

Scoring guidelines

The AASM Manual for the Scoring of Sleep and Associated Events

RULES, TERMINOLOGY AND TECHNICAL SPECIFICATIONS



VERSION 2.6

Current international scoring guidelines: AASM V2.6 (2020)

Sleep staging

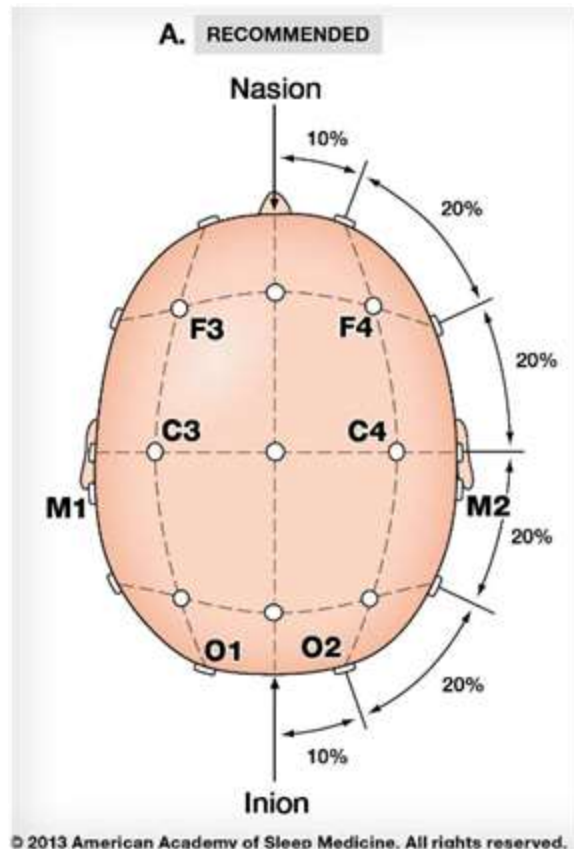
AASM montage

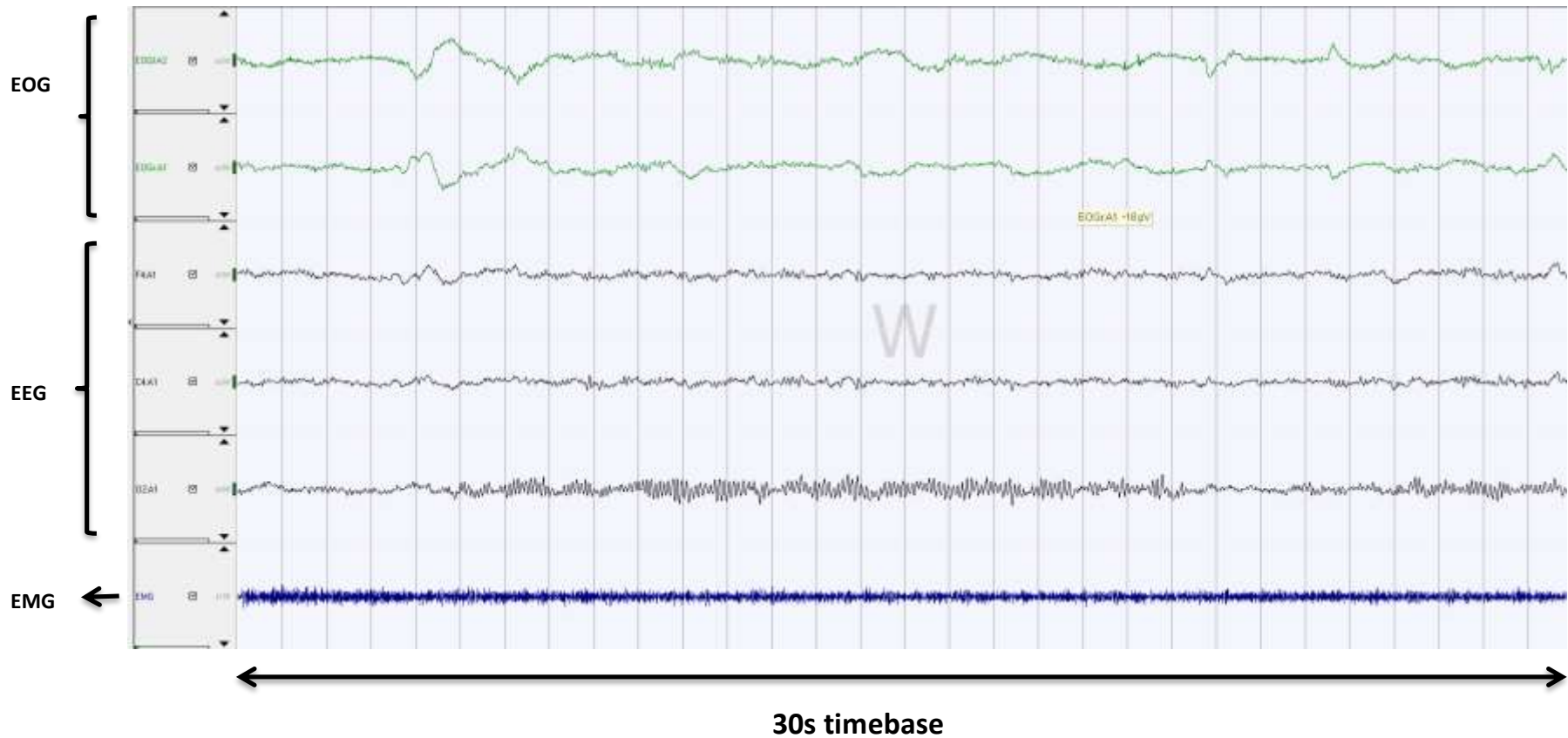
Read from right EEG channels:

- F4-M1 – best for slow waves
- C4-M1 – best for spindles
- O2-M1 – best for alpha rhythm

Left EEG channels as back-up:

- F3-M2
- C3-M2
- O1-M2





Scoring PSG

- Scroll through study several times:
 - Sleep staging – 30s epoch
 - EEG arousals – 30s epoch
 - Respiratory events – 1min / 2min / 5min epoch
 - Dependent on respiratory rate
 - Periodic leg movements – 5min epoch

Stage W

Score epochs as W when >50% of the epoch contains either or both of

- Age-appropriate posterior dominant rhythm in occipital region
- Other findings consistent with W
 - Eye blinks
 - REMs with normal/high chin EMG
 - Reading eye movements

Stage N

- If all epochs of NREM sleep contain no recognisable sleep spindles, K-waves or slow wave activity, score all epochs as Stage N.
- If some epochs of NREM contain spindles or K-waves, score those as Stage N2.
- If some epochs of NREM contain >20% slow wave activity, score as Stage N3.
- Otherwise, score as Stage N.
- If NREM is sufficiently developed, then score using N1/N2/N3 as in adults.

Wake

N1

N2

N3

REM

Slow Rolling
Eye
Movements

K-complex

Spindle

Slow wave activity

Rapid Eye Movements

Alpha

Assessing sleep stage

- Review EEG
 - Background frequency
 - Distinct, measurable features
- Review EOG
 - SEMs? REMs? Slow wave artefact?
- Review EMG
 - Maintained? Atonia? Phasic twitches?
- Overall picture
 - $\geq 50\%$ of epoch



Kim Traynor

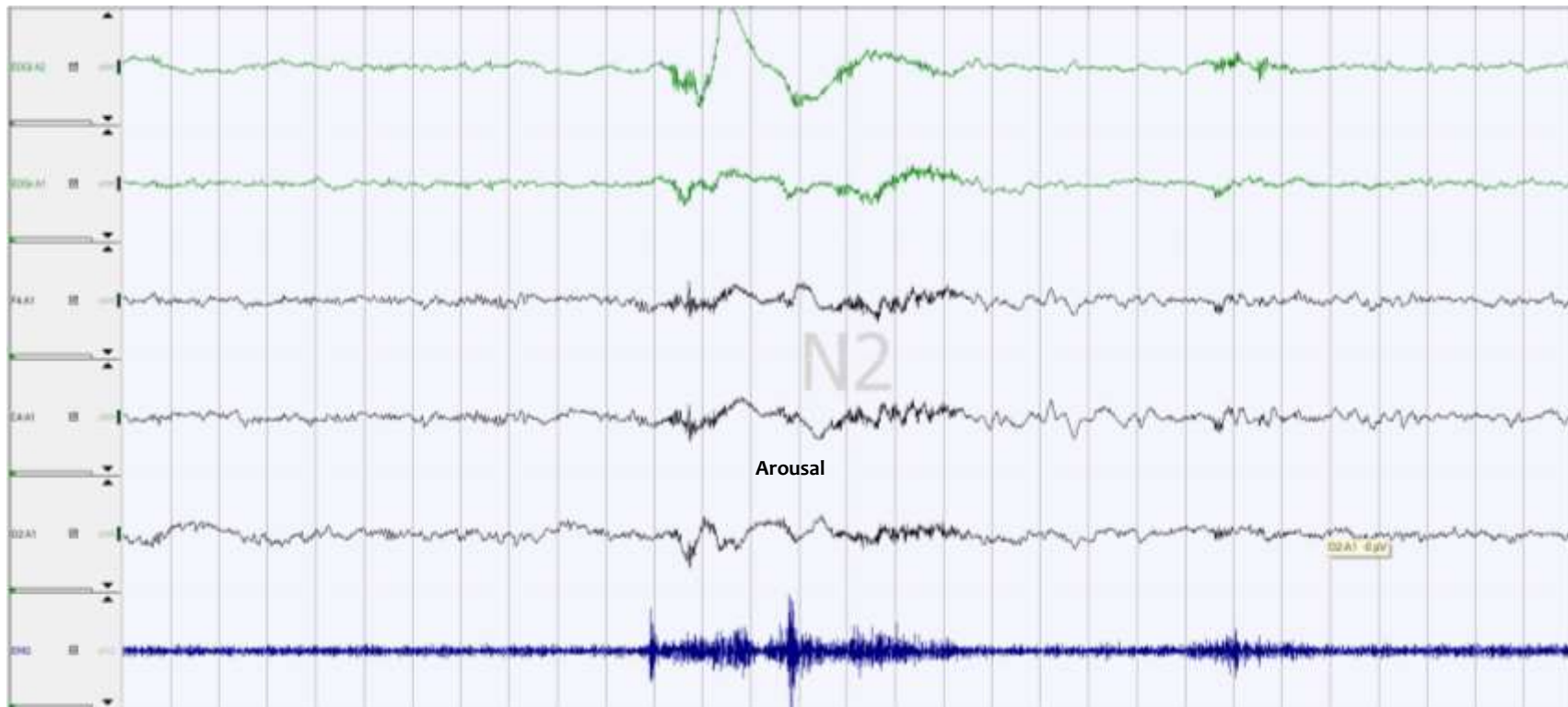
Scoring EEG arousals

EEG arousals

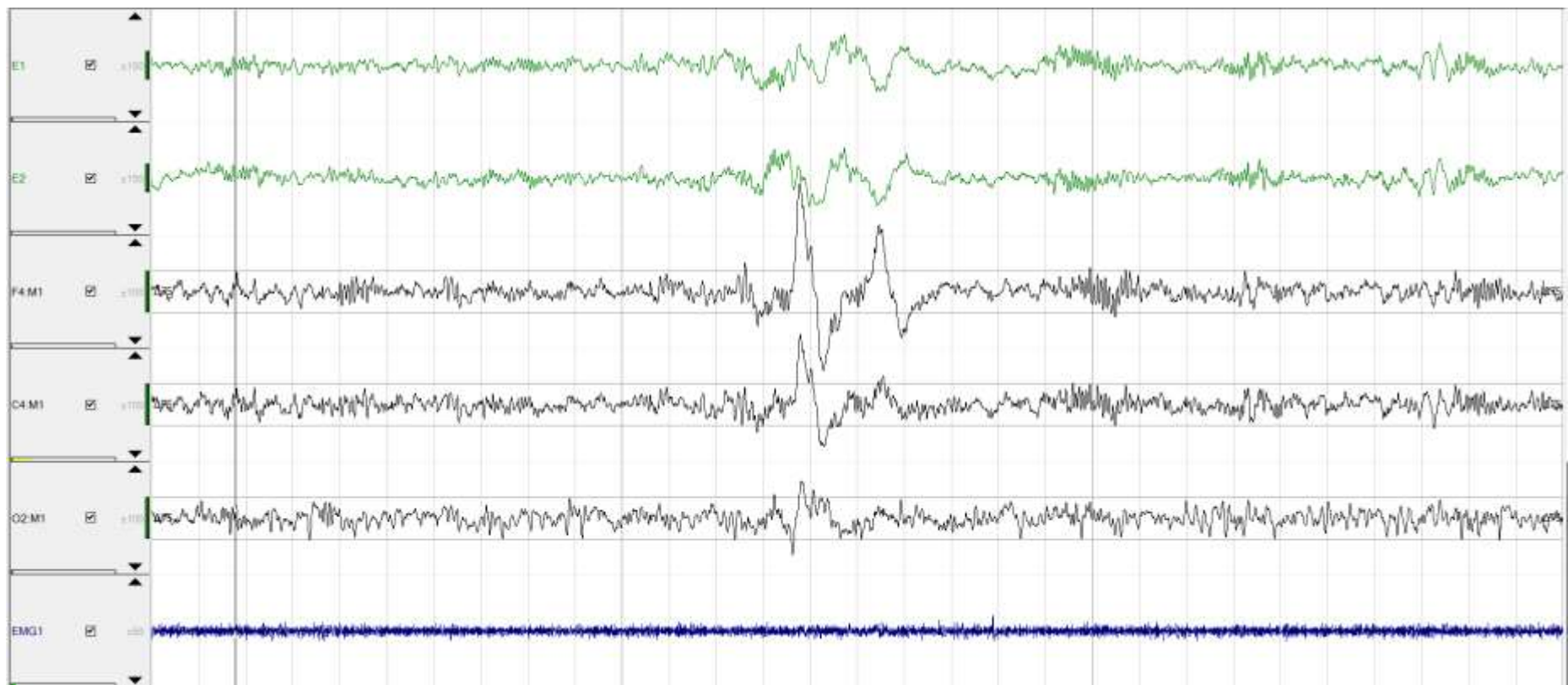
- Brief interruption of sleep continuity
- AASM definition:
 - abrupt shift in EEG frequency → theta, alpha or >16Hz (not spindles)
 - ≥ 3 s duration
 - preceded by ≥ 10 s stable sleep
 - in stage R, \uparrow EMG
 - arousals in NREM do not require \uparrow EMG
- Scored in any stage including W
- Arousals cannot be scored on changes in submental EMG alone.



EEG arousal

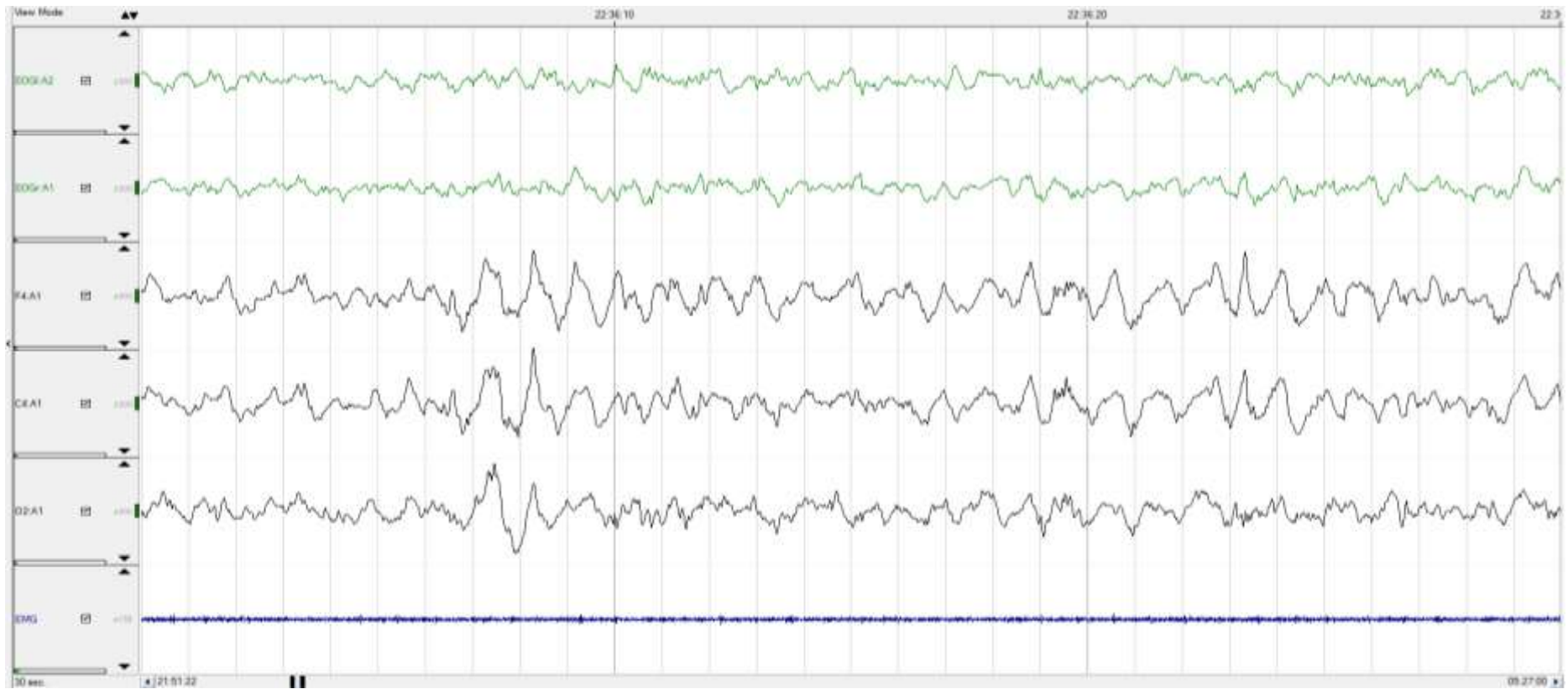


Now it's your turn!



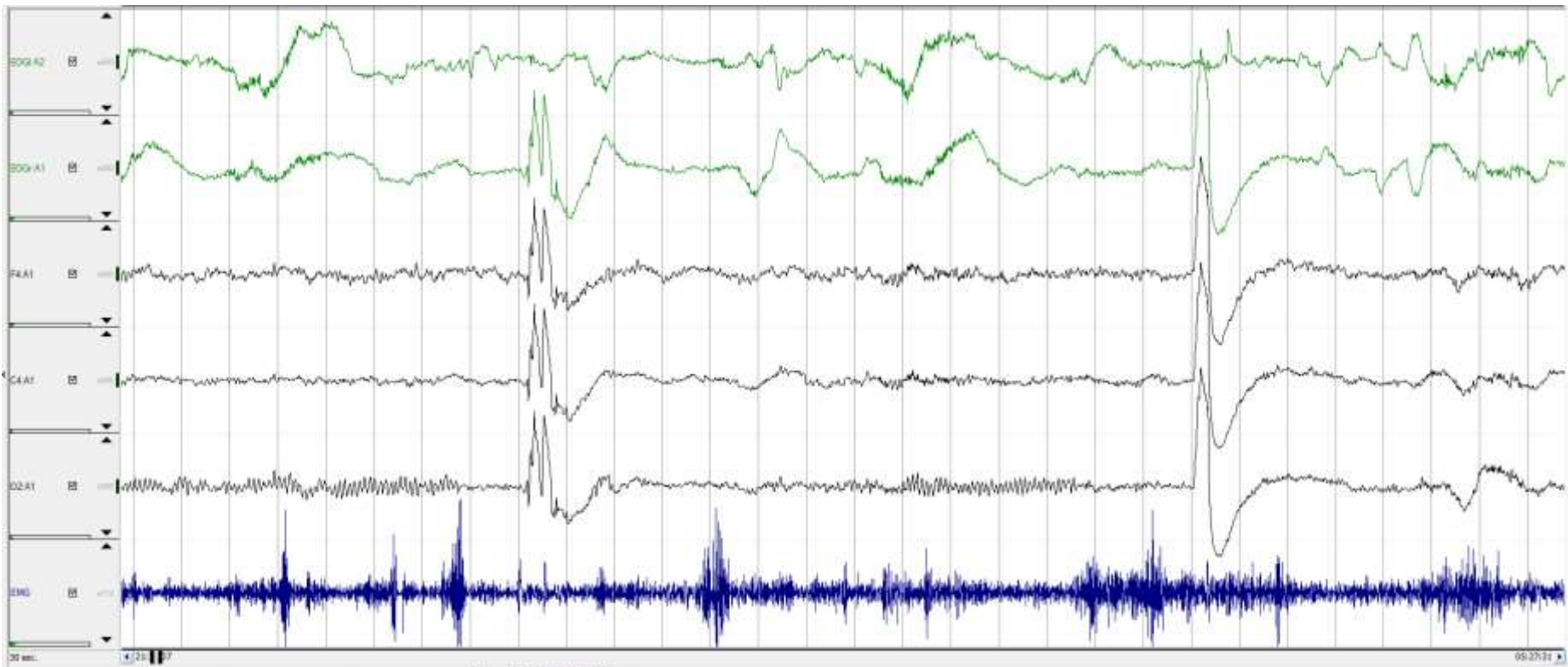
- Which sleep stage is this?
- Which characteristic features led you to this conclusion?

Stage N2:
LAMF, spindles, K-complexes



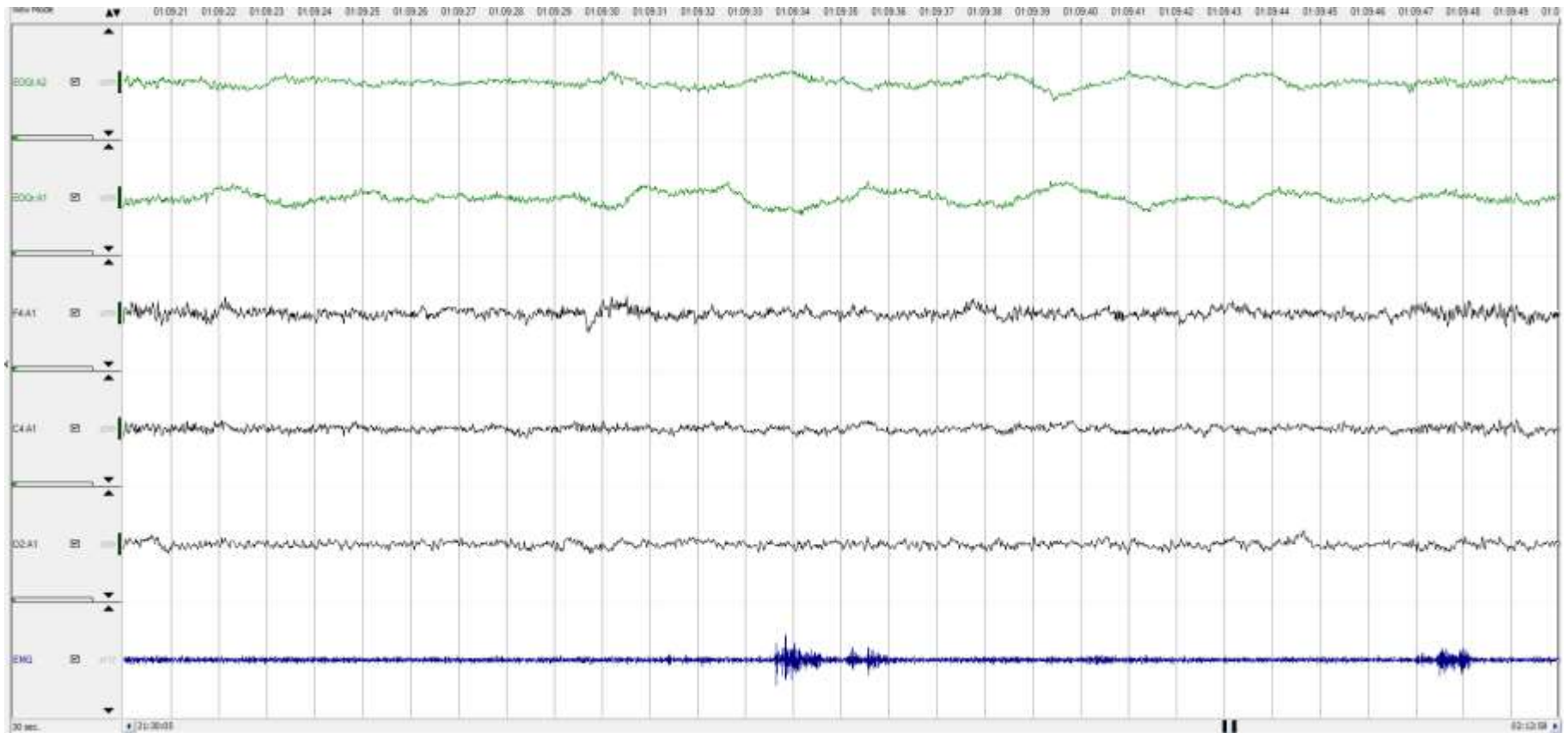
- Which sleep stage is this?
- Which characteristic features led you to this conclusion?

Stage N3:
High-amplitude slow waves over
 $\geq 20\%$ of epoch



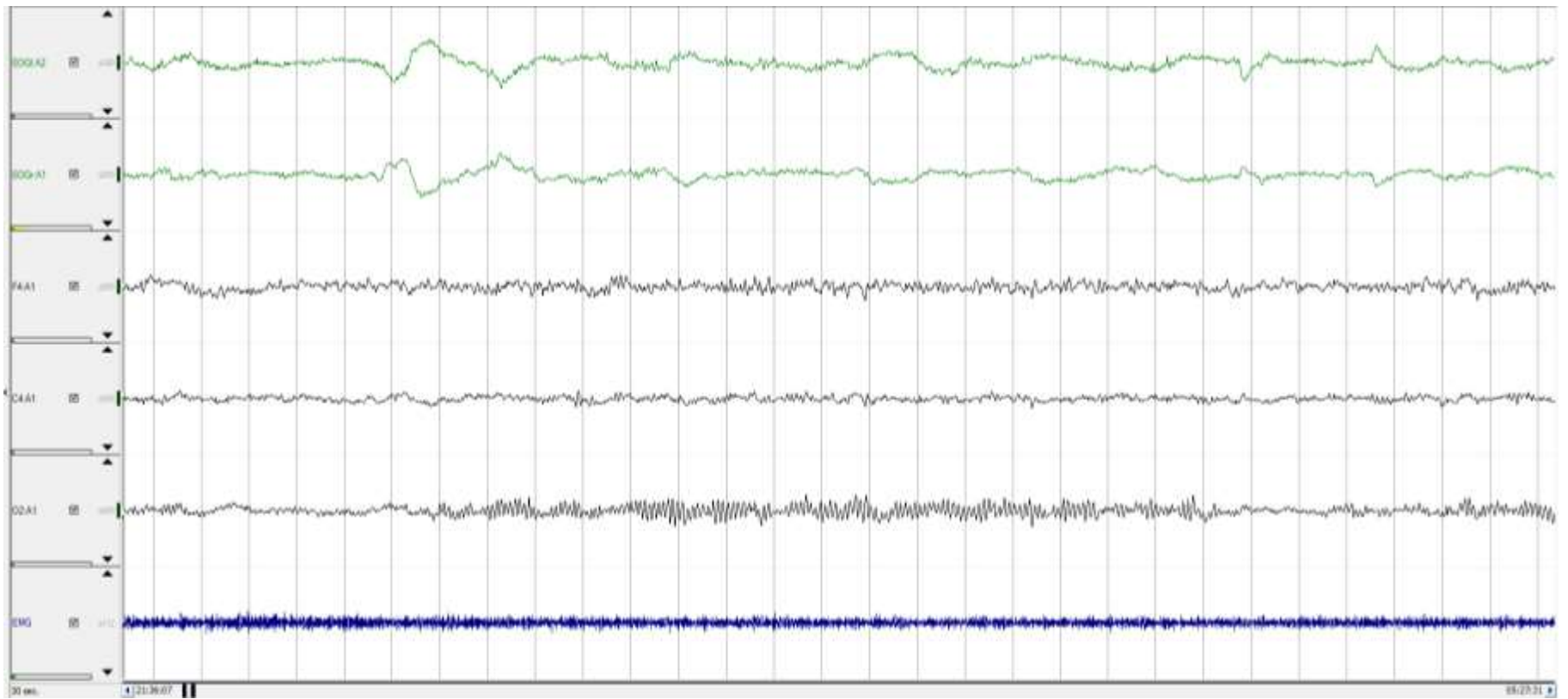
- Which sleep stage is this?
- Which characteristic features led you to this conclusion?

**Stage W (eyes open):
PDR (alpha), eye movements,
high chin EMG**



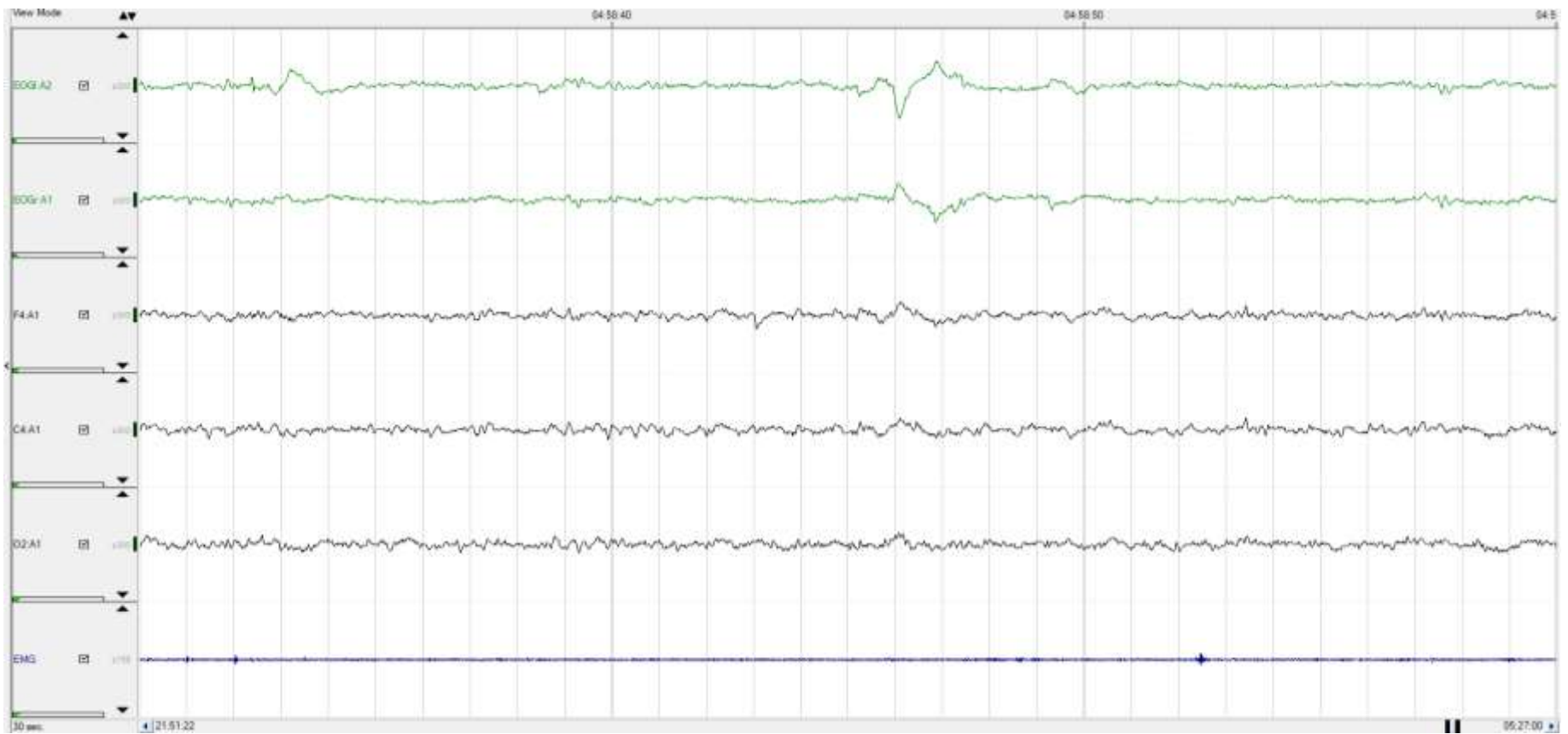
- Which sleep stage is this?
- Which characteristic features led you to this conclusion?
- What other feature might you see in this stage?

Stage N1:
LAMF, SEMs (vertex sharp waves)



- Which sleep stage is this?
- Which characteristic features led you to this conclusion?

**Stage W (eyes closed):
PDR**

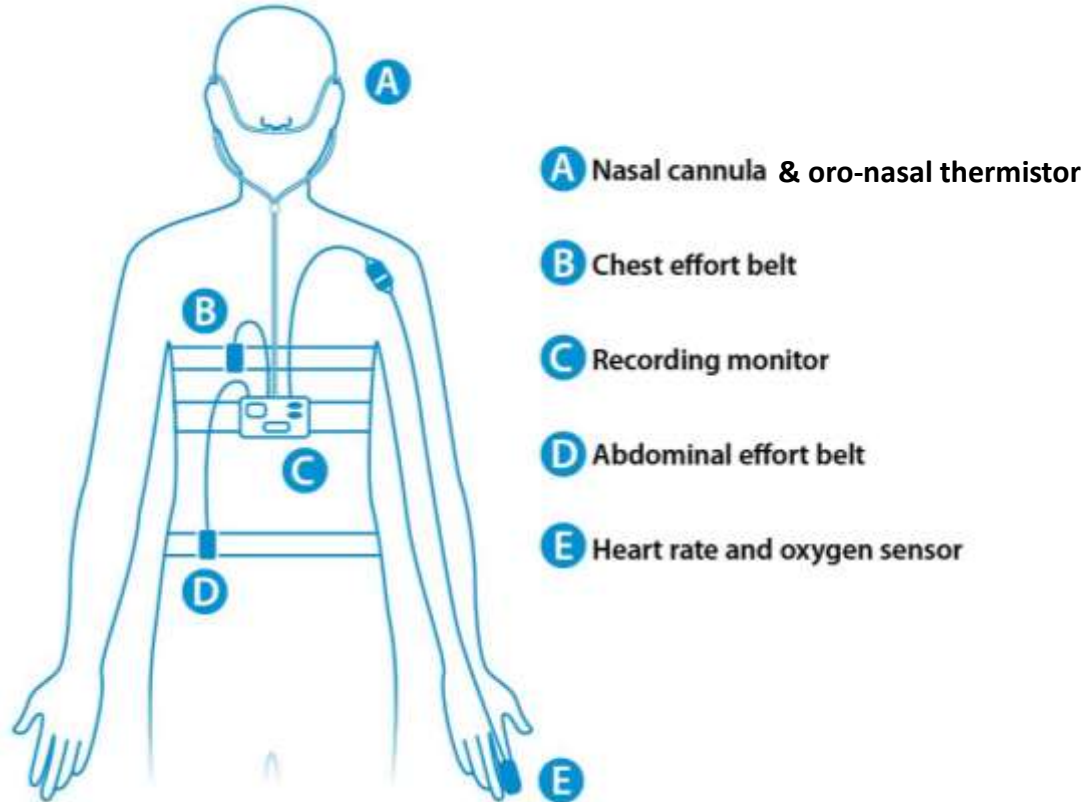


- Which sleep stage is this?
- Which characteristic features led you to this conclusion?

**Stage R:
LAMF, REMs, low chin EMG,
TMA**

Scoring Respiratory Events

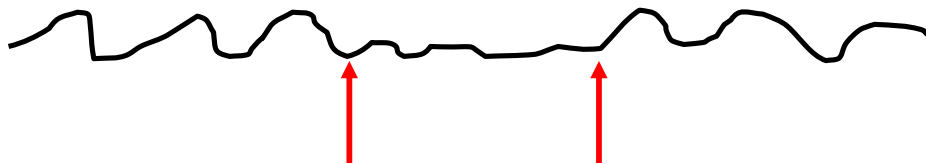
AASM recommended sensors



- Nasal cannula
= scoring hypopnoea
- Oro-nasal thermistor
= scoring apnoea
- CO₂ monitoring
(end-tidal or
transcutaneous)

B. Measuring Event Duration

1. For scoring either an apnea or a hypopnea, the event duration is measured from the nadir preceding the first breath that is clearly reduced to the beginning of the first breath that approximates the baseline breathing amplitude. (see red bracket, Figures 1 and 2) **RECOMMENDED**
2. For apnea duration, the oronasal thermal sensor signal (diagnostic study) or PAP device flow signal (PAP titration study) should be used to determine the event duration. For hypopnea event duration, the nasal pressure signal (diagnostic study) or PAP device flow signal (PAP titration study) should be utilized. When the diagnostic study sensors fail or are inaccurate, *alternative* sensors may be used (see Technical Specifications for adults A.2 and A.4). **RECOMMENDED**
3. When baseline breathing amplitude cannot be easily determined (and when underlying breathing variability is large), events can also be terminated when either there is a clear and sustained increase in breathing amplitude, or in the case where a desaturation has occurred, there is event-associated resaturation of at least 2%. **RECOMMENDED**



≥10s in adults

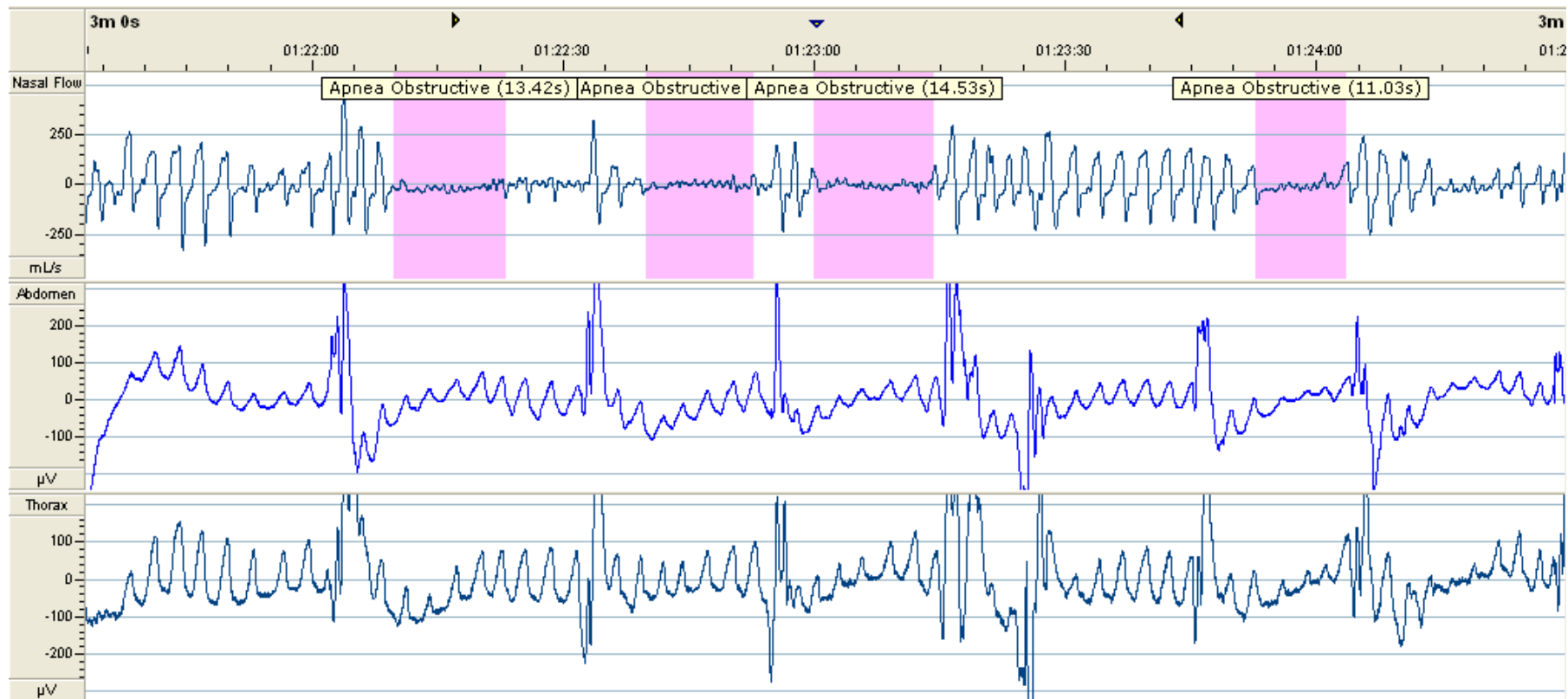
≥2 breaths in children

Obstructive apnoea

- Score an obstructive apnoea when all of the following criteria are met:
 - $\geq 90\%$ reduction in airflow
 - Duration ≥ 2 breaths (breathing rate varies with age)
 - Respiratory effort present throughout period of absent airflow
- No requirement for desaturation or arousal



Obstructive apnoea

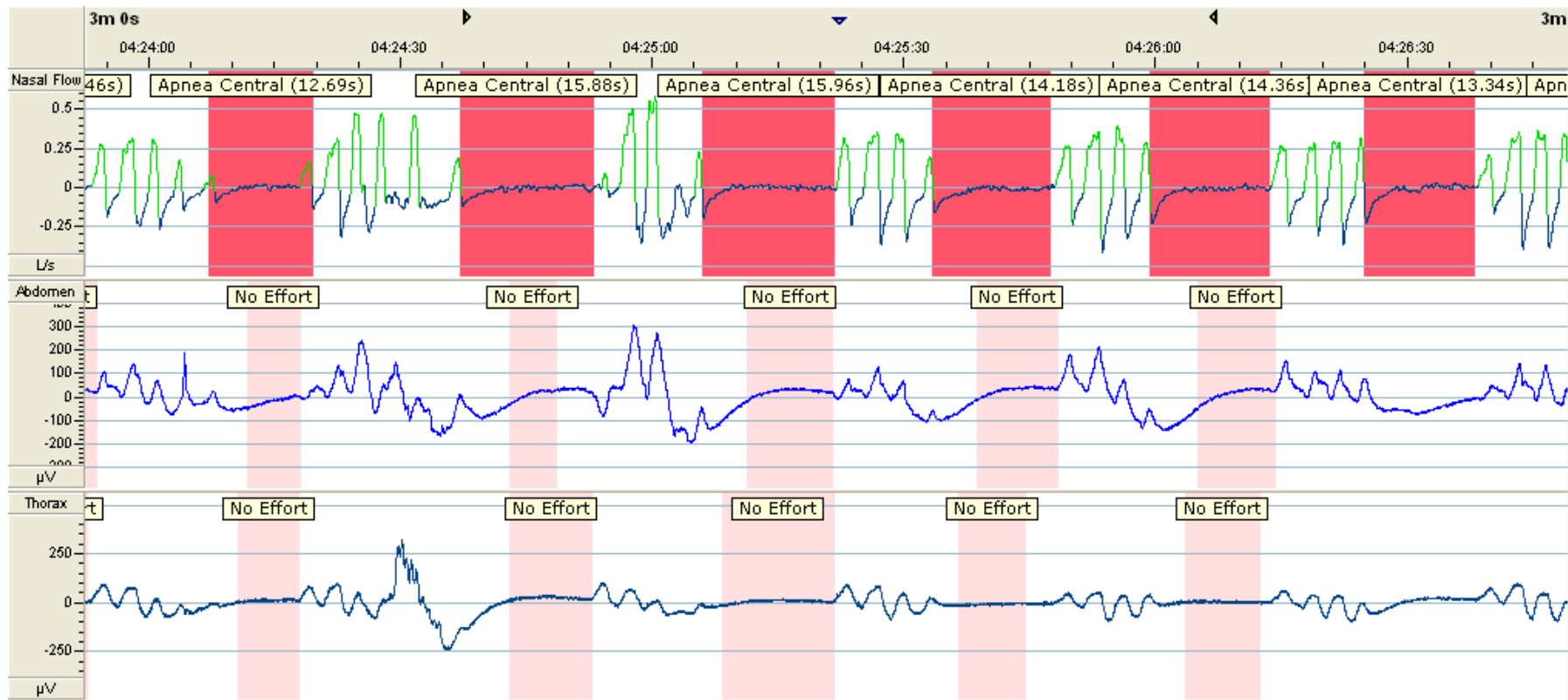


Central apnoea

- Score a central apnoea when all of the following criteria are met:
 - $\geq 90\%$ reduction in airflow
 - Respiratory effort absent throughout period of absent airflow
- Plus one of
 - Duration ≥ 20 s
 - Duration ≥ 2 breaths + arousal or $\geq 3\%$ desaturation
 - Duration ≥ 2 breaths + heart rate < 50 bpm for ≥ 5 s or < 60 bpm for ≥ 15 s (infants < 1 yr only)



Central apnoea

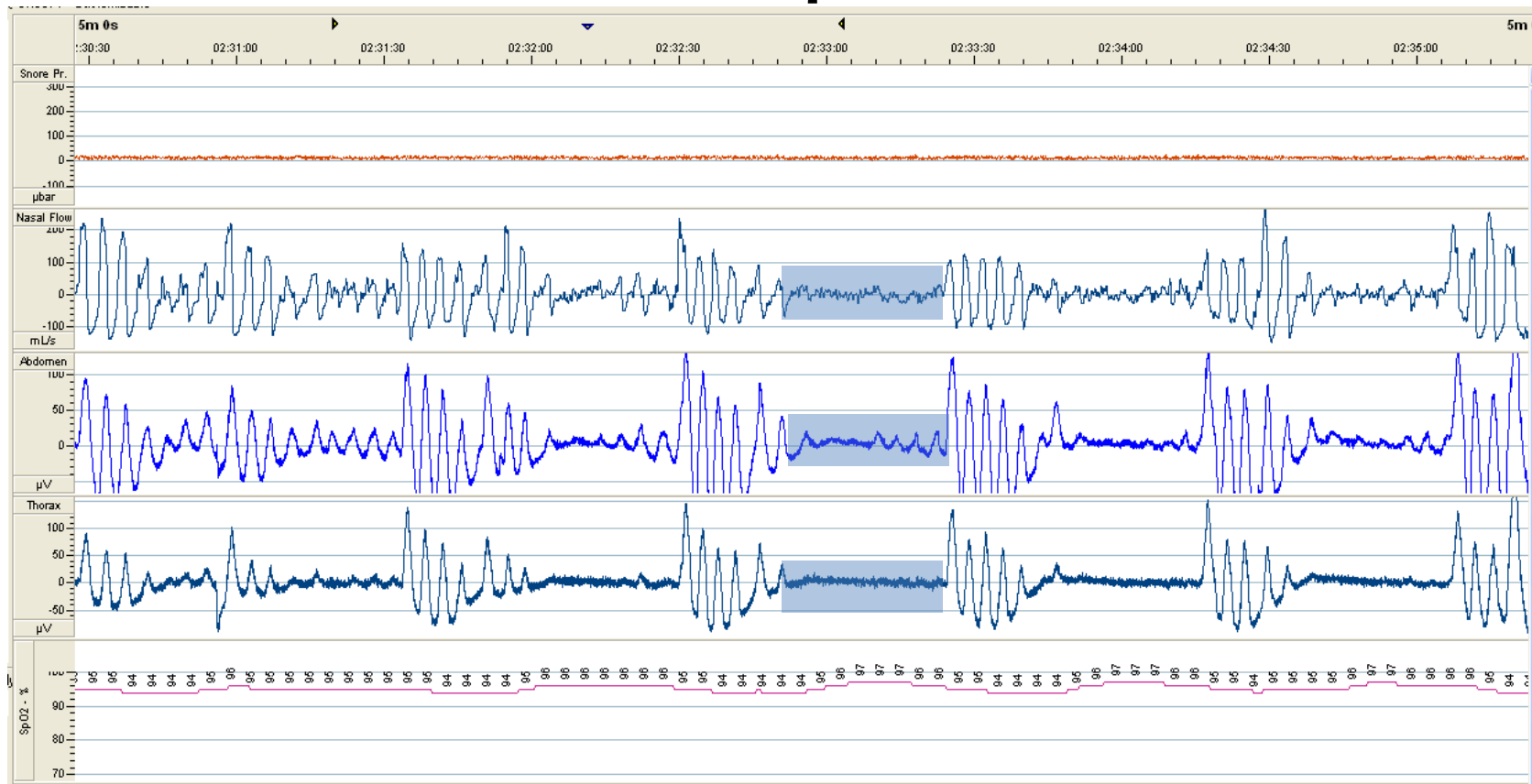


Mixed apnoea

- Score a mixed apnoea when
 - Duration ≥ 2 breaths
 - Respiratory effort present during one period of the event and absent during another, regardless of which comes first (different from adults)



Mixed apnoea

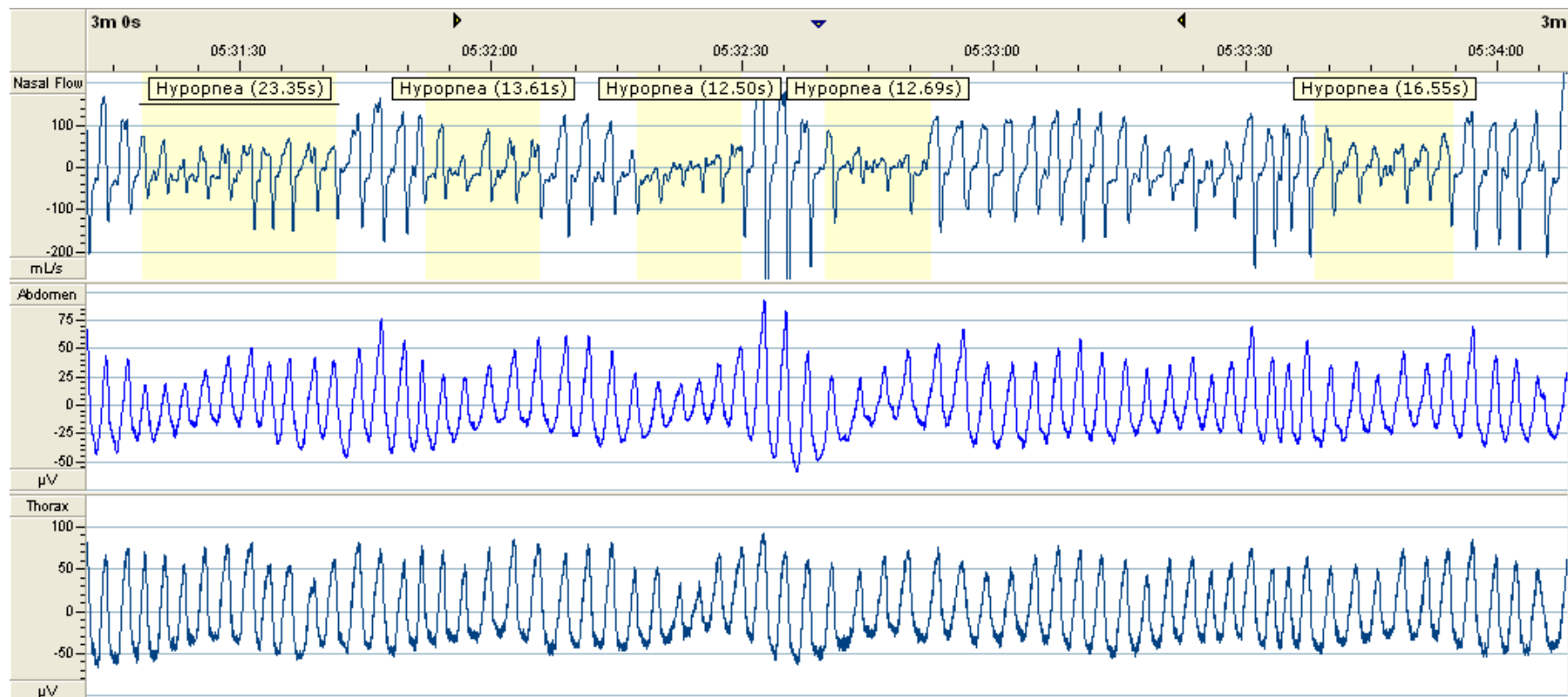


Hypopnoea

- Score a hypopnoea when all of the following criteria are met:
 - $\geq 30\%$ reduction in airflow
 - Duration ≥ 2 breaths
 - $\geq 3\%$ desaturation or arousal
- In children, important to classify hypopnoeas as central or obstructive
 - Will change treatment plan



Hypopnoea



Obstructive v. central hypopnoea

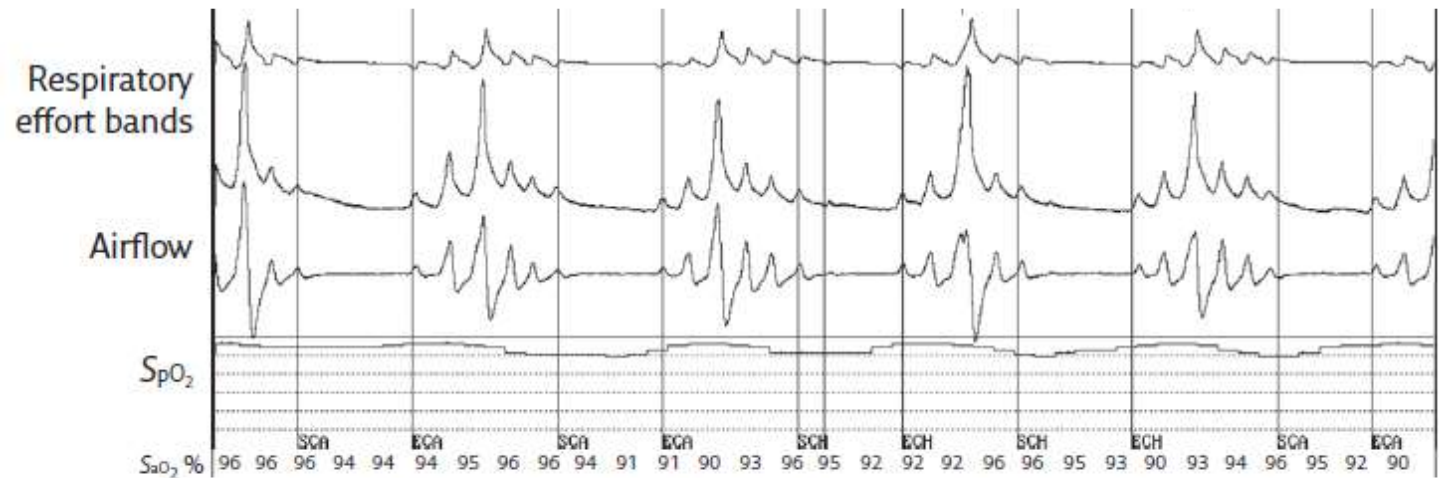
	<i>Obstructive</i>	<i>Central</i>
• Snoring	+	-
	<i>or</i>	<i>and</i>
• Inspiratory flattening	+	-
	<i>or</i>	<i>and</i>
• Paradoxical breathing	+	-

Periodic breathing

H. Scoring of Periodic Breathing

1. Score a respiratory event as periodic breathing if there are ≥ 3 episodes of central pauses in respiration (absent airflow and inspiratory effort) lasting >3 seconds separated by ≤ 20 seconds of normal breathing.^{N1} **RECOMMENDED**

Note 1. Central apneas that occur within a run of periodic breathing should be scored as individual apneas as well.



Hypoventilation

G. Scoring of Hypoventilation

Monitoring hypoventilation in children is recommended during a diagnostic study and optional during a PAP titration study.

1. Score as hypoventilation during sleep when **>25% of the total sleep time as measured by either the arterial PCO₂ or surrogate is spent with a PCO₂ >50 mmHg.** ^{N1,N2} **RECOMMENDED**

Note 1. See Technical Specifications for children (B.9 and B.10) for information on surrogate signals for monitoring hypoventilation.

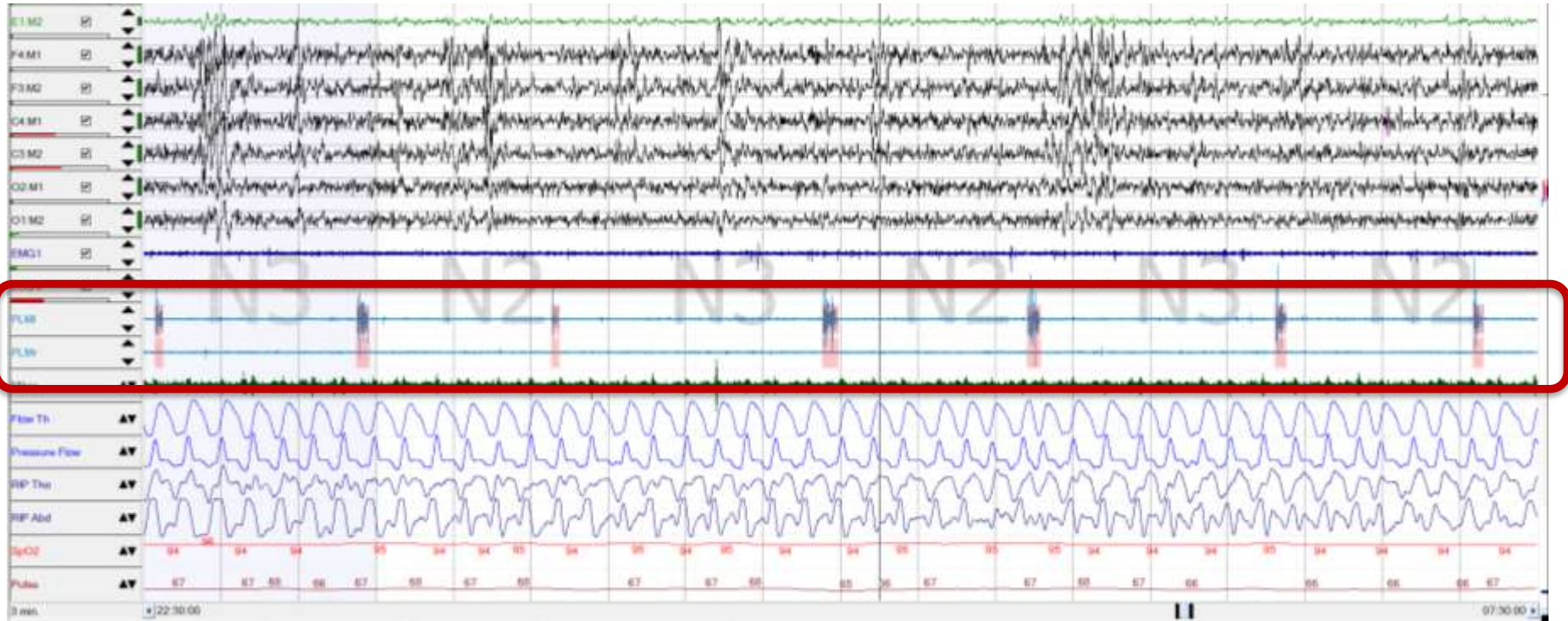
Note 2. Use the following conversion factor in order to change the units of the pressures listed from mmHg to kPa:
1 mmHg = 0.133 kPa.

Scoring Periodic Limb Movements

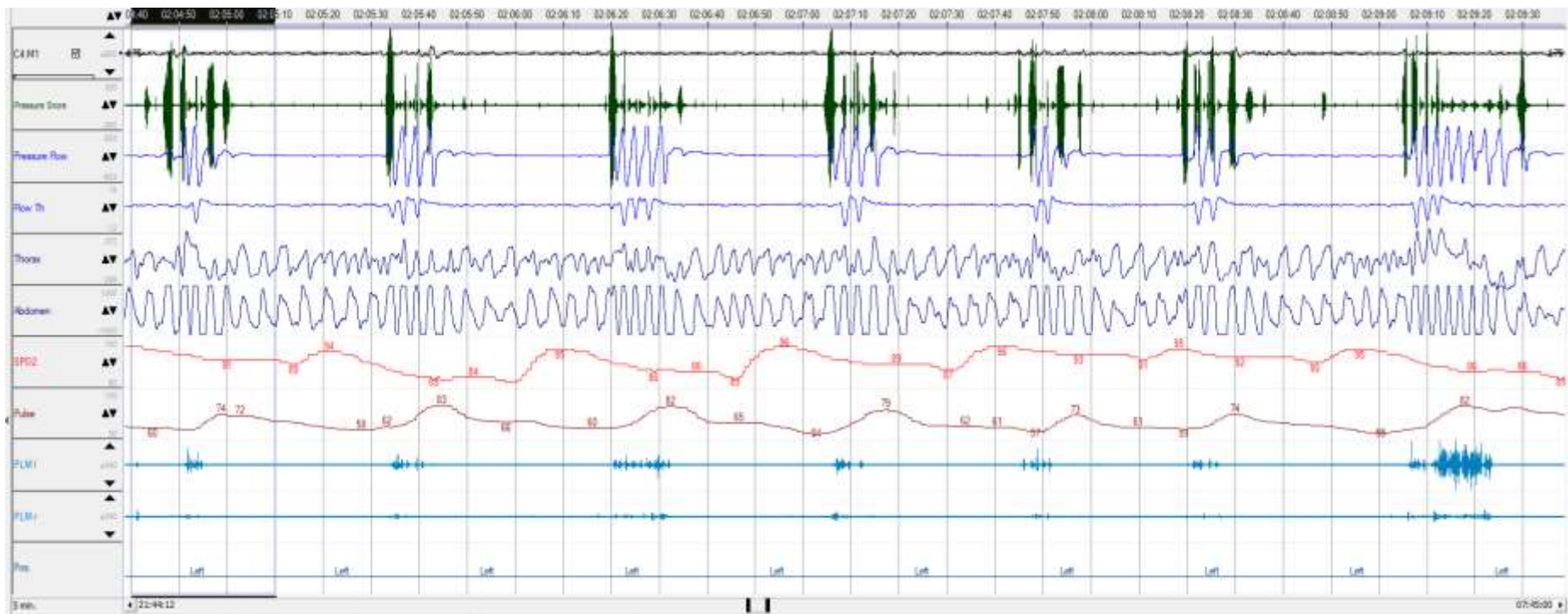
Periodic leg movements

- Score individual leg movements, then group into PLM series
- LM:
 - \uparrow leg EMG of $\geq 8\mu\text{V}$ above resting EMG
 - duration 0.5-10s
 - Not scored within 0.5s before/after respiratory event
- PLM series:
 - group of ≥ 4 LMs
 - 5 - 90s between movements
 - LMs on different (both??) legs $< 5\text{s}$ apart considered one movement

Periodic limb movements



Now it's your turn!



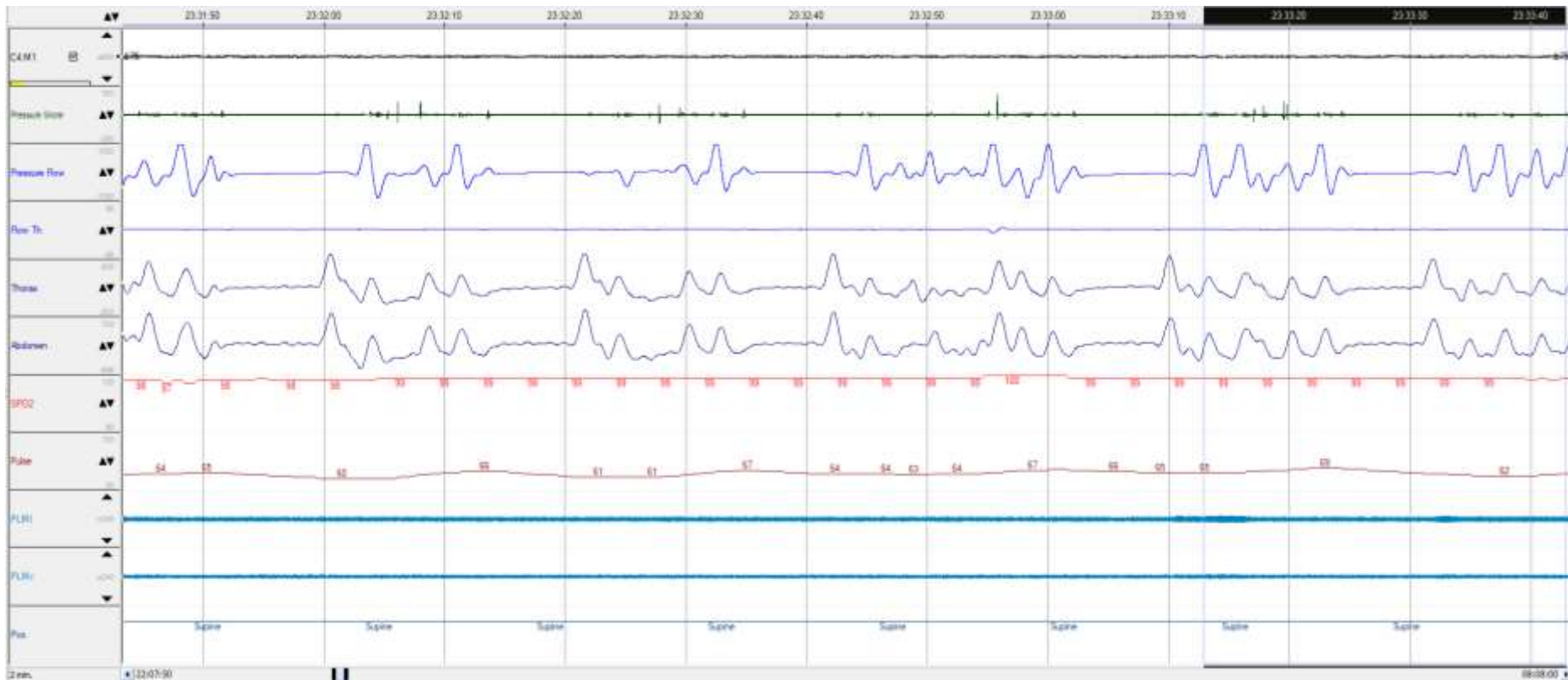
- What type of events can you see here?
- What features led you to this conclusion?
- What might you expect to see on the EEG?

Obstructive apnoeas:
Airflow reduction $\geq 90\%$ for $\geq 10s$,
continued/increasing effort,
Desaturations $\geq 3\%$,
snores & LM at end of events
(EEG arousals?)



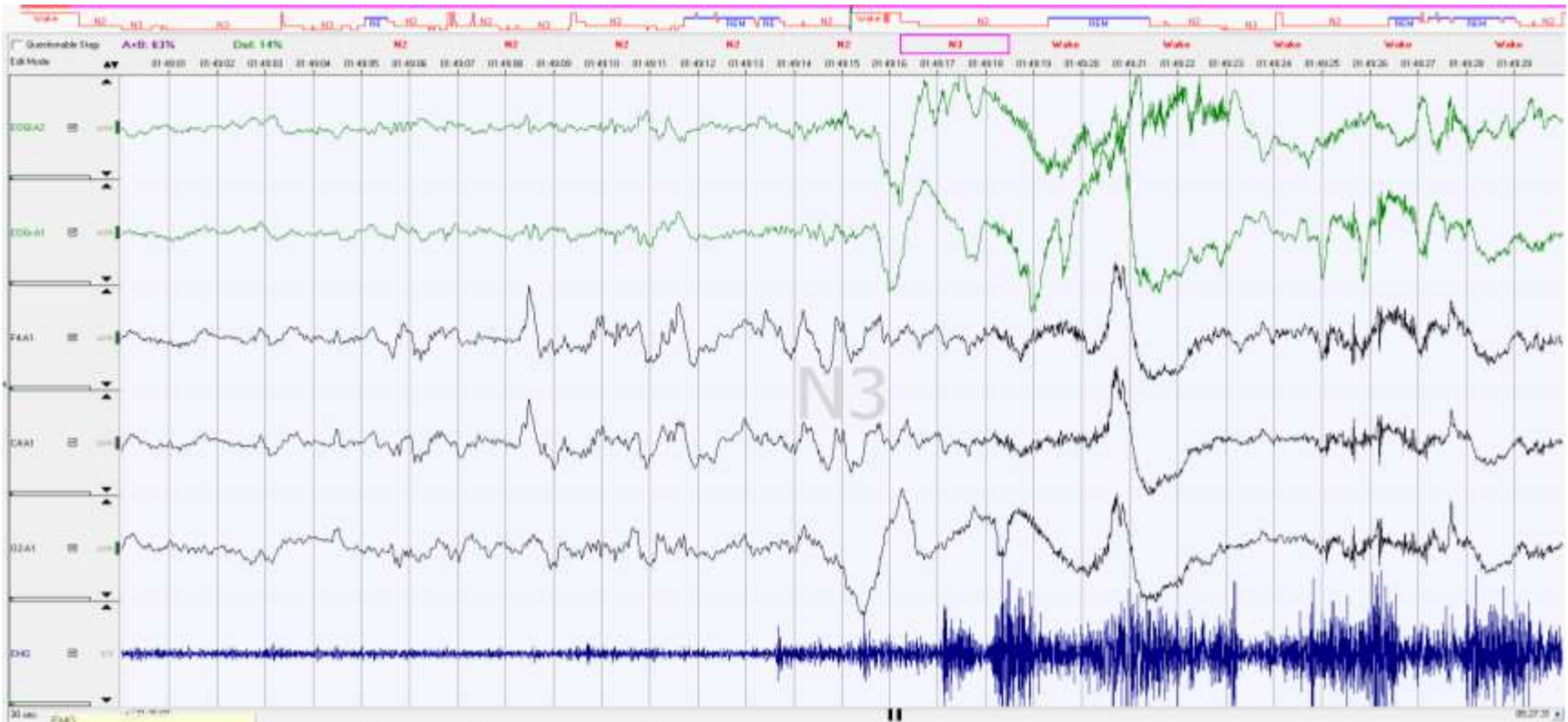
- How many event(s) can you see here, if any?
- What type of event(s)?
- What features led you to this conclusion?

One event – central apnoea:
Airflow reduction $\geq 90\%$ for $\geq 10s$,
absence of respiratory effort



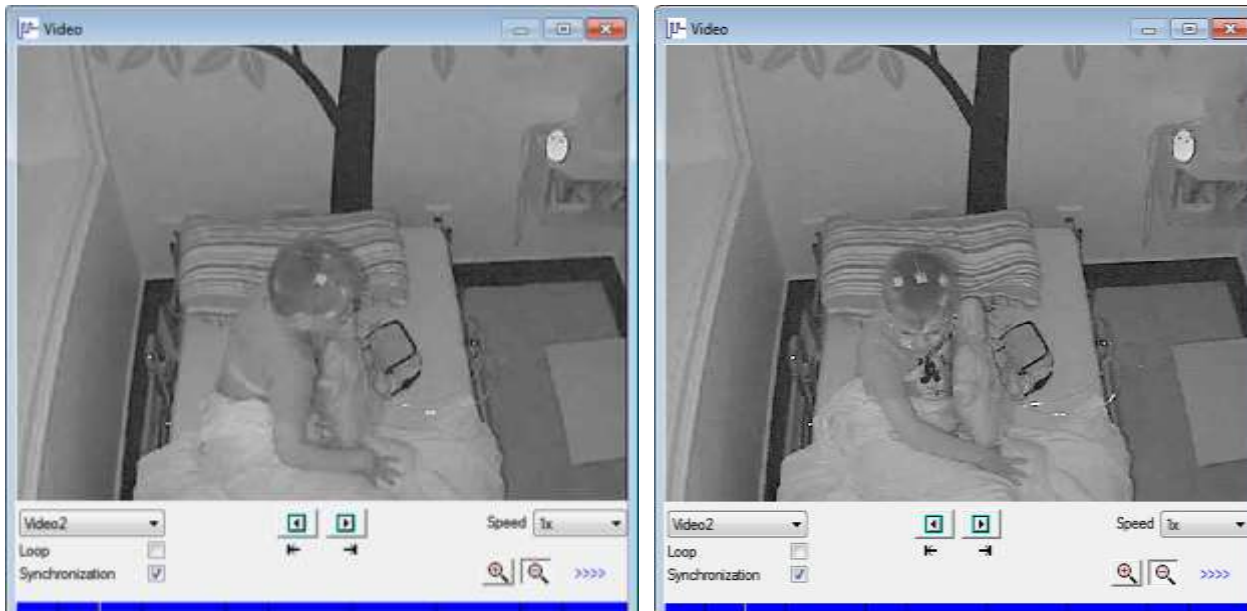
- Are there any scoreable events here?
- If so, what are they?
- Any additional information you require to make your decision?

?Central or mixed apnoeas:
Airflow reduction $\geq 90\%$ for $\geq 10s$,
absence of respiratory effort
(Thermistor signal absent)

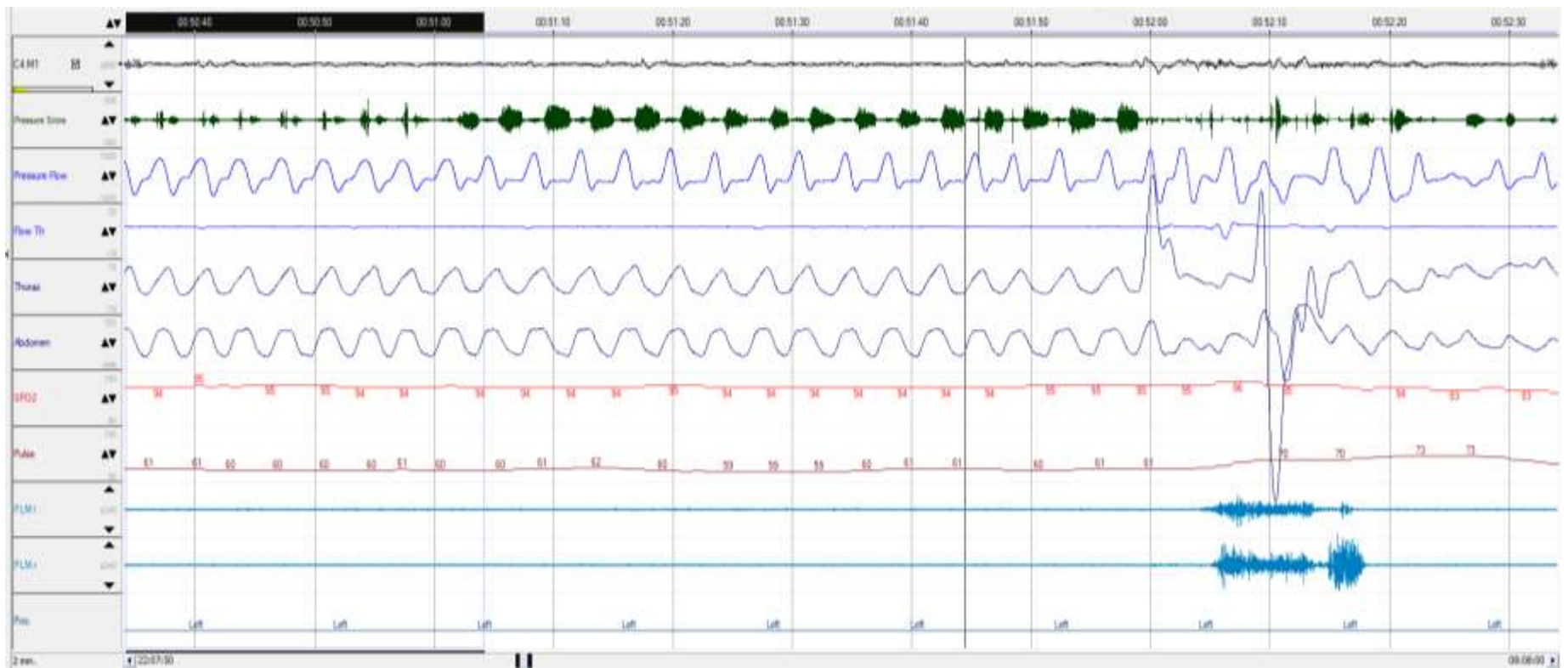


- Is there a scoreable event here?
- If so, what is it?
- What condition might this be associated with?

EEG arousal:
Abrupt shift in frequency of $\geq 3s$
preceded by 10s stable sleep
(?NREM parasomnia)

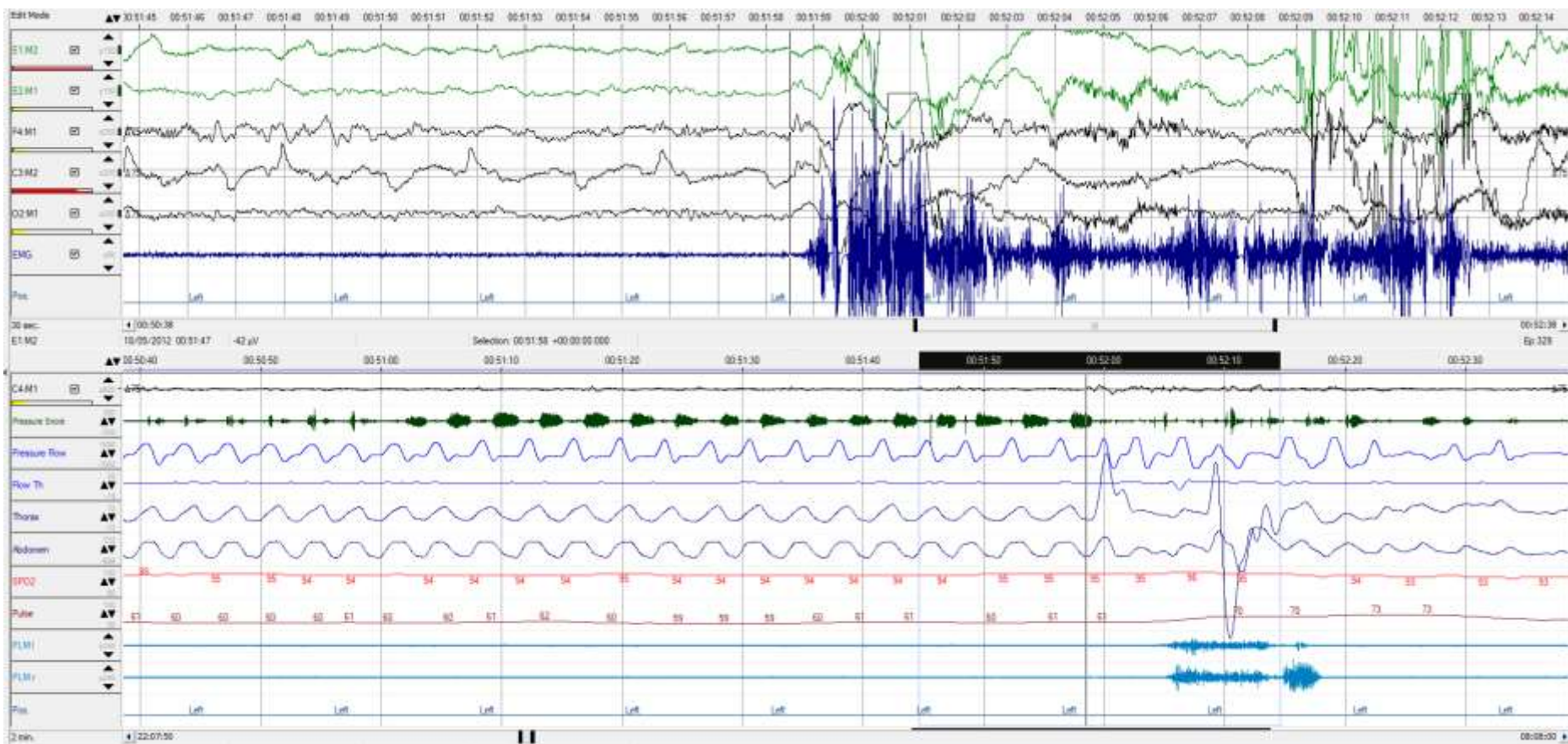


Spontaneous arousal from N3 – confusional arousal seen on video

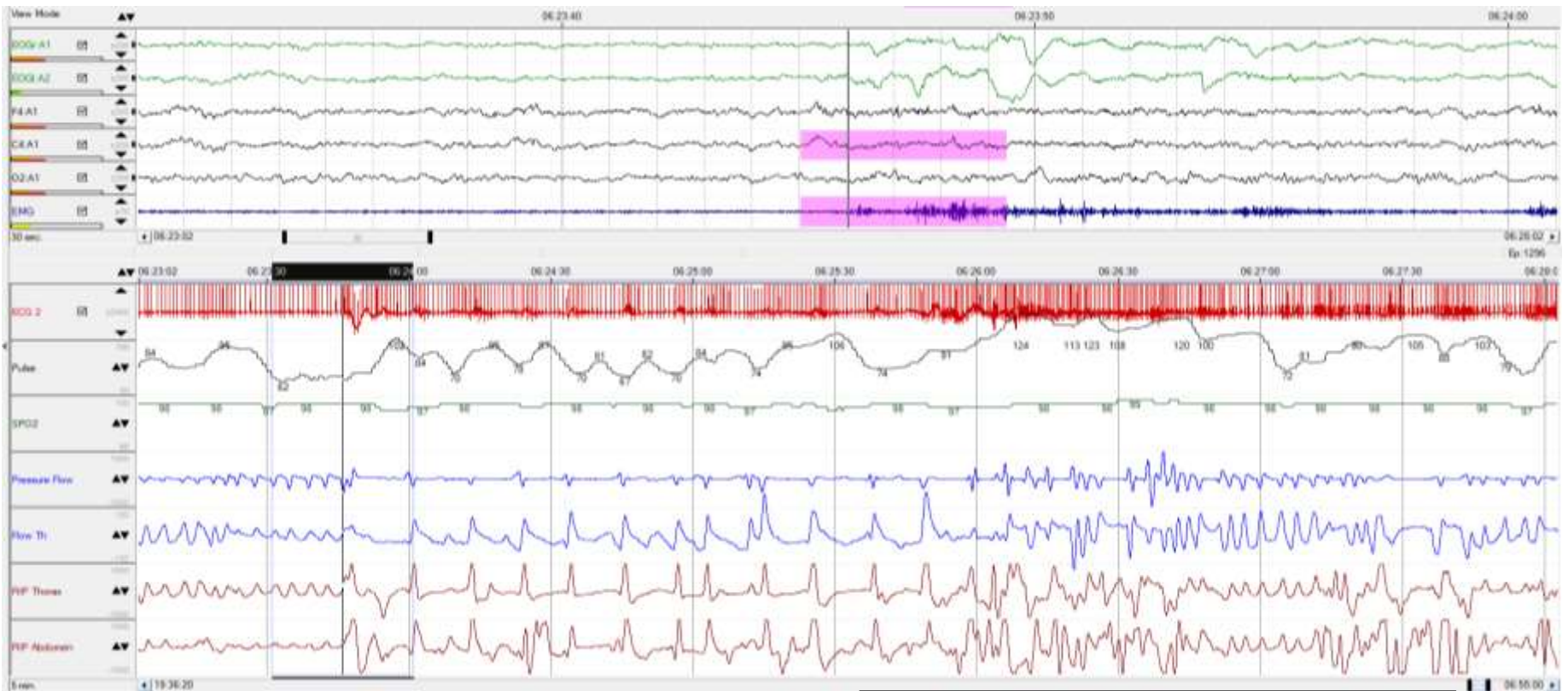


- Is there a scoreable event here?
- What do you think is going on?
- What might you expect to see on the EEG?

No scoreable event:
Brief arousal post-snoring
(?EEG arousal)

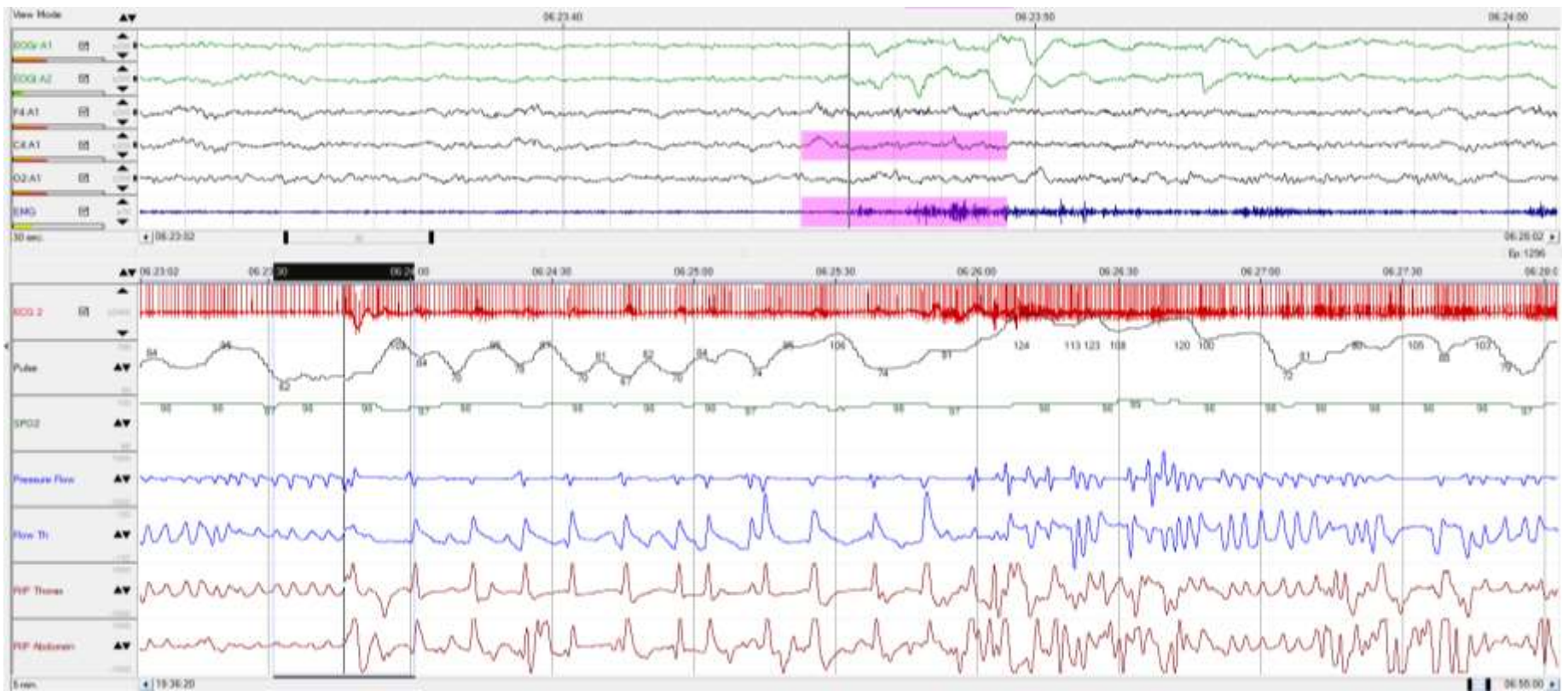


Snoring resulting in arousal, EEG arousal/awakening evident



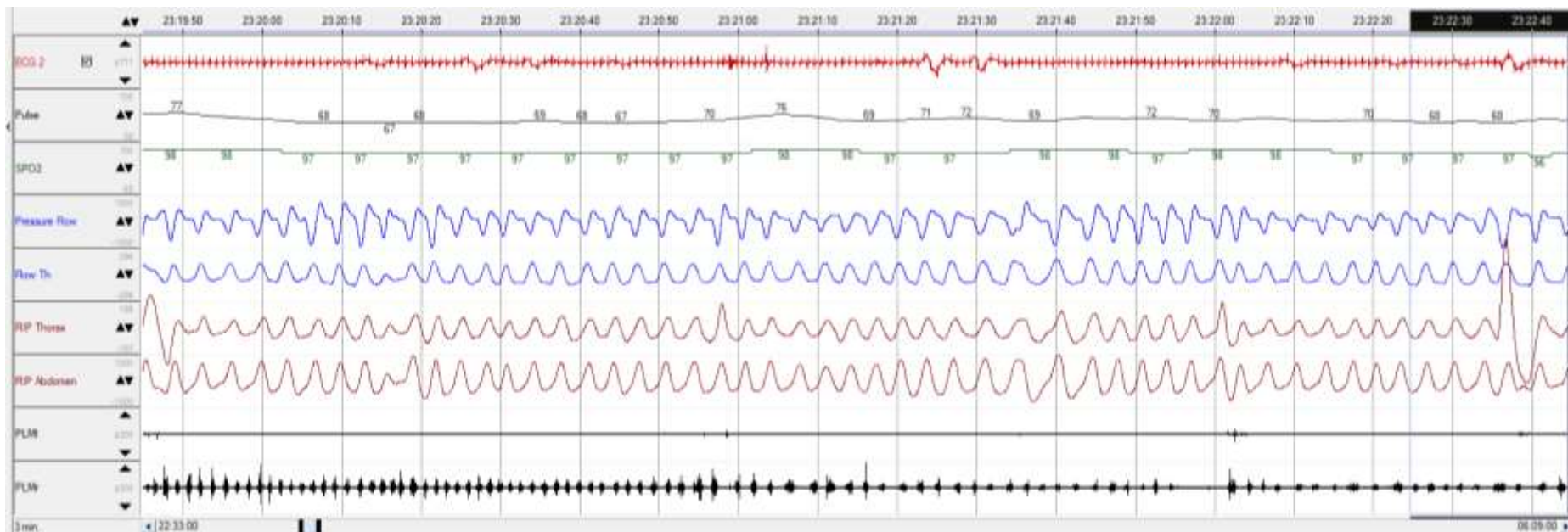
- Describe what you can see here.
- What do you think might be going on?
- What other recorded information might be useful?

**EEG arousal,
Rise in EMG tone,
Run of short central pauses,
Fluctuating pulse rate**



Catathrenia – noisy breathing after an arousal from N₂, confirmed by video

Langley RJ, Hill L, Hill EA, et al. The curious incident of groaning in the night-time. *Breathe* 2017; 13: 123–126.



- What do you think is happening here?
- Real signal or artefact?
- What other recorded information might be useful?

D. Scoring Hypnagogic Foot Tremor (HFT)

1. The following define HFT:

OPTIONAL

- The minimum number of EMG bursts needed to make a train of bursts in a HFT series is 4 HFT bursts.
- The minimum frequency of the EMG bursts in a HFT is 0.3 Hz.
- The maximum frequency of the EMG bursts in a HFT is 4.0 Hz.

Note 1. The usual range for duration of hypnagogic foot tremor is 250-1,000 msec.

Note 2. HFT may simply be a benign movement phenomenon associated with characteristic EMG patterns as there have been no reported clinical consequences.

Recommended reading

