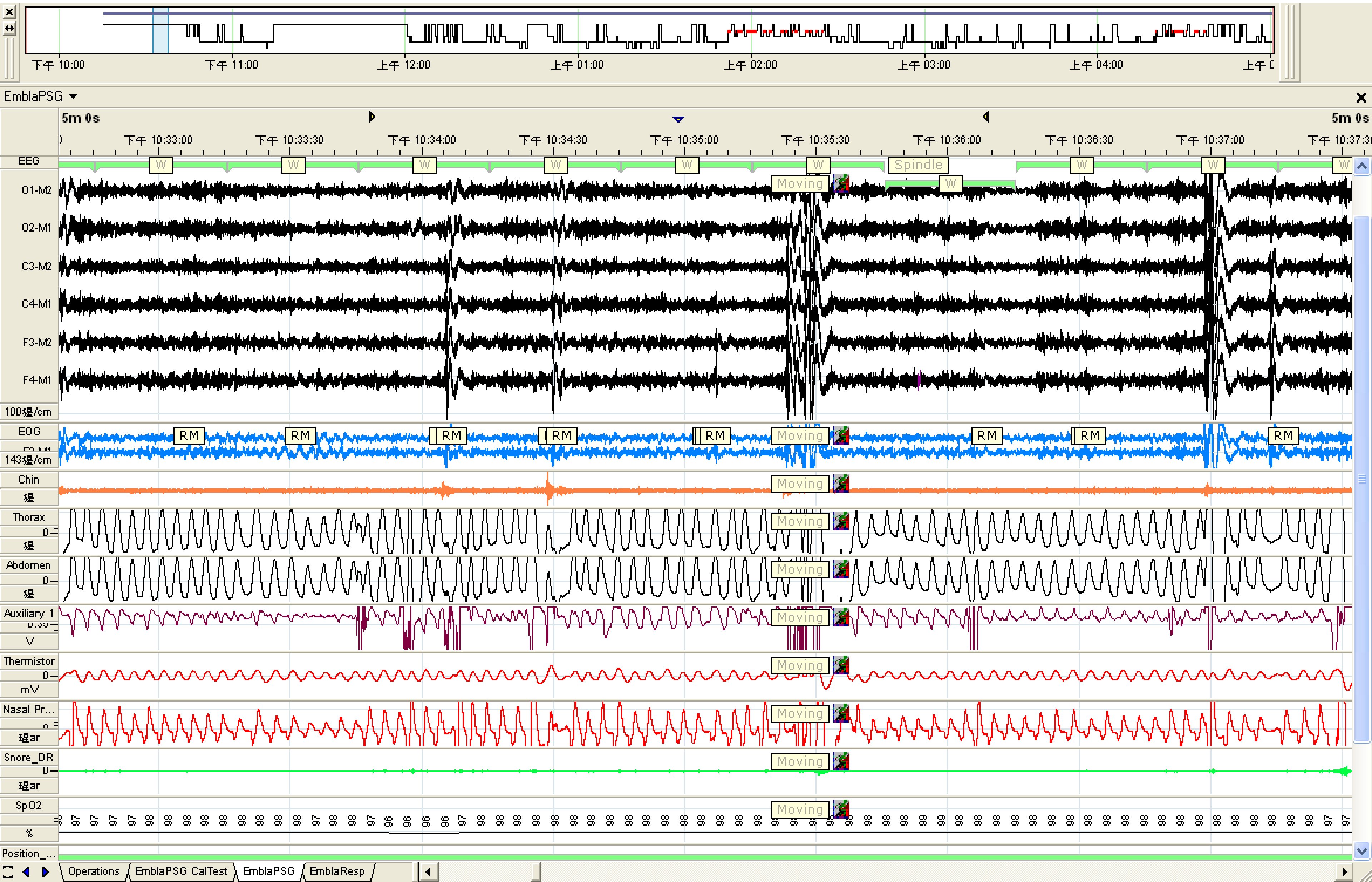
Basic Interpretation of Polysomnography Reports

Albert C. Yang, M.D., Ph.D.

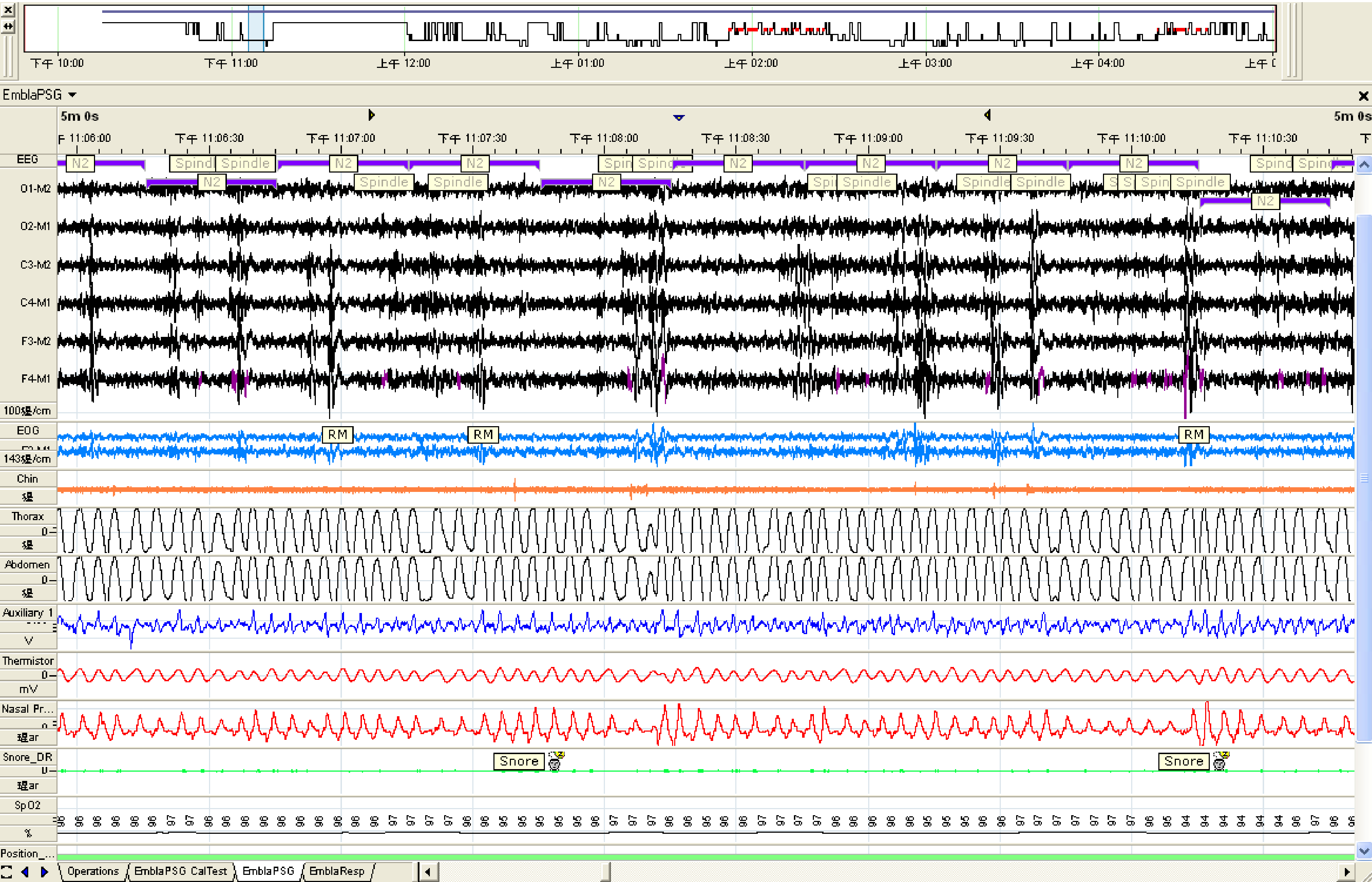
Beth Israel Deaconess Medical Center, Harvard Medical School, USA

Wake



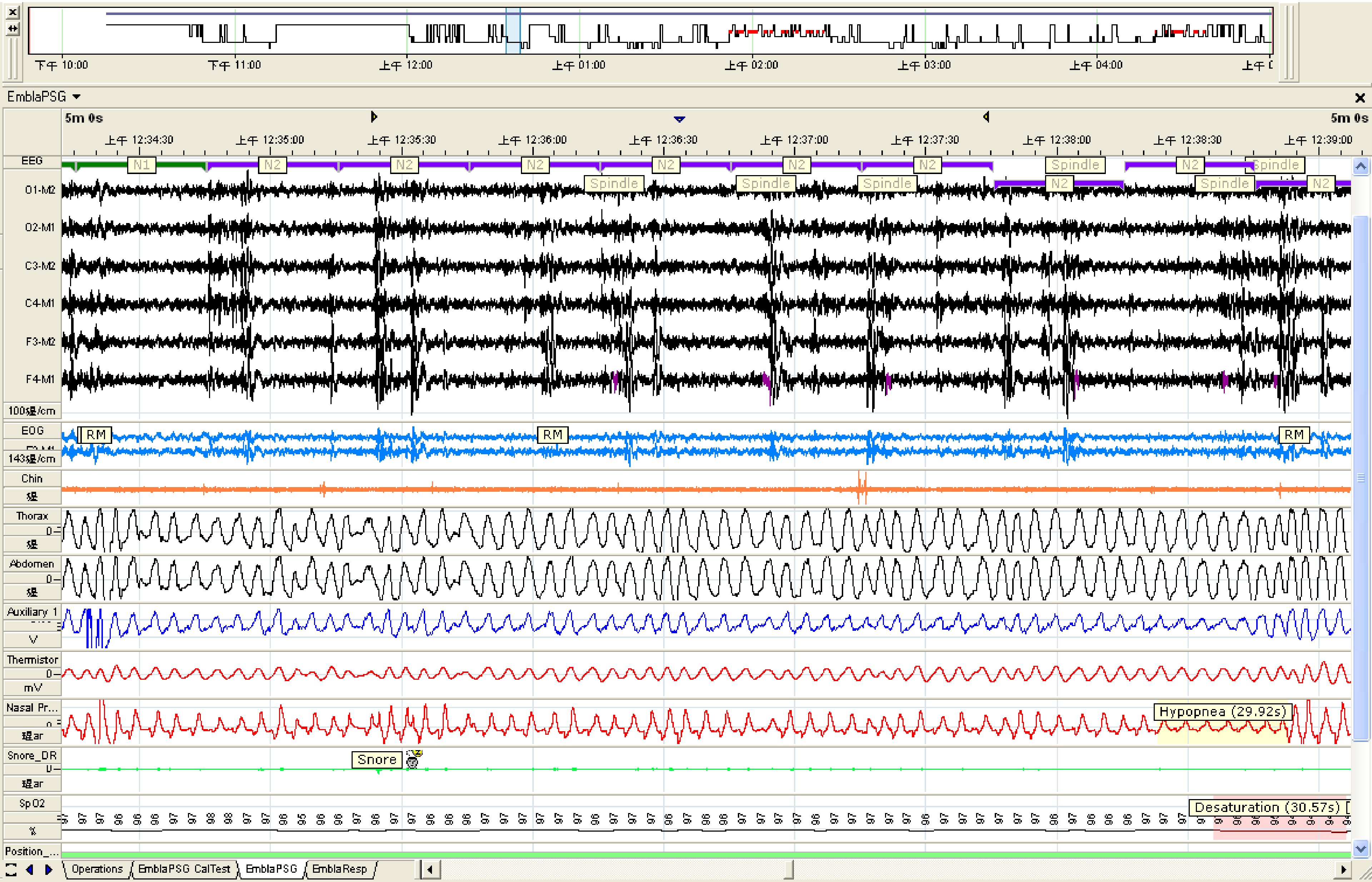
EmblaPSG
5m 0s
EEG
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
Nasal Pr...
Snore_DR
SpO2
Position_...
W
Spindle
Moving
RM
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

N2 Sleep



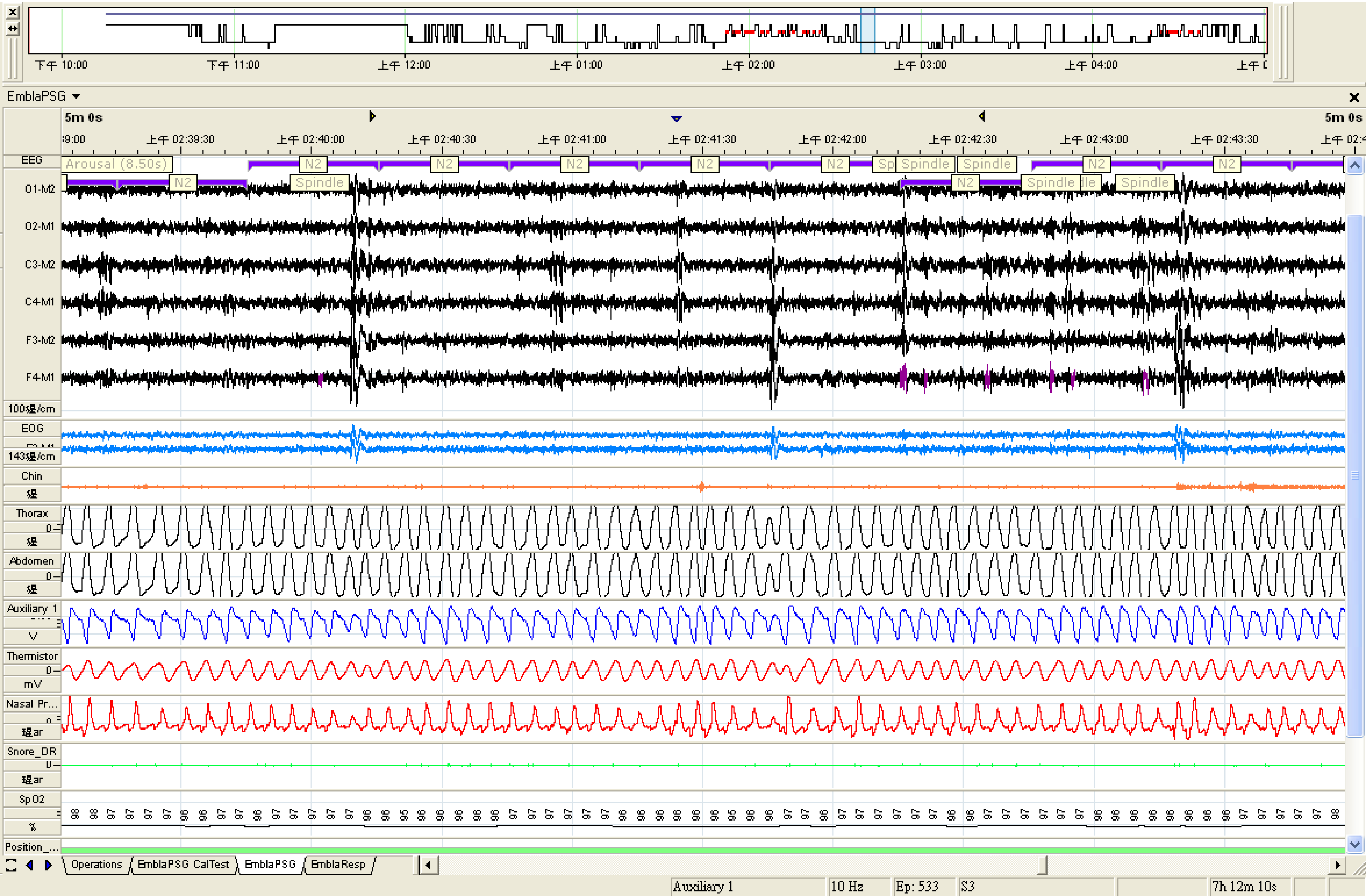
EmblaPSG
5m 0s
EEG
N2
Spindle
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
RM
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
mV
Nasal Pr...
Snore_DR
Snore
SpO2
Position_...
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

N2 Sleep

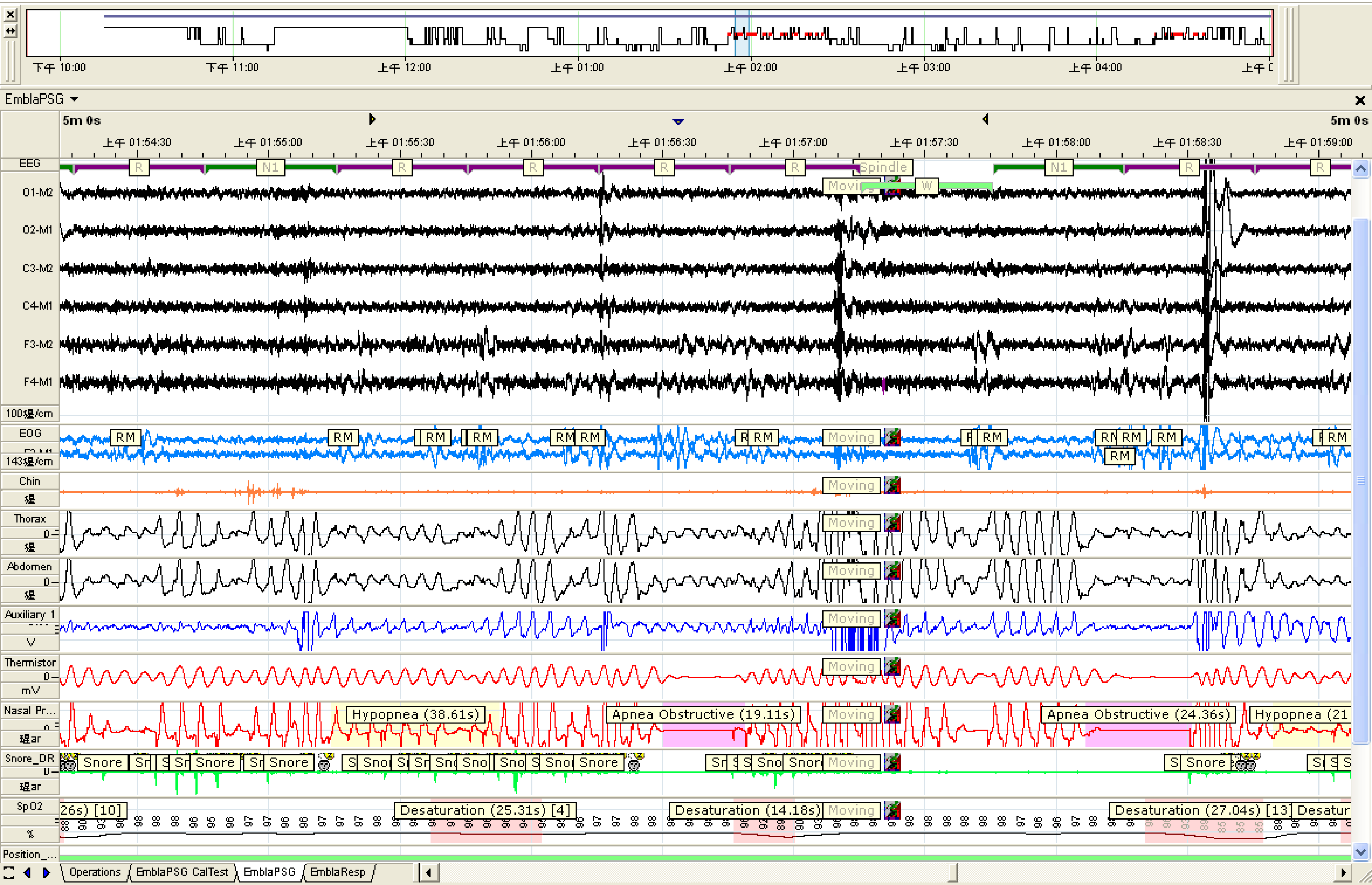

EmblaPSG
5m 0s
上午 12:34:30
上午 12:35:00
上午 12:35:30
上午 12:36:00
上午 12:36:30
上午 12:37:00
上午 12:37:30
上午 12:38:00
上午 12:38:30
上午 12:39:00
EEG
N1
N2
Spindle
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
RM
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
Nasal Pr...
Hypopnea (29.92s)
Snore_DR
Snore
SpO2
Desaturation (30.57s)
Position_...
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

Unstable NREM Sleep

Stable NREM Sleep

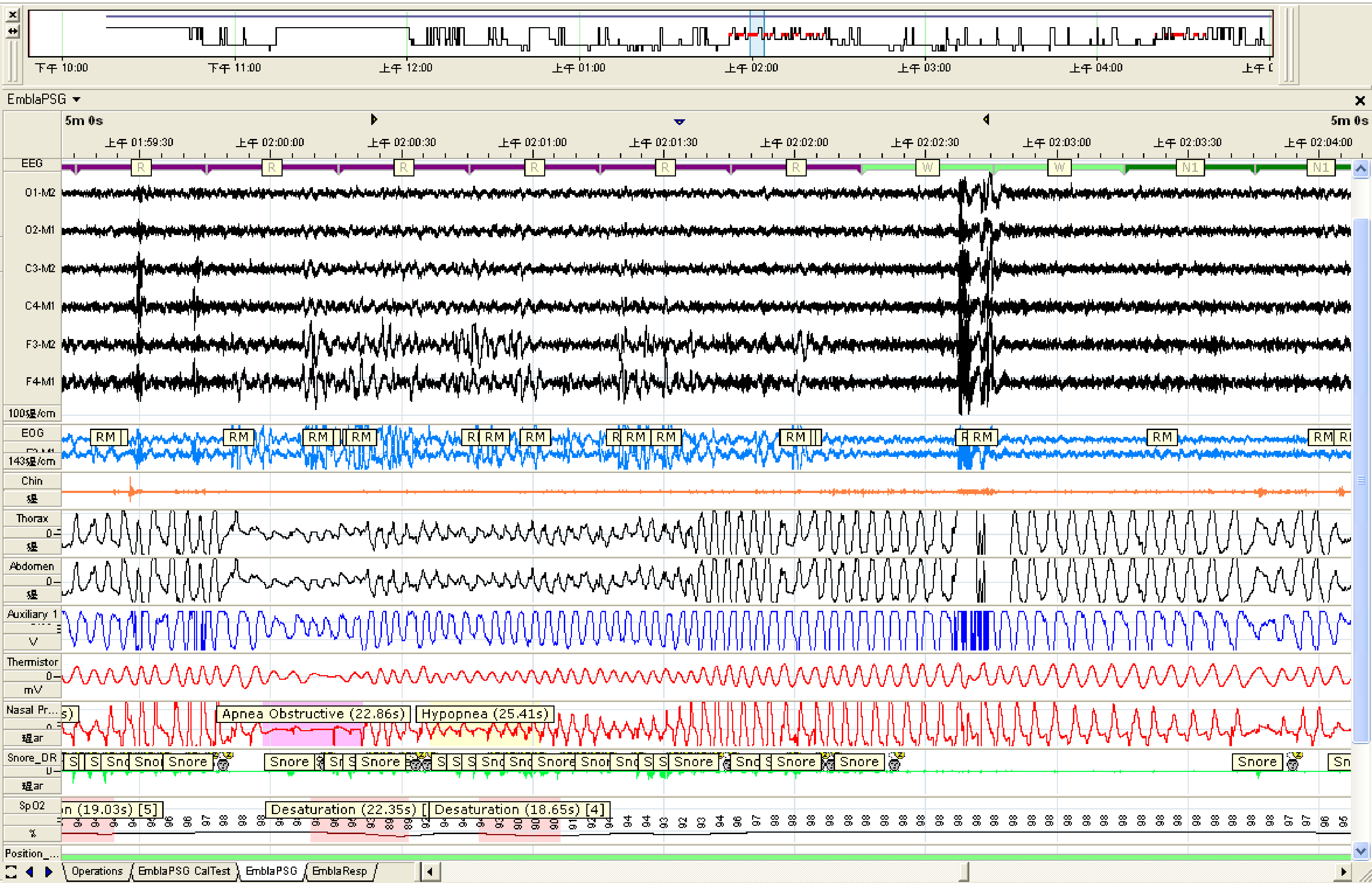


REM



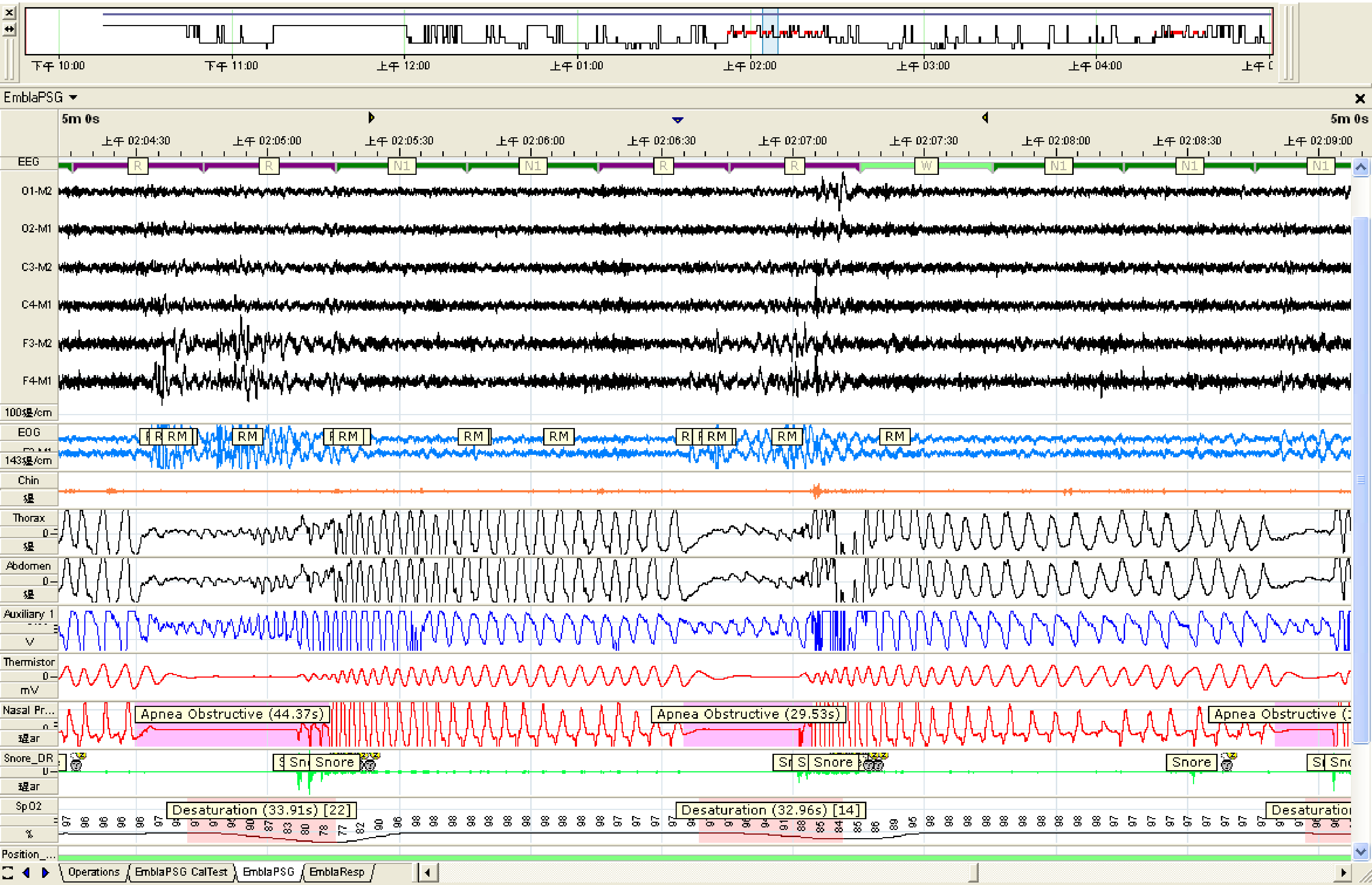
EmblaPSG
5m 0s
上午 01:54:30
上午 01:55:00
上午 01:55:30
上午 01:56:00
上午 01:56:30
上午 01:57:00
上午 01:57:30
上午 01:58:00
上午 01:58:30
上午 01:59:00
EEG
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
Nasal Pr...
Snore_DR
SpO2
Position_...
Spindle
Moving
Hypopnea (38.61s)
Apnea Obstructive (19.11s)
Apnea Obstructive (24.36s)
Desaturation (25.31s) [4]
Desaturation (14.18s)
Desaturation (27.04s) [13]
Snore
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

REM – Apnea



EmblaPSG
5m 0s
EEG
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
Nasal Pr...
Snore_DR
SpO2
Position_...
Apnea Obstructive (22.86s)
Hypopnea (25.41s)
Desaturation (22.35s)
Desaturation (18.65s) [4]
Snore
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

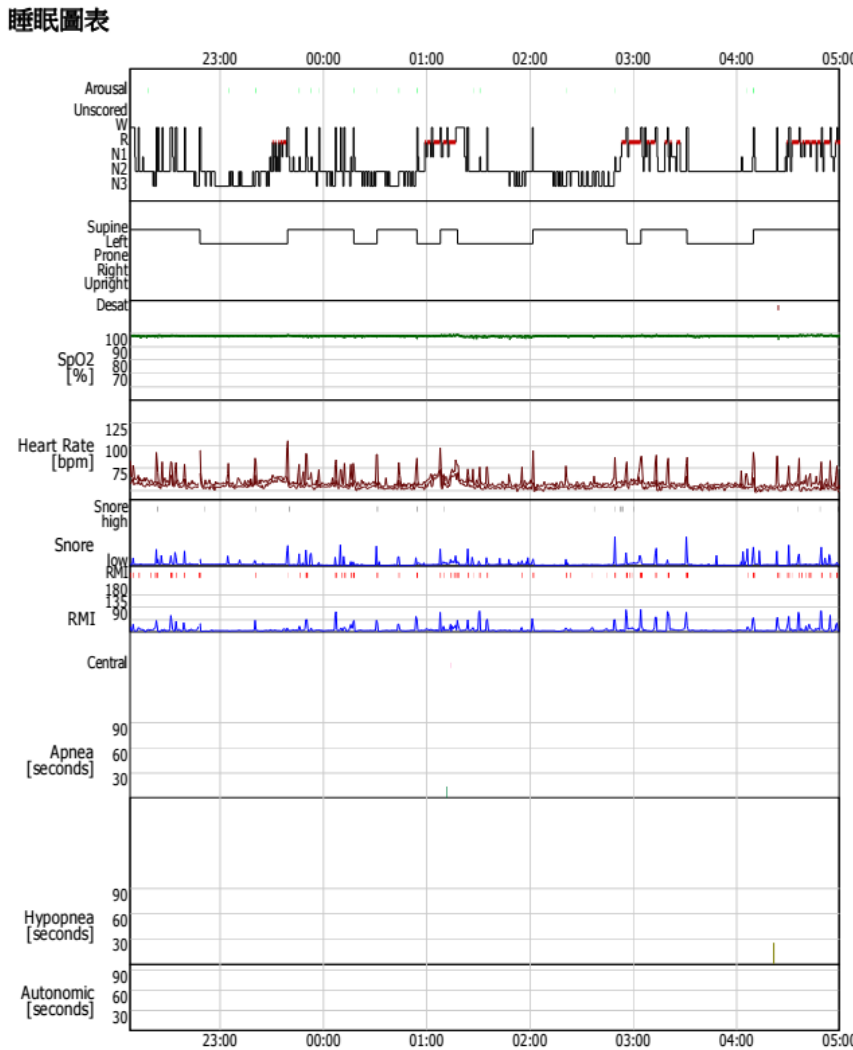
REM - Apnea

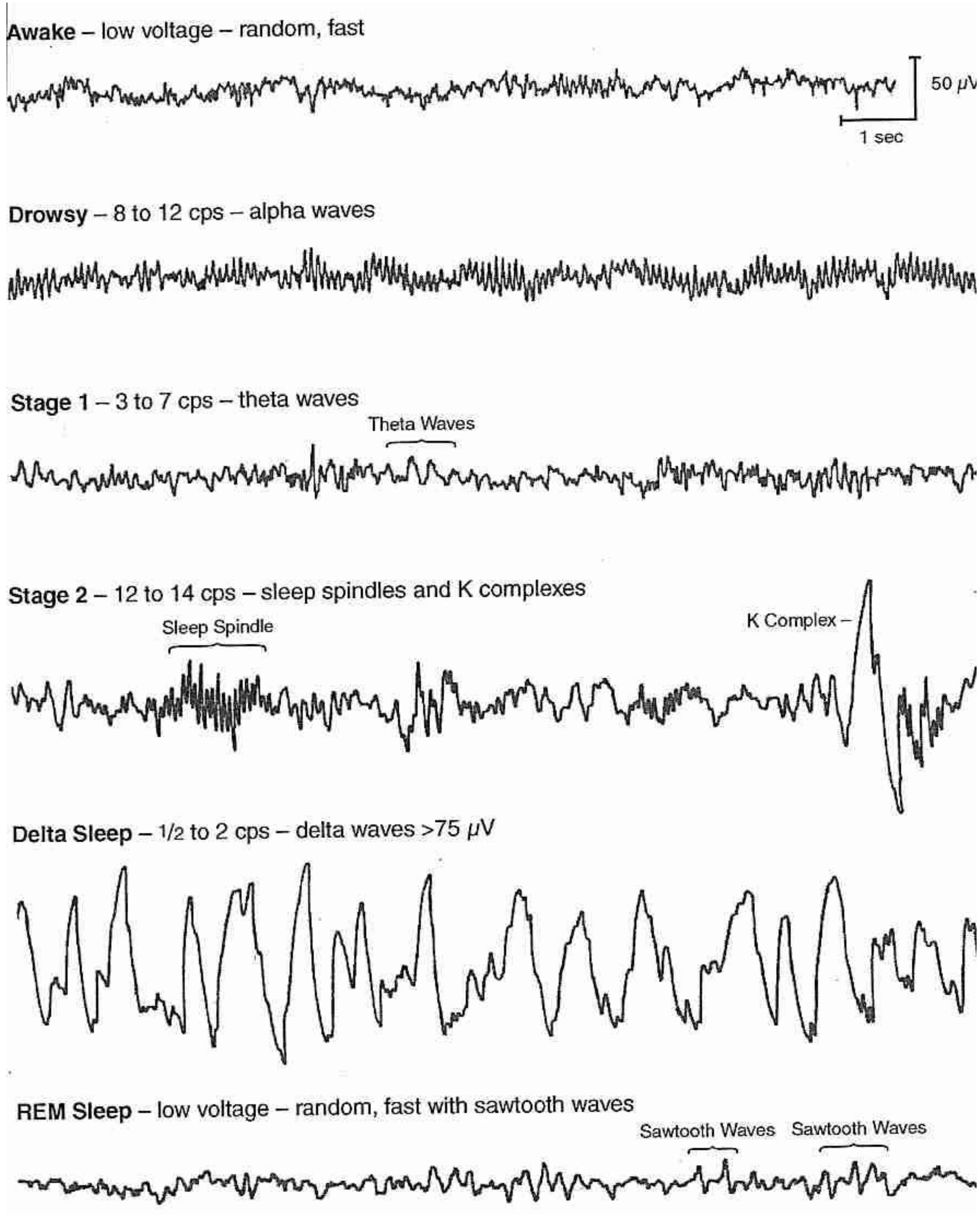


EmblaPSG
5m 0s
EEG
O1-M2
O2-M1
C3-M2
C4-M1
F3-M2
F4-M1
EOG
Chin
Thorax
Abdomen
Auxiliary 1
Thermistor
Nasal Pr...
Snore_DR
SpO2
Position_...
Apnea Obstructive (44.37s)
Apnea Obstructive (29.53s)
Desaturation (33.91s) [22]
Desaturation (32.96s) [14]
Snore
Operations
EmblaPSG CalTest
EmblaPSG
EmblaResp

Summary Graph of Sleep Recording

- EEG Staging
- Respiration / Sleep Position
- Limb Movement
- Autonomic Functions and Cardio-pulmonary Coupling Analysis

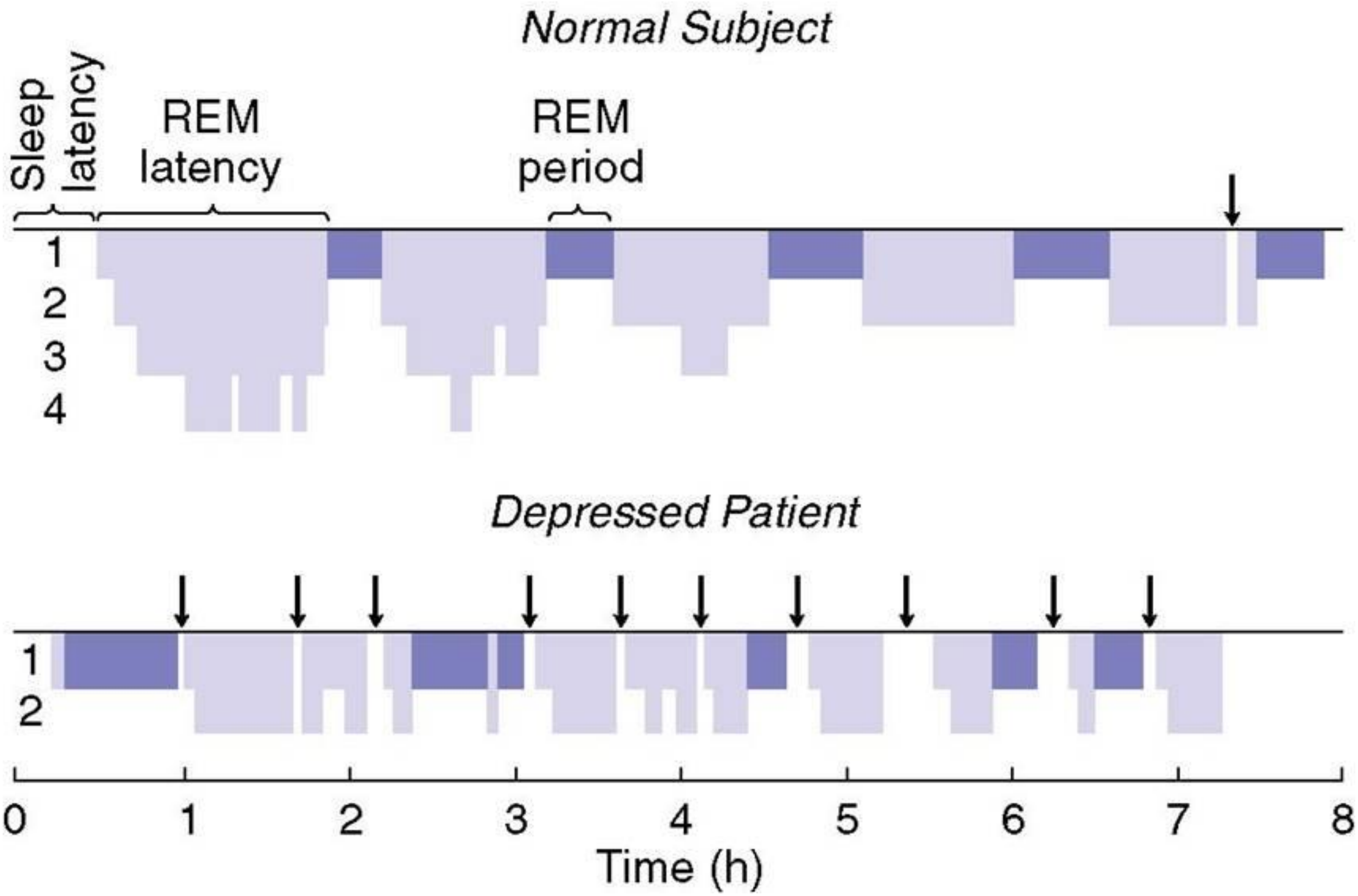



Awake – low voltage – random, fast
50 μV
1 sec
Drowsy – 8 to 12 cps – alpha waves
Stage 1 – 3 to 7 cps – theta waves
Theta Waves
Stage 2 – 12 to 14 cps – sleep spindles and K complexes
Sleep Spindle
K Complex –
Delta Sleep – 1/2 to 2 cps – delta waves >75 μV
REM Sleep – low voltage – random, fast with sawtooth waves
Sawtooth Waves
Sawtooth Waves

Wake/Arousal is a Marker for Sleep Quality

- Total sleep time
- Sleep onset time
- Wake after sleep onset
- Sleep efficiency

Polysomnographic Findings in Major Depression



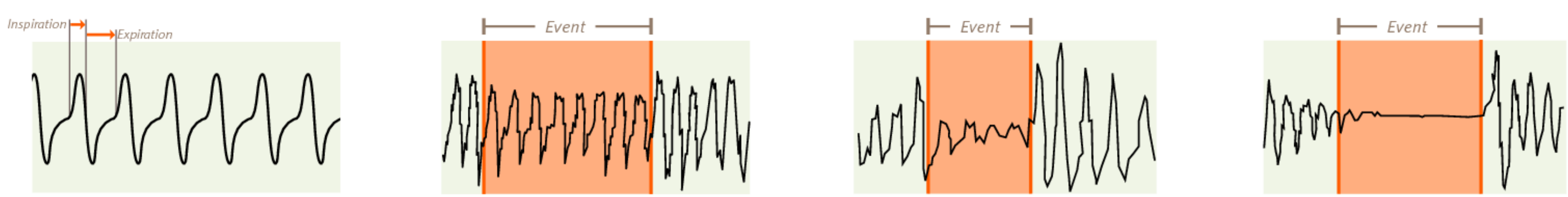
Sleep Apnea

Why Sleep Apnea is Important?

- Common
- Dangerous
- Easily recognized
  - Loud snoring
  - Non-restorative sleep
  - Hypertension
- Treatable

The Fundamentals of Sleep and Obstructive Sleep Apnea

Event Type	Normal Breathing	Flow Limitation	Obstructive Hypopnea	Obstructive Apnea
	Breaths are characterized by a semi-sinusoidal wave-like pattern. Transitions from inspiration to expiration, and vice versa, are rounded and smooth.	The rounded inspiratory portion of the breath starts to flatten.	A reduction in airflow of ≥ 50% of baseline with a 3% desaturation **OR** a reduction in airflow of ≥ 30% with a 4% desaturation **AND** lasting for at least 10 seconds.*	A reduction in airflow of ≥ 90% of baseline lasting for at least 10 seconds.*
Airway Cross-section				
Flow Through Airway	No obstruction	Partially obstructed airway	Increasingly obstructed airway	Completely obstructed airway
Inspiratory Flow Shape	Semi-sinusoidal – unobstructed flow	Flattening & reduced flow	Flattening & *further* reduced flow	Flat – minimal or zero flow
Flow Tracing				



* Iber et al., The AASM Manual for the scoring of sleep and associated events: Rules, Terminology and Technical Specifications, 1st ed.: Westchester, Illinois: American Academy of Sleep Medicine, 2007.

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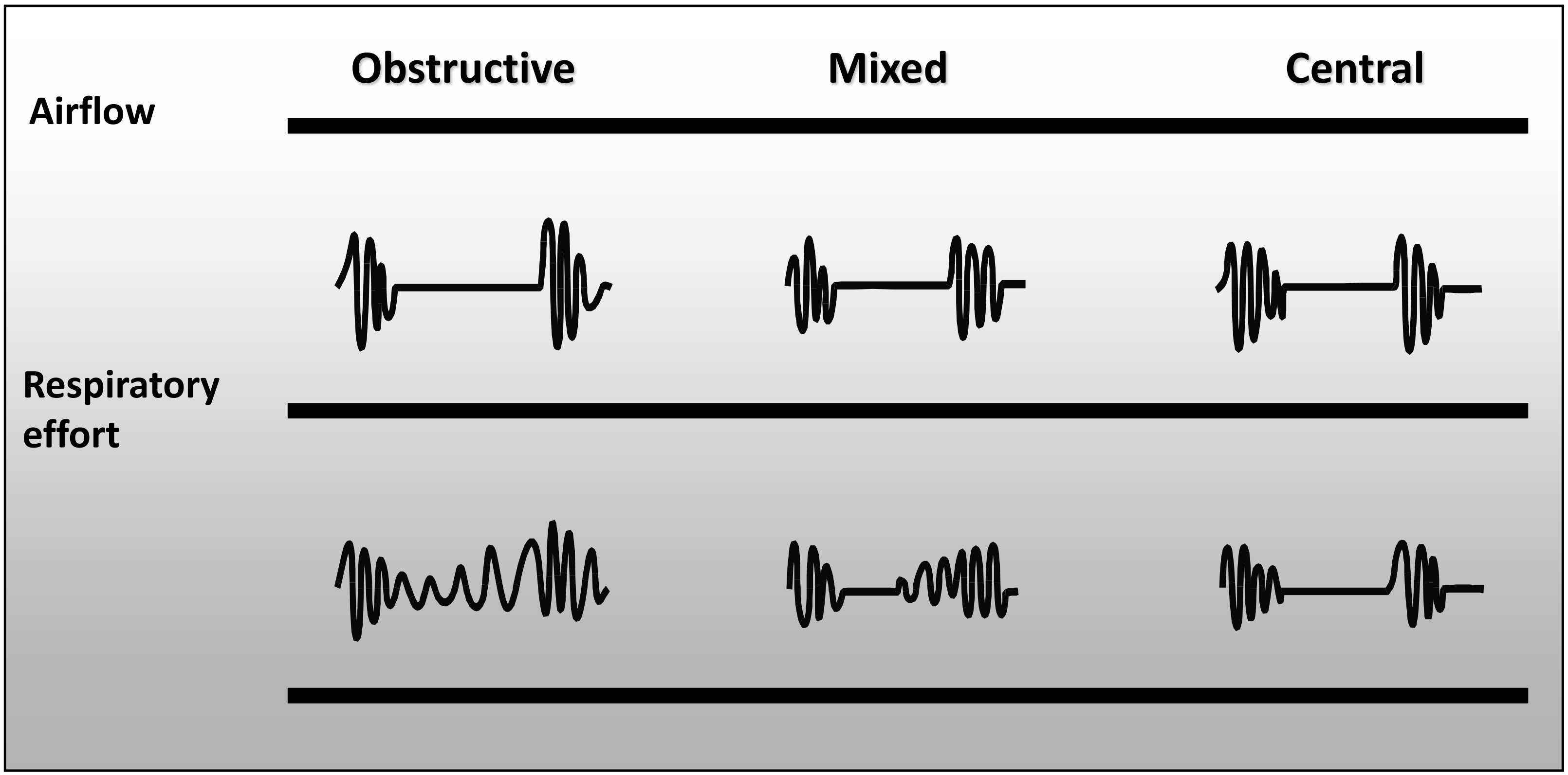
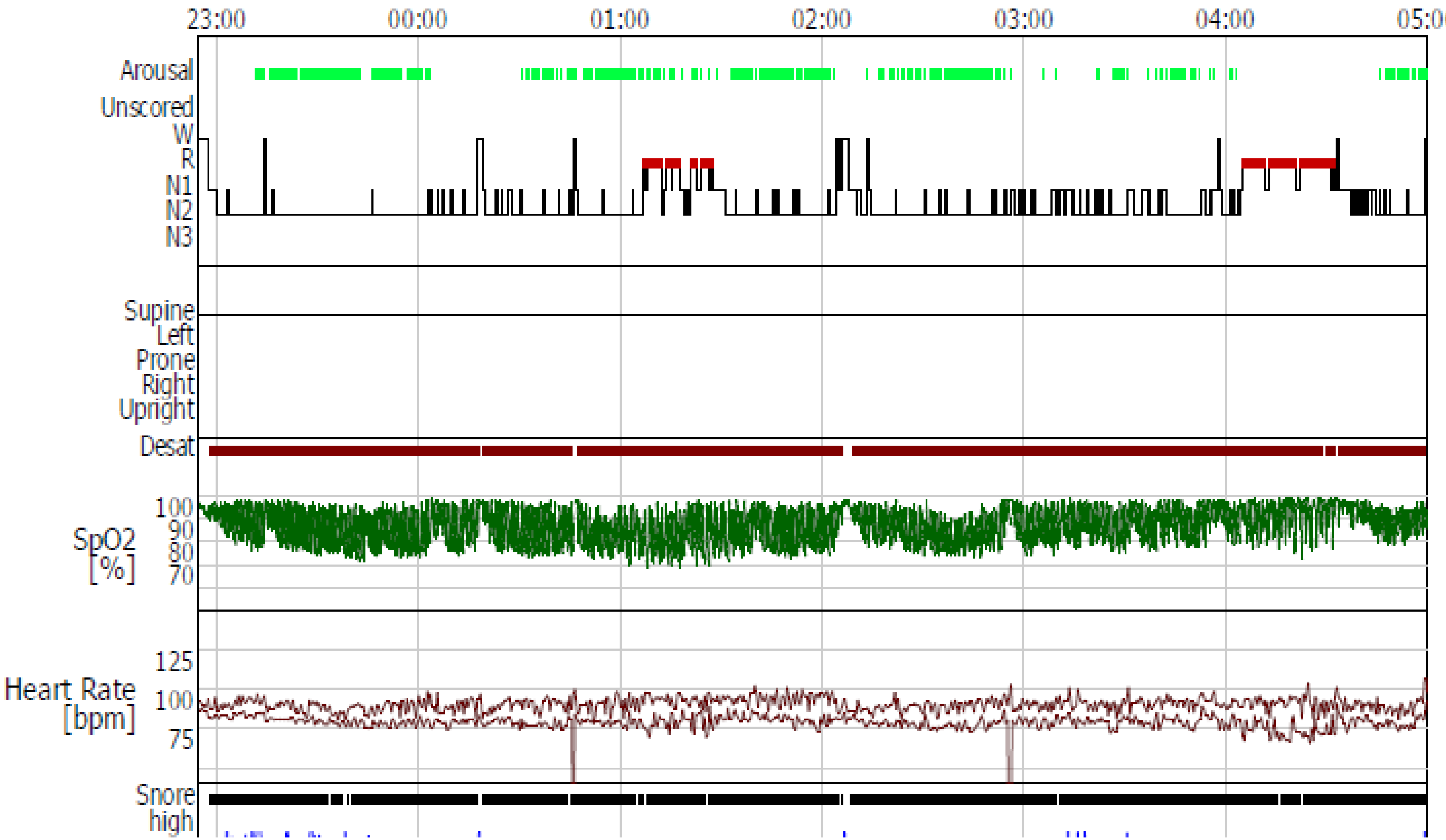
Apnea Patterns



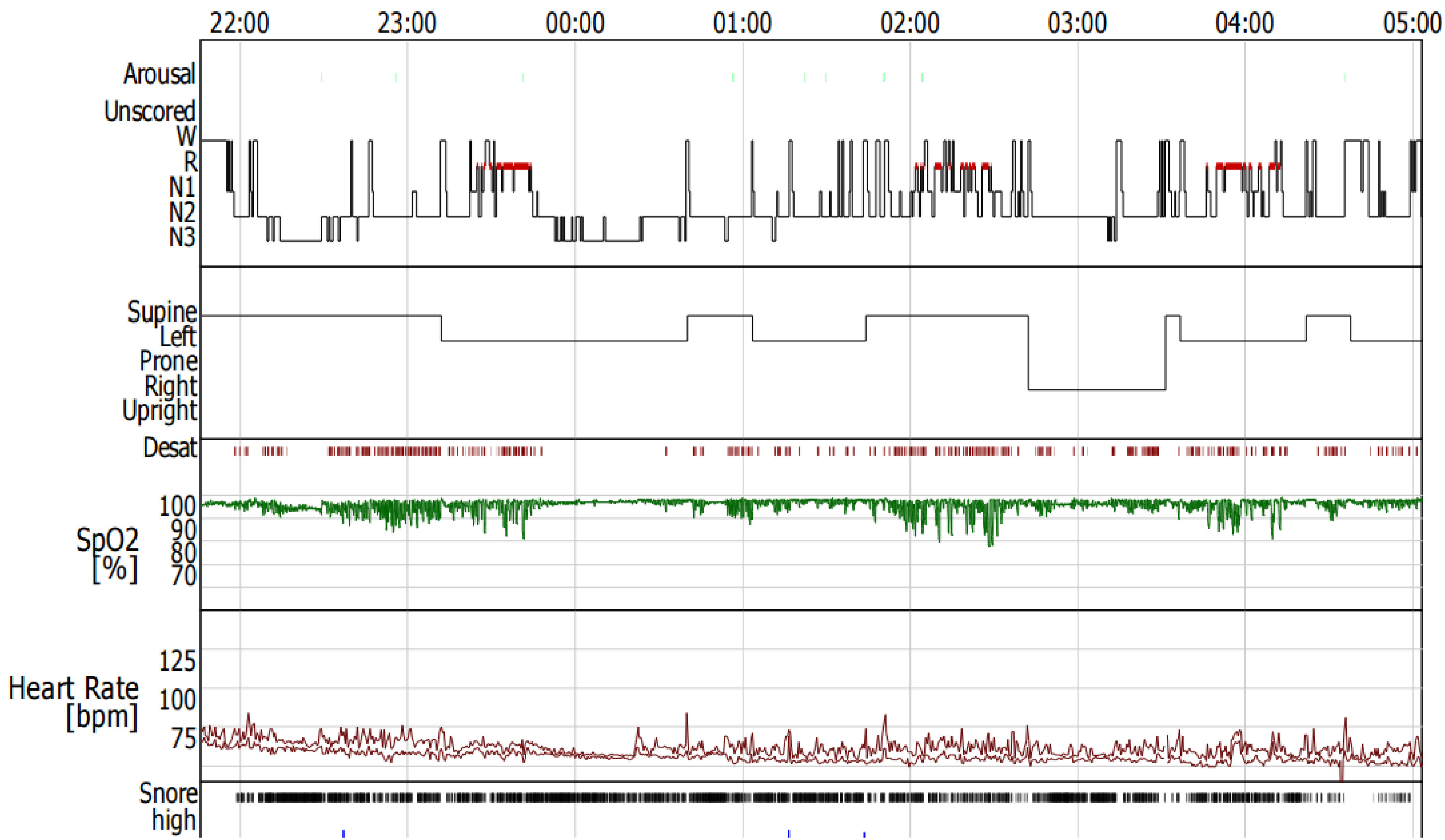
Apnea Hypopnea Index (AHI)

- # apneas + hypopneas per hour of sleep
- Key components
  - Air flow (pressure sensor and/or thermistor)
  - Respiratory effort (thoracic/abdominal movement)
  - Oxygen saturation
- Severity
  - AHI < 5: Normal
  - 5 <= AHI < 15: Mild SA
  - 15 <= AHI < 30: Moderate SA
  - 30 <= AHI: Severe SA

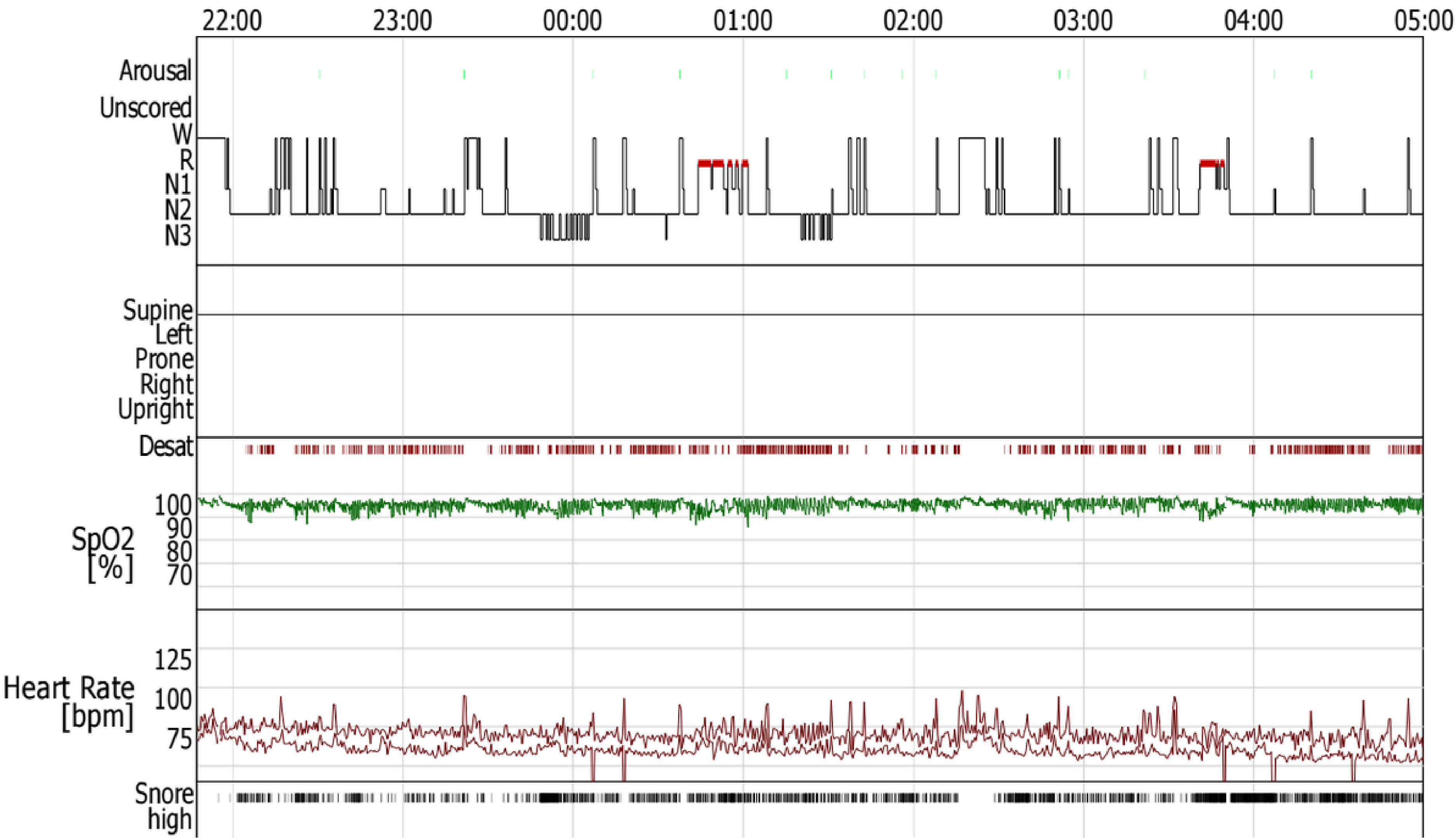
An Example of Severe OSA



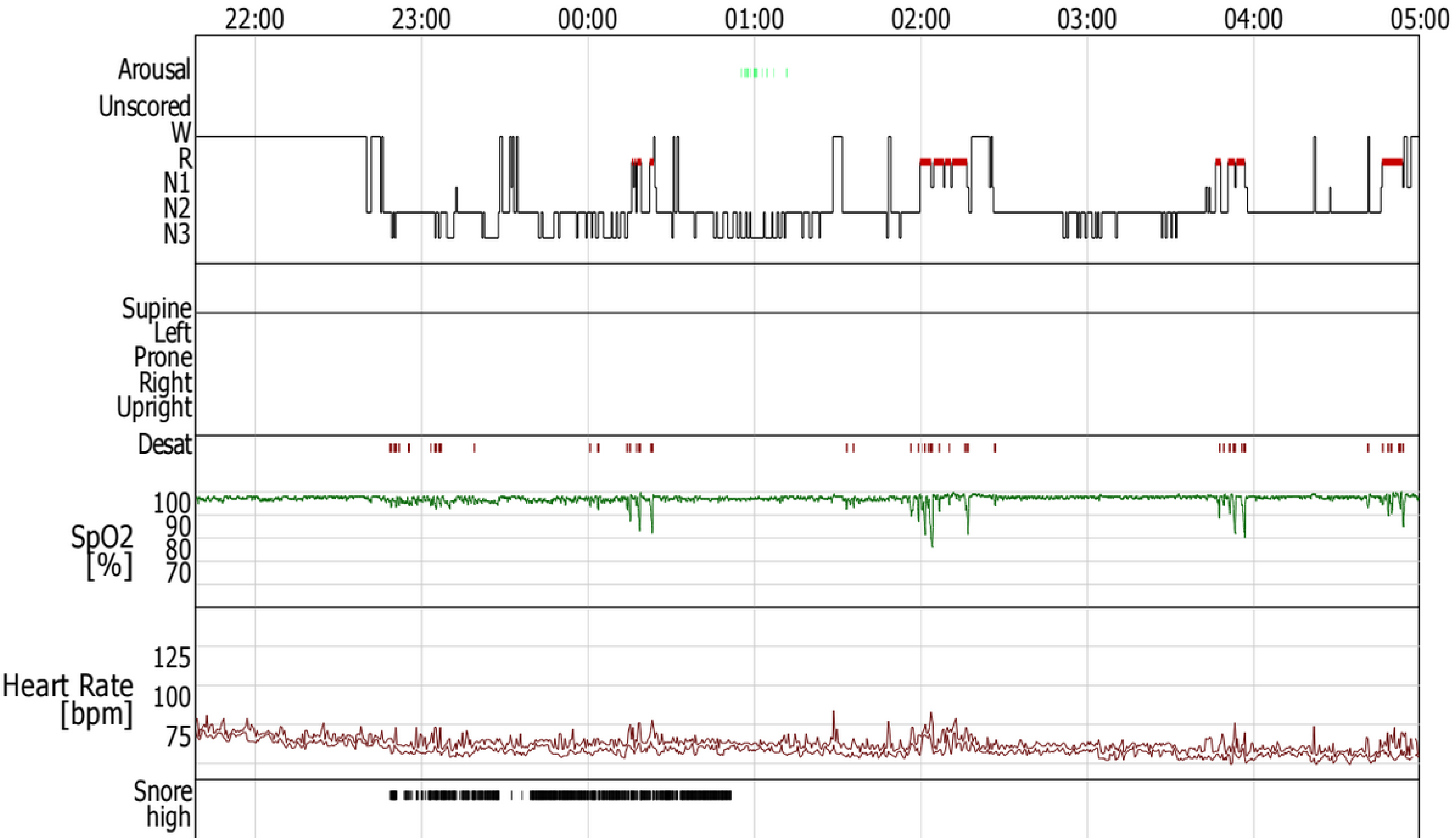
AHI is not a “Perfect” Index



AHI is not a “Perfect” Index

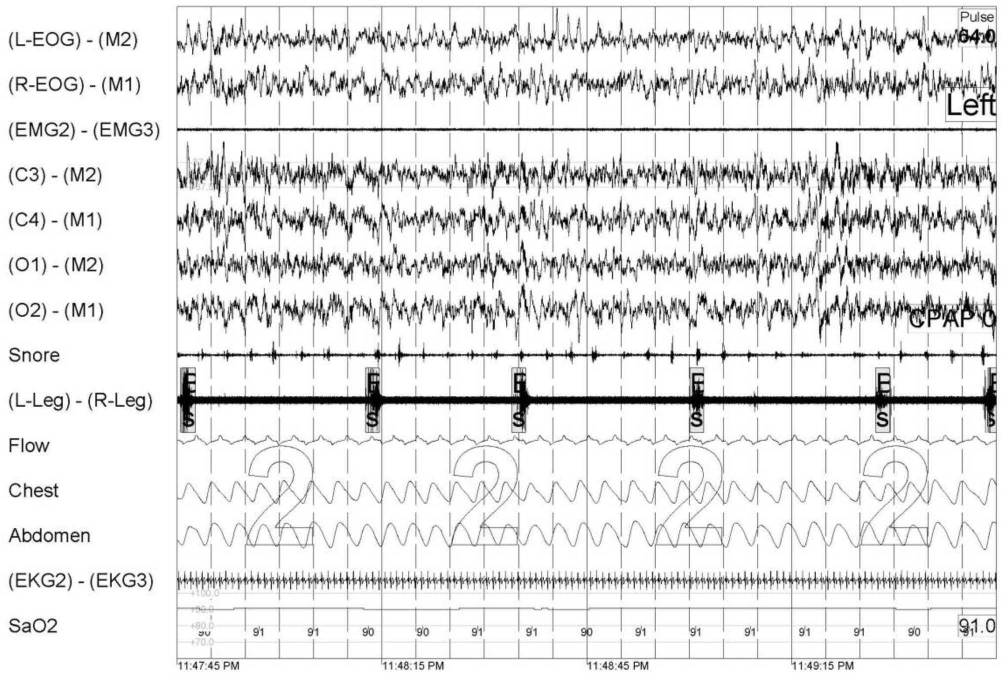


AHI is not a "Perfect" Index



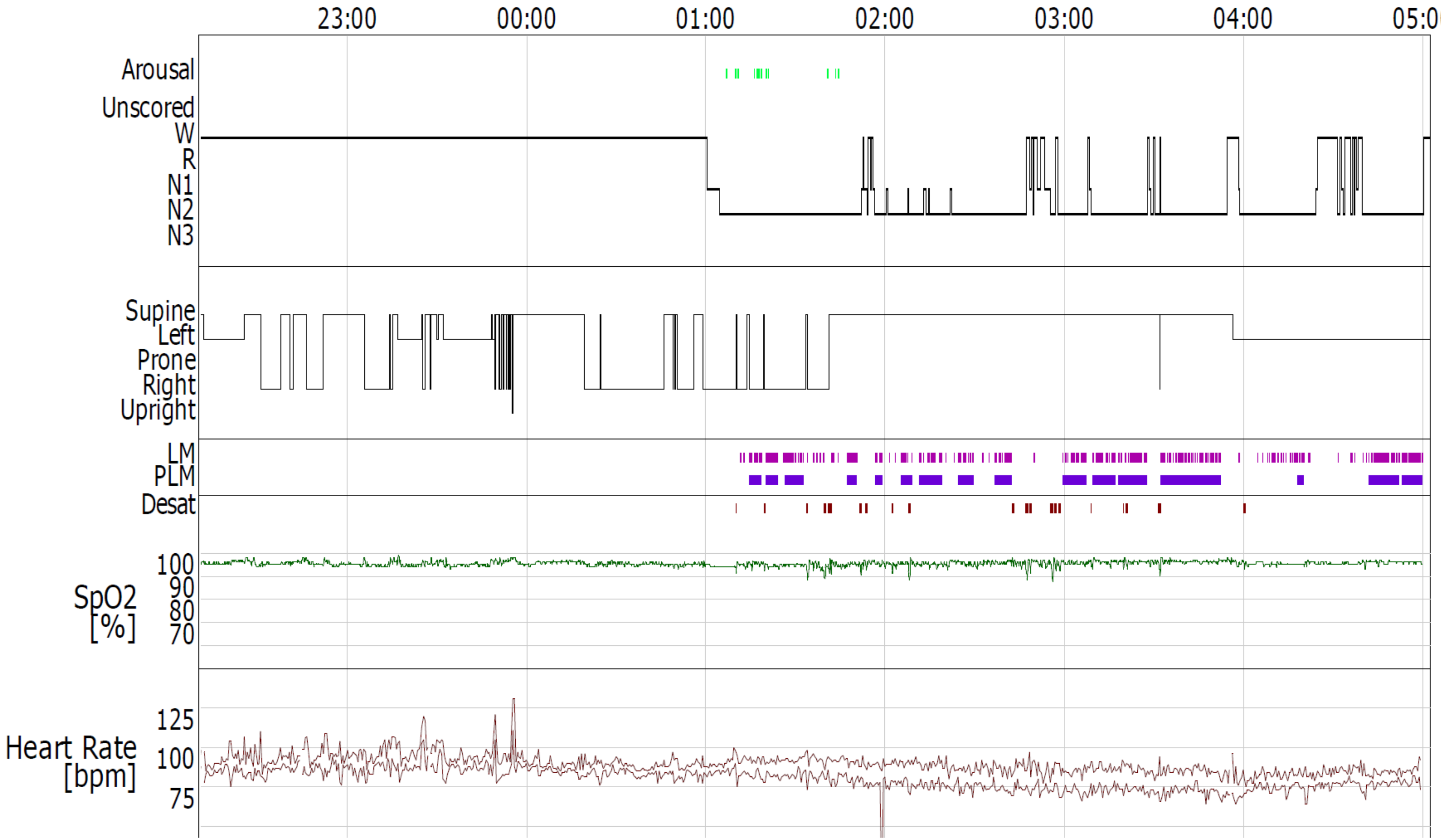
Periodic Limb Movements

- PLMs are diagnosed by an overnight PSG that show of a series of four or more movements during any stage of sleep at intervals of 5–90 s that last 0.5–10 s.



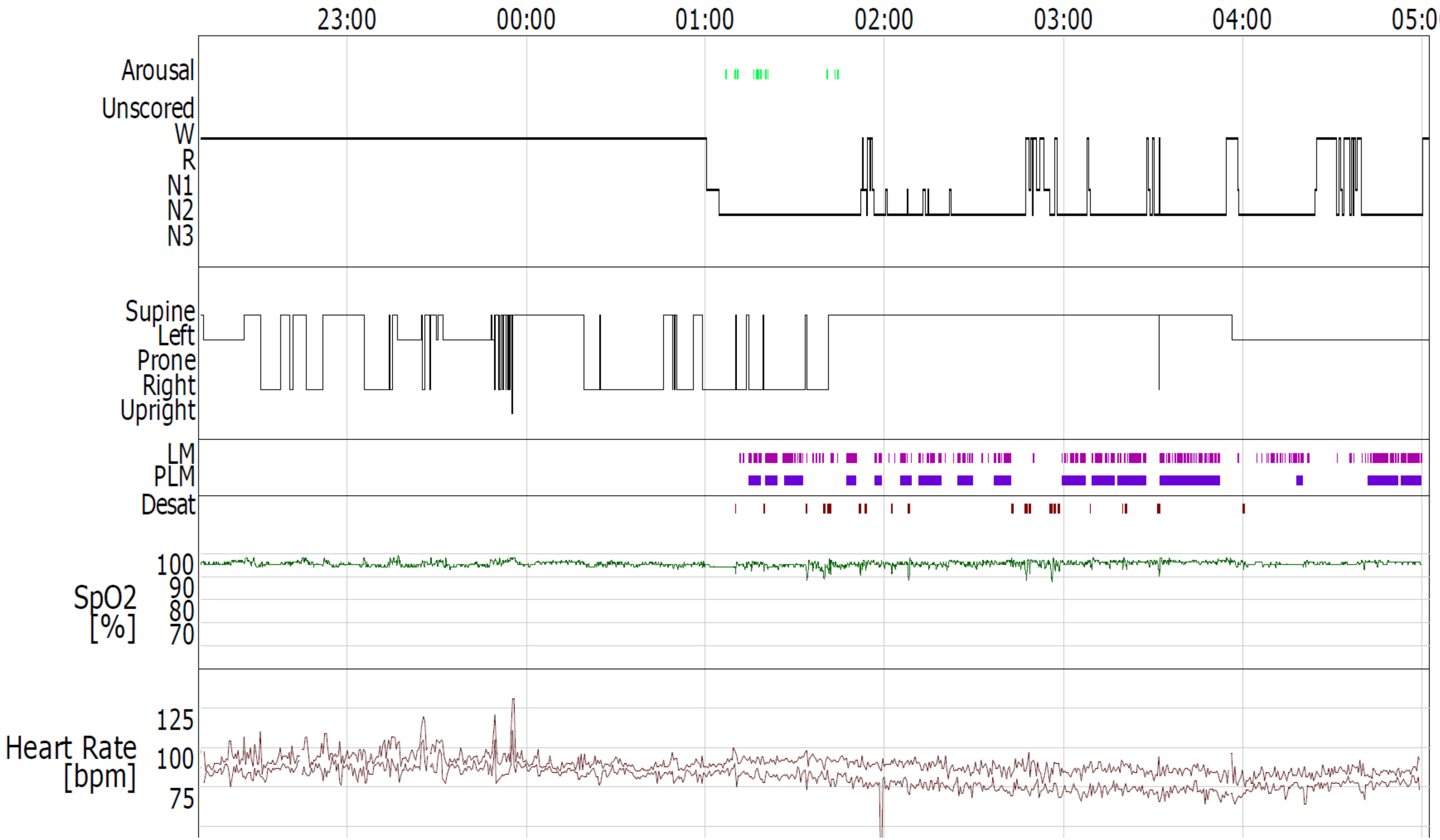
Restless Leg Syndrome

- The symptoms are more severe at night
- An irresistible urge to move the legs and/or arms
- The sensations begin following relaxation or a period of staying still, and during sleep
- Temporary relief from these sensations during movement of the affected legs and/or arms

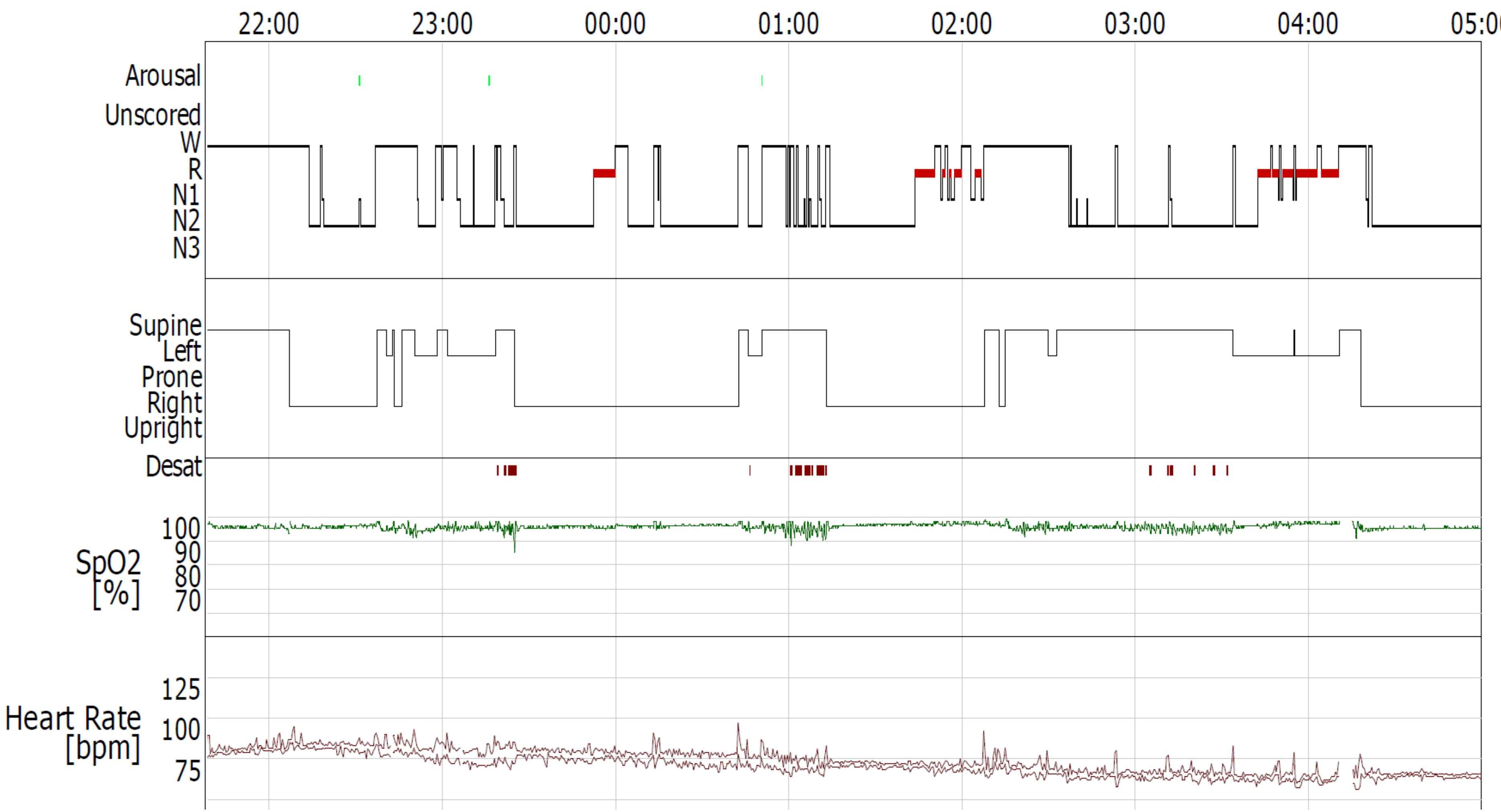

23:00
00:00
01:00
02:00
03:00
04:00
05:00
Arousal
Unscored
W
R
N1
N2
N3
Supine
Left
Prone
Right
Upright
LM
PLM
Desat
SpO2
[%]
100
90
80
70
Heart Rate
[bpm]
125
100
75

Good Sleeper

Poor Sleeper (PLM)



Poor Sleeper
(Primary Insomnia)



Poor Sleeper (Sleep Apnea)