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Sleep scoring using Neuroscore

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Protocol status: Working
We use this protocol and it's working

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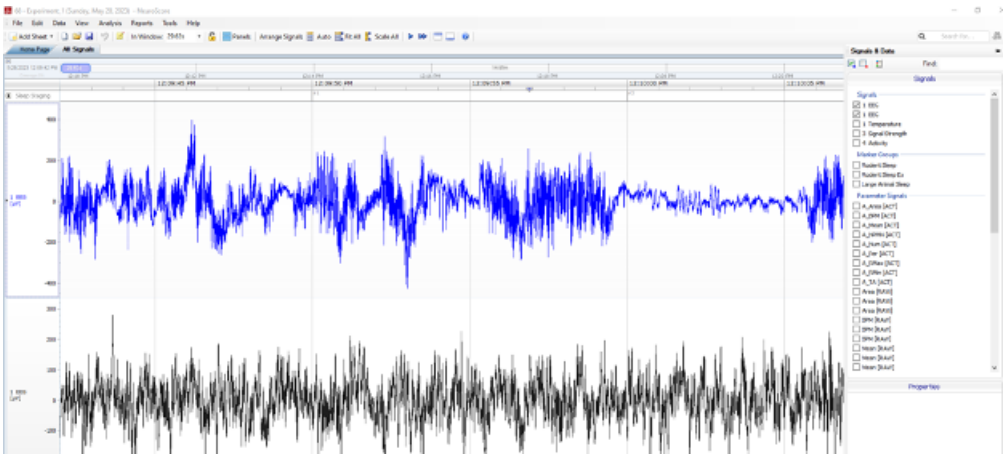
Abstract

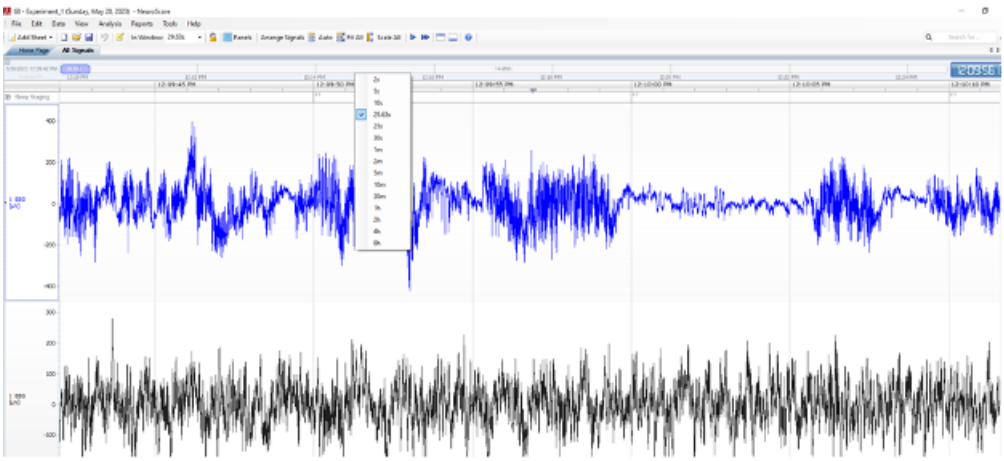
Analysis of sleep data using Neuroscore v.30

1 Open the file using File – Open Recording – Browse – Open

2 Remove unused signals using the right side tools “signal & data” and unselect all markers:

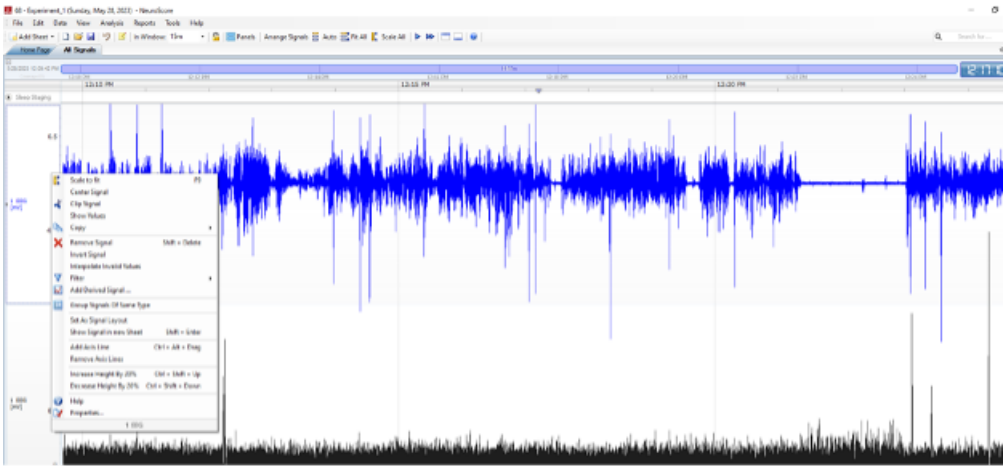


3 Identify the EEG and EMG signals by adjusting the time windows:

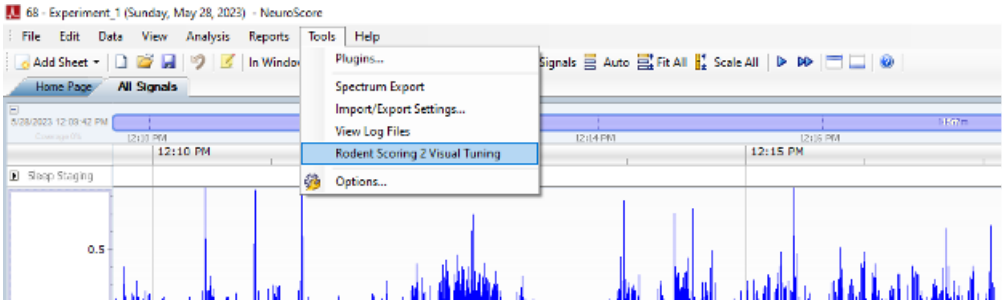


4 If the signal is unusable, just move to another recording. Here the top signal is EMG and bottom is EEG. You can see clear changes in EMG corresponding to movement and nice oscillation in EEG, the signal is as expected.

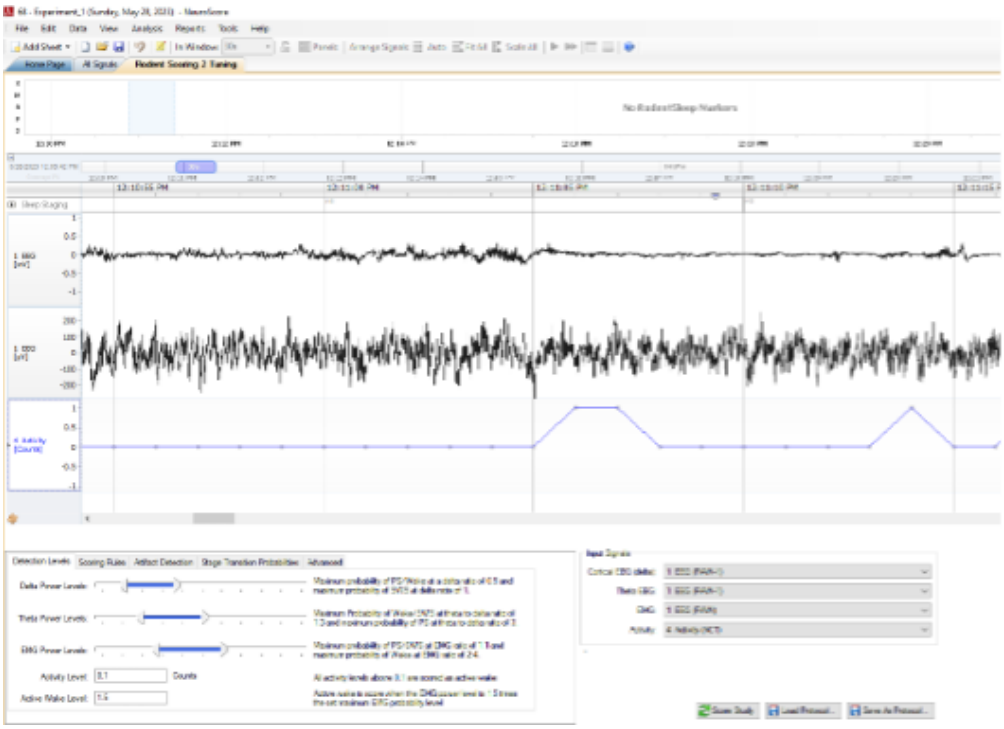
5 You can adjust the vertical scale for each signal using the right+click on the axis and scale to fit.



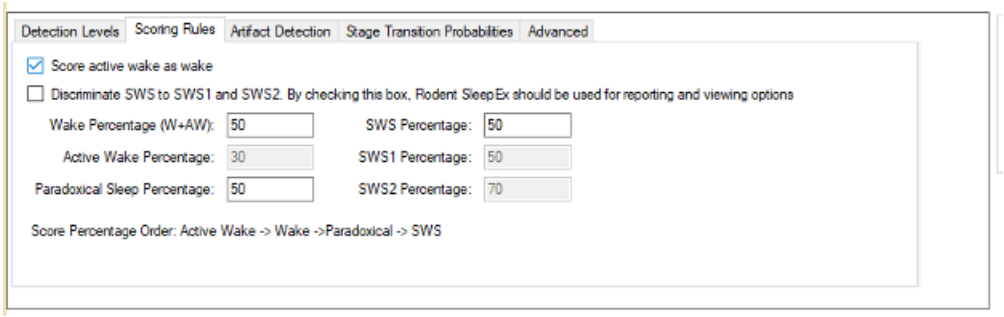
6 Once the signal is identified, you can proceed to sleep scoring. The built-in sleep scoring allows perfect scoring of frontal cortex EEG/EMG.



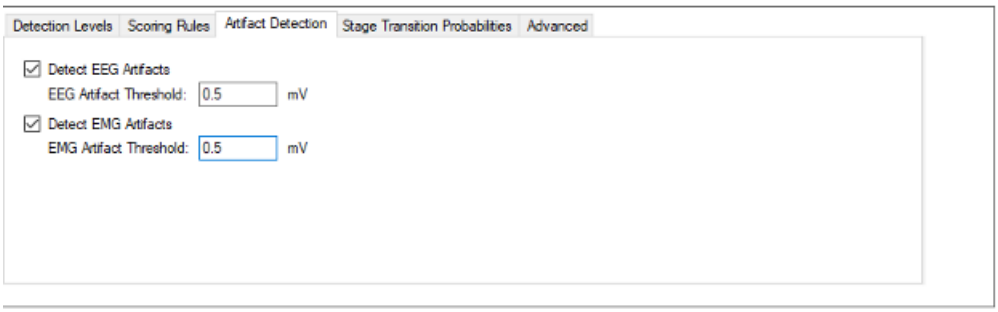
7 In inputs signal, select EEG channel for both Cortical EEG and theta EEG, EMG for EMG and activity for activity. Adjust the vertical scale to confirm the selection of correct signals.



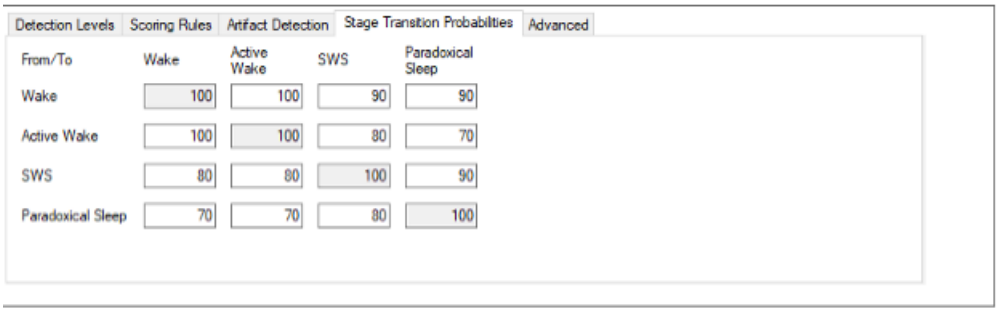
8 In scoring rules, select “score active wake as awake.”



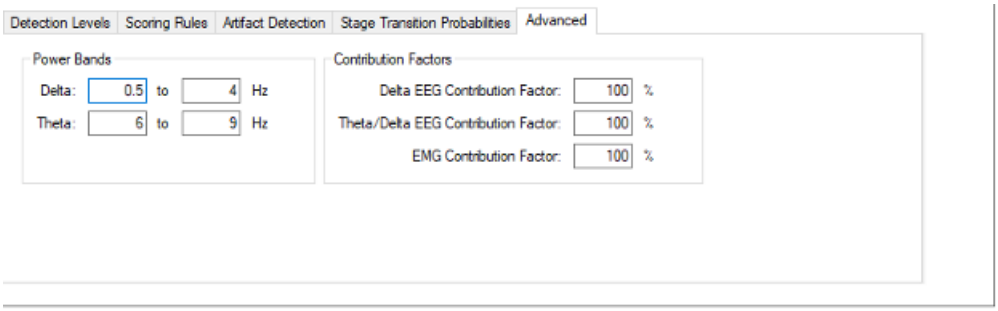
9 In artifact detection, select the threshold based on the signal of the recordings. Move the time windows to avoid cutting off signals.



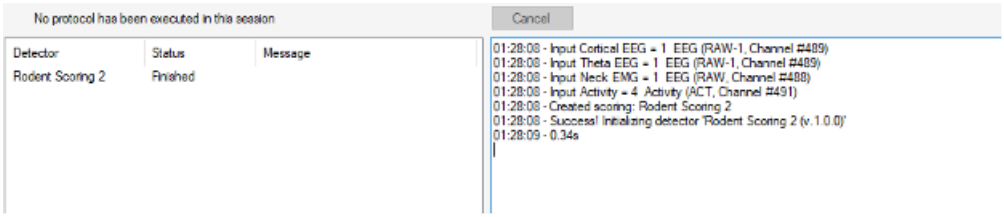
10 Select the stage transition as below:



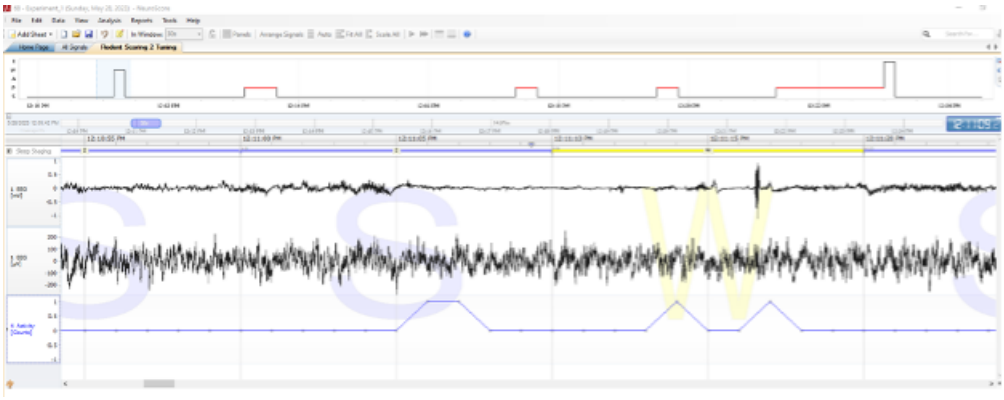
11 In advanced, select delta oscillation starting at 0.5Hz.



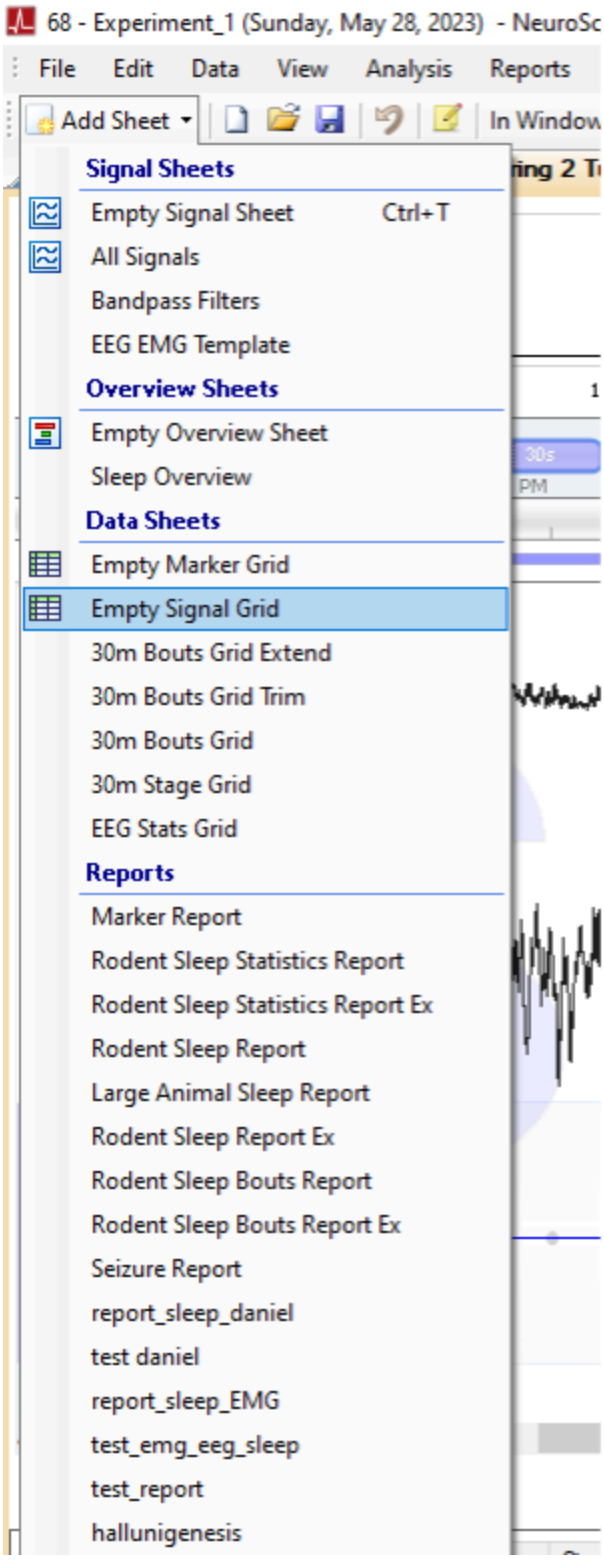
12 Press score study.



13 You should have sleep scoring for all your recordings on top of the signals.

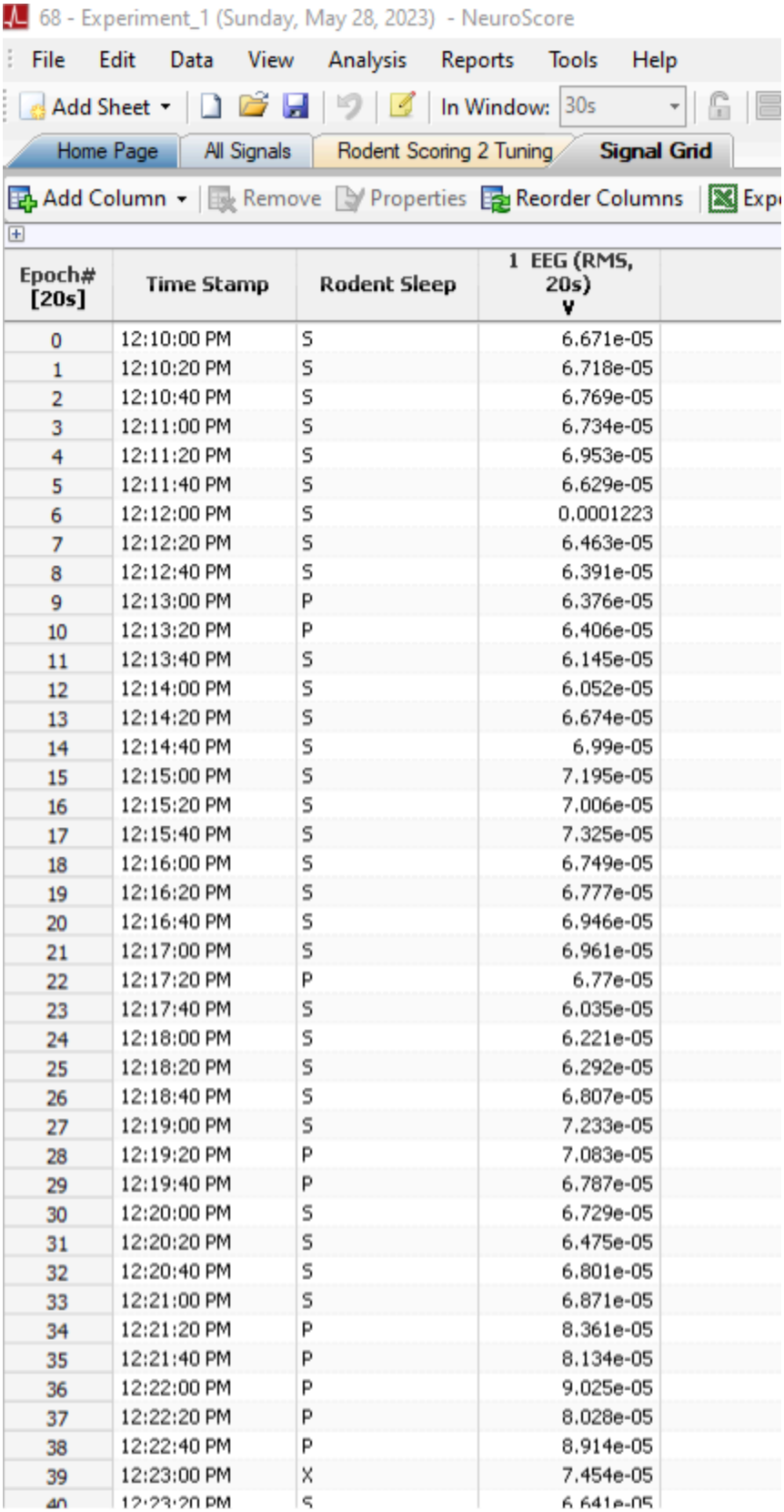


14 Extract the data.



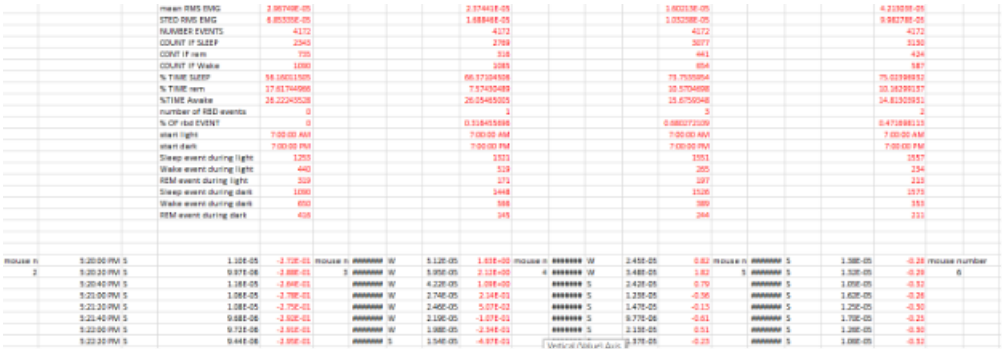
15 Select the data that need to be analyzed:

- time stamps normally 20s
-sleep scoring S is NREM, P is REM, W is awake and X is artifact
- select add column – select EMG channel – select statistical Root Mean Square



Epoch# [20s]	Time Stamp	Rodent Sleep	1 EEG (RMS, 20s) V
0	12:10:00 PM	S	6.671e-05
1	12:10:20 PM	S	6.718e-05
2	12:10:40 PM	S	6.769e-05
3	12:11:00 PM	S	6.734e-05
4	12:11:20 PM	S	6.953e-05
5	12:11:40 PM	S	6.629e-05
6	12:12:00 PM	S	0.0001223
7	12:12:20 PM	S	6.463e-05
8	12:12:40 PM	S	6.391e-05
9	12:13:00 PM	P	6.376e-05
10	12:13:20 PM	P	6.406e-05
11	12:13:40 PM	S	6.145e-05
12	12:14:00 PM	S	6.052e-05
13	12:14:20 PM	S	6.674e-05
14	12:14:40 PM	S	6.99e-05
15	12:15:00 PM	S	7.195e-05
16	12:15:20 PM	S	7.006e-05
17	12:15:40 PM	S	7.325e-05
18	12:16:00 PM	S	6.749e-05
19	12:16:20 PM	S	6.777e-05
20	12:16:40 PM	S	6.946e-05
21	12:17:00 PM	S	6.961e-05
22	12:17:20 PM	P	6.77e-05
23	12:17:40 PM	S	6.035e-05
24	12:18:00 PM	S	6.221e-05
25	12:18:20 PM	S	6.292e-05
26	12:18:40 PM	S	6.807e-05
27	12:19:00 PM	S	7.233e-05
28	12:19:20 PM	P	7.083e-05
29	12:19:40 PM	P	6.787e-05
30	12:20:00 PM	S	6.729e-05
31	12:20:20 PM	S	6.475e-05
32	12:20:40 PM	S	6.801e-05
33	12:21:00 PM	S	6.871e-05
34	12:21:20 PM	P	8.361e-05
35	12:21:40 PM	P	8.134e-05
36	12:22:00 PM	P	9.025e-05
37	12:22:20 PM	P	8.028e-05
38	12:22:40 PM	P	8.914e-05
39	12:23:00 PM	X	7.454e-05
40	12:23:20 PM	S	6.641e-05

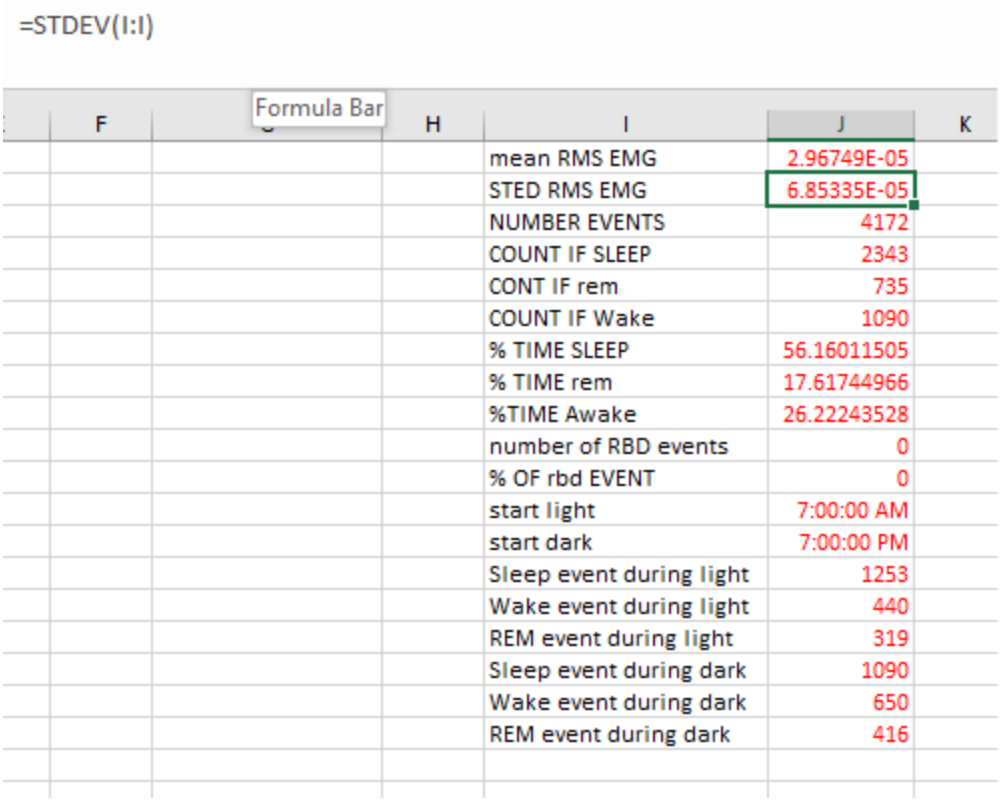
16 Copy this to excel:
a) Using the time you can extract the total number of sleep events, number of Awake, REM and NREM and thus express it onto %



b) You can extract the % of time in dark/light phase based on the timestamps
c) You can average/stdev EMG signal and thus express is as a z score

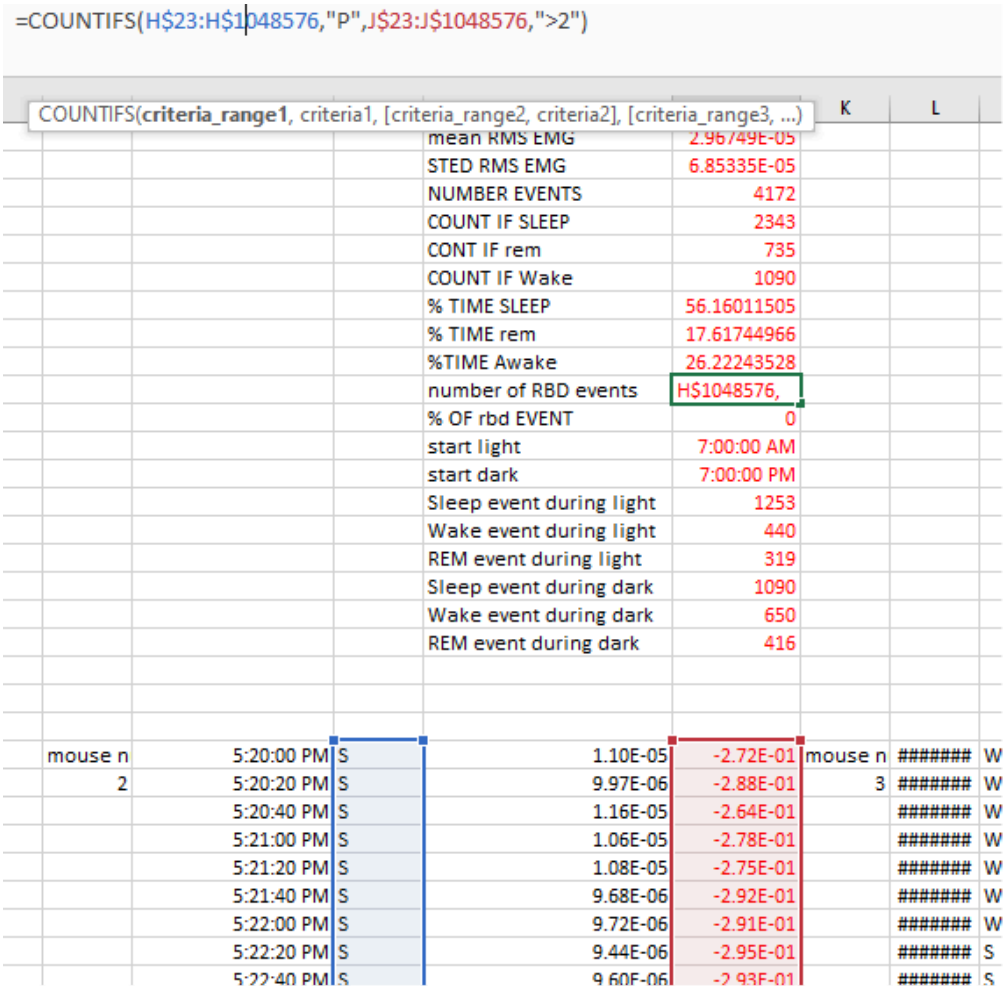
=AVERAGE(I:I)

F	G	H	I	J
			mean RMS EMG	2.96749E-05
			STED RMS EMG	6.85335E-05
			NUMBER EVENTS	4172
			COUNT IF SLEEP	2343
			CONT IF rem	735
			COUNT IF Wake	1090
			% TIME SLEEP	56.16011505
			% TIME rem	17.61744966
			%TIME Awake	26.22243528
			number of RBD events	0
			% OF rbd EVENT	0
			start light	7:00:00 AM
			start dark	7:00:00 PM
			Sleep event during light	1253
			Wake event during light	440
			REM event during light	319
			Sleep event during dark	1090
			Wake event during dark	650
			REM event during dark	416



	F		H	I	J	K
				mean RMS EMG	2.96749E-05	
				STED RMS EMG	6.85335E-05	
				NUMBER EVENTS	4172	
				COUNT IF SLEEP	2343	
				CONT IF rem	735	
				COUNT IF Wake	1090	
				% TIME SLEEP	56.16011505	
				% TIME rem	17.61744966	
				%TIME Awake	26.22243528	
				number of RBD events	0	
				% OF rbd EVENT	0	
				start light	7:00:00 AM	
				start dark	7:00:00 PM	
				Sleep event during light	1253	
				Wake event during light	440	
				REM event during light	319	
				Sleep event during dark	1090	
				Wake event during dark	650	
				REM event during dark	416	

Using the z-score of the EMG, you can detect significant increase (SD >2SD) during REM events. This will be the rem sleep behavior disorders events.


=COUNTIFS(H$23:H$1048576,"P",J$23:J$1048576,">2")
COUNTIFS(criteria_range1, criteria1, [criteria_range2, criteria2], [criteria_range3, ...])
mean RMS EMG 2.96749E-05
STED RMS EMG 6.85335E-05
NUMBER EVENTS 4172
COUNT IF SLEEP 2343
CONT IF rem 735
COUNT IF Wake 1090
% TIME SLEEP 56.16011505
% TIME rem 17.61744966
%TIME Awake 26.22243528
number of RBD events H$1048576,
% OF rbd EVENT 0
start light 7:00:00 AM
start dark 7:00:00 PM
Sleep event during light 1253
Wake event during light 440
REM event during light 319
Sleep event during dark 1090
Wake event during dark 650
REM event during dark 416
mouse n 5:20:00 PM S 1.10E-05 -2.72E-01 mouse n ####### W
2 5:20:20 PM S 9.97E-06 -2.88E-01 3 ####### W
5:20:40 PM S 1.16E-05 -2.64E-01 ####### W
5:21:00 PM S 1.06E-05 -2.78E-01 ####### W
5:21:20 PM S 1.08E-05 -2.75E-01 ####### W
5:21:40 PM S 9.68E-06 -2.92E-01 ####### W
5:22:00 PM S 9.72E-06 -2.91E-01 ####### W
5:22:20 PM S 9.44E-06 -2.95E-01 ####### S

=(J10*100)/J5

F	G	H	I	J	K	L
			mean RMS EMG	2.96749E-05		
			STED RMS EMG	6.85335E-05		
			NUMBER EVENTS	4172		
			COUNT IF SLEEP	2343		
			CONT IF rem	735		
			COUNT IF Wake	1090		
			% TIME SLEEP	56.16011505		
			% TIME rem	17.61744966		
			%TIME Awake	26.22243528		
			number of RBD events	0		
			% OF rbd EVENT	0		
			start light	7:00:00 AM		
			start dark	7:00:00 PM		
			Sleep event during light	1253		
			Wake event during light	440		
			REM event during light	319		
			Sleep event during dark	1090		
			Wake event during dark	650		
			REM event during dark	416		