#15-5**



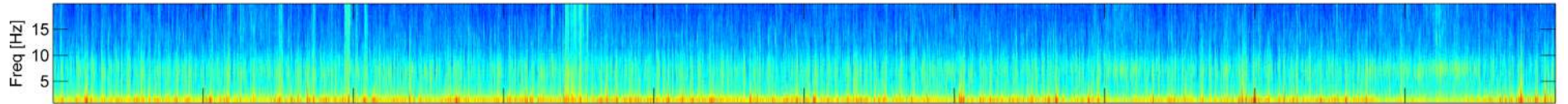
**Right Lateral**



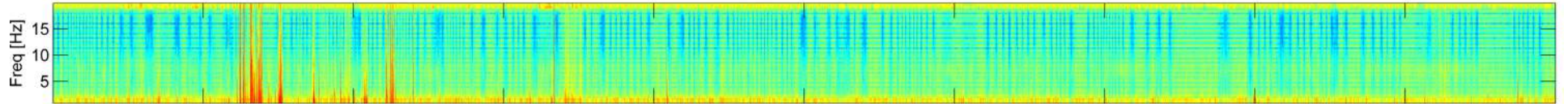
**Lateral Asymmetry**



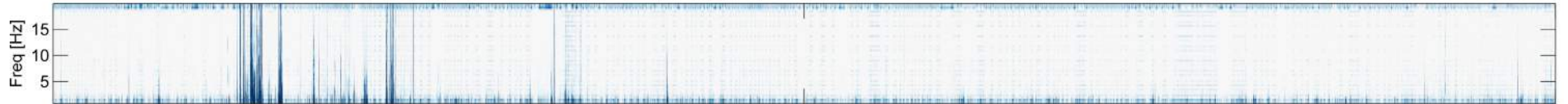
**Left Central**



**Right Central**

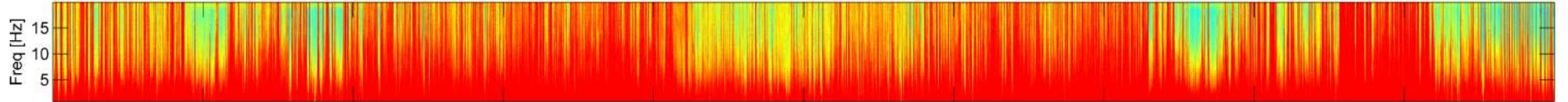


**Central Asymmetry**

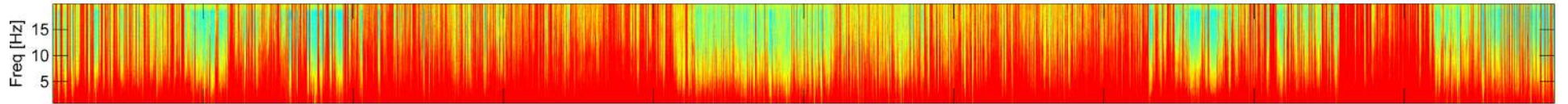


8 9 10  
Time [hours]

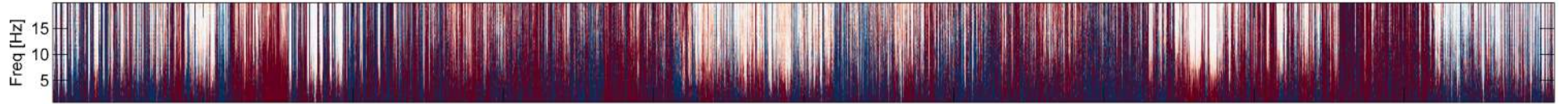
**Left Lateral Case#22-3**



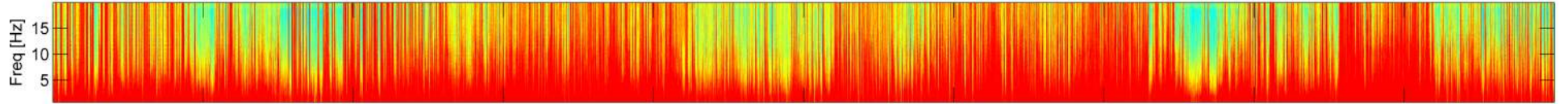
**Right Lateral**



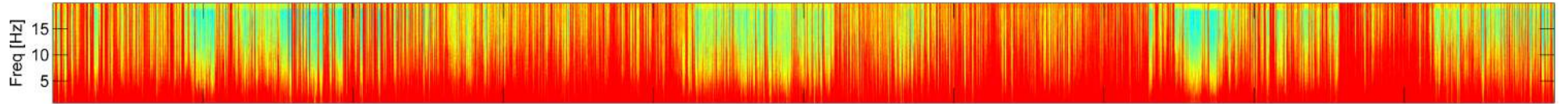
**Lateral Asymmetry**



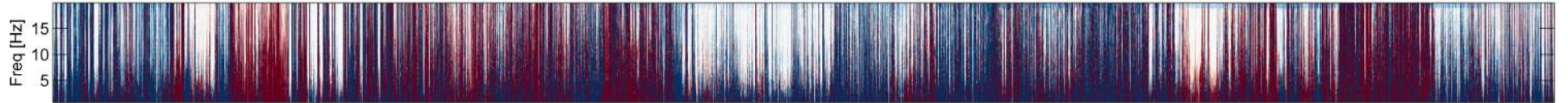
**Left Central**



**Right Central**

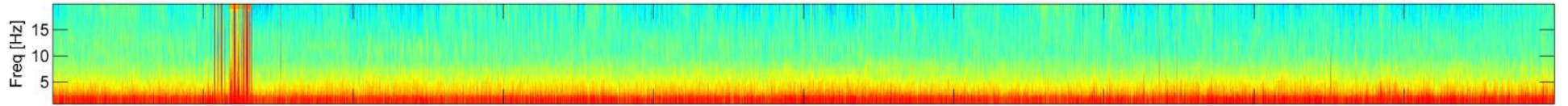


**Central Asymmetry**

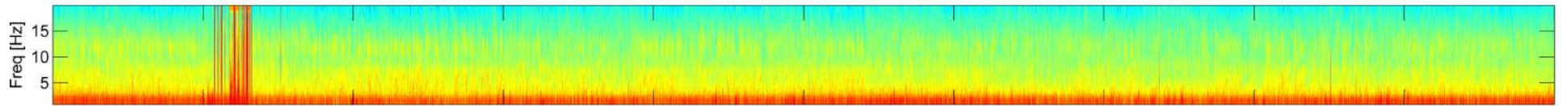


4 5 6  
Time [hours]

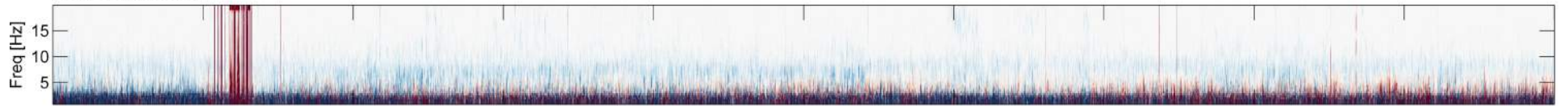
**Left Lateral Case#28-2**



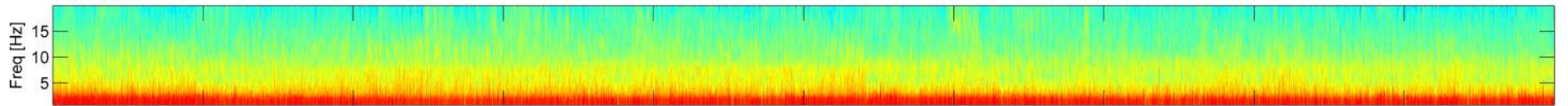
**Right Lateral**



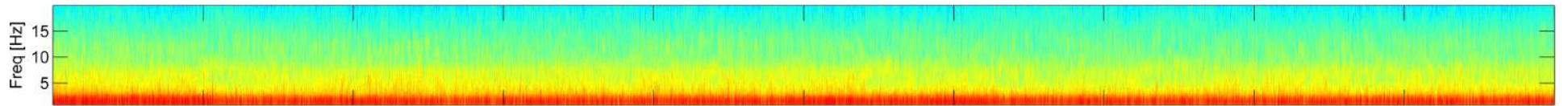
**Lateral Asymmetry**



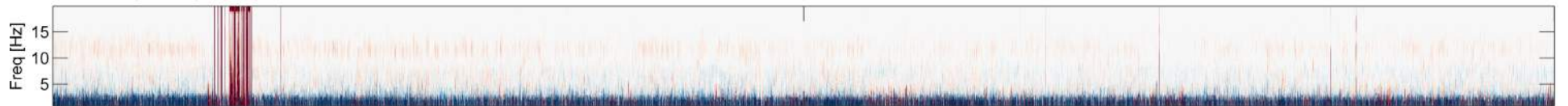
**Left Central**



**Right Central**



**Central Asymmetry**



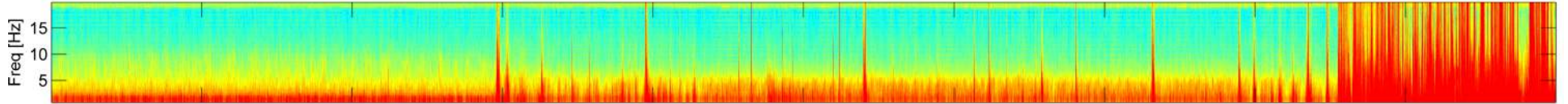
2

3

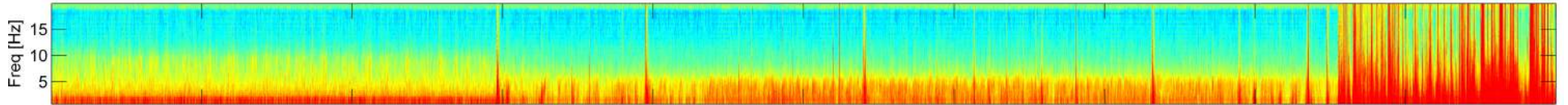
4

Time [hours]

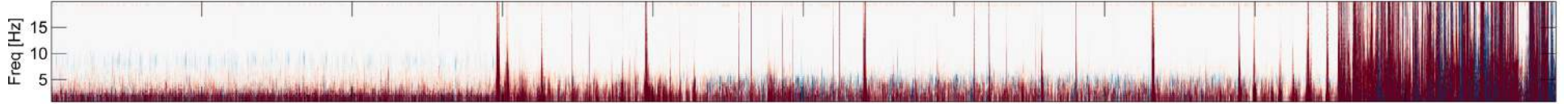
**Left Lateral Case#22-6**



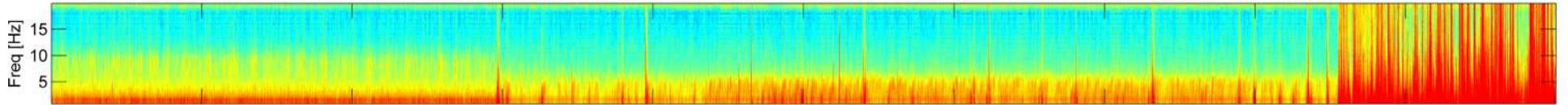
**Right Lateral**



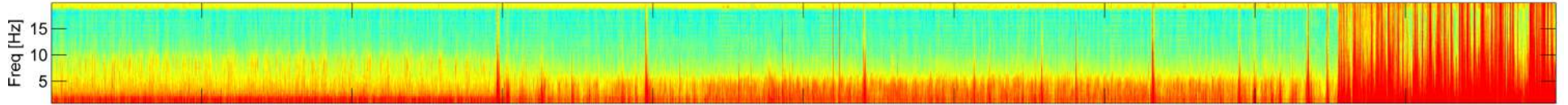
**Lateral Asymmetry**



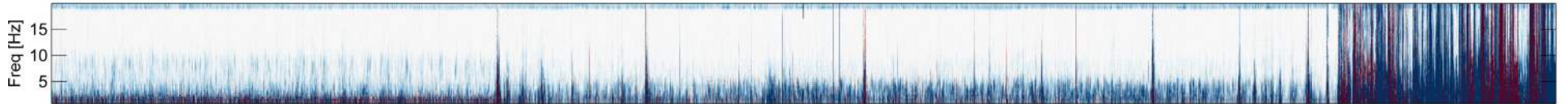
**Left Central**



**Right Central**



**Central Asymmetry**

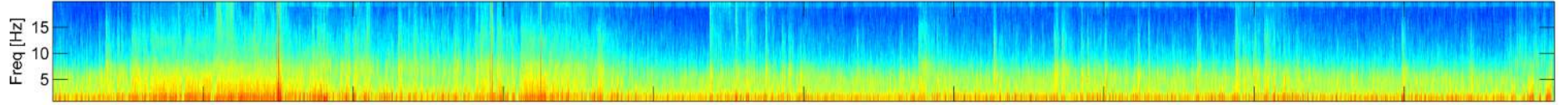


10

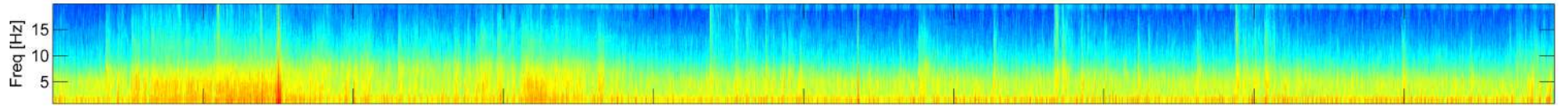
11  
Time [hours]

12

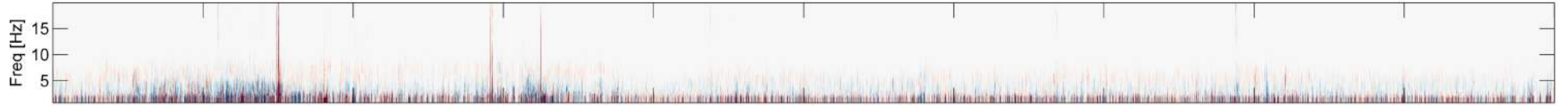
**Left Lateral Case#92-2**



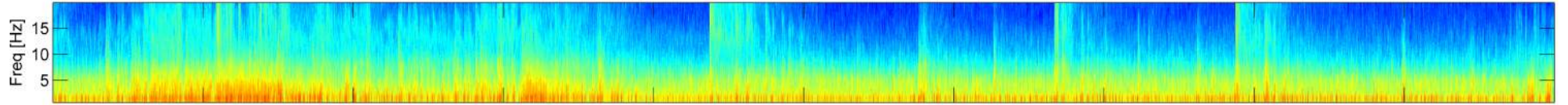
**Right Lateral**



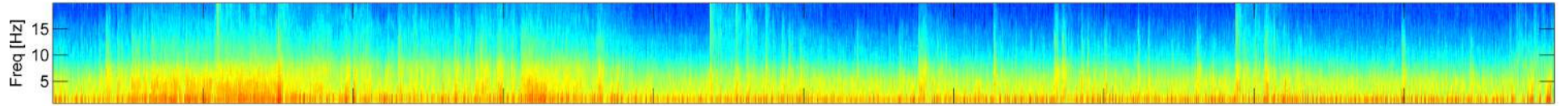
**Lateral Asymmetry**



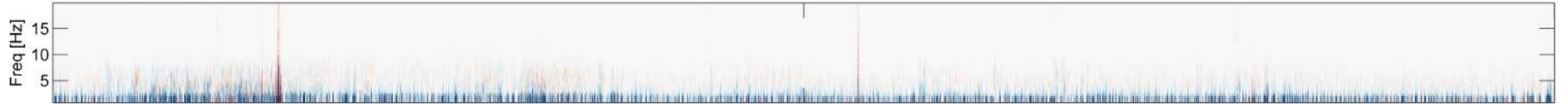
**Left Central**



**Right Central**

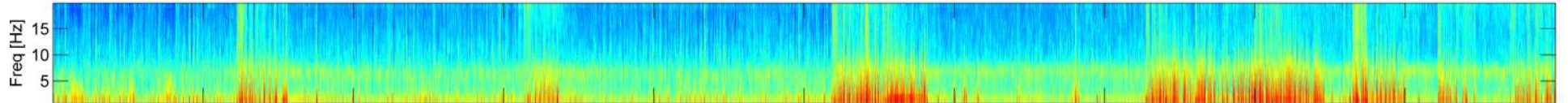


**Central Asymmetry**

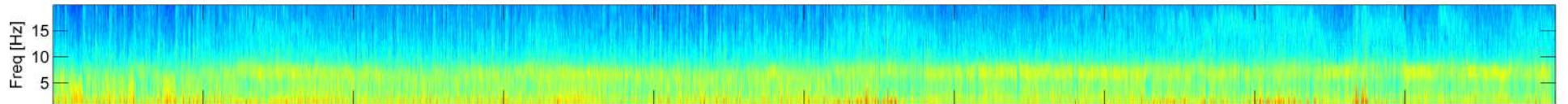


2 3 4  
Time [hours]

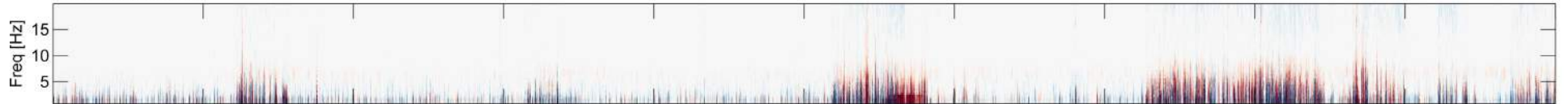
**Left Lateral Case#87-12**



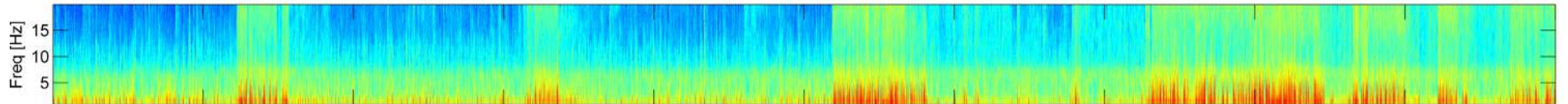
**Right Lateral**



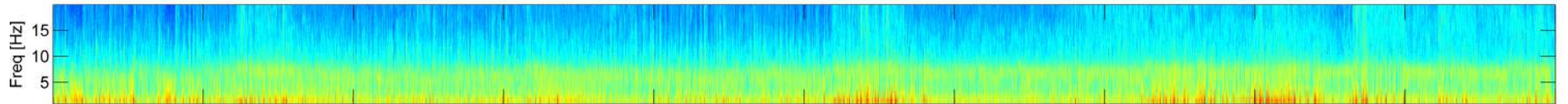
**Lateral Asymmetry**



**Left Central**



**Right Central**



**Central Asymmetry**



22 23 24  
Time [hours]