EEG Course 2020

Benign Variants and EEG artifact

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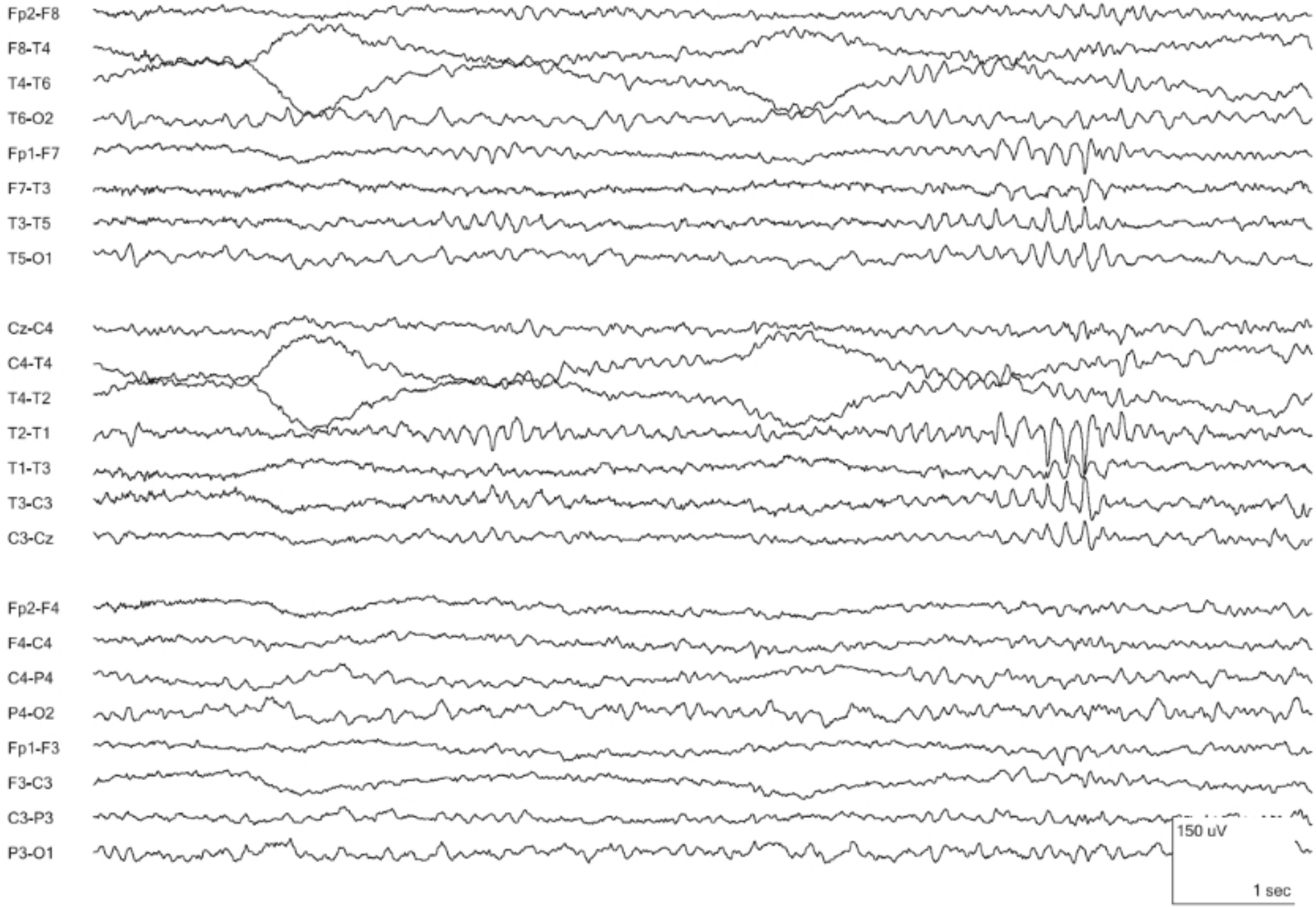
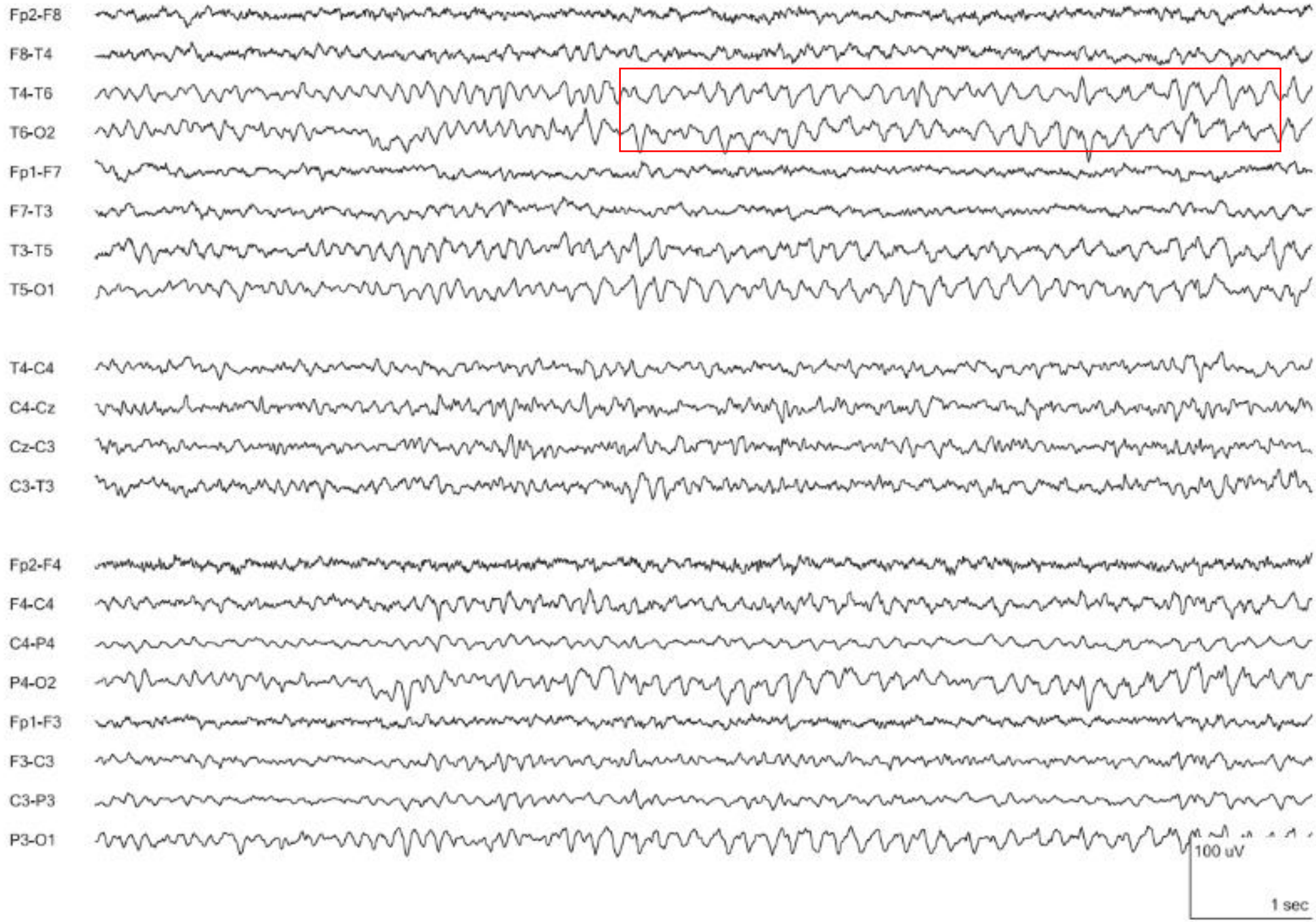

Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F7
F7-T3
T3-T5
T5-O1
Cz-C4
C4-T4
T4-T2
T2-T1
T1-T3
T3-C3
C3-Cz
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
150 uV
1 sec

Wicket Rhythm/Waves/Spikes

- Wicket waves are not followed by slow waves, and do not disrupt the background EEG rhythms.
- Wicket Rhythm: Alpha
- **Location:** Temporal regions. May be unilateral or occur independently on both sides
- **State:** Relaxed wakefulness and drowsiness.
- **Prevalence:** > age 30, 0.9% in this population.
- Commonly **misidentified** and leads to diagnosis of epilepsy (Krauss 2005, Benbadis 2008)
- **Physiological Origin**: MEG analysis -> Localizing to supratemporal auditory cortex, auditory stimulation can decrease the rhythm (Tihonen 1991)


Fp2-F8
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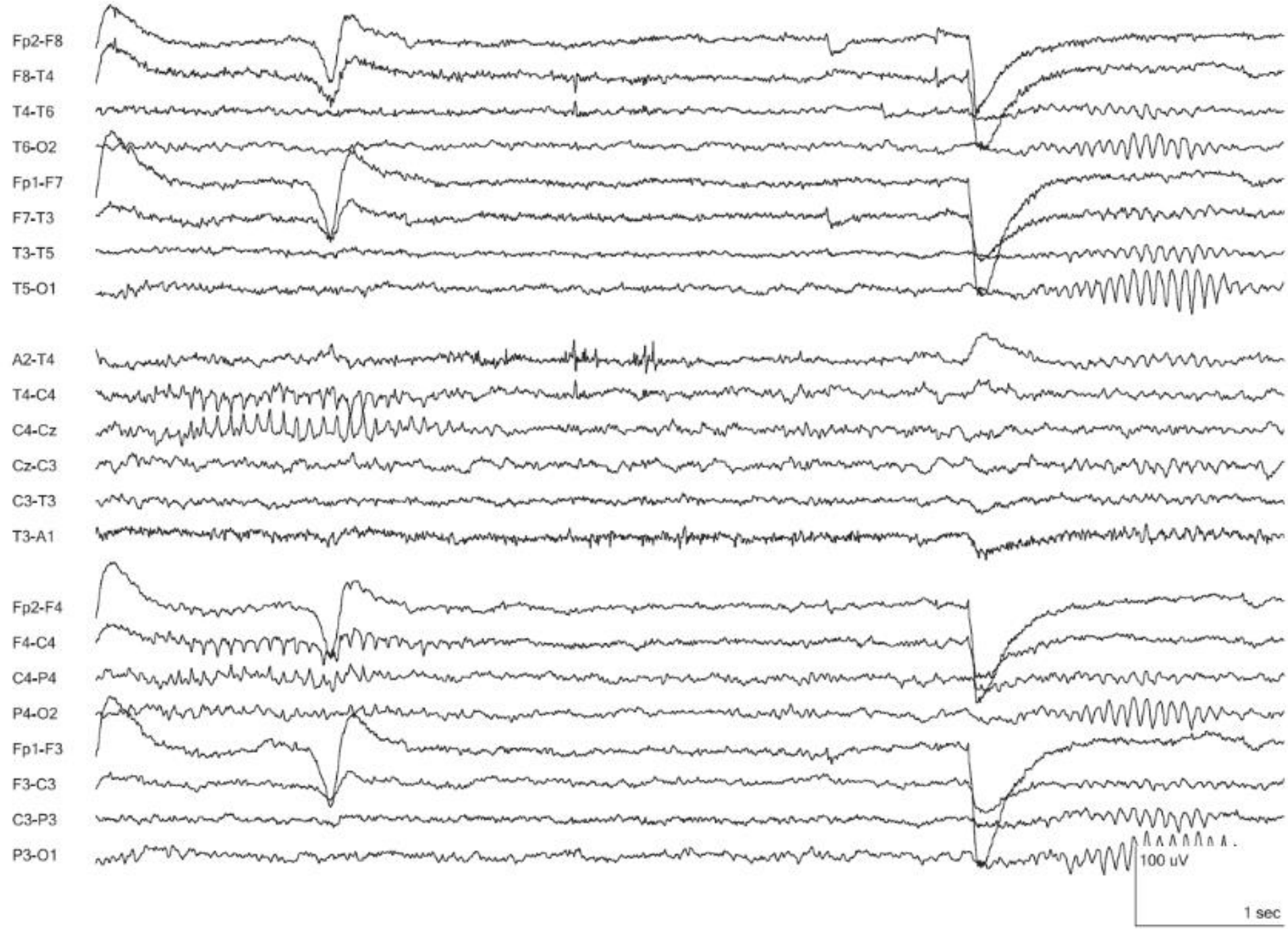
F7-T3
T3-T5
T5-O1
T4-C4
C4-Cz
Cz-C3
C3-T3
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
100 uV
1 sec

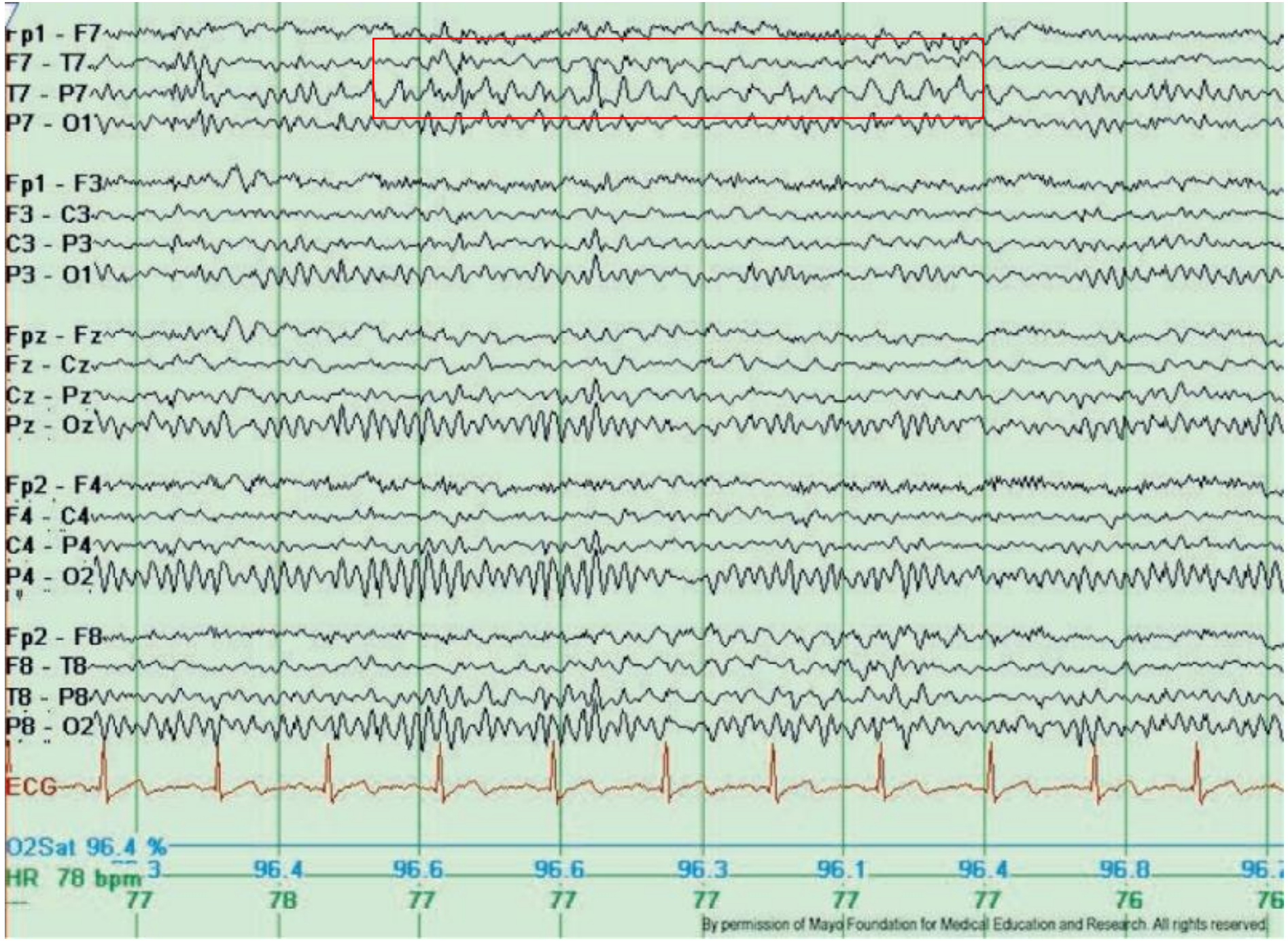
Slow Alpha Variant

- Alpha rhythm was the first recognized EEG pattern in EEG. (Berger 1929)
- The slow variant is subharmonic of alpha rhythm which is likely due to fusion of adjacent waves (Blume 2002)
- It is usually 4-5 Hz
- Seen in around 1% of normal EEG.
- Fast alpha variant: 16-20 Hz


Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F7
F7-T3
T3-T5
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
100 uV
1 sec

Mu

- Somatosensory Alpha rhythm
- **Greek letter "μ":** Rounded phase is positive and sharply contoured phase is negative (Blume 2002)
- **Location:** C3/C4, Usually occurs unilaterally with shifting asymmetry.
- May appear unilateral in setting of breach
- **Physiological origin**: Fusion of 10 Hz signal from SS cortex and 20 Hz signal from Premotor cortex (Hari 1997)


Fp1 - F7
F7 - T7
T7 - P7
P7 - O1
Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Fpz - Fz
Fz - Cz
Cz - Pz
Pz - Oz
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fp2 - F8
F8 - T8
T8 - P8
P8 - O2
ECG
O2Sat 96.4 %
HR 78 bpm
96.4
96.6
96.6
96.3
96.1
96.4
96.8
77
78
77
77
77
77
76
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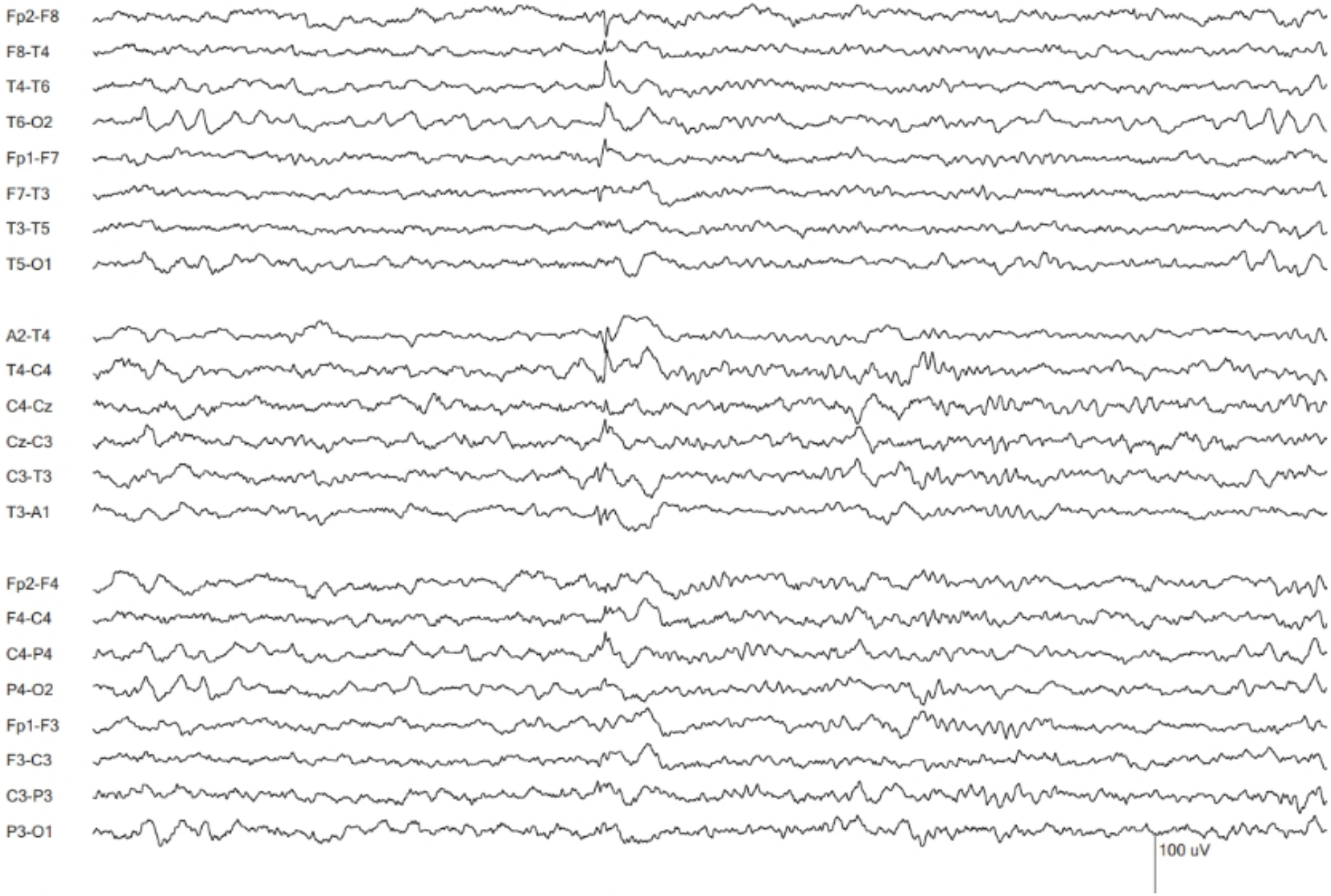
RMTD

- RMTD was originally called “psychomotor variant” because it resembles the rhythmic temporal theta activity seen in a temporal lobe “psychomotor” seizure.
- Does not evolve.
- **Appearance:** Typically 5-7 Hz, lasting for 5-10 sec
- **Location:** Maximal temporally, usually mid-temporal. May be unilateral or occur independently on both sides.
- **State:** Most common during relaxed wakefulness and drowsiness.
- **Prevalence:** Most common in adolescents and adults, has been reported to occur in about 2% of normal adults.


Fp2-F8
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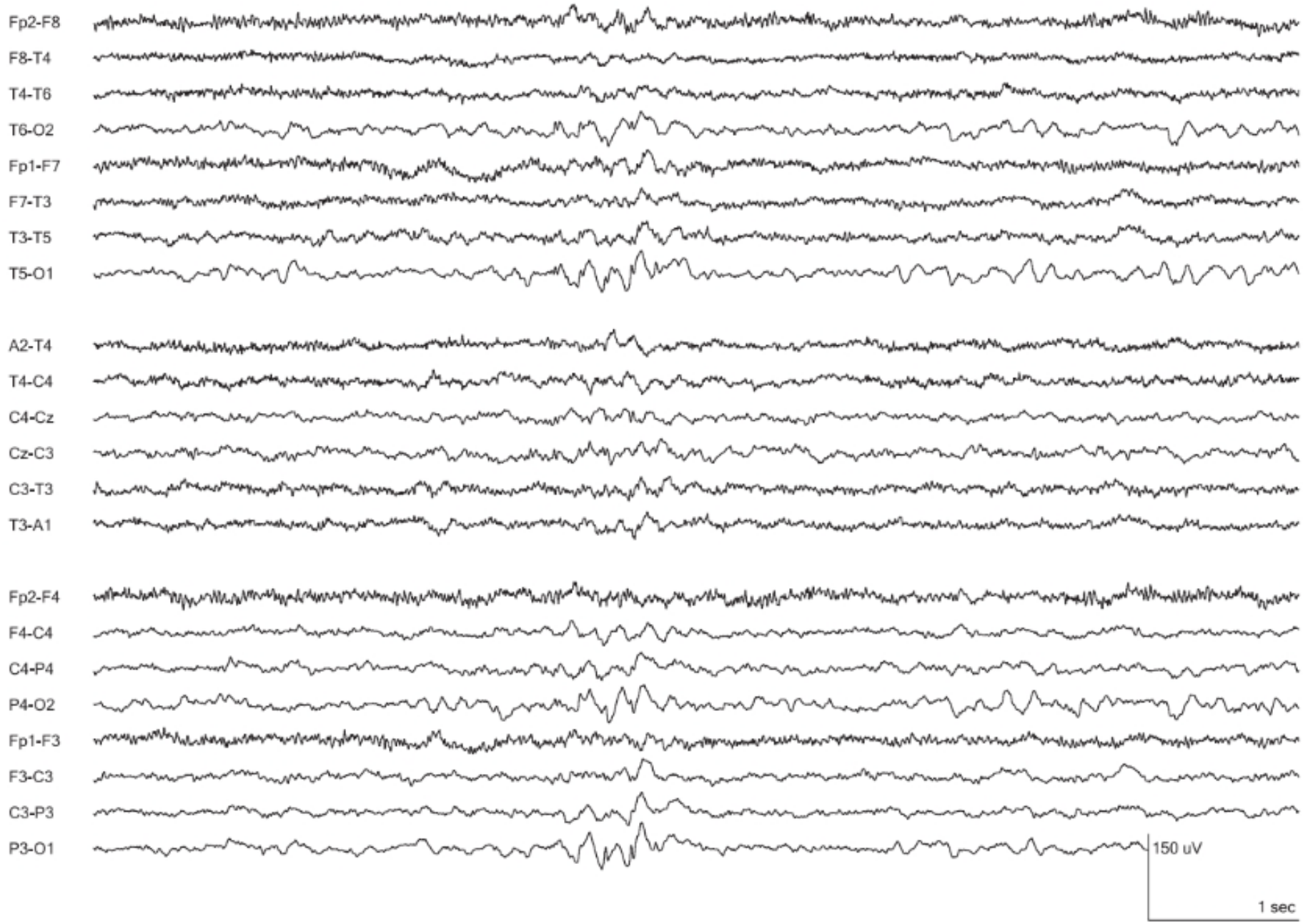
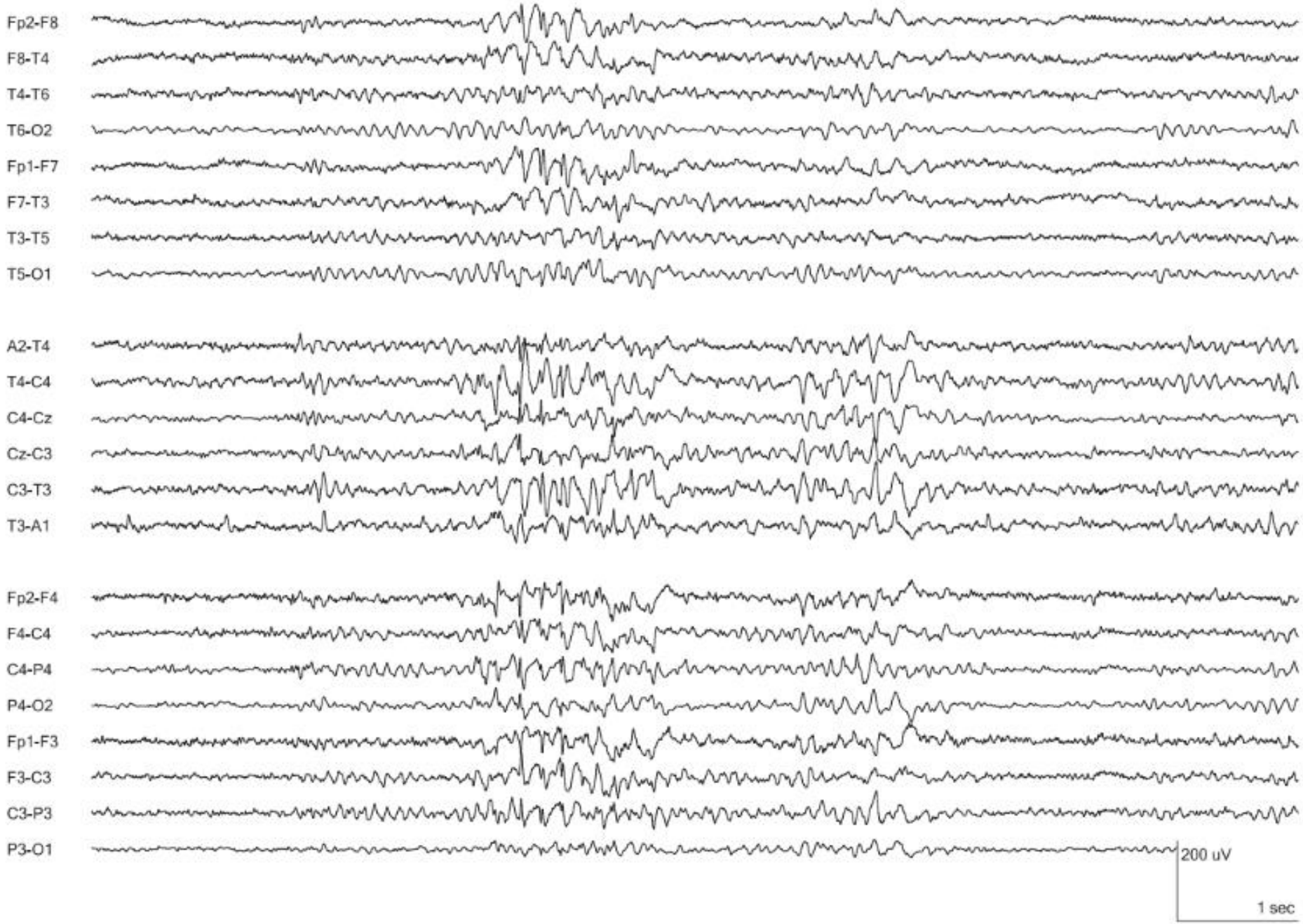
T4-T6
T6-O2
Fp1-F7
F7-T3
T3-T5
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
100 uV

BETS (Benign Epileptiform Transients of Sleep)

- Small sharp spikes (< 50 uV, < 50 msec)
- **Appearance**: Spikes, often with **small** after-going slow waves. May have broad field
- They do not occur in trains
- **Location*:*** Temporal, unilateral or simultaneously
- **State*:*** Most common during drowsiness and NREM Stage 1,2. Not in 3.
- **Prevalence*:*** In 20 – 25% of normal adults
- **Physiological origin:** Electromagnetic studies found two sources separated by 30 msec

  1. Post insular
  2. Mesial temporal (Zumsteg 2006)


Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F7
F7-T3
T3-T5
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
150 uV
1 sec


Fp2-F8
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F7-T3
T3-T5
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
200 uV
1 sec

Phantom Spike/Wave

- 6 Hz spike and wave bursts.
- **Appearance:** The spikes are small and and difficult to see, and may not be visible in association with some of the slow waves in the burst, hence the name “phantom” spike-and-wave.
- **Location:** Variable, may be widespread or more focal. May be larger over the front of the head or over the back.
- **State:** Relaxed wakefulness and drowsiness, and go away in deep sleep.
- **Prevalence:** 2.5% of normal adults

- The significance of phantom spike-and-wave is unclear.

- Subdivided into two categories, with mnemonics WHAM and FOLD.

- **WHAM** (in Wakefulness, High-voltage, Anterior maximum, in Males) – Commonly has co-occurring epileptiform abnormality.
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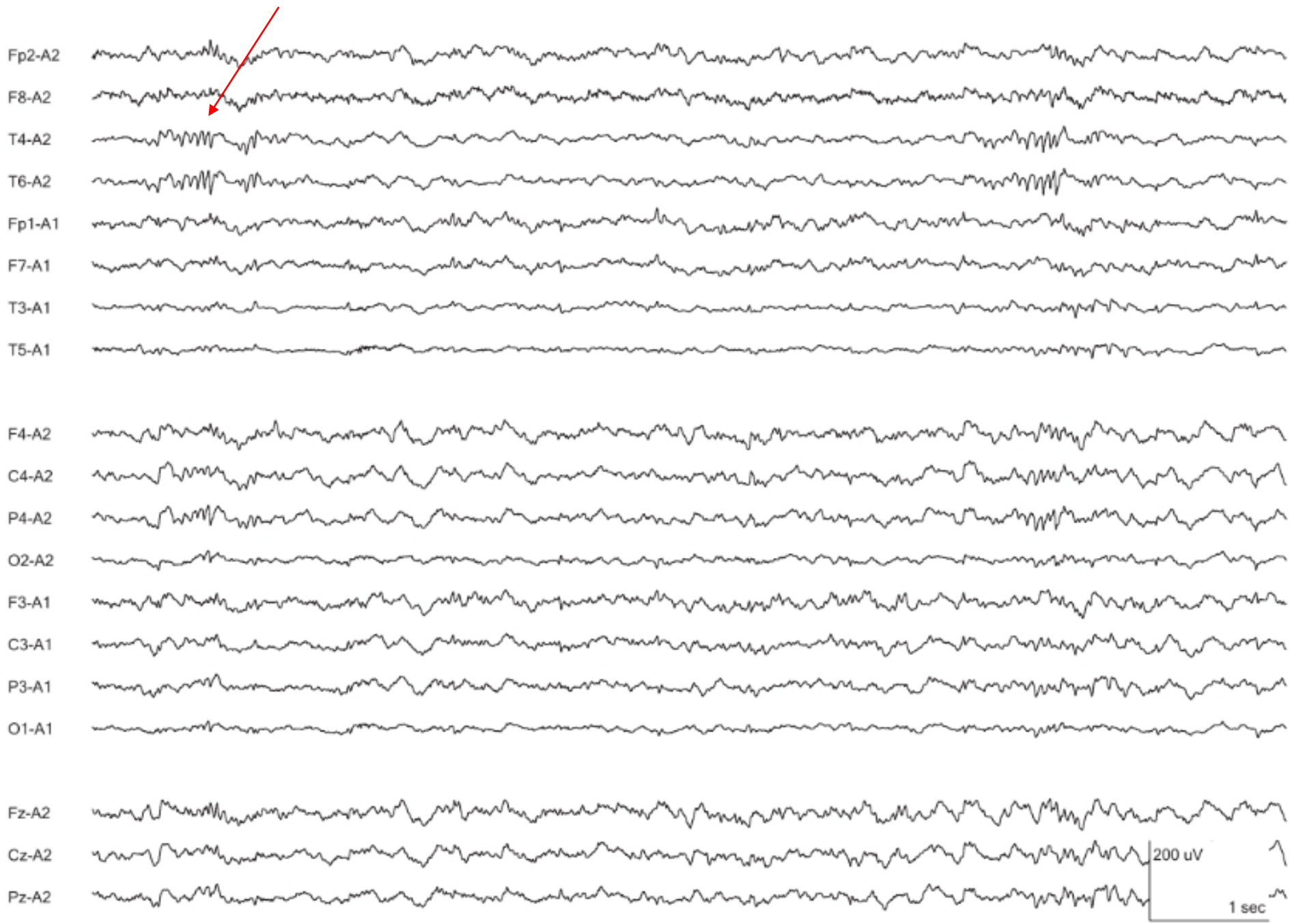
- **FOLD** (Female, Occipital maximum, Low-voltage, in Drowsiness) – appears to be a more benign pattern.


Fp2-A2
F8-A2
T4-A2
T6-A2
Fp1-A1
F7-A1
T3-A1
T5-A1
F4-A2
C4-A2
P4-A2
O2-A2
F3-A1
C3-A1
P3-A1
O1-A1
Fz-A2
Cz-A2
Pz-A2
200 uV
1 sec

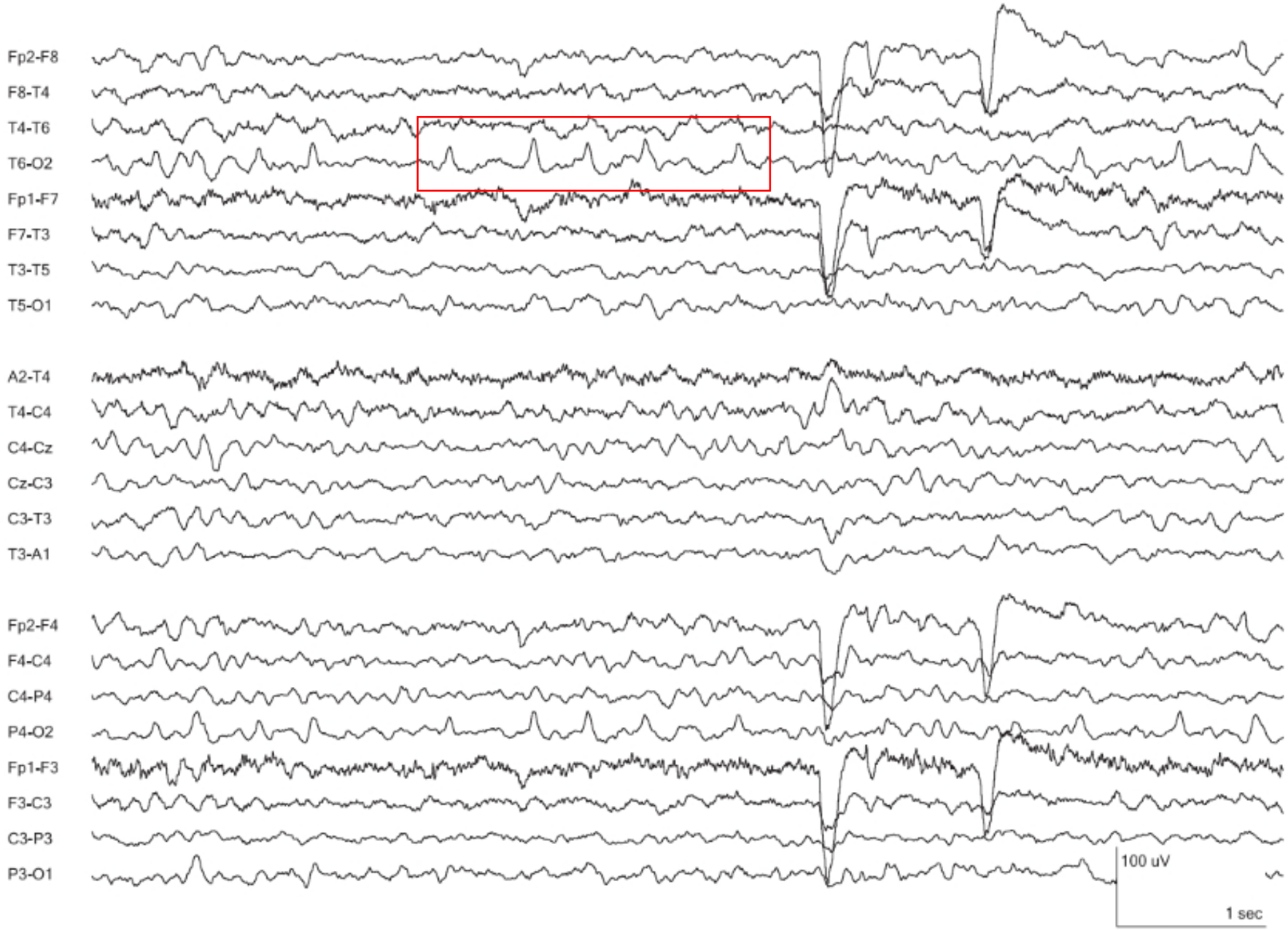
14 and 6 Hz Positive Spike bursts

- **Appearance**: Trains of arch-shaped waveforms with positive-polarity spikes and smoothly-curved negative phases (inverse of “μ”). Amp: 75 uV, Duration: 0.5-1 sec.

- **Location:** Post temporal. Uni or bilat.

- **State:** Drowsiness and light sleep. Absent in awake state and S -3 sleep. (Olofsson 1971)

- **Prevalence:** Common 8-14 years (Niedermeyer 1999)


Fp2-F8
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T3-T5
T5-O1
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C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
100 uV
1 sec

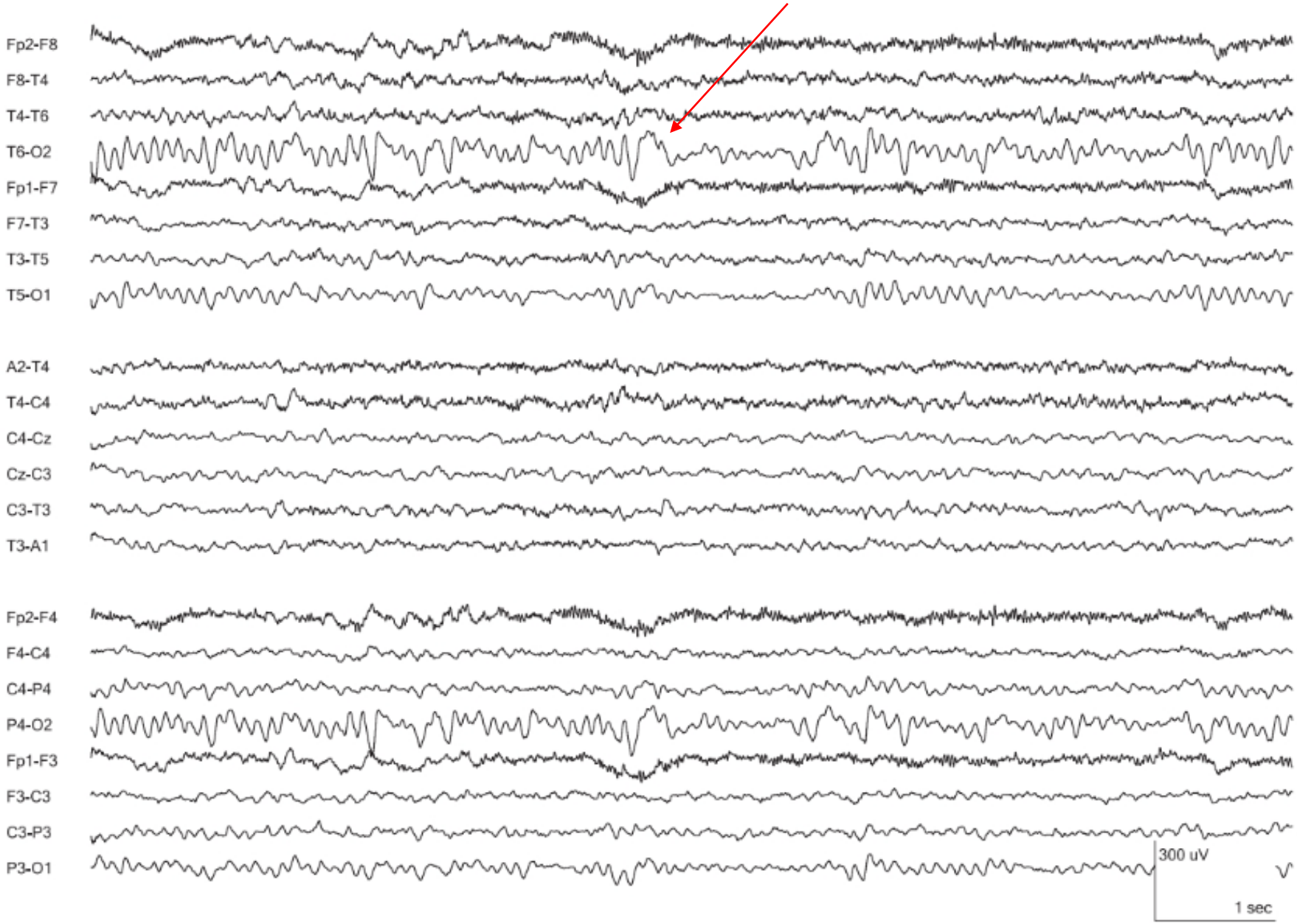
Lambda Waves

- Positive occipital sharp waves in wakefulness with visual exploration.

- Clinical significance:

  No increase in likelihood of Focal epileptiform discharges.

  More likely to see POST and Photic driving


Fp2-F8
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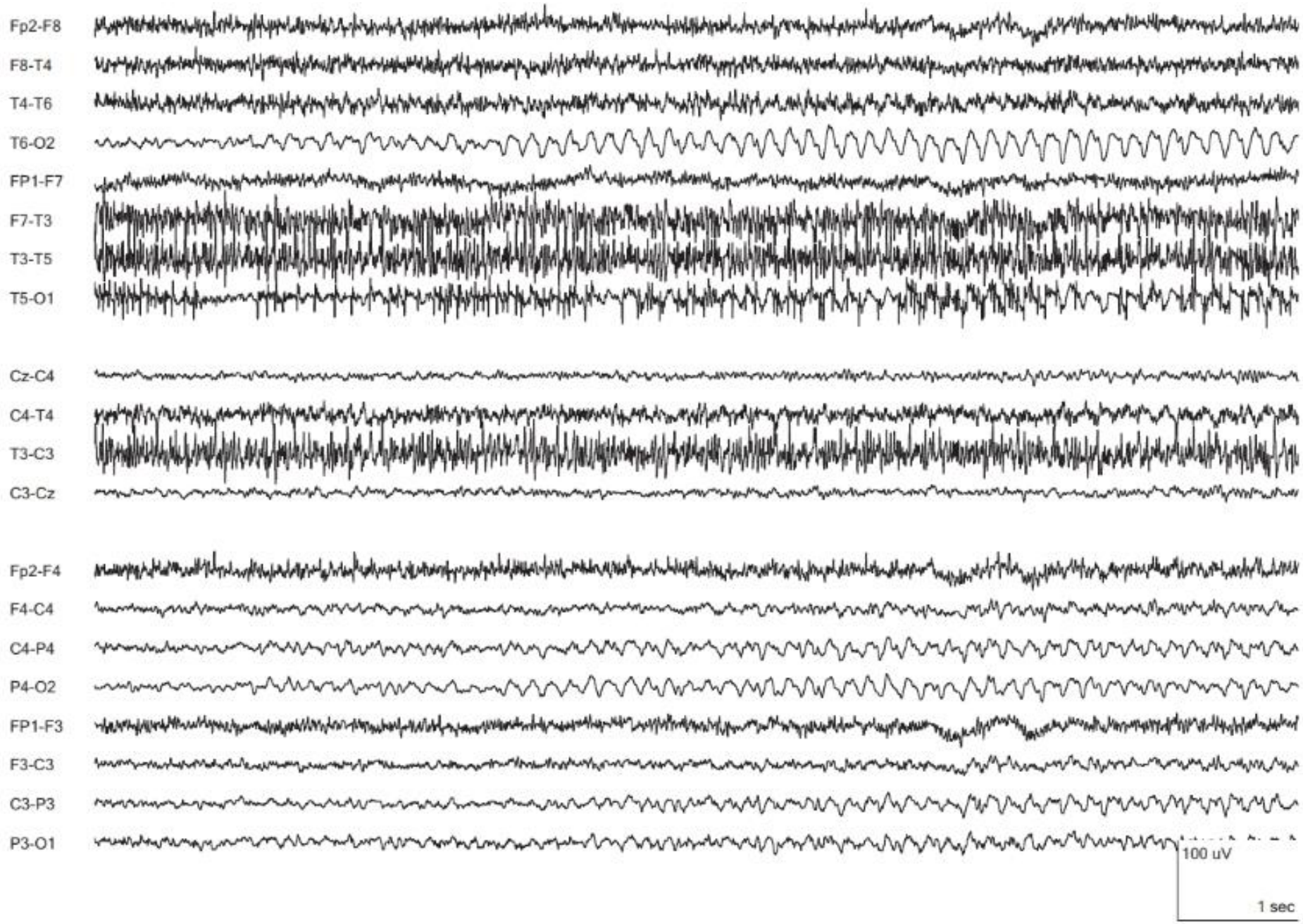
T5-O1
A2-T4
T4-C4
C4-Cz
Cz-C3
C3-T3
T3-A1
Fp2-F4
F4-C4
C4-P4
P4-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
300 uV
1 sec

Posterior Slow waves of Youth

- Slow waves of inconsistent polarity lasting for 0.3-05 seconds occurring during PDR

- Common from 2-6 years and 12-21 years

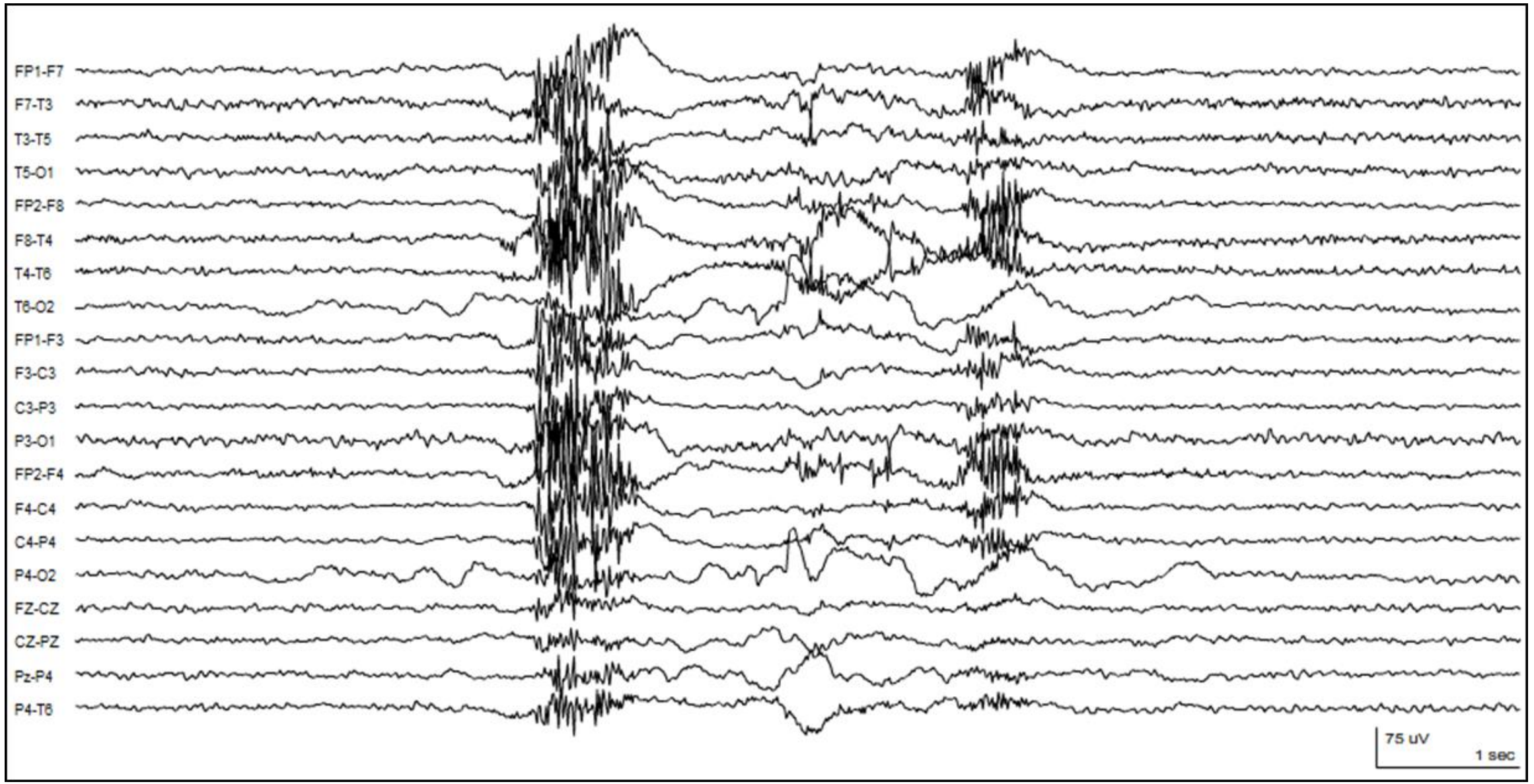

Fp2-F8
F8-T4
T4-T6
T6-O2
FP1-F7
F7-T3
T3-T5
T5-O1
Cz-C4
C4-T4
T3-C3
C3-Cz
Fp2-F4
F4-C4
C4-P4
P4-O2
FP1-F3
F3-C3
C3-P3
P3-O1
100 uV
1 sec

SREDA

- Subclinical rhythmic electrographic discharge in adults
- > 50 years
- Rhythmic activity at post temp/parietal region
- Evolves delta to theta range (note: no spikes) lasting for 20-80 seconds typically, but may in some cases last for as long as several minutes. (Westmoreland and Klass 1997)
- It may have an abrupt or a stuttering onset. No clinical change.
- State: Most common during relaxed wakefulness and drowsiness. It may also be seen during hyperventilation.
- Incidence: 0.05% (S Kumar 2009).

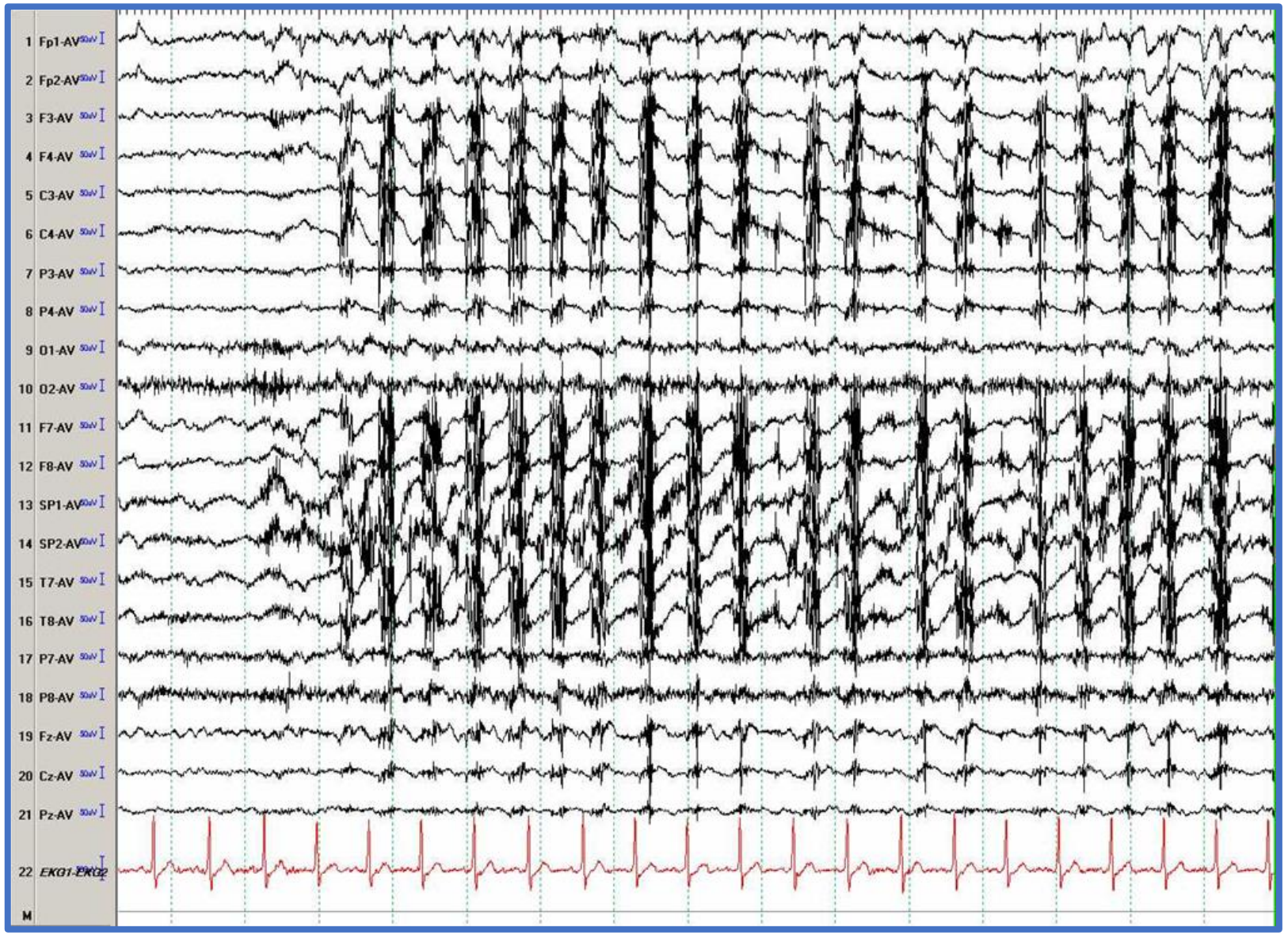
EEG Artifacts

Muscle Artifact

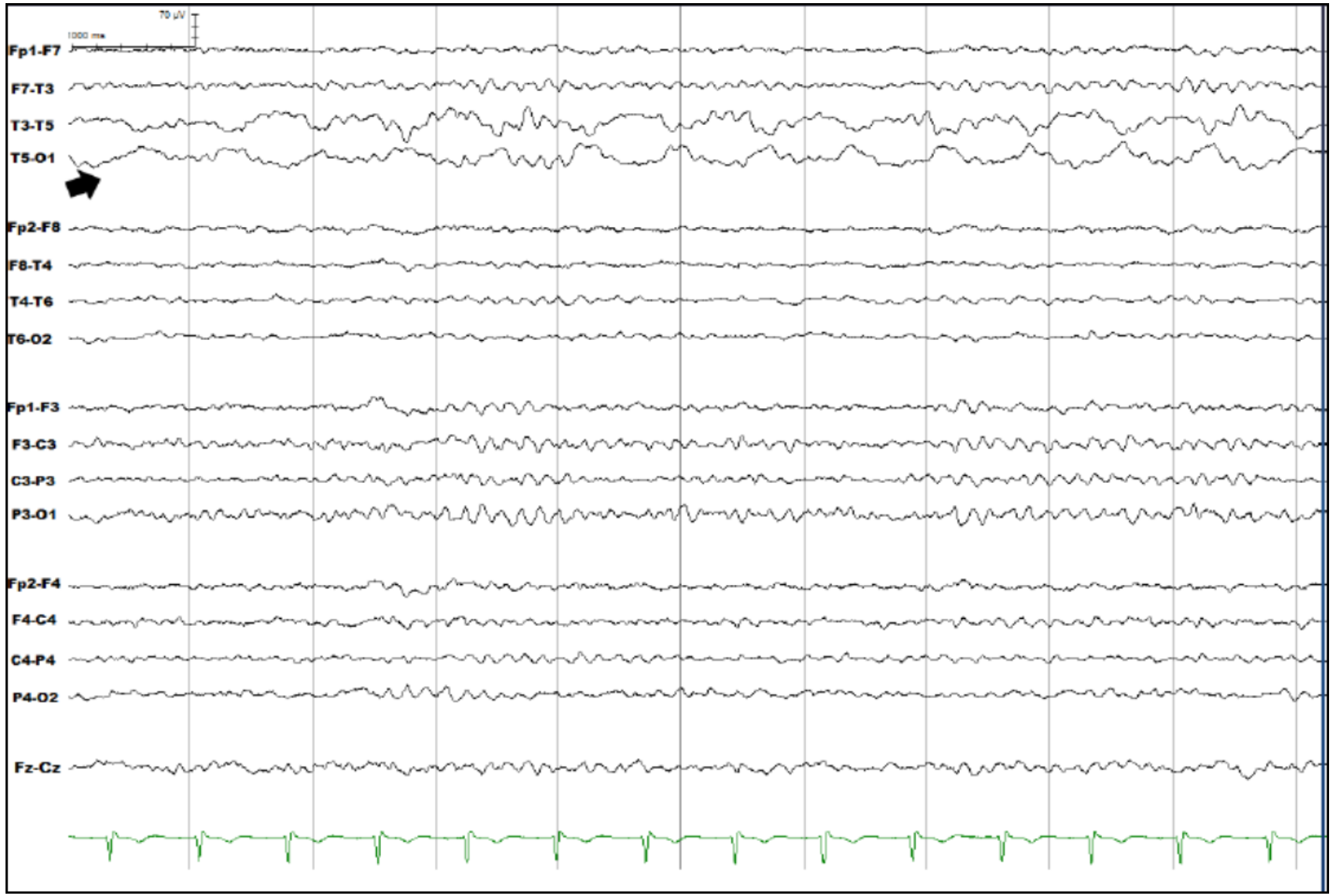


EKG Artifacts

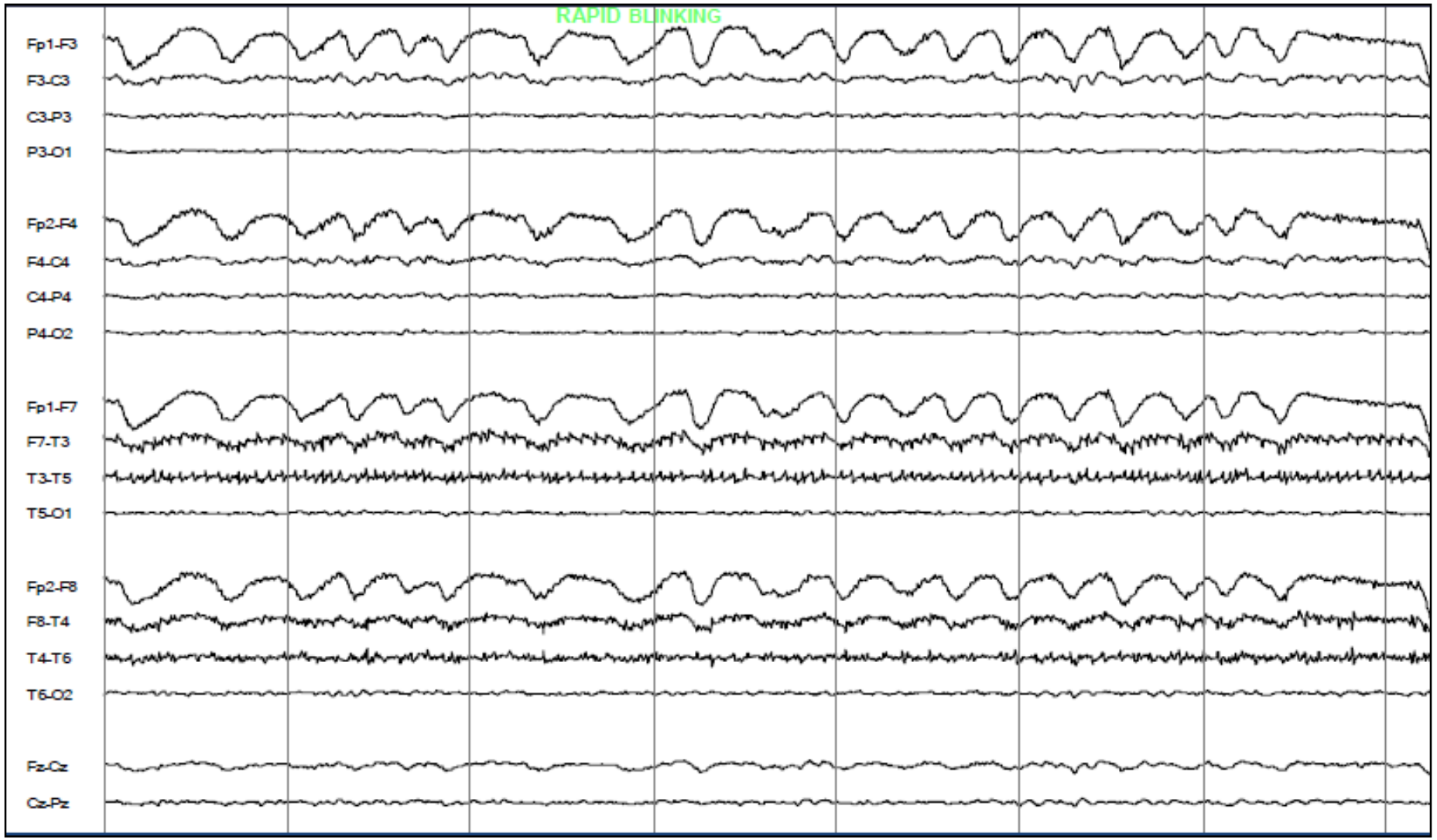
Muscle Artifact-Chewing



Movement Artifact-Pulse

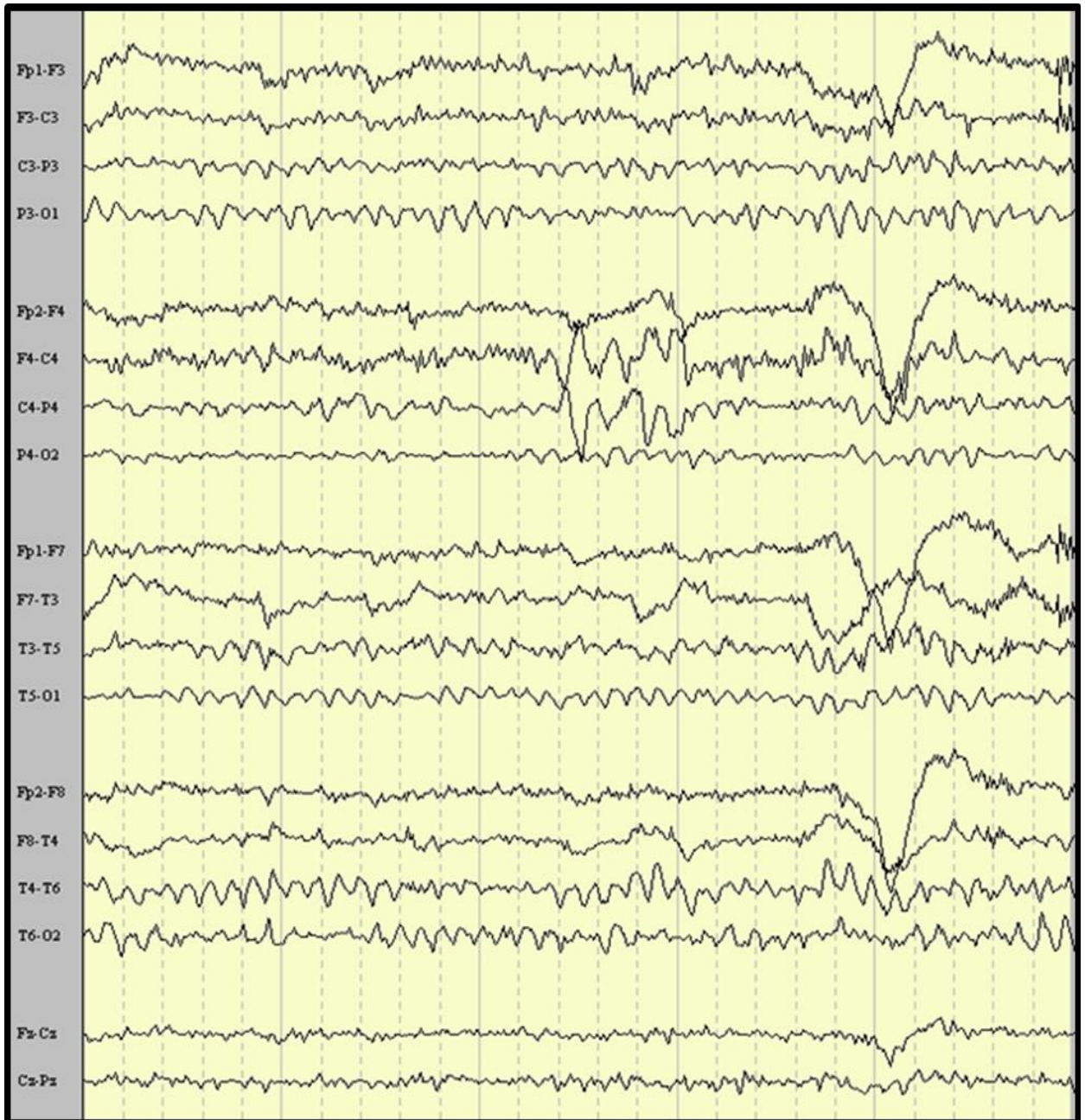


Rapid Eye Blinking



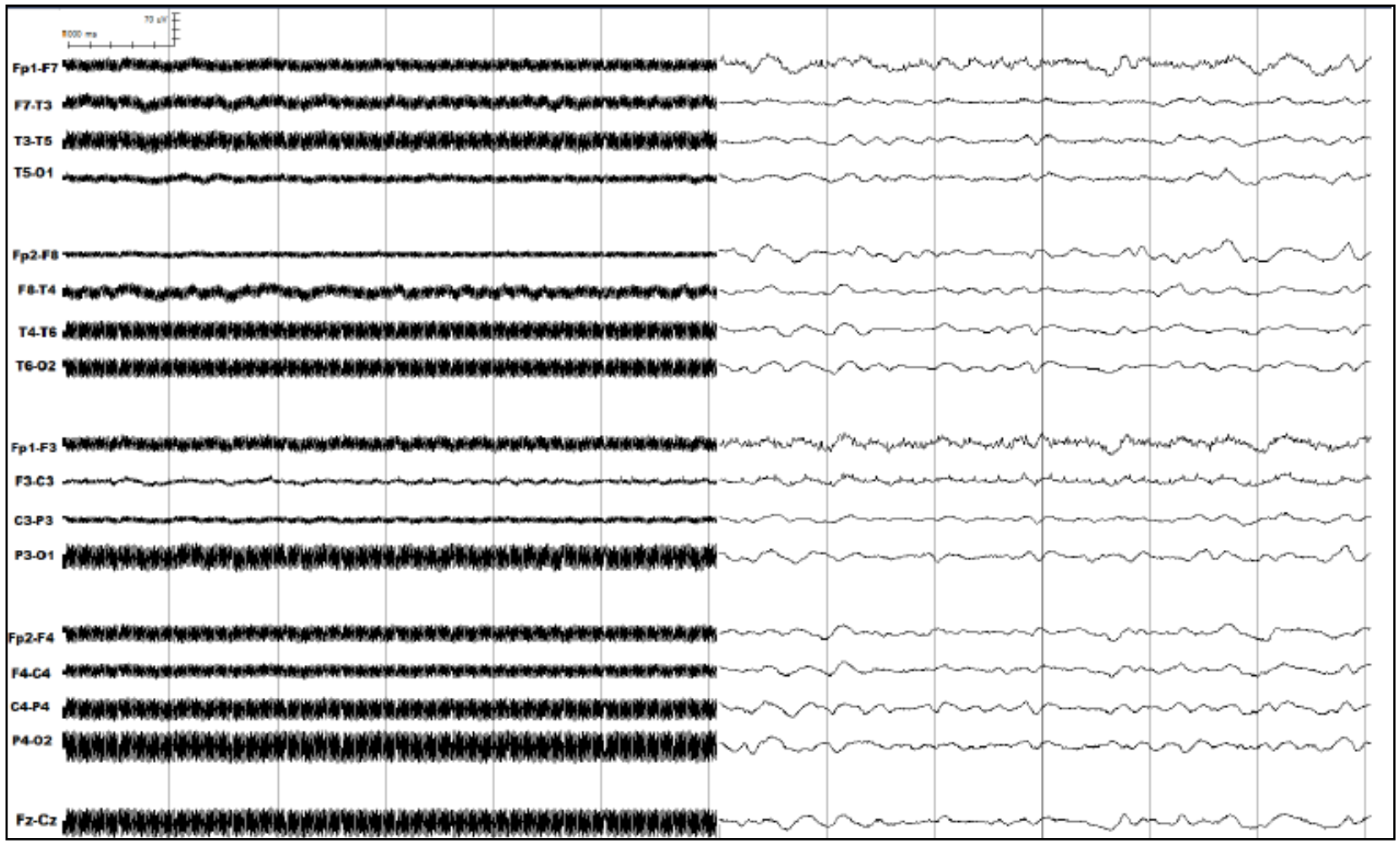
Electrode Artifact

- More problems with electrode artifact in the ICU
  - Prolonged monitoring
  - Scalp integrity
  - Vigilance required to keep electrodes from “going bad”
    - Many pts require repair 2-3 x / day

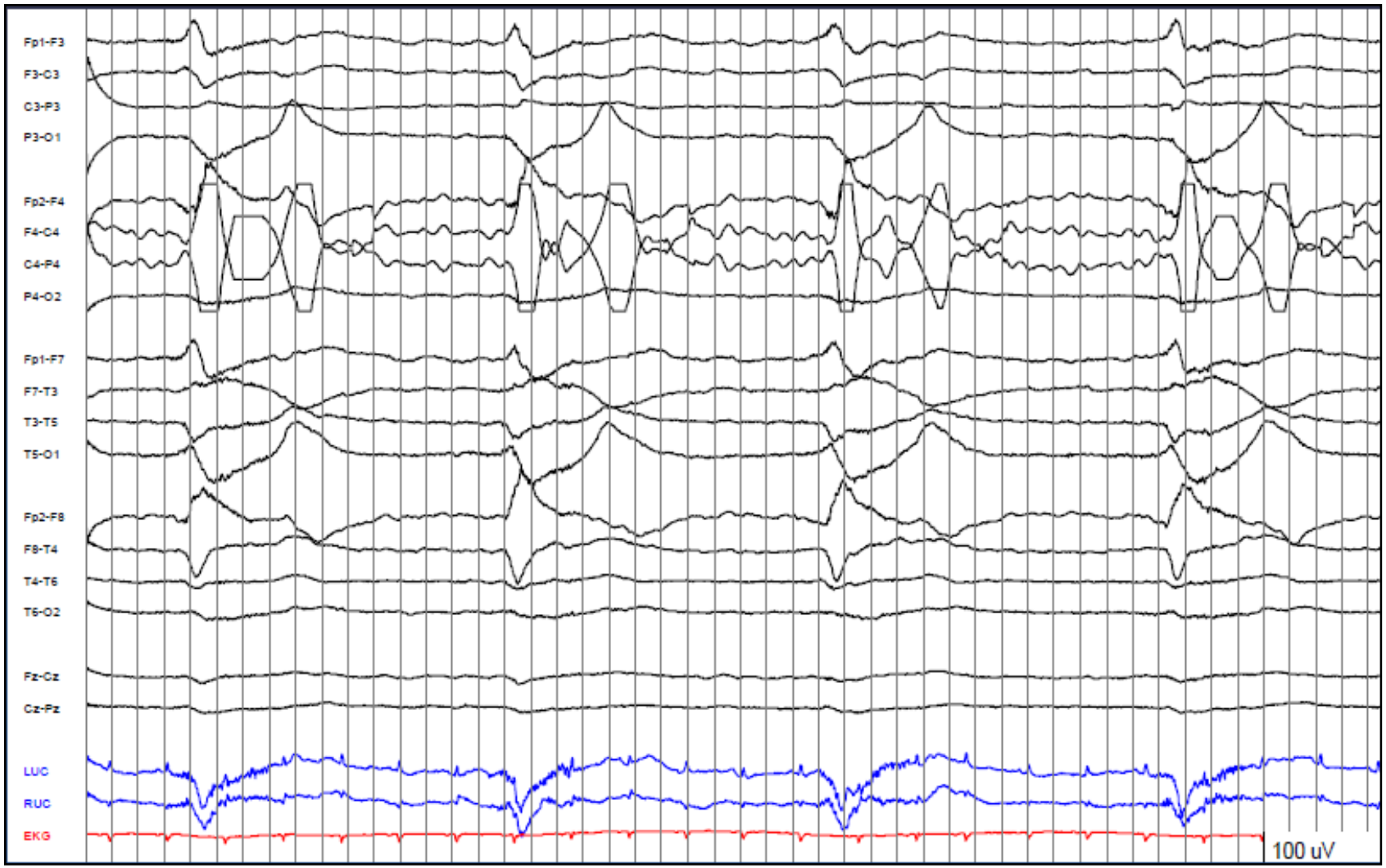


60Hz Artifact

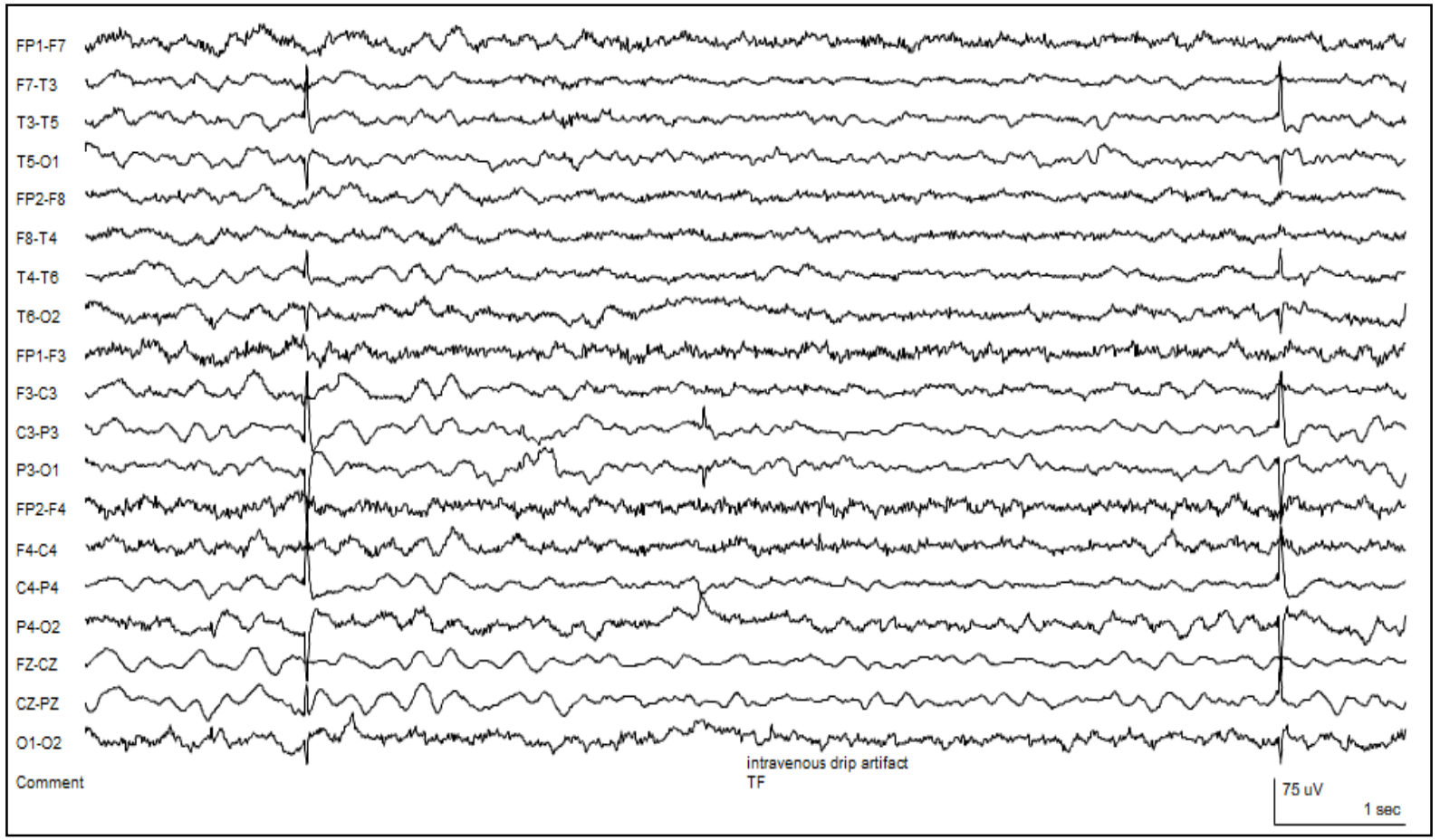
Application of Notch Filter



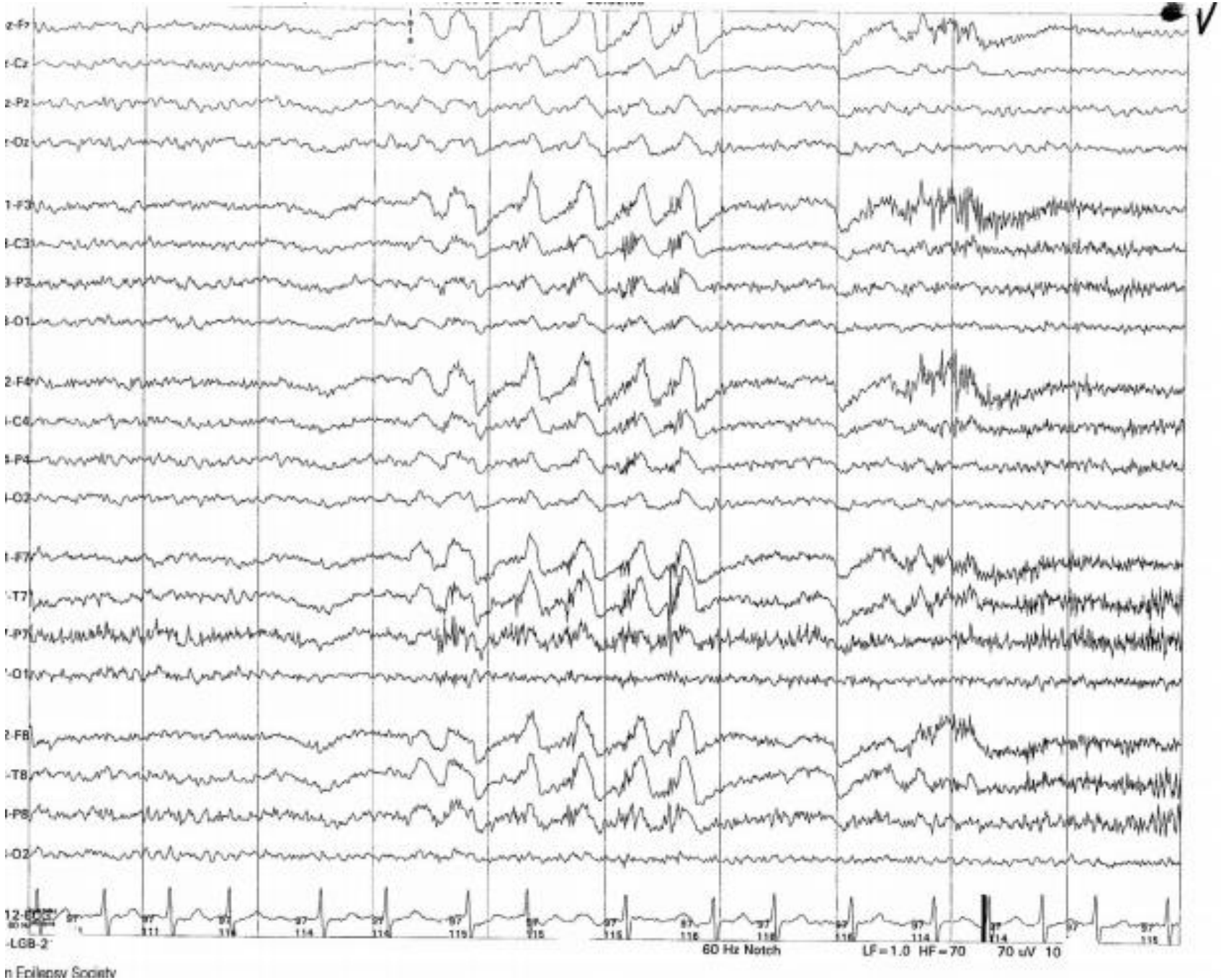
Ventilator Artifact

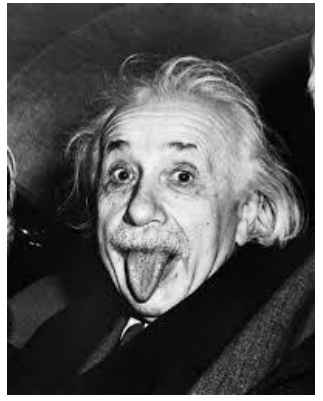


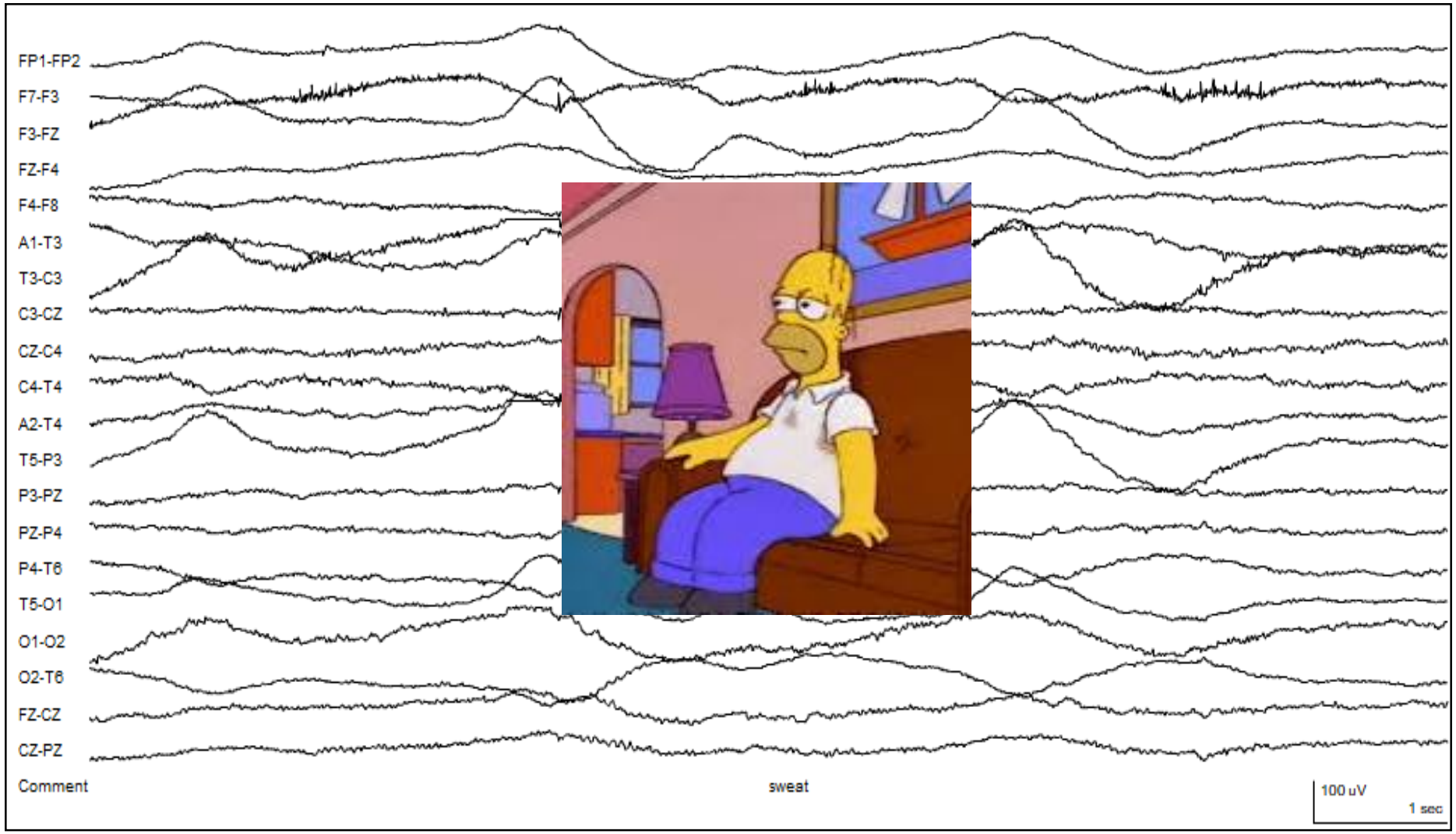
IV Drip Artifact



Water droplets are charged!


60 Hz Notch
LF = 1.0 HF = 70
70 uV 10
-LGB-2




FP1-FP2
F7-F3
F3-FZ
FZ-F4
F4-F8
A1-T3
T3-C3
C3-CZ
CZ-C4
C4-T4
A2-T4
T5-P3
P3-PZ
PZ-P4
P4-T6
T5-O1
O1-O2
O2-T6
FZ-CZ
CZ-PZ
Comment
sweat
100 uV
1 sec

Questions ?

Thank you