

Teaching an Old Dog New Tricks

A Primer on the *New* AASM Sleep Scoring Guidelines

Gregory J. Miller RPSGT

Manager St. Mary's of Michigan
Sleep Disorder Center



Disclaimers

- Presenting Recommended guidelines only today
- Up to each lab to use alternative or optional choices
- No insurance company has a requirement that any specific recommendations be followed for reimbursement

RULES

- *RECOMMENDED*: these rules are recommended for the routine scoring of Polysomnography.
- *ALTERNATIVE*: may be used as an alternative to the recommended rules at the discretion of the clinician.
- *OPTIONAL*: suggested rules for uncommon events or those events not known to have physiological significance. May be scored at the discretion of the clinician.

Recommended Parameters

- EEG
- EOG
- Chin EMG
- Leg EMG
- Airflow
- Effort
- Oxygen saturation
- Body position

Rules for Children

Applies to children 2 months post-term and older.

Terminology of sleep stages:

1. Stage W
(wakefulness)

2. Stage N1 (NREM 1)

3. Stage N2 (NREM 2)

4. Stage N3 (NREM 3)

5. Stage N (NREM)

6. Stage R (REM)

Stage N

RULE 1

- If all epochs of NREM sleep contain no recognizable sleep spindles, K complexes or high-amplitude 0.5-2 Hz slow wave activity, score all epochs of NREM sleep as stage N.

RULE 2

- If some epochs of NREM sleep contain sleep spindles or K complexes, score as stage N2
- If there is no slow wave activity comprising more than 20% of epoch, score as stage N

RULE 3

- If some epochs of NREM sleep contain greater than 20% slow wave activity, score as stage N3.
- If remaining NREM epochs have no K complexes or spindles, score as stage N.

RULE 4

- If NREM is sufficiently developed that some epochs contain sleep spindles or K complexes and other epochs contain sufficient amounts of slow wave activity, then score NREM sleep as either stage N1, N2 or N3 as you would in an adult.

Notes on pediatric scoring

- Sleep spindles are present at 2-3 months
- K complexes are present at 4-6 months
- NREM can be scored as N1, N2, N3 in most infants 5-6 months of age
- Alpha shows up by 3 years of age
- Non-EEG correlates can help differentiate NREM and REM.
 - REM correlates are irregular respiration, chin EMG atonia, transient muscle activity and rapid eye movements
 - NREM correlates are regular respirations, no eye movements and high chin EMG

Electrode Placement and Sensitivity

- Same electrode placement as an adult
- Distance on chin EMG decreased from 2 cm to 1 cm
- Distance on EOG decreased from 1 cm to 0.5 cm
- Initial sensitivity 7, but may be adjusted to 10 or 15.

Dominant Posterior Rhythm (DPR)

- Dominant reactive EEG rhythm over the occipital regions in relaxed wakefulness with eyes closed is slower in infants and young children and attenuates with eyes opening or attention.
- Frequency = 3.5-4.5 Hz in 3-4 months post term, 5-6 Hz by 5-6 months, 7.5-9.5 by 3 y.o.a.

RULE 1

- In children the dominant posterior rhythm replaces that term alpha rhythm for the purpose of scoring wakefulness and NREM stages

RULE 2

- Score epochs as stage W when more than 50% of the epoch has either reactive alpha or age-appropriate dominant posterior rhythm over the occipital region.

RULE 3

- If there is no discernable reactive alpha or no age-appropriate dominant posterior rhythm, score epochs as stage W if any of the following are present:
 - Eye blinks at a frequency of 0.5-2 Hz
 - Reading eye movements
 - Irregular conjugate rapid eye movements associated with normal or high chin muscle tone

Stage N1

- In infants with DPR, score stage N1 if posterior rhythm is attenuated or replaced by low amplitude mixed frequency activity for more than 50% of the epoch.

cont...

- In infants who do not generate DPR, score stage N1 beginning with the earliest of any of the following:
 - Activity 4-7 Hz with slowing of background frequencies by greater than or equal to 1-2 Hz from stage W
 - Slow eye movements
 - Vertex sharp waves
 - Rhythmic anterior theta activity (RAT)
 - Hypnagogic hypersynchrony
 - Diffuse or occipital predominant high amplitude rhythmic 3-5 Hz activity

Stage N2, N3 and R

- Rules for infants for these stages are the same as rules outlined previously for adults.

Recommended Scoring Arousals

- Score arousals during stages N1, N2, N3 or R if there is an abrupt shift of EEG frequency including alpha, theta and/or frequencies greater than 16 Hz (not spindles) that last at least 3 seconds, with at least 10 seconds of stable sleep preceding the change.
- Scoring of arousals in REM requires a concurrent increase in submental EMG lasting at least 1 second.

Arousals continued...

- Arousal scoring should incorporate data from both occipital and central derivations.
- Use of respiratory events or other EEG channels may be used in scoring arousals, but should not be based on that information alone, without the data from the required channels.

Recommended Cardiac Rules

Single modified ECG Lead II using torso electrode placement is recommended.

Placement: Second inter-costal space, right anterior torso, sixth inter-costal space, left anterior torso.

Scoring Rhythmic movement disorder

- Minimum frequency 0.5 sec
- Maximum frequency 2 sec
- Minimum number of episodes is 4
- Rhythmic bursts 2 times the background EMG

Respiratory sensors for pediatric

- The sensor used is an oronasal thermal sensor
- The sensor used for a hypopnea is a oronasal pressure transducer
- The sensor for the detection of respiratory effort is either esophageal manometry or inductance plethysmography
- Sensor for blood oxygen with a maximum of 3 sec averaging time
- End tidal PCO₂ monitor for assessing alveolar hypoventilation

Obstructive apnea

- At least 2 missed breaths or the duration of two breaths based on baseline breathing pattern
- >90% drop in amplitude for $\geq 90\%$ duration of the event as seen on the thermistor
- Continued or increased effort during the event
- Duration measured from end of last breath to the beginning of the first breath to return to baseline

Mixed Apnea

- At least 2 missed breaths or the duration of two breaths based on baseline breathing pattern
- >90% drop in amplitude for $\geq 90\%$ duration of the event as seen on the thermistor
- No effort at the beginning of the event followed by increased effort

Central apnea

- No respiratory effort for the duration of the event and one of the following
 - The event last 20 seconds
 - The event last 2 breaths and is associated with an arousal, an awakening or a $\geq 3\%$ desaturation

Pediatric Hypopnea Rules

- $\geq 50\%$ fall in the nasal pressure transducer
- The event is at least 2 missed breaths
- The fall must be $>90\%$ of the duration of the event
- The event is associated with an arousal, an awakening, or $\geq 3\%$ desaturation

Pediatric Hypoventilation rules

- >25% of the recording is spent with a CO₂ >50mm Hg

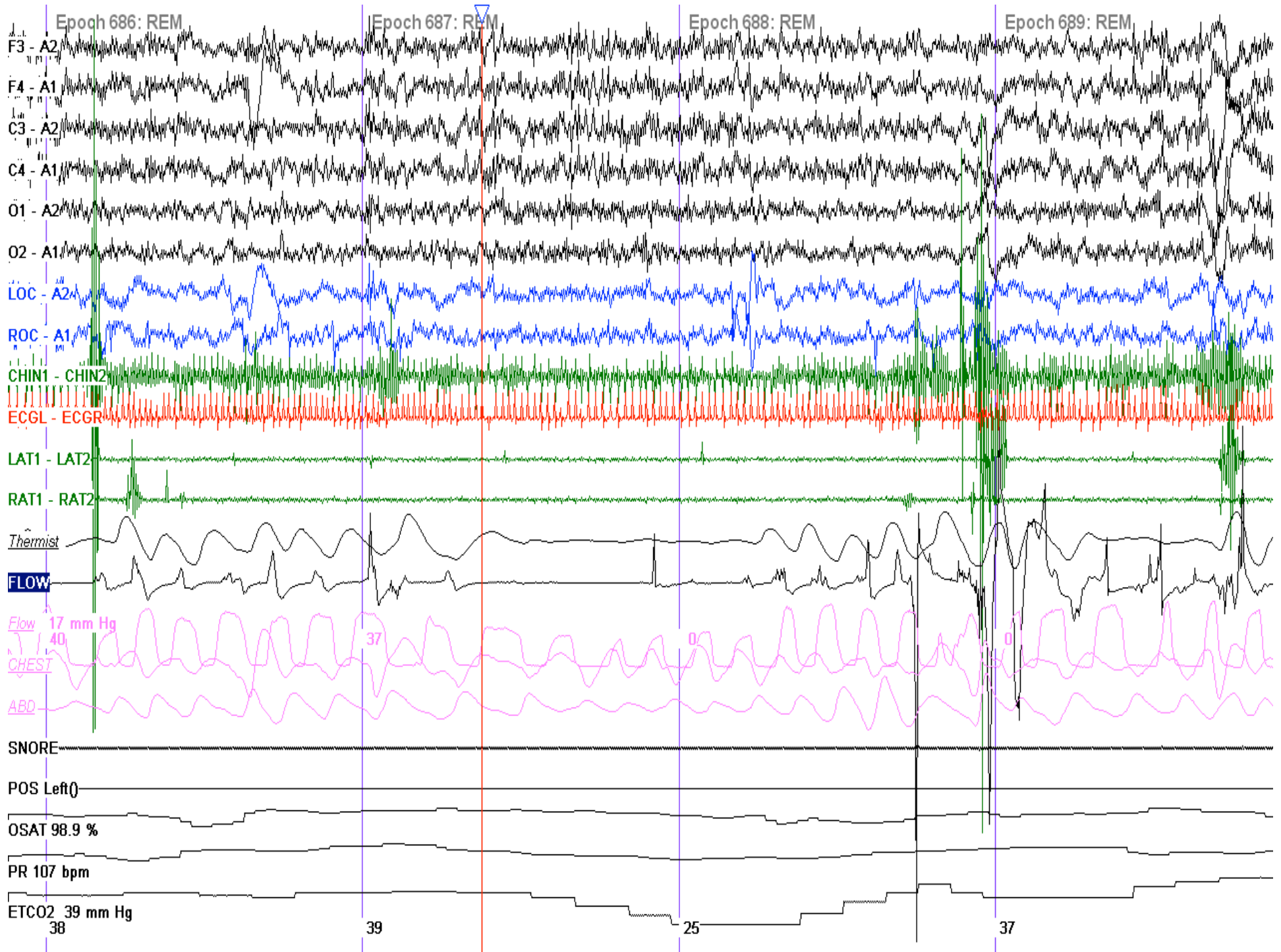
Periodic Breathing rule

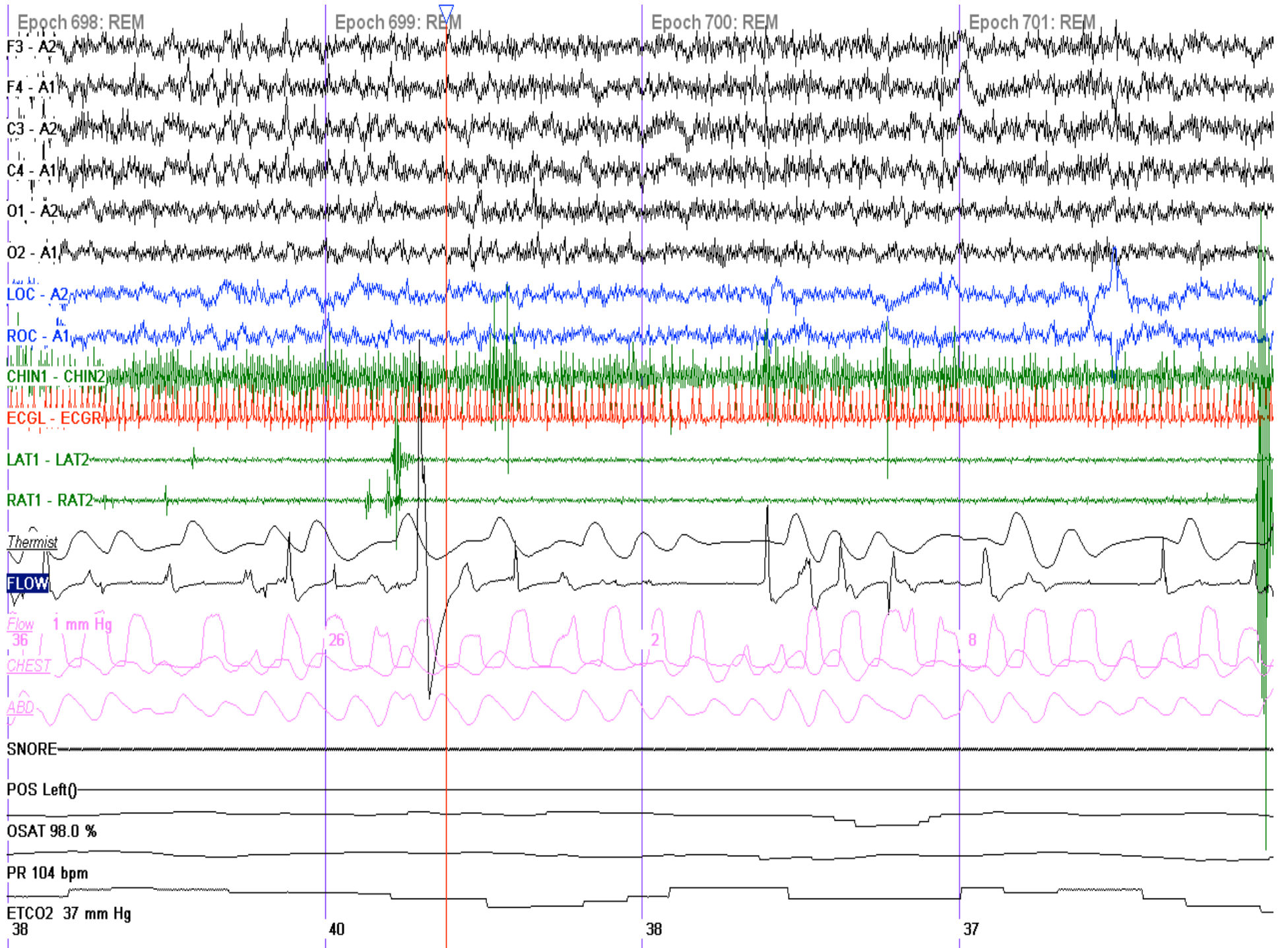
- Periodic breathing is scored when there are >3 episodes of central apnea lasting >3 seconds separated by no more than 20 seconds of normal breathing

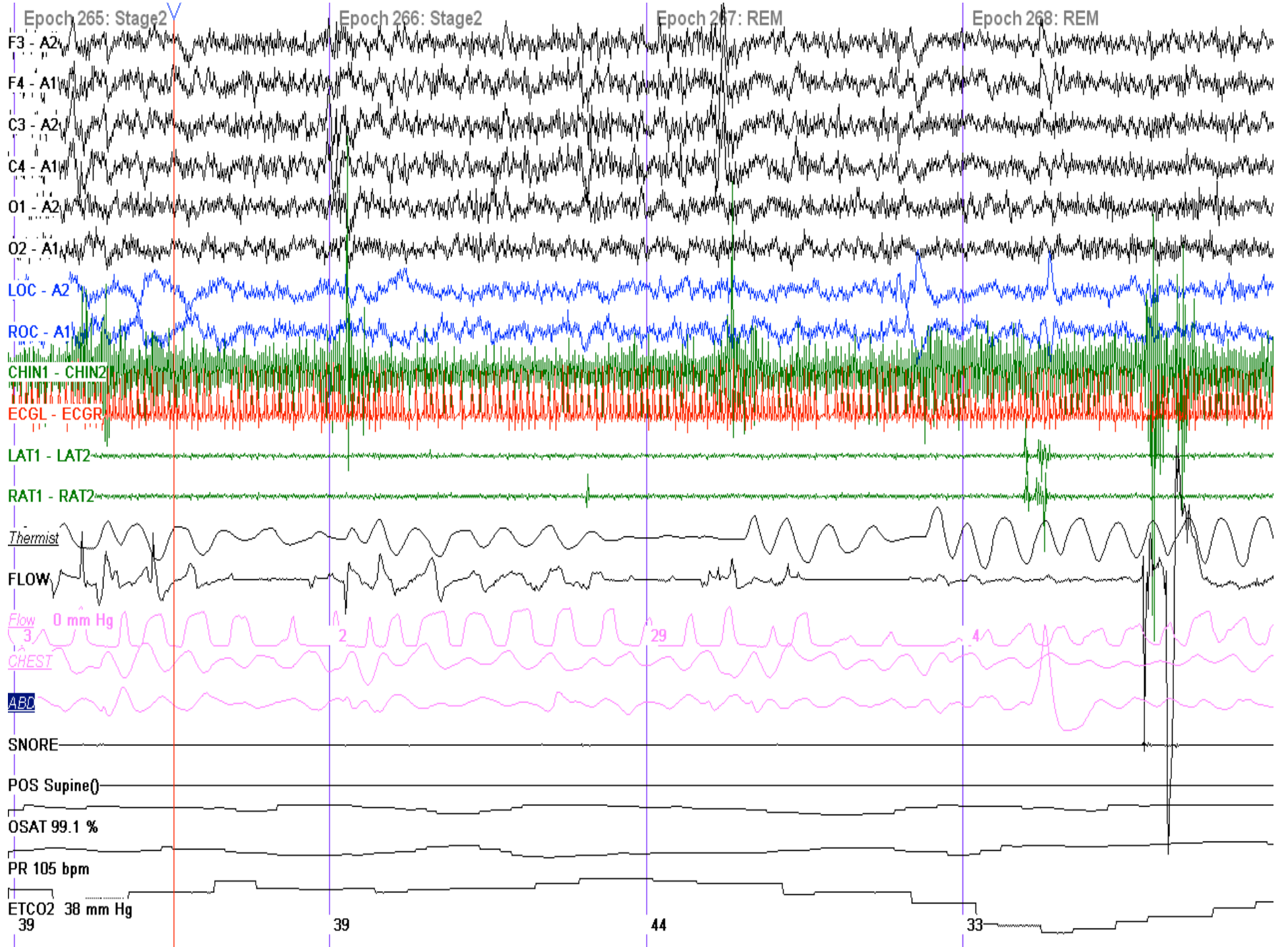


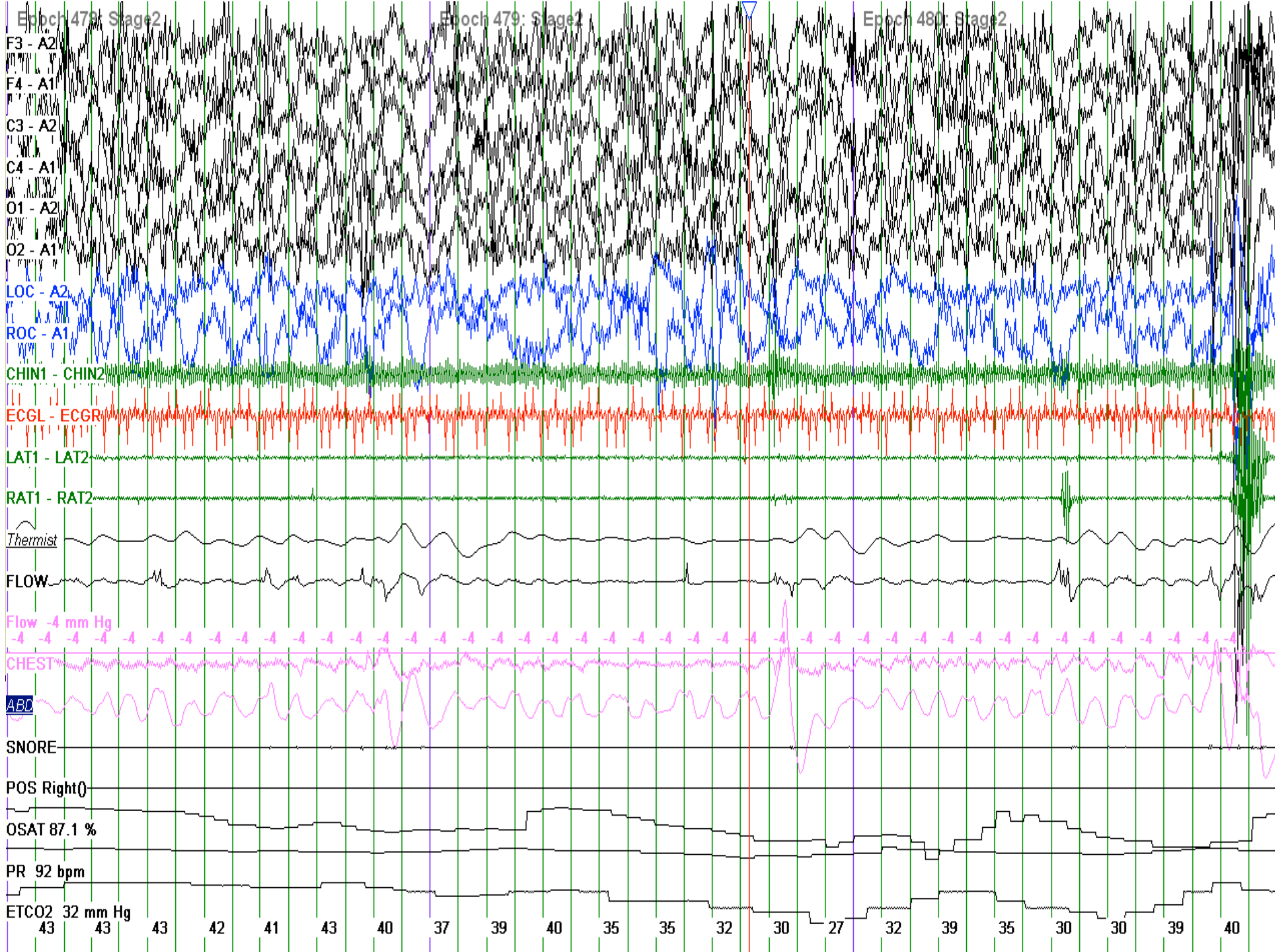
Examples

Kind of the way they will look in your lab

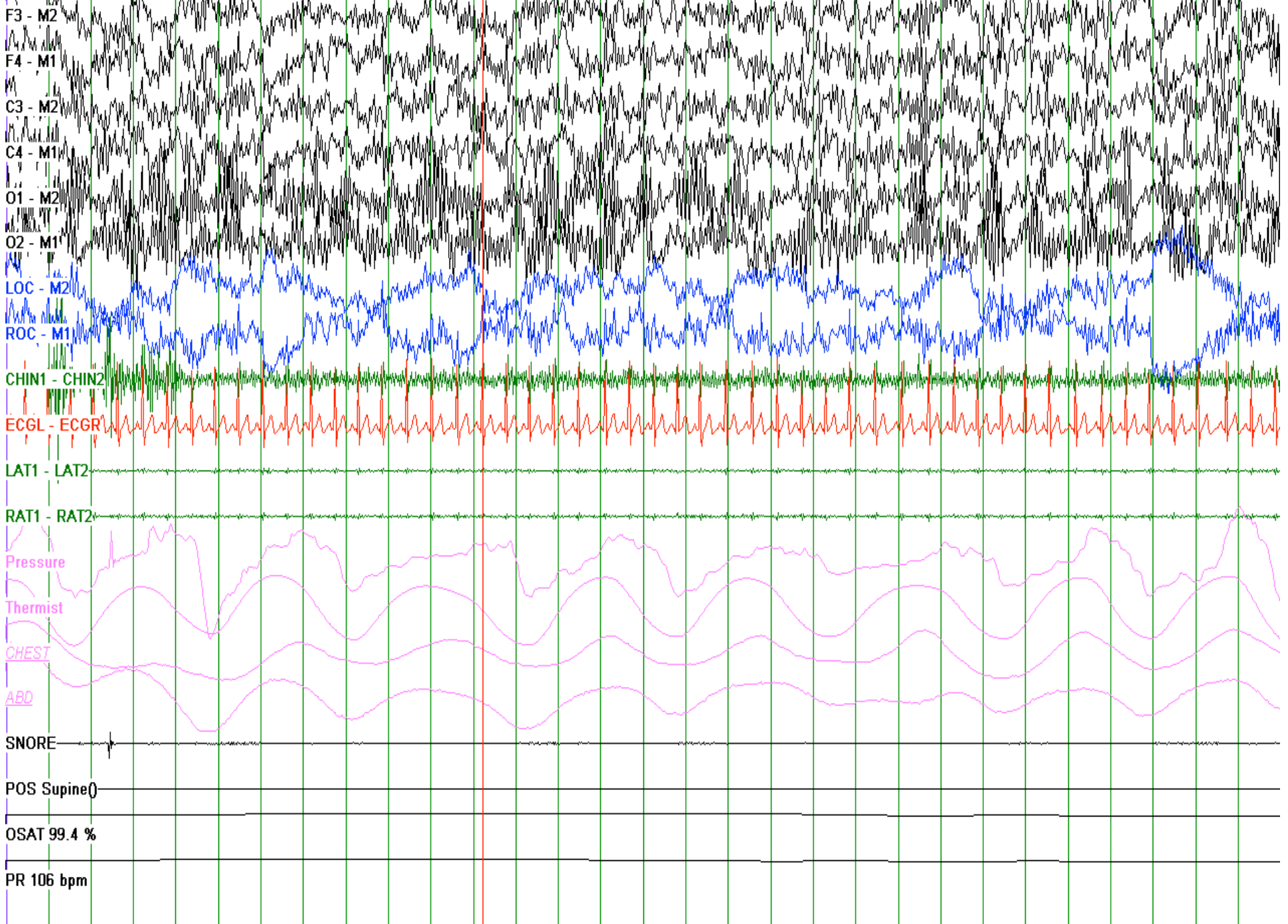




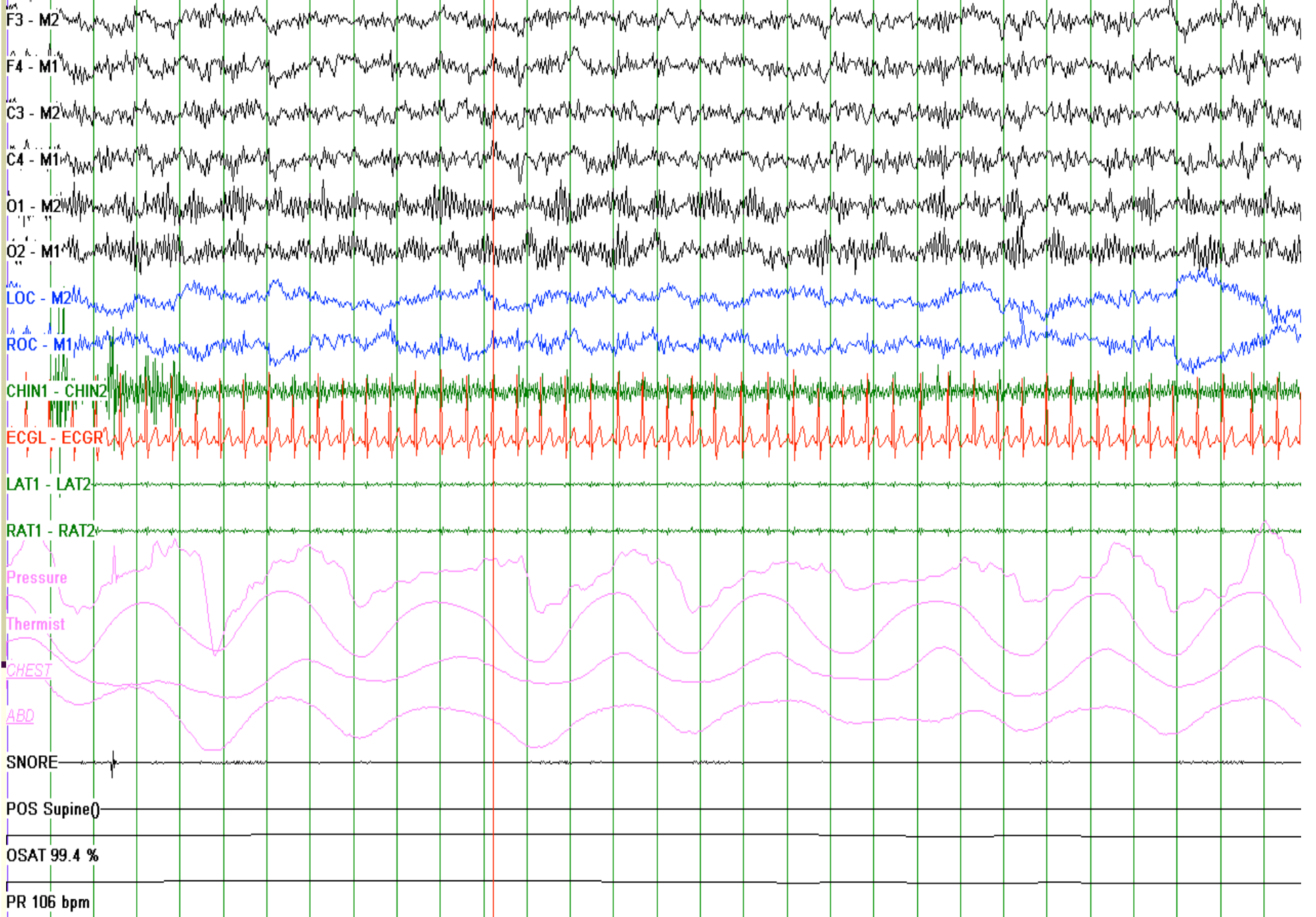




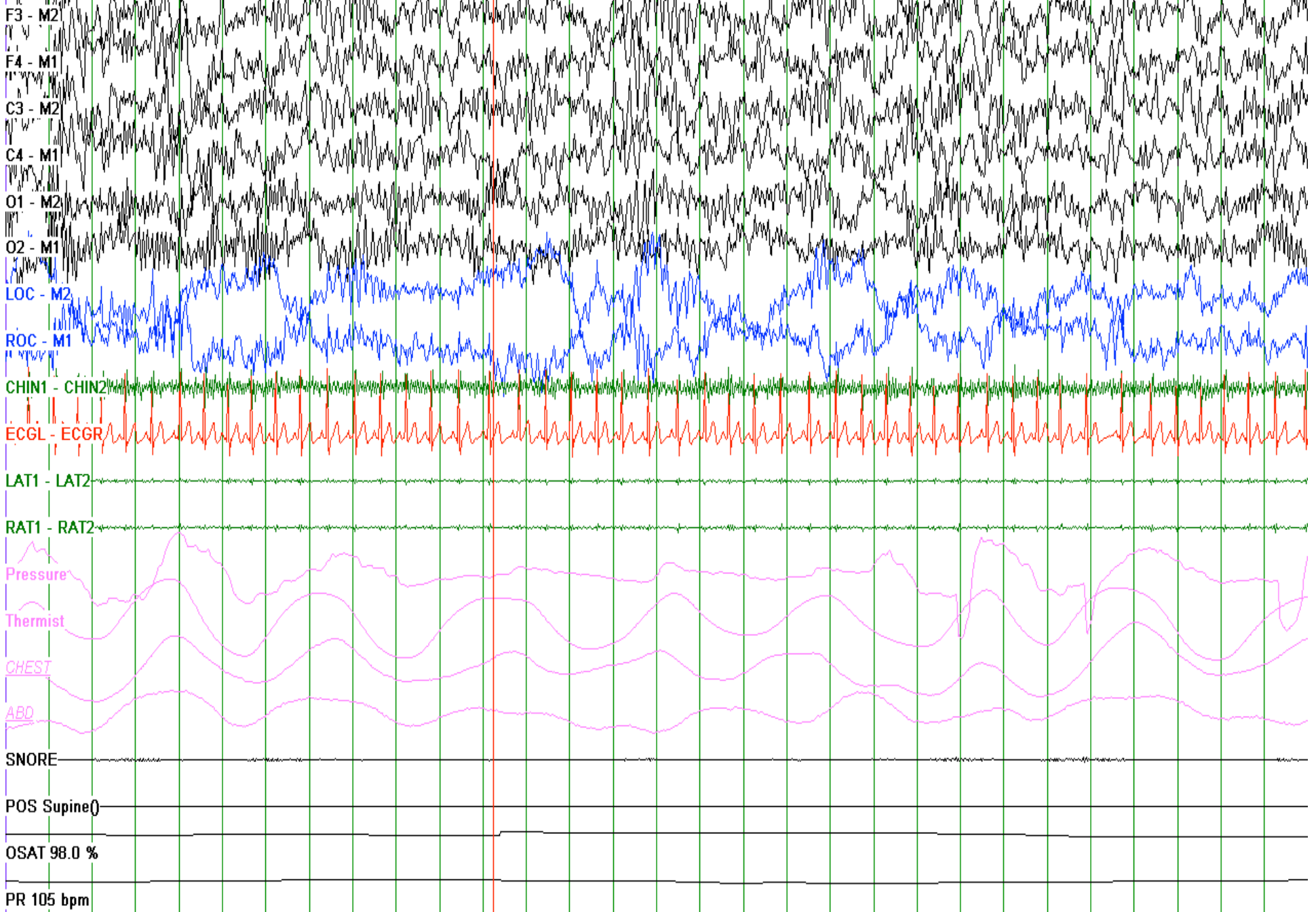
Epoch 52 Wake



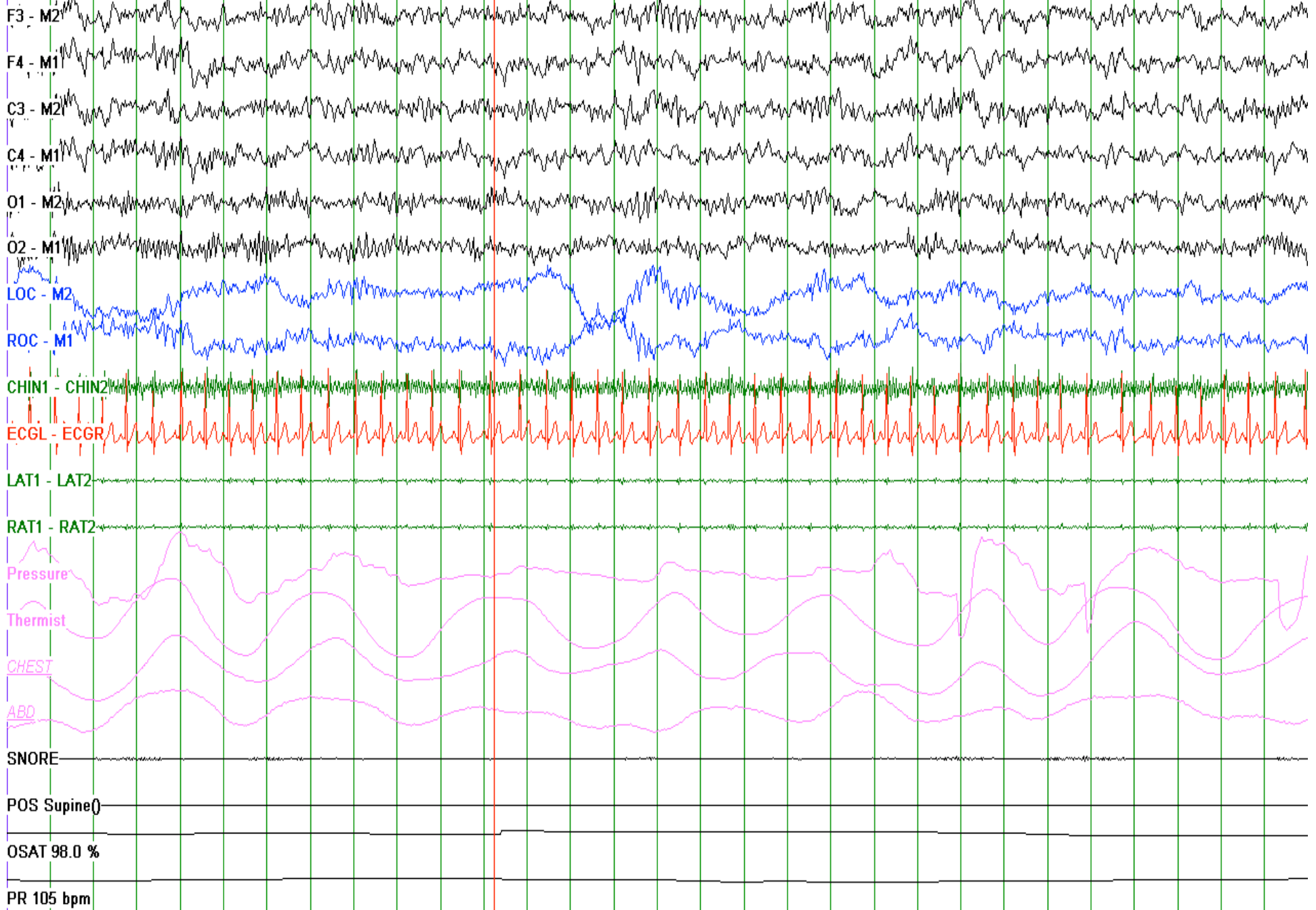
Epoch 52: Wake

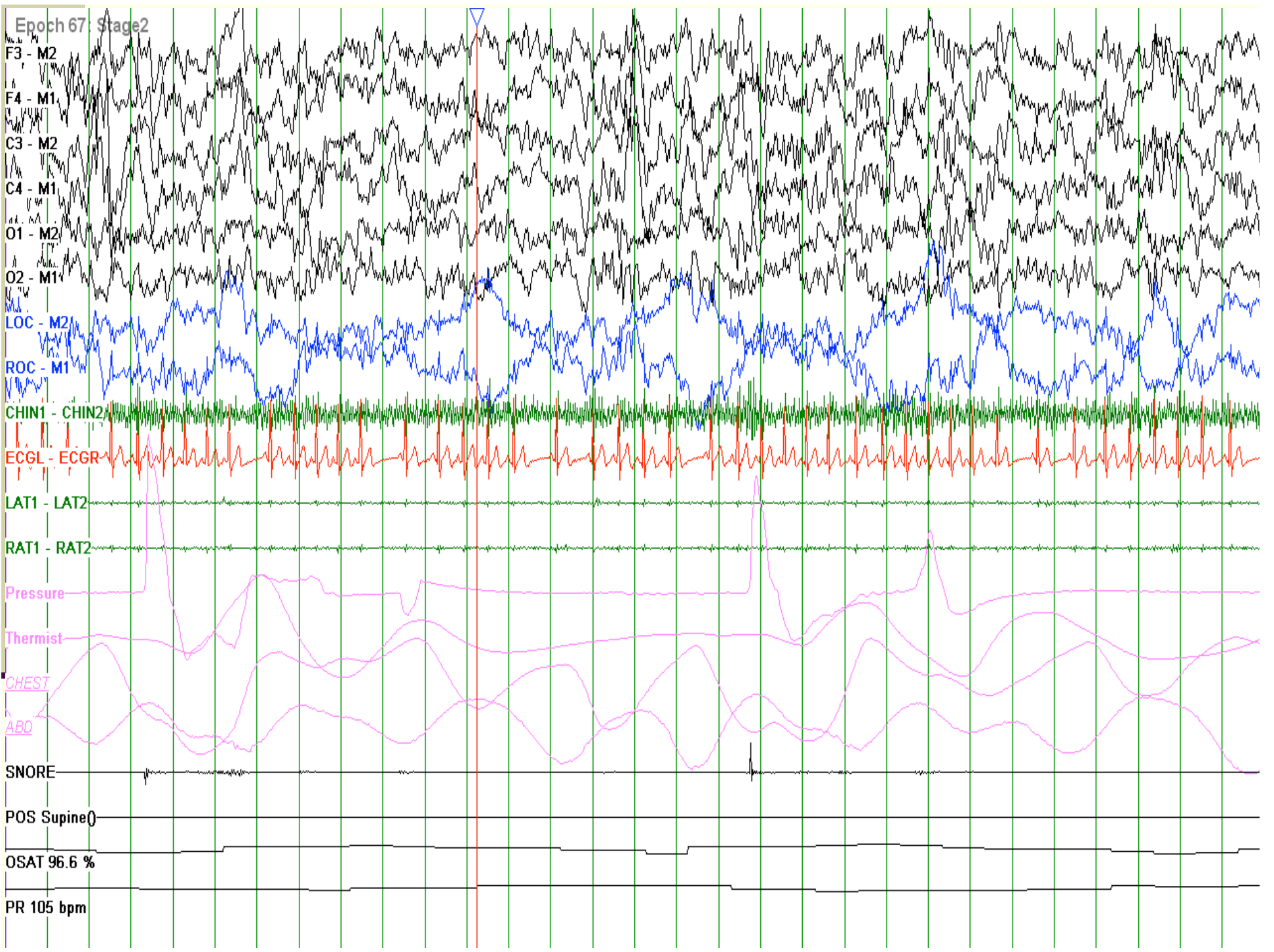


Epoch 55: Stage 2



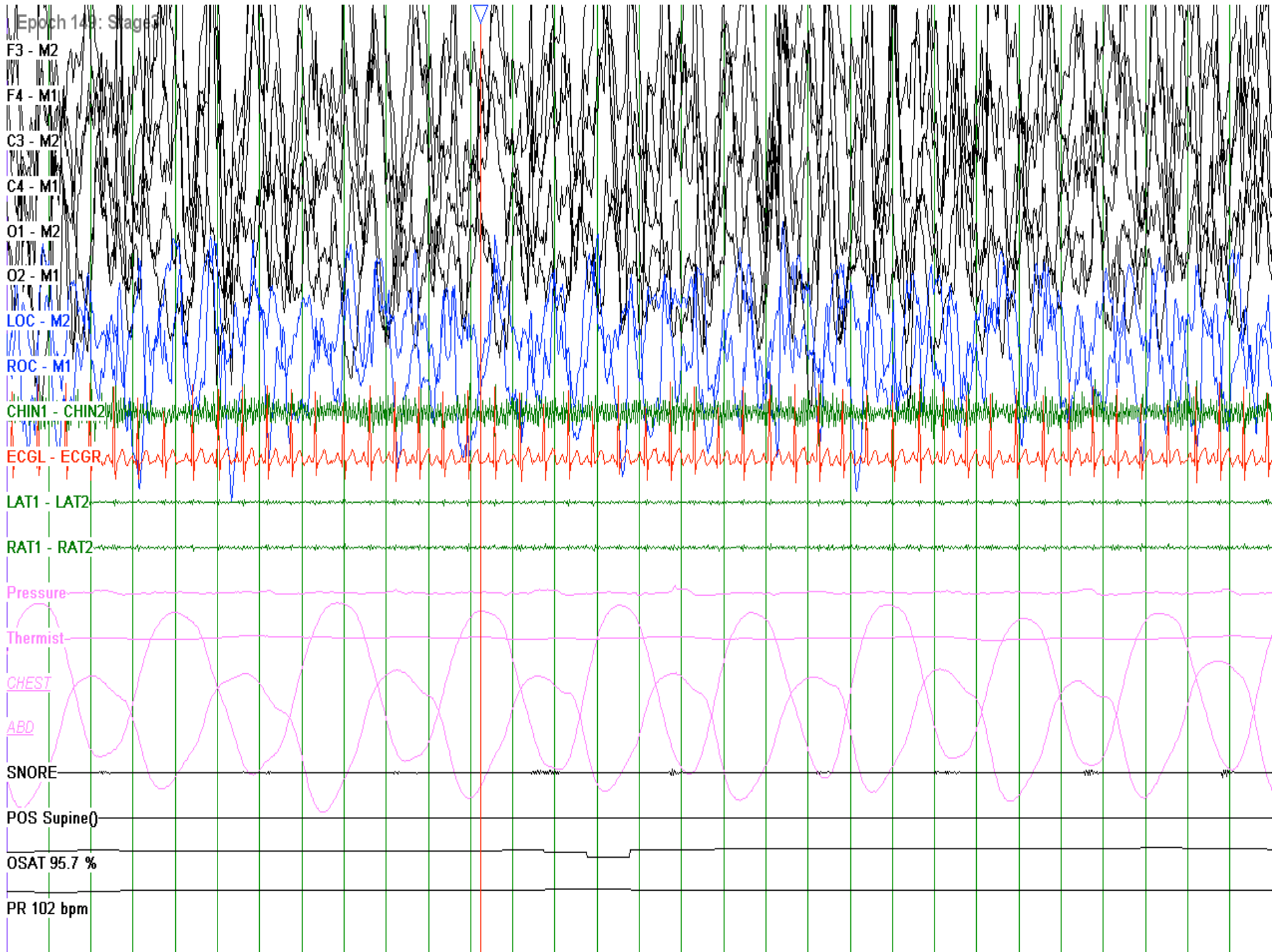
Epoch 55: Stage2





Epoch 67: Stage2

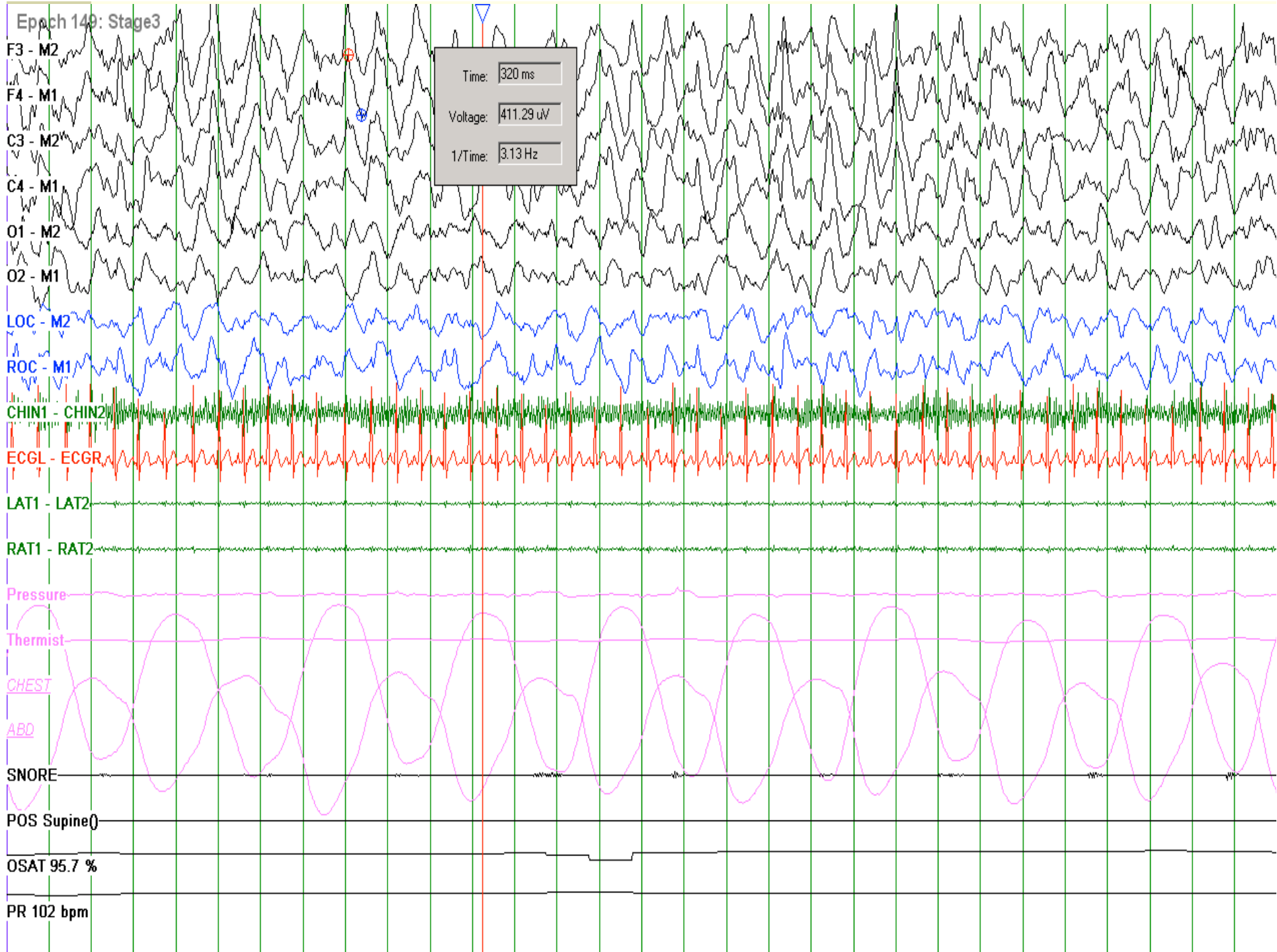


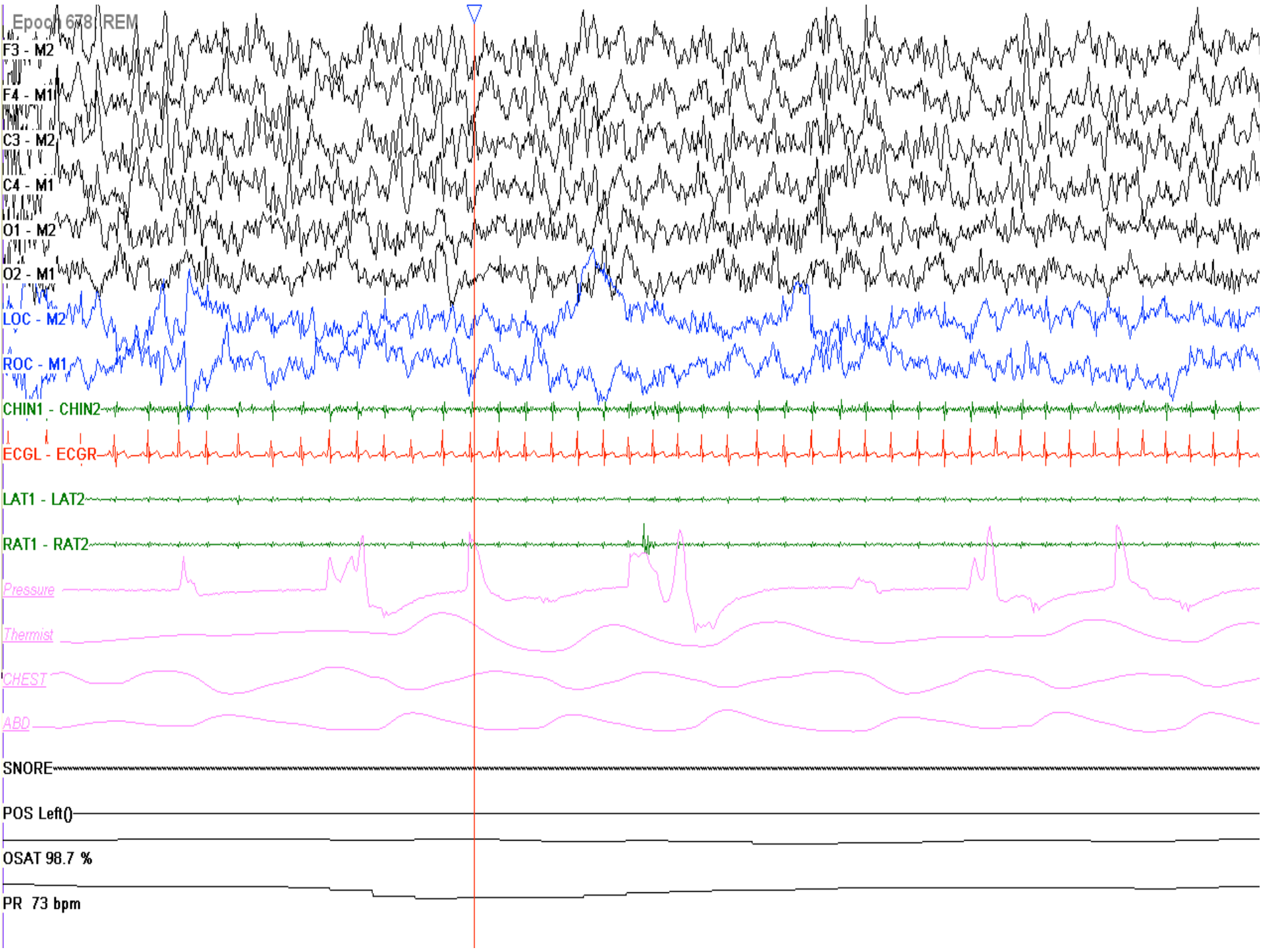


Epoch 149: Stage3

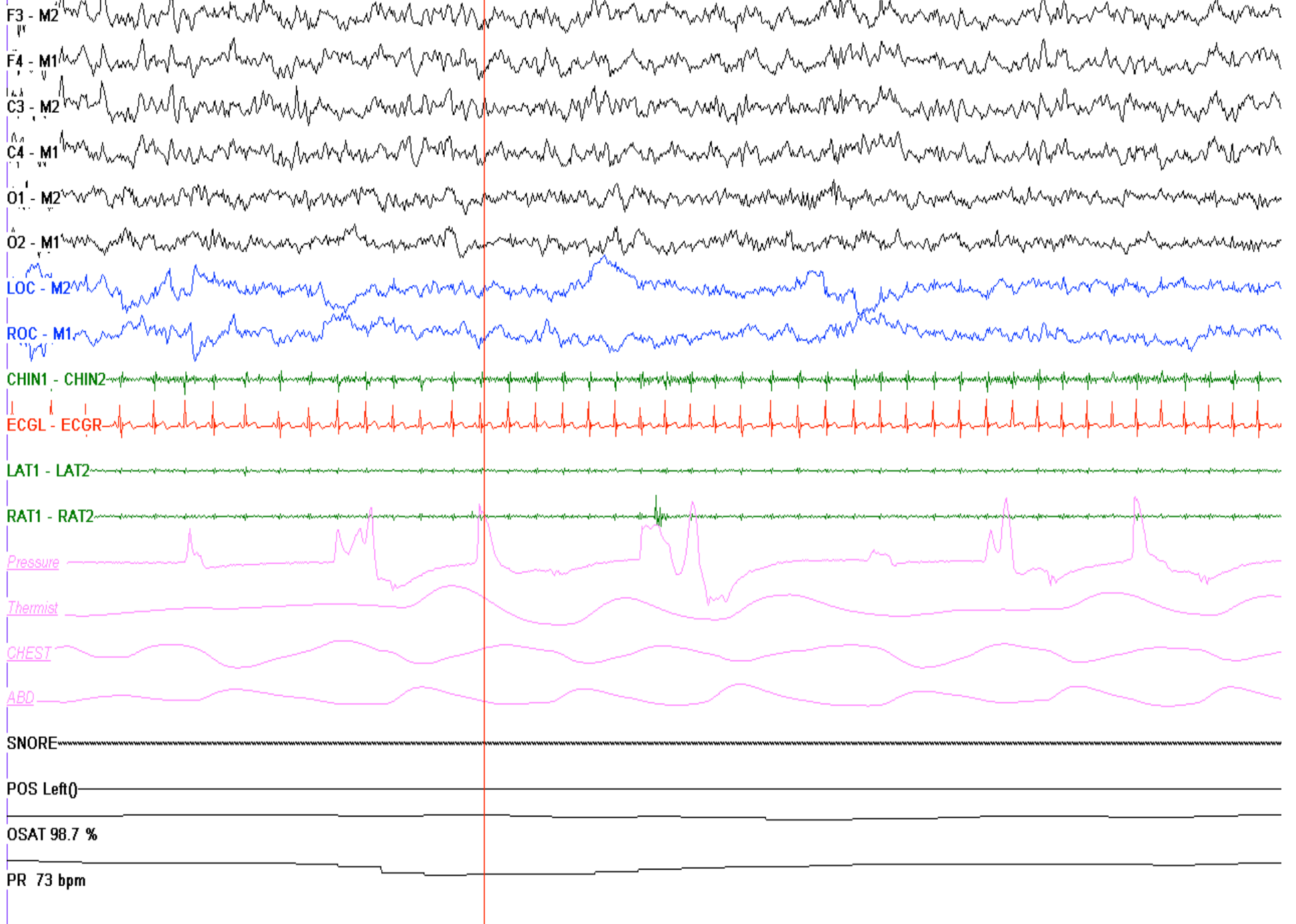
F3 - M2
F4 - M1
C3 - M2
C4 - M1
O1 - M2
O2 - M1
LOC - M2
ROC - M1
CHIN1 - CHIN2
ECGL - ECGR
LAT1 - LAT2
RAT1 - RAT2
Pressure
Thermist
CHEST
ABD
SNORE
POS Supine()
OSAT 95.7 %
PR 102 bpm

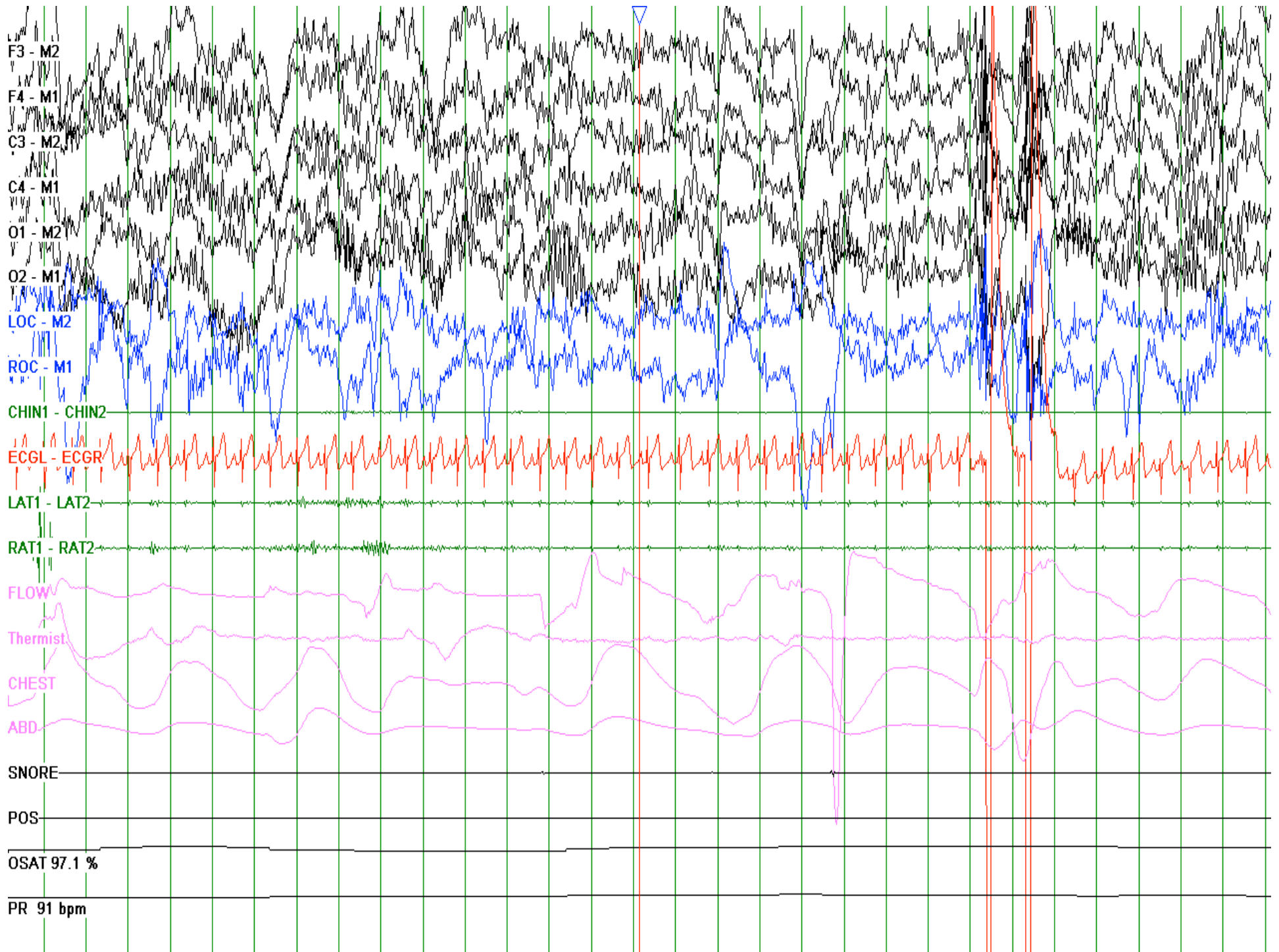
Time: 320 ms
Voltage: 411.29 μ V
1/Time: 3.13 Hz

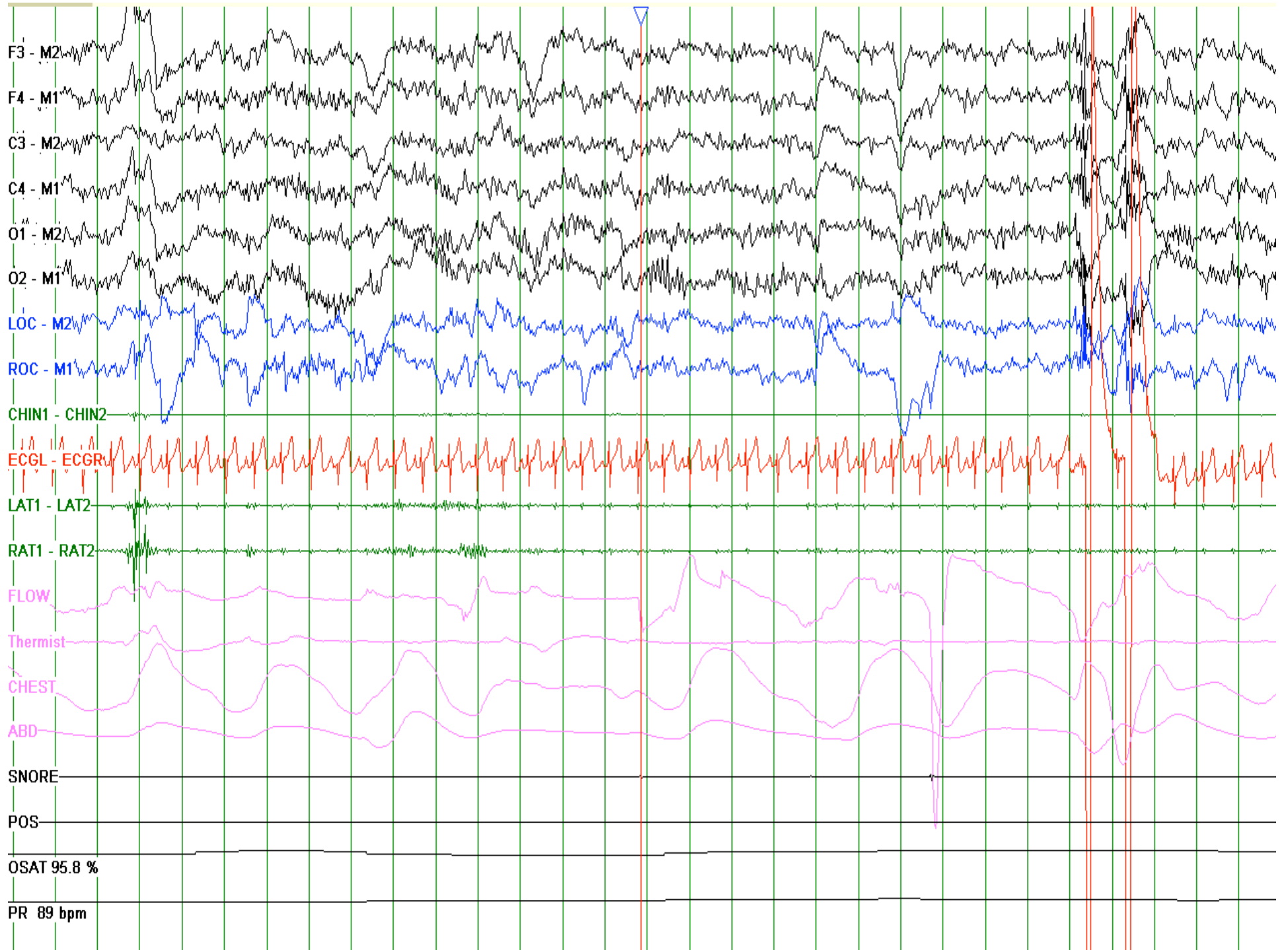




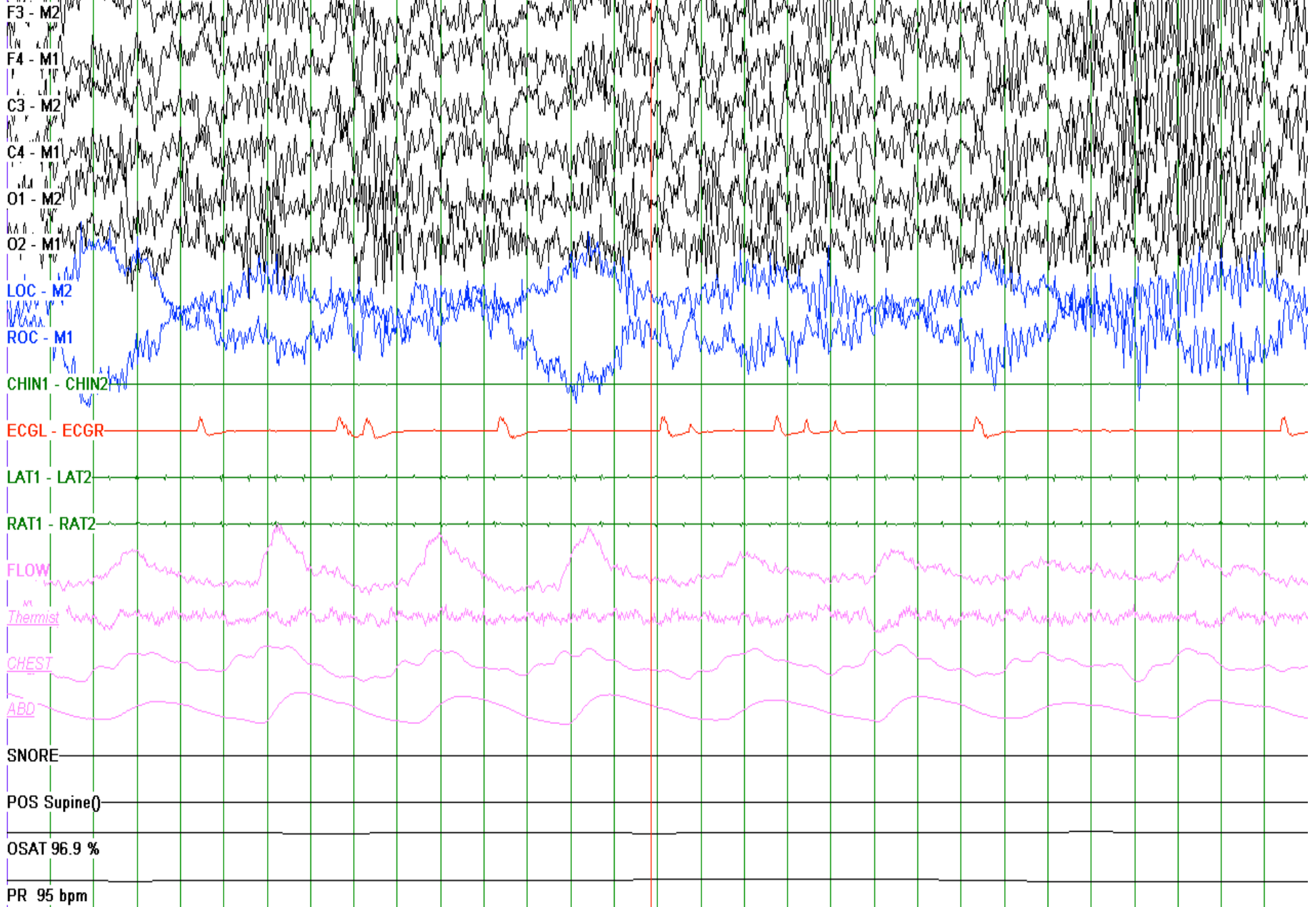
Epoch 678: REM



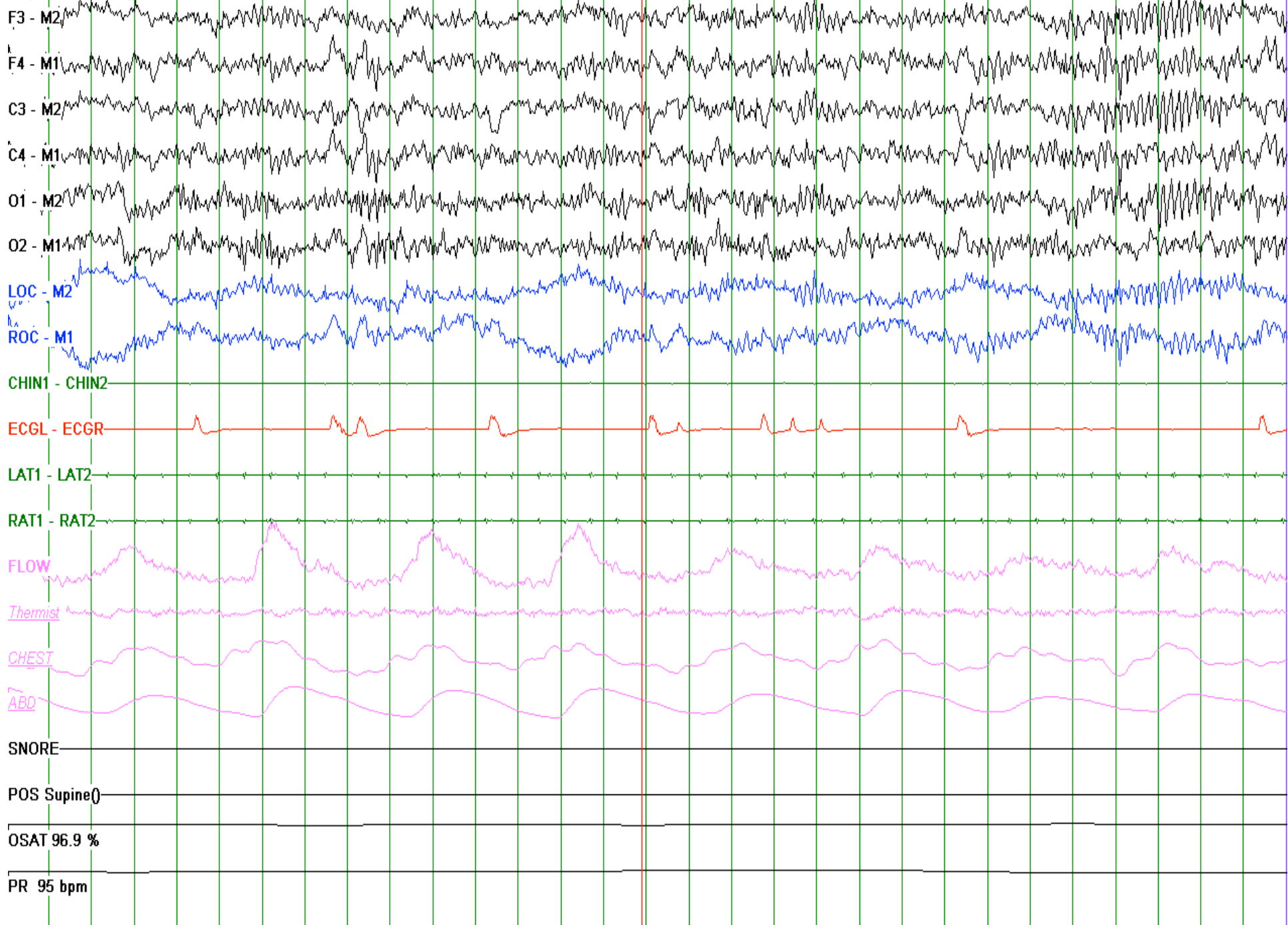




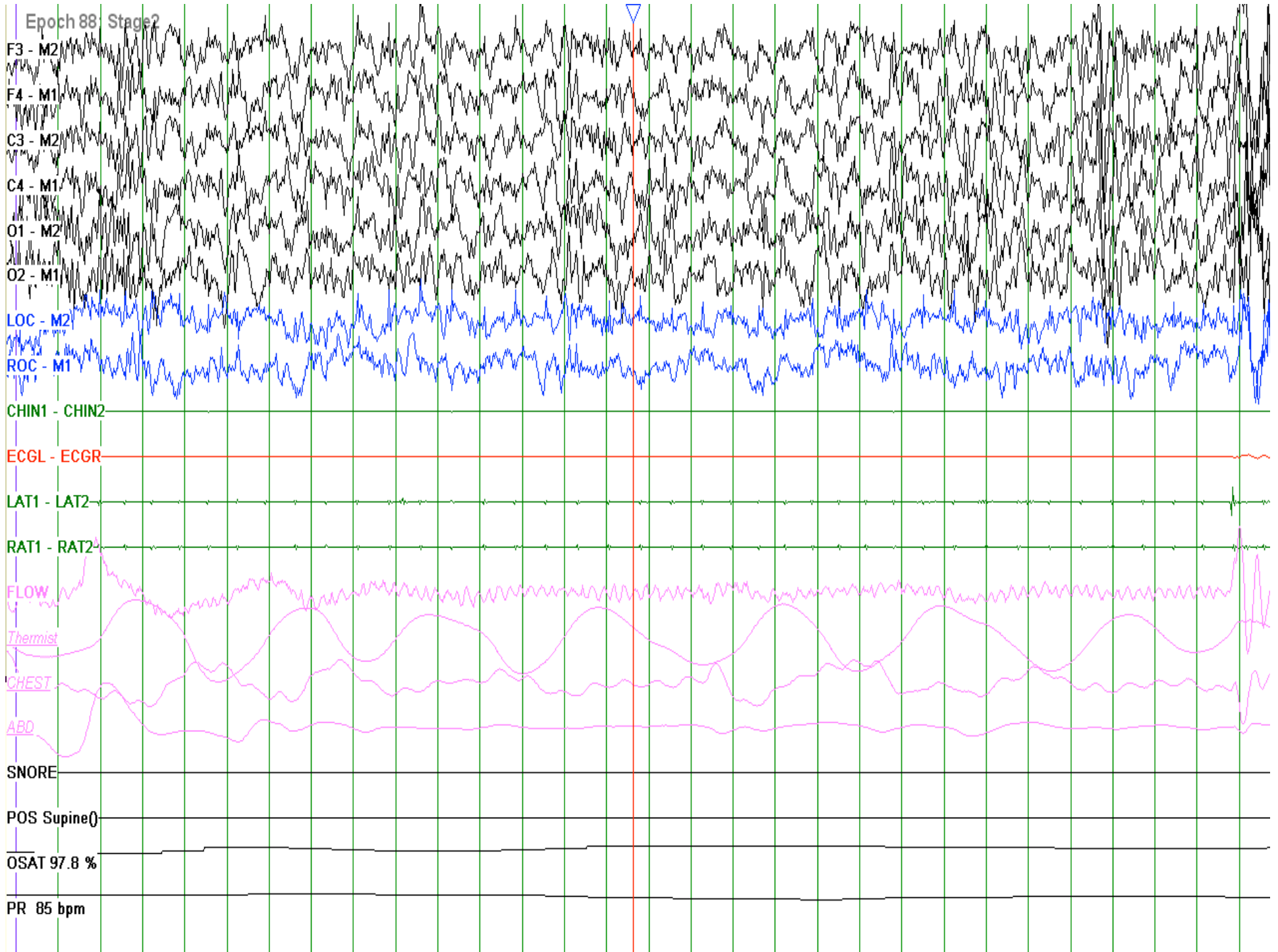
Epoch 58, Stage 1



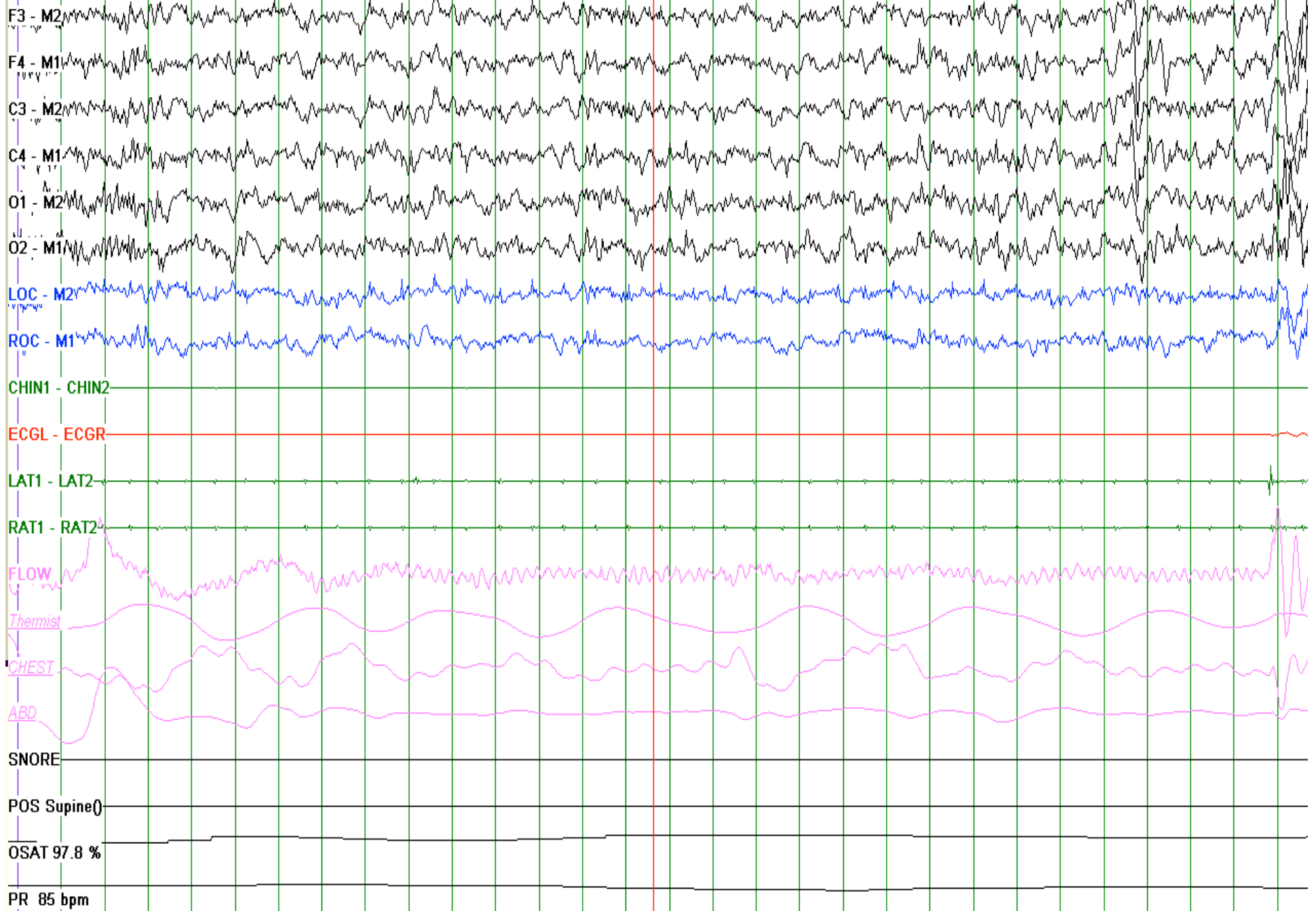
Epoch 58: Stage1



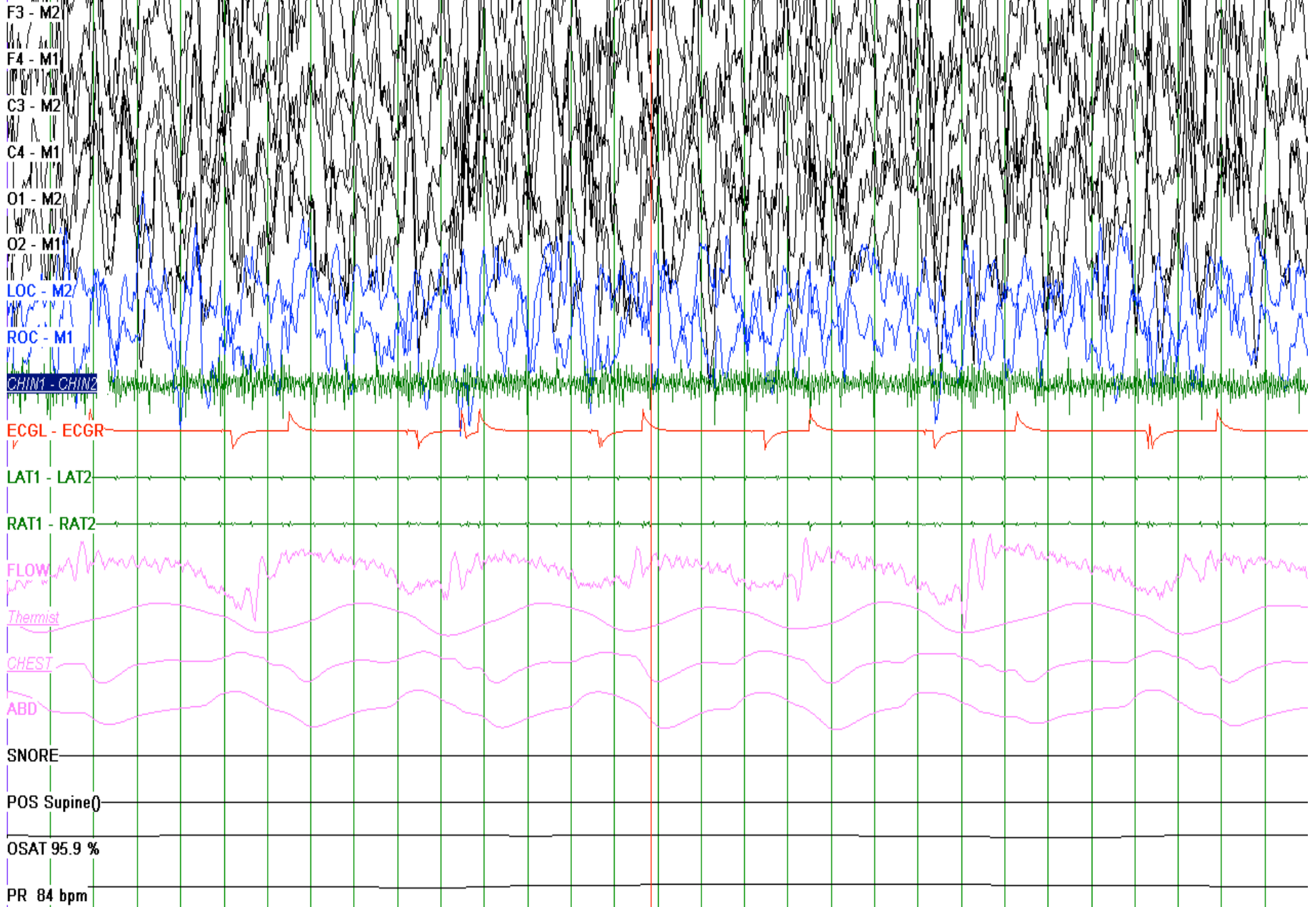
Epoch 88 Stage 2

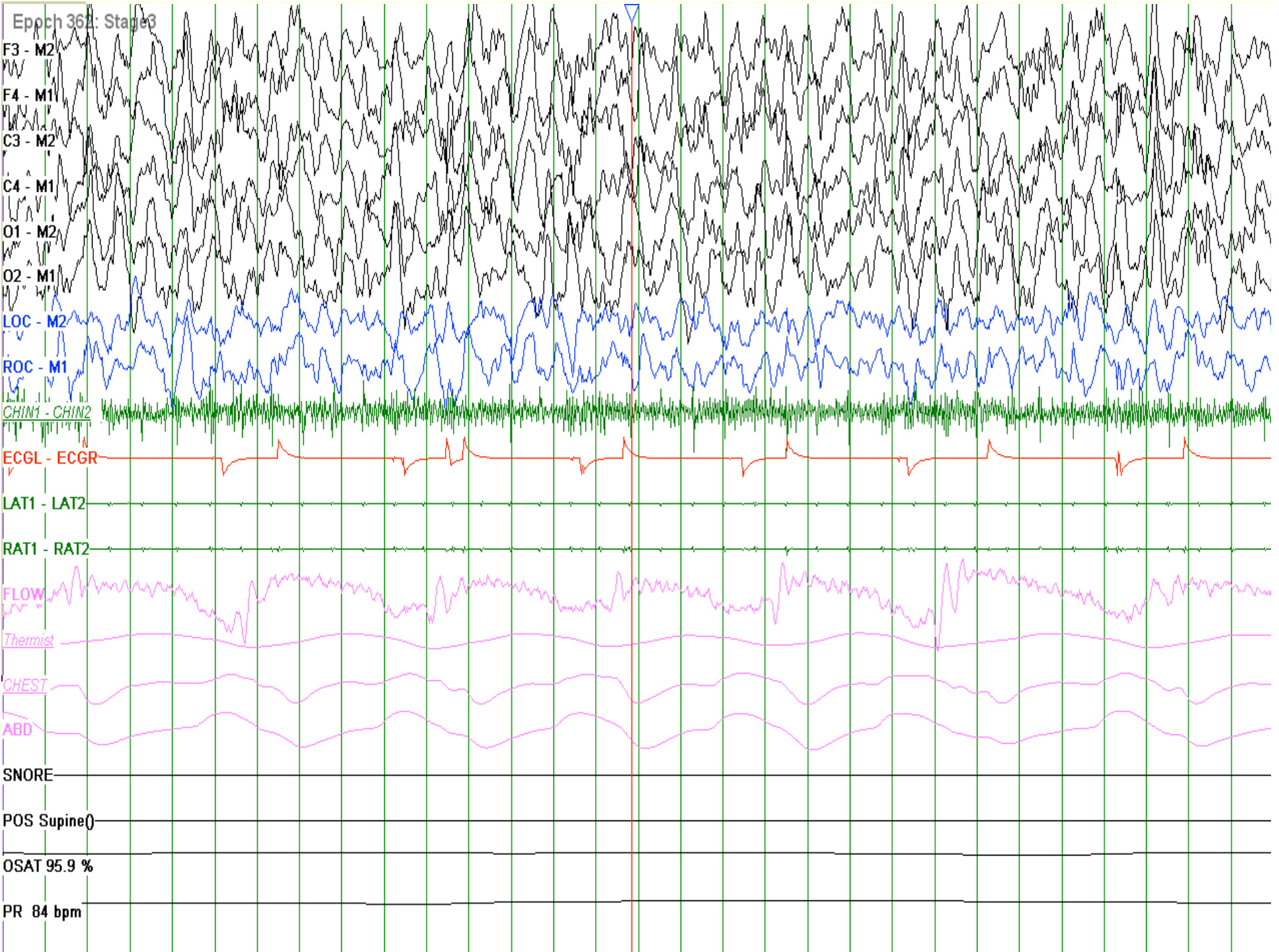


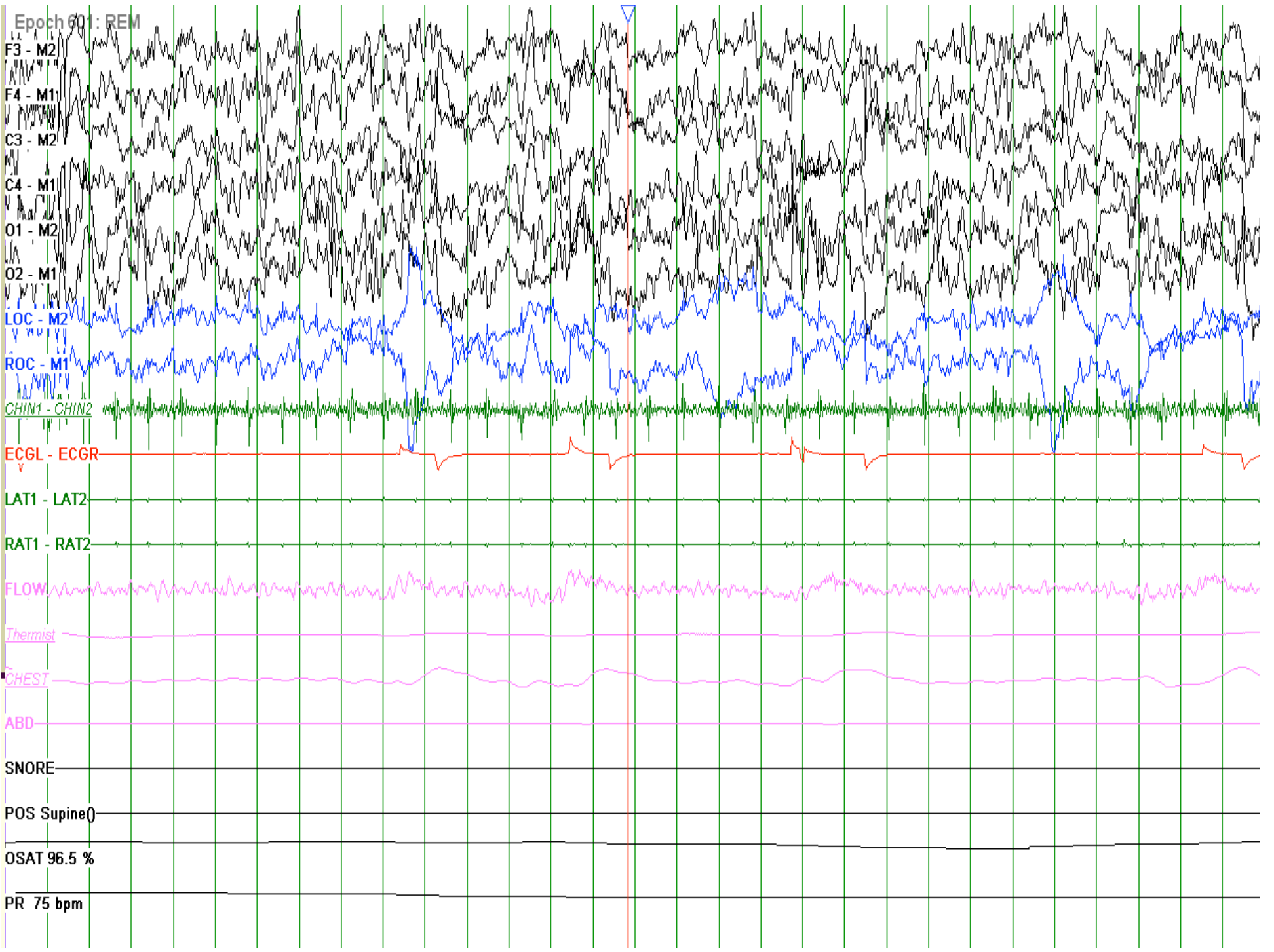
Epoch 88 Stage2



Epoch 362: Stage3







Epoch 601: REM

