

24 septembre 2024

Pour l' Association des Pharmaciens Hospitaliers d' Alsace et de Lorraine

# PHYSIOLOGIE ET EXPLORATION DU SOMMEIL

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Dr. Nicolas Carpentier

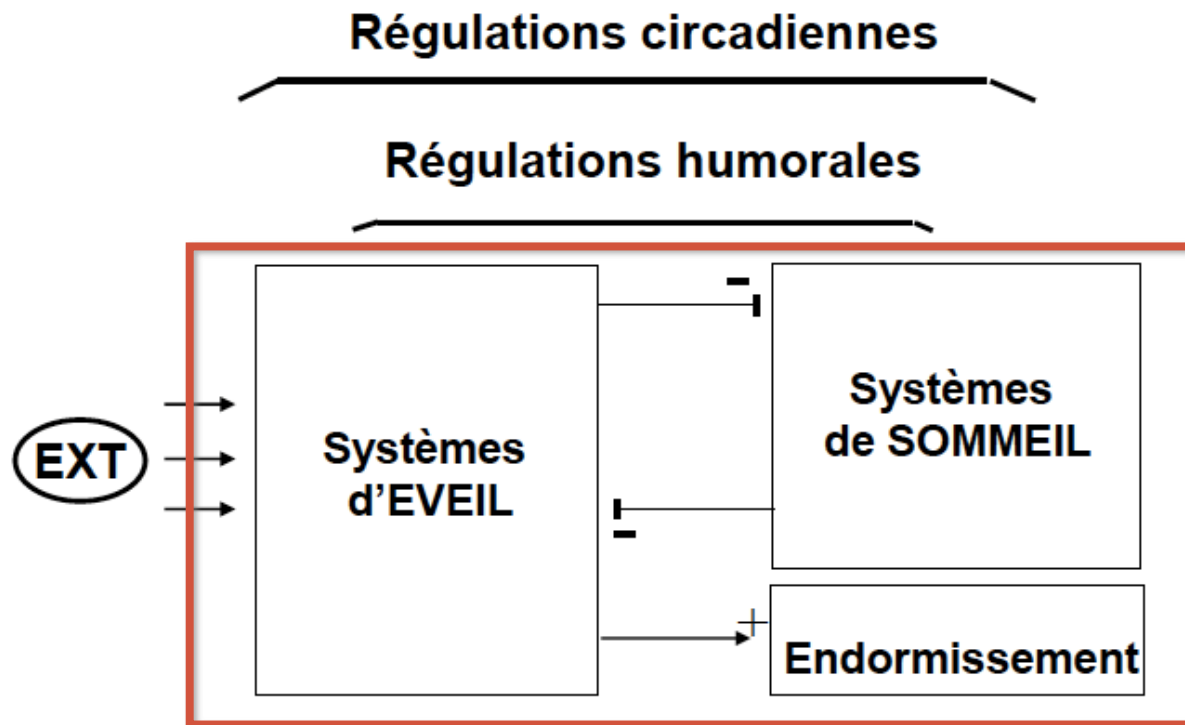
Centre de Médecine et de Recherche sur le Sommeil (CMRS)

Service de Neurologie

CHRU Nancy - France

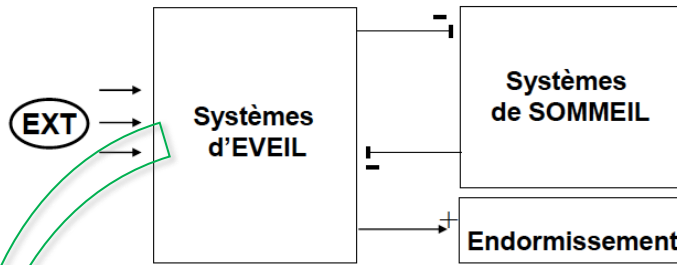


# Etats de veille et sommeil

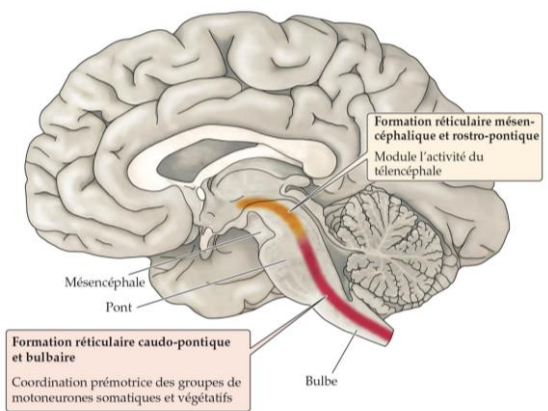
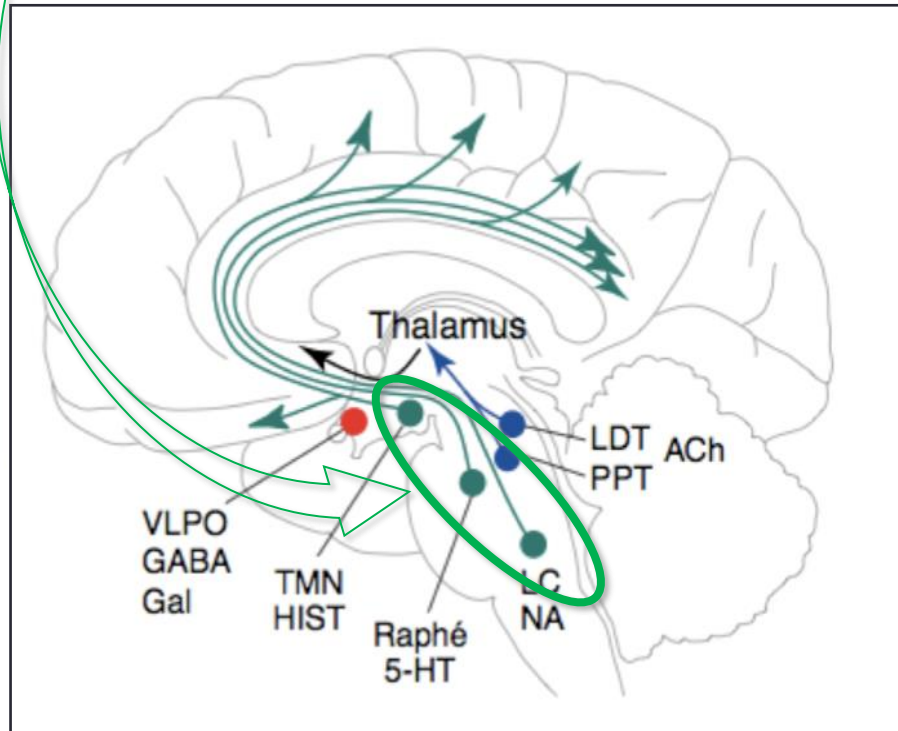


Régulations circadiennes

Régulations humorales

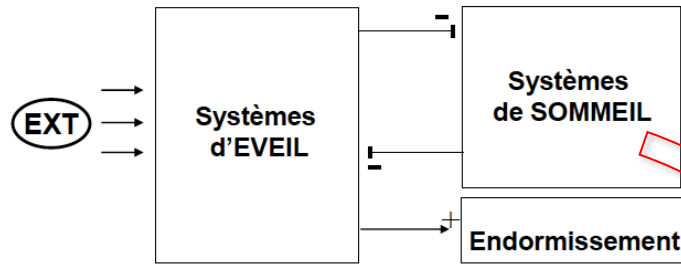


**TMN**  
**DR**  
**LC**

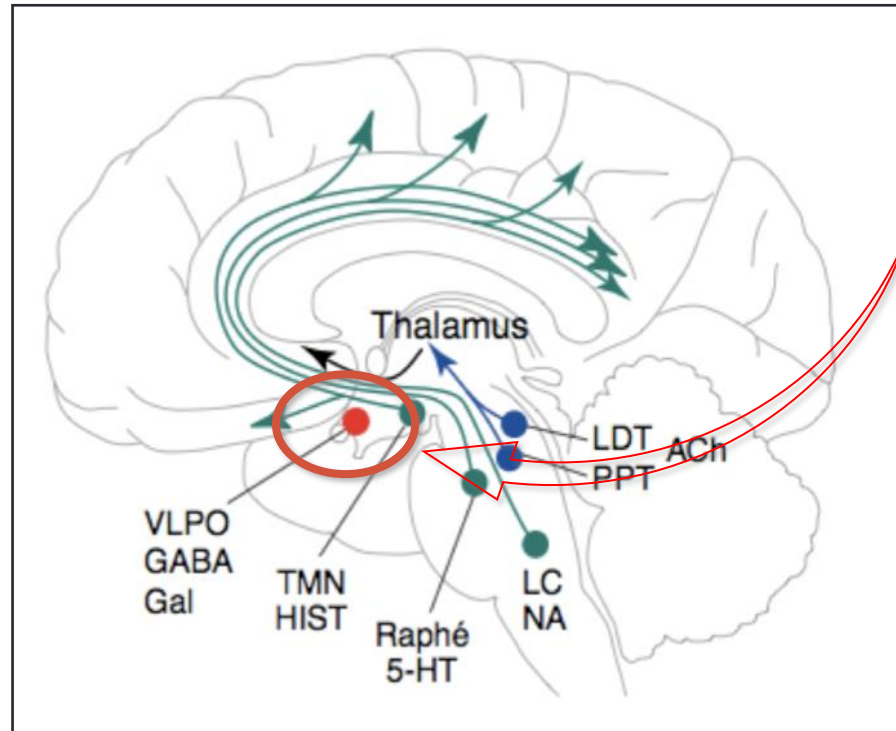
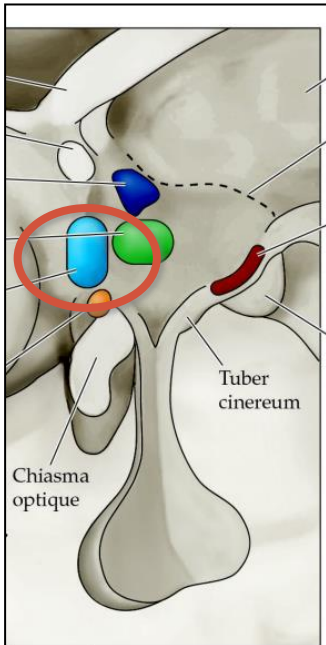


## Régulations circadiennes

## Régulations humorales

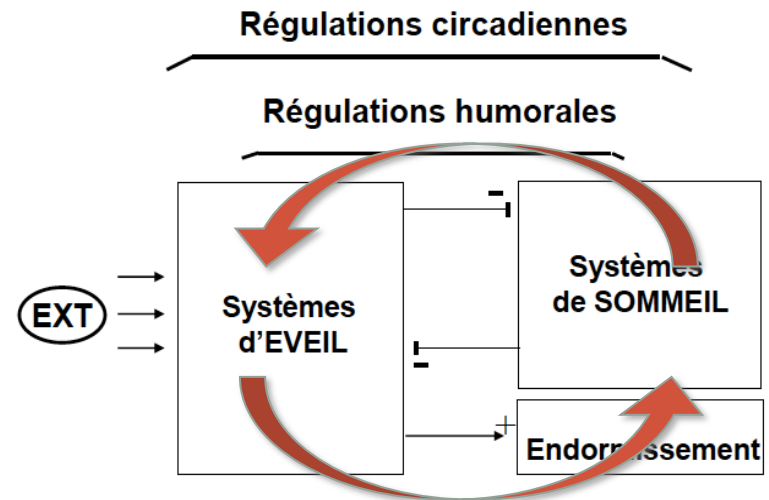
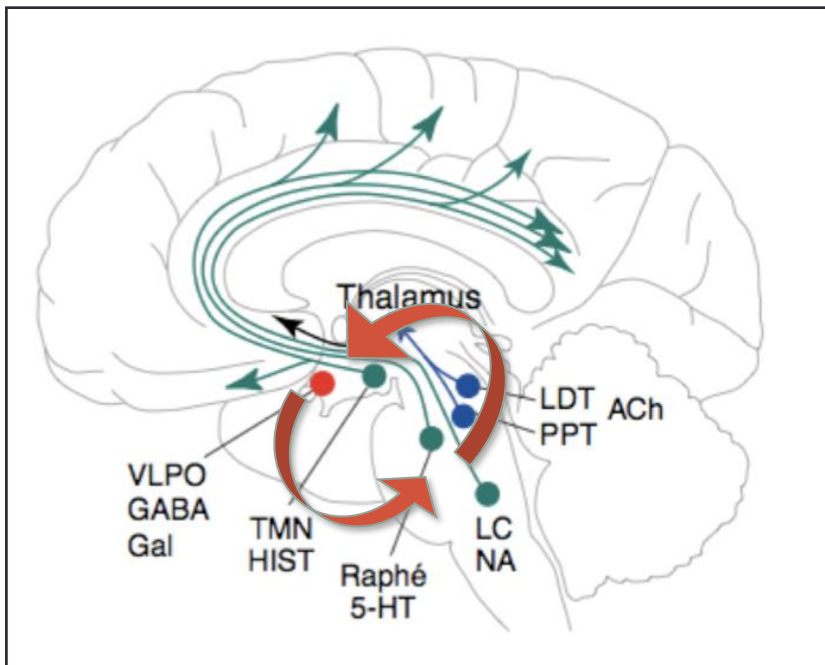


**VLPO**



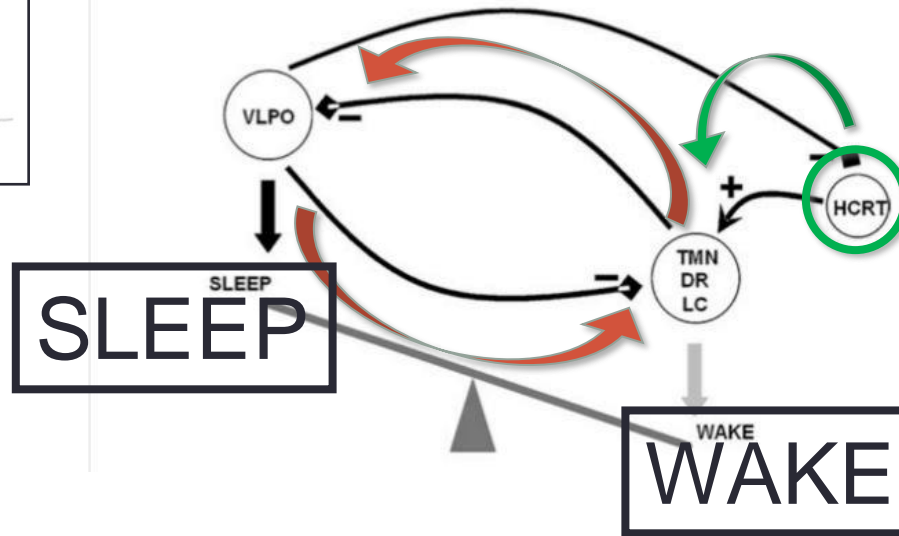
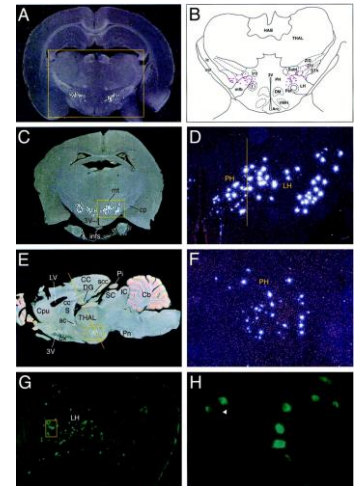
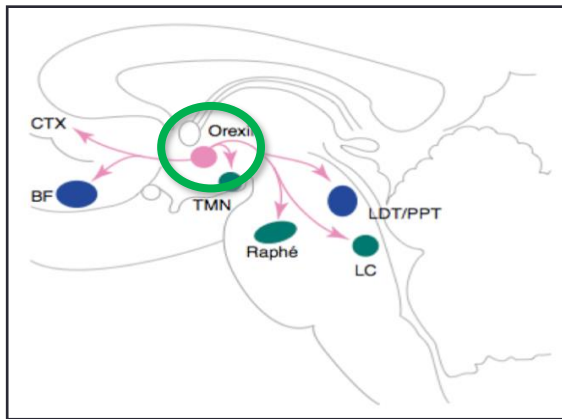
# Flip-flop veille/sommeil

## INHIBITION RECIPROQUE

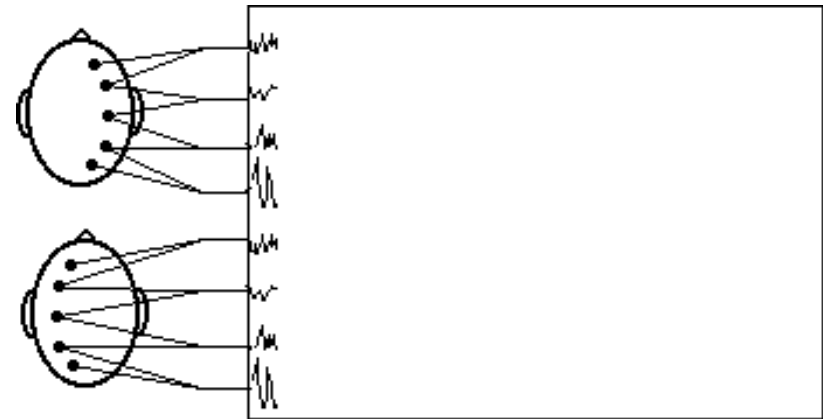
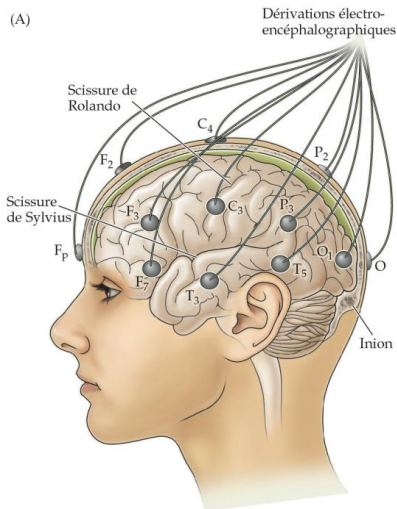
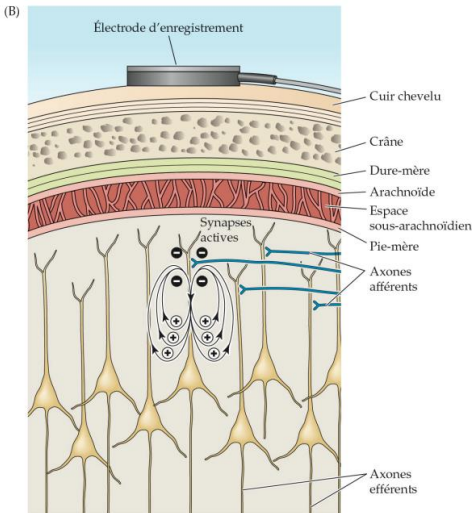


# Stabilisation de la veille

## HYPOCRETINE/OREXINE



# Approche neurophysiologique



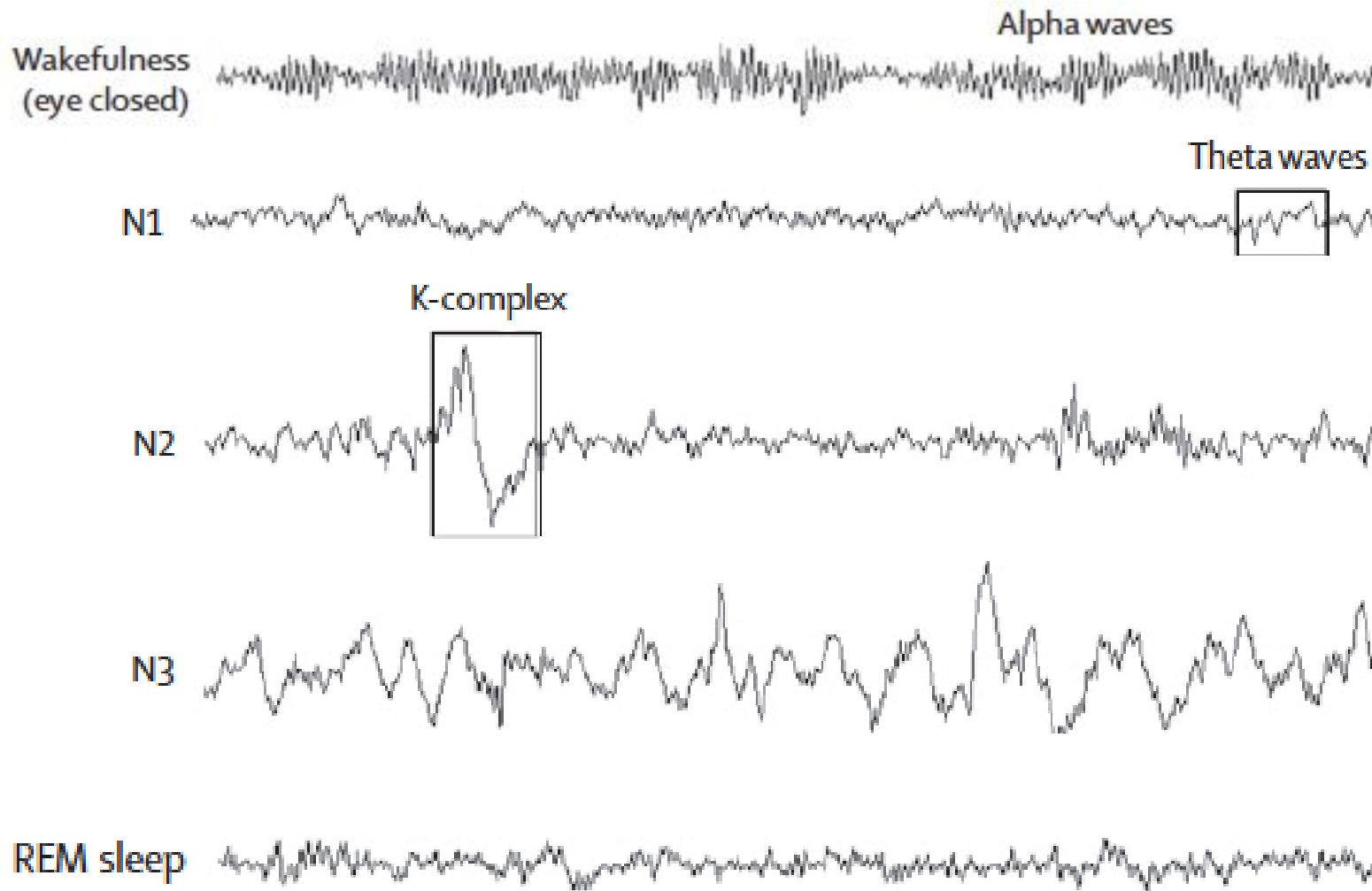
yeux fermés.....ouverts.....fermés  
Électrophysiologie médicale, Collège Ahuntsic

Wakefulness  
(eye closed)



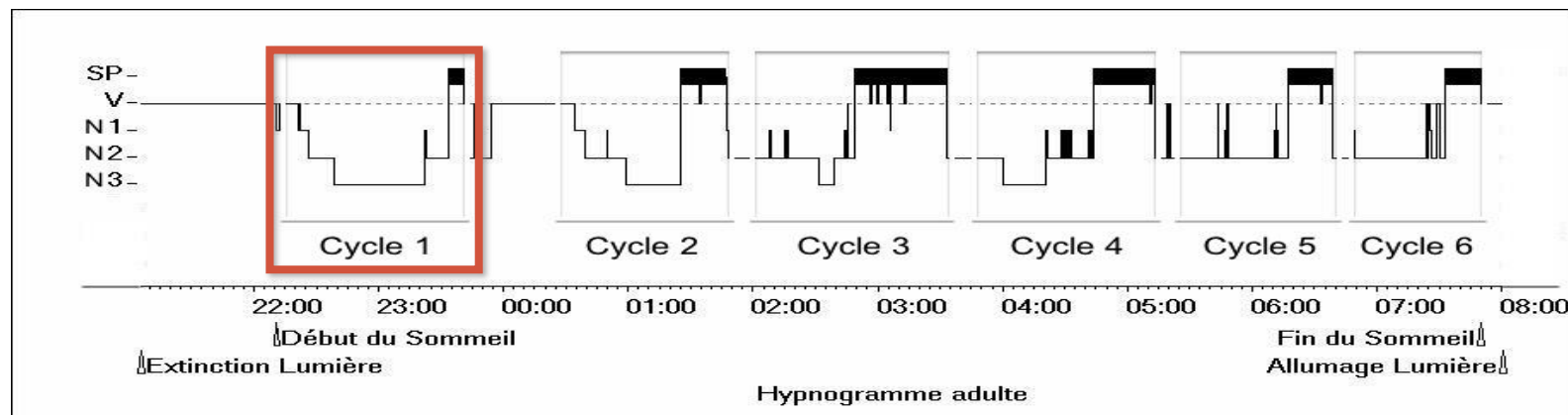
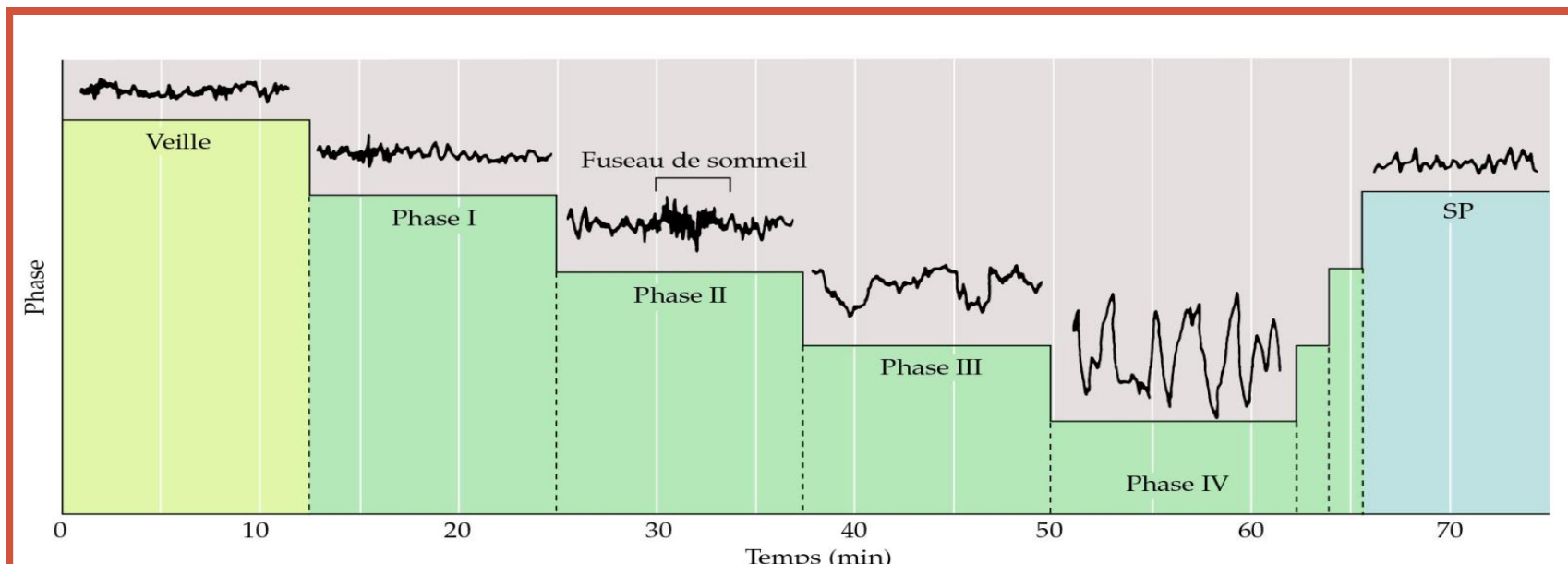
Alpha waves

# Neurophysiologie du sommeil



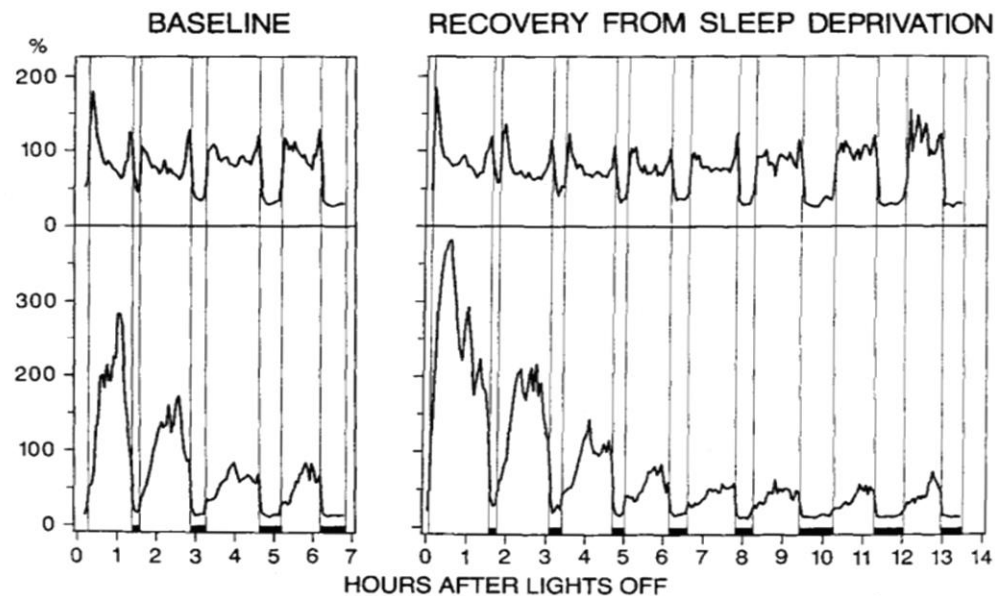
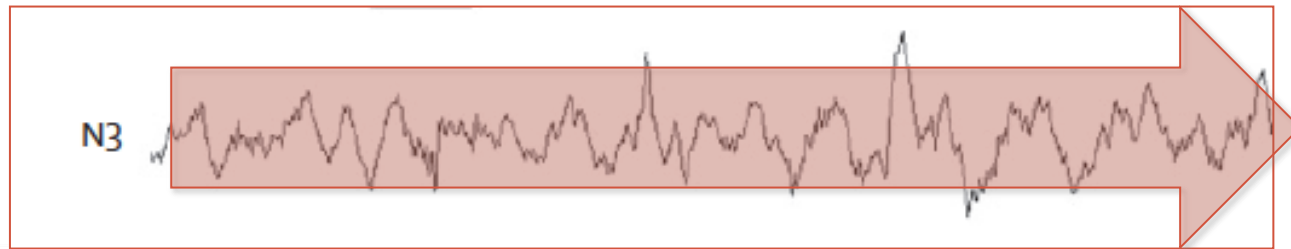


# Neurophysiologie du sommeil



# Sommeil lent et homéostat

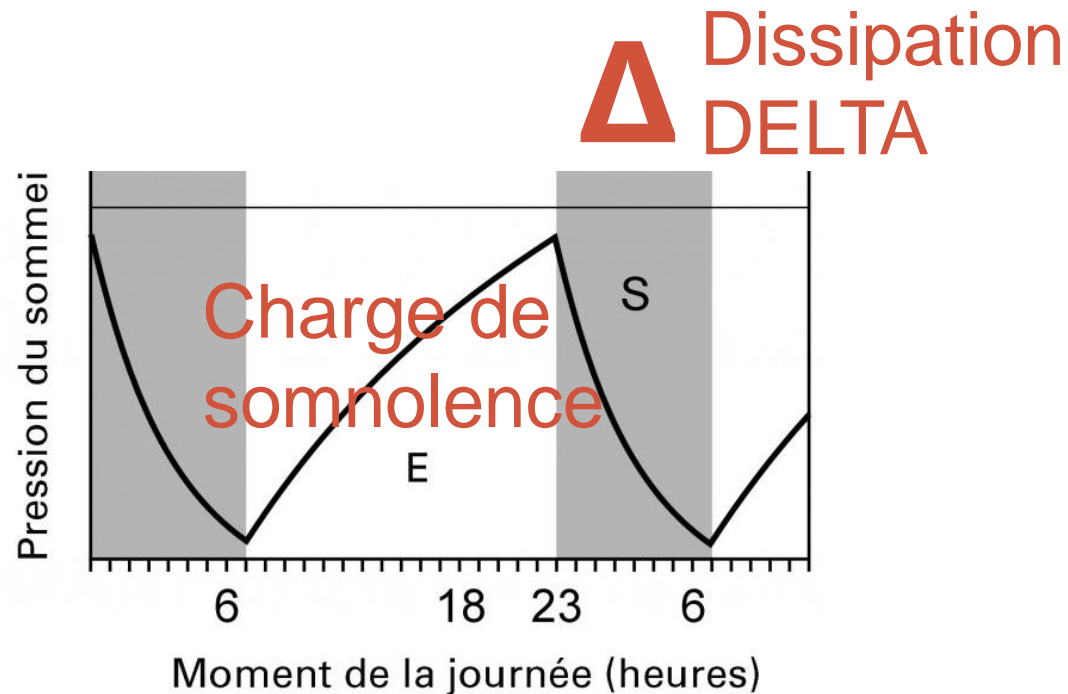
- La **puissance delta** : accumulation et décharge de somnolence



**Figure 29-3.** Time course of slow wave activity (power density in the 0.75- to 4.5-Hz band; lower curves) and activity in the spindle frequency range (13.25- to 15.0-Hz; upper curves) recorded under baseline conditions and after sleep deprivation (36 h of wakefulness). The NREM sleep episodes were divided into 20 equal parts, the REM sleep episode into five equal parts. The curves represent mean percentile values ( $N = 8$  except for cycle 8 of recovery sleep where  $N = 6$ ) and have been expressed relative to the mean slow wave activity level in baseline NREM sleep (100%). The mean timing of REM sleep episodes is delimited by vertical lines and horizontal bars above the abscissa. (Reanalysis of the data from Dijk DJ, Brunner DB, Borbély AA. Time course of EEG power density during long sleep in humans. *Am J Physiol.* 1990;258:R650-651, by D. Aeschbach.)

# Processus homéostatique

- Modélisation du processus homéostatique S



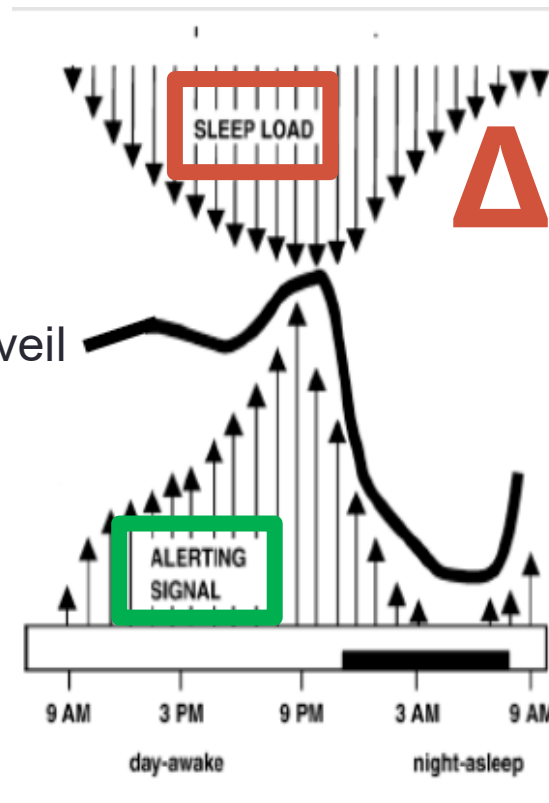
# Processus homéostatique

- Le niveau de vigilance est la résultante des niveaux d'activité des réseaux de l'éveil (« alerting signal ») et de charge de somnolence (« sleep load »)

Charge de somnolence

Dissipation DELTA

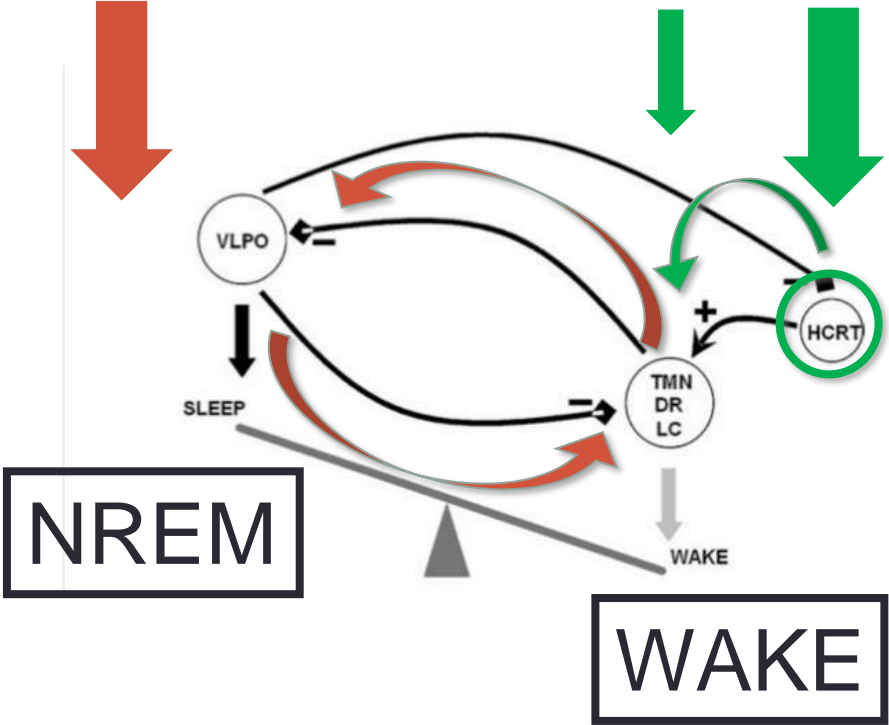
Niveau d'éveil



Activation  
bottom-up (SRAA)  
et top-down (cortex)

Sleep load

CORTEX DRIVE & Alerting signal

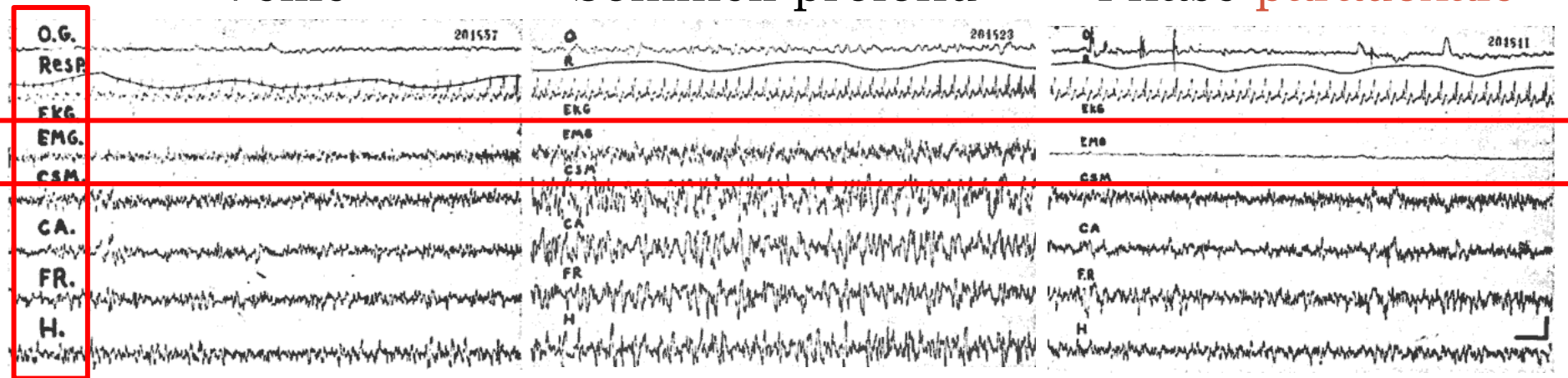


# Le sommeil paradoxal

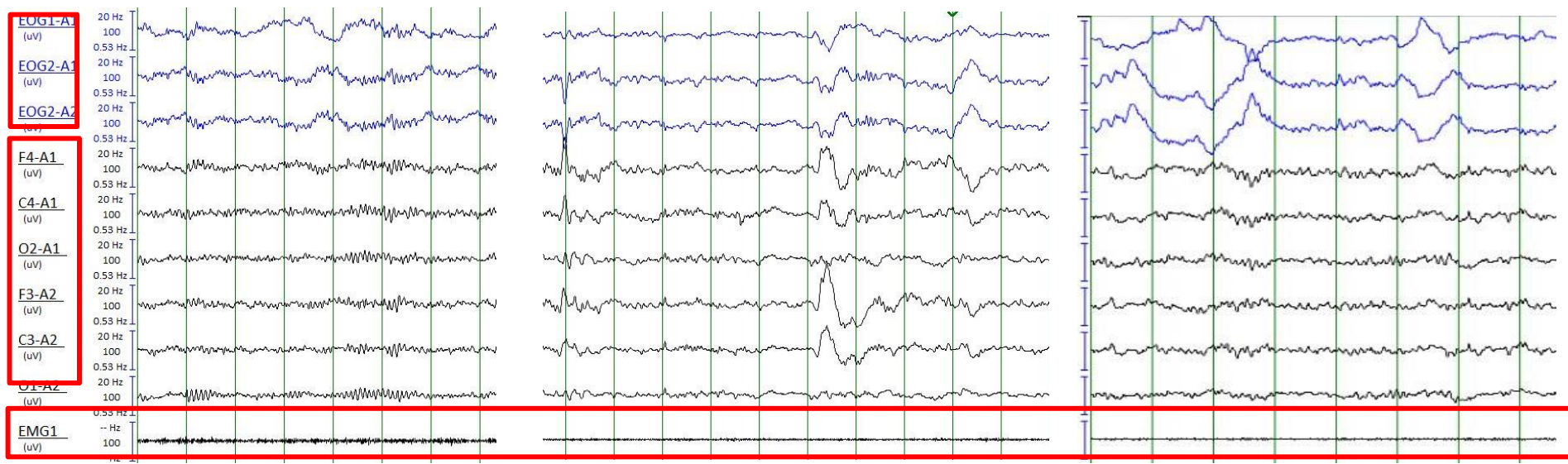
Veille

Sommeil profond

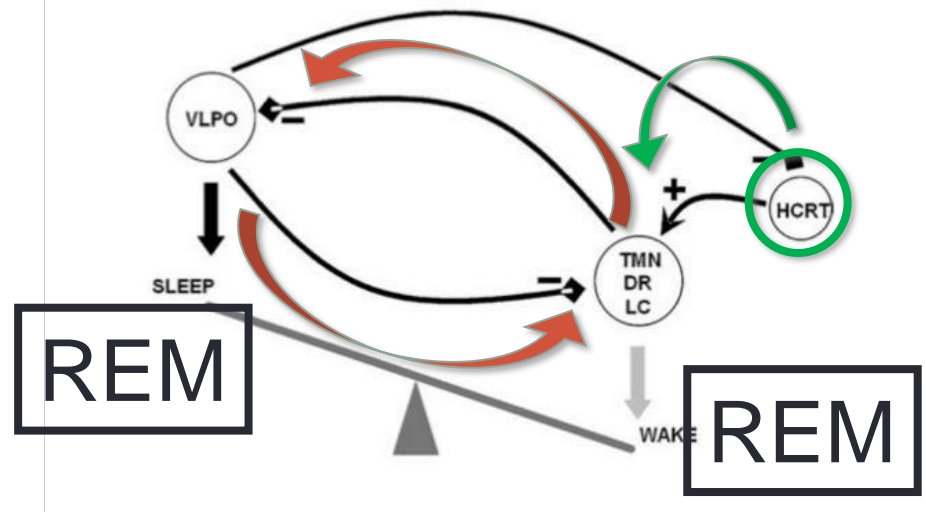
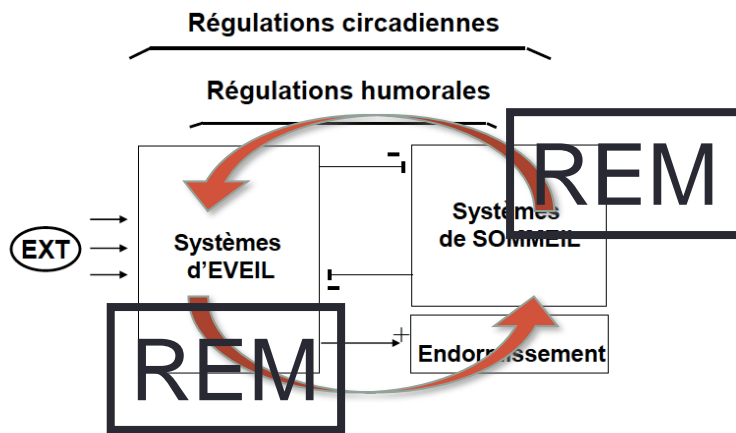
« Phase paradoxale »

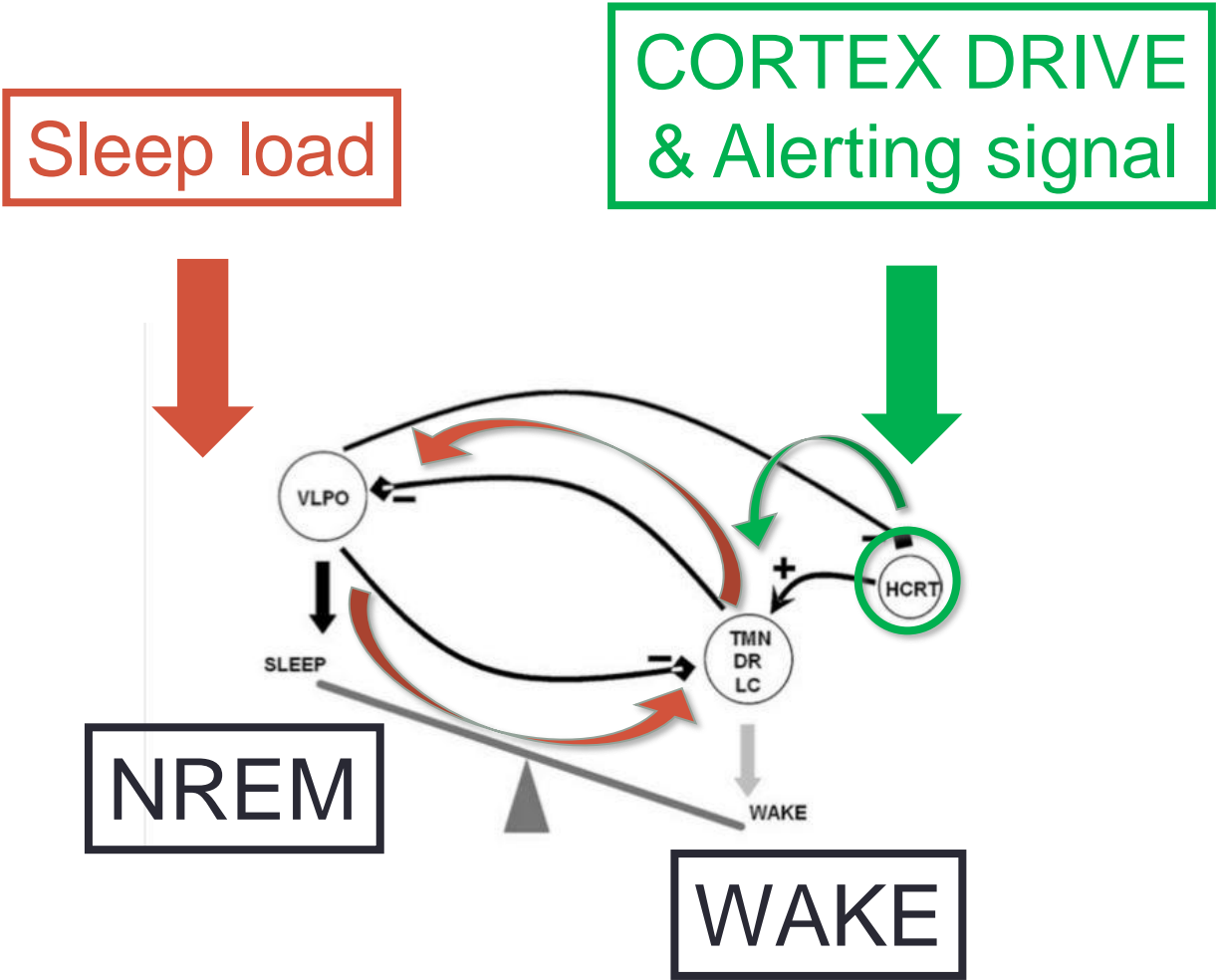


Jouvet, 1959



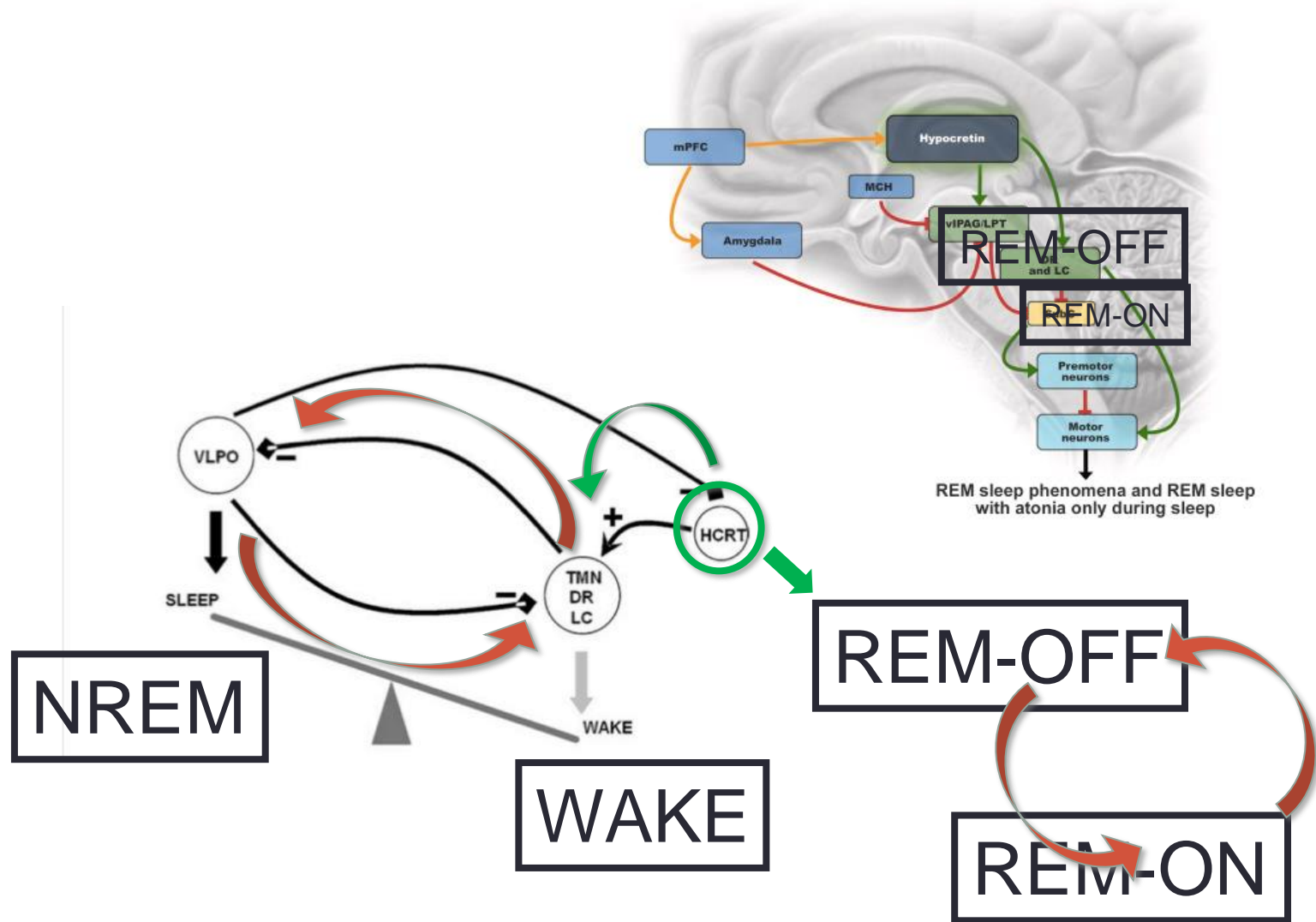
# Le sommeil paradoxal





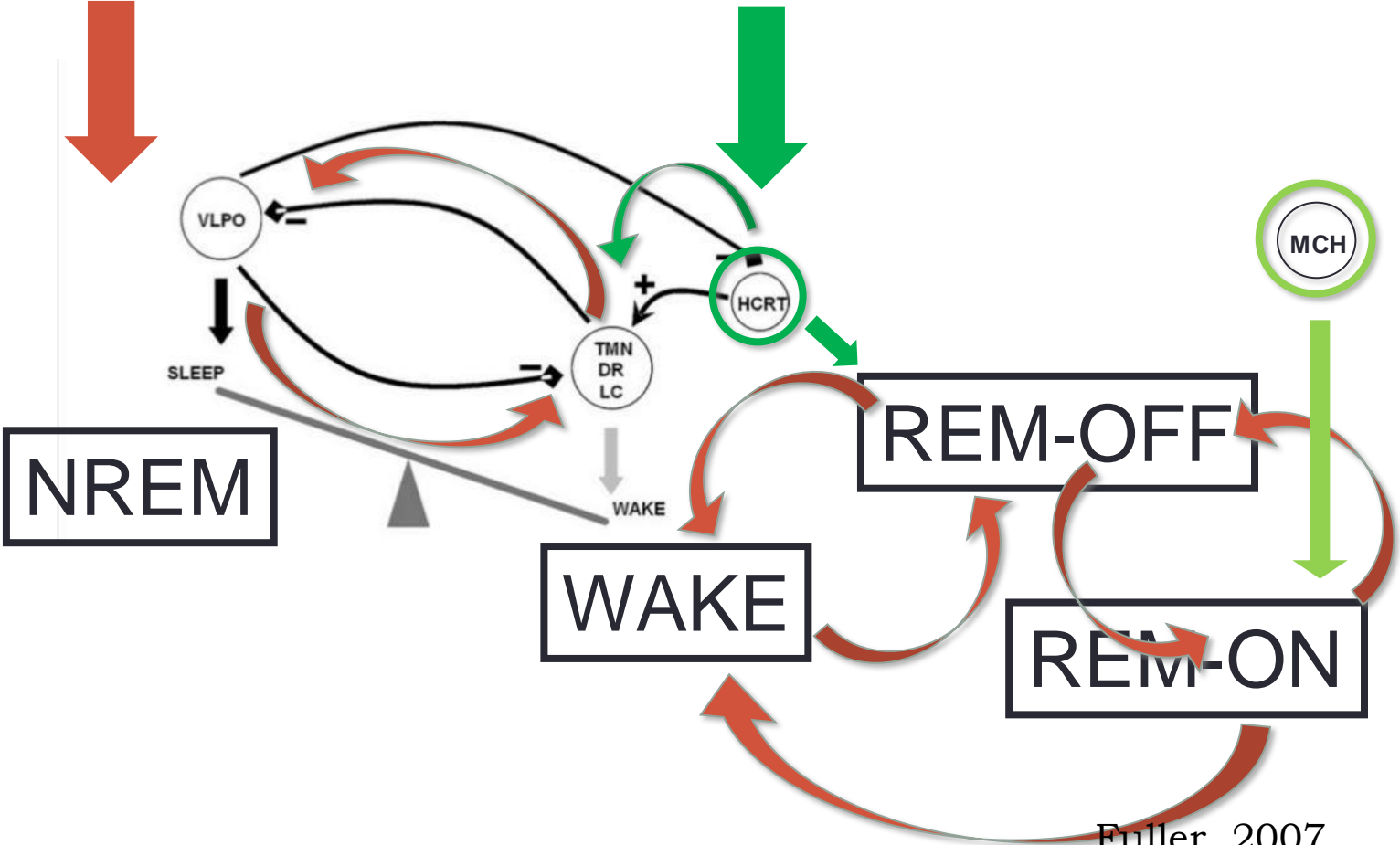


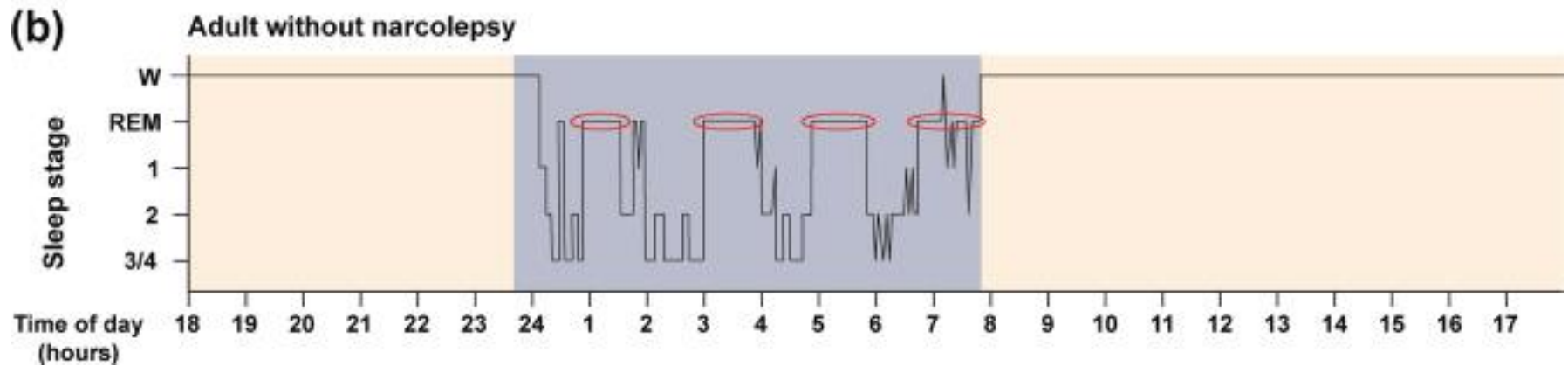
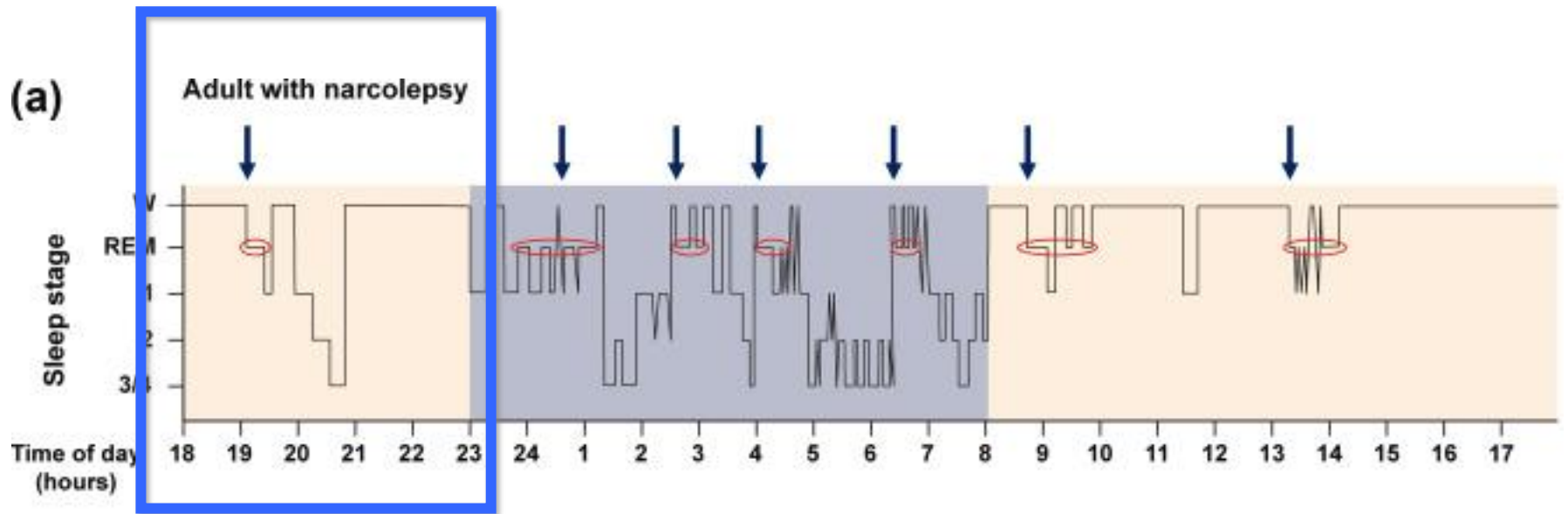
(a) Without narcolepsy  
Normal hypocretin level



Sleep load

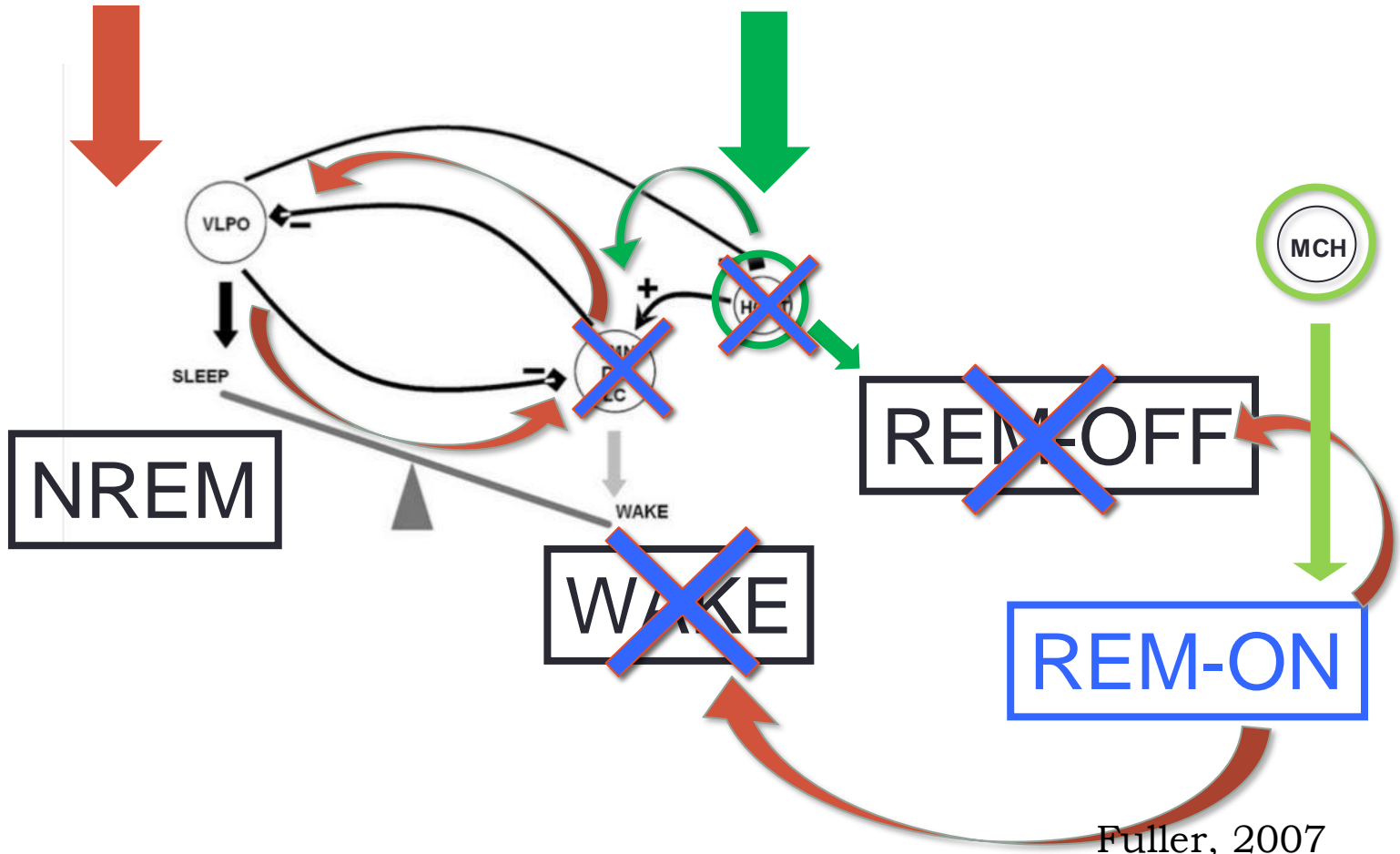
CORTEX DRIVE & Alerting signal



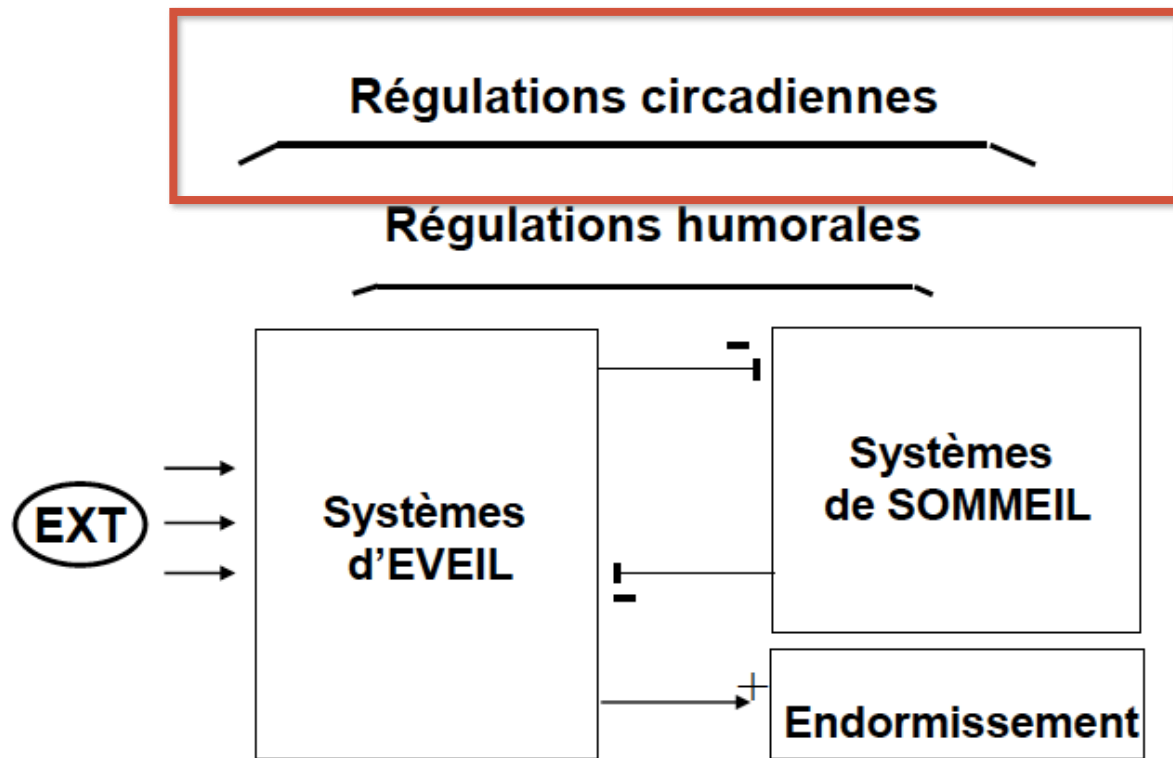


Sleep load

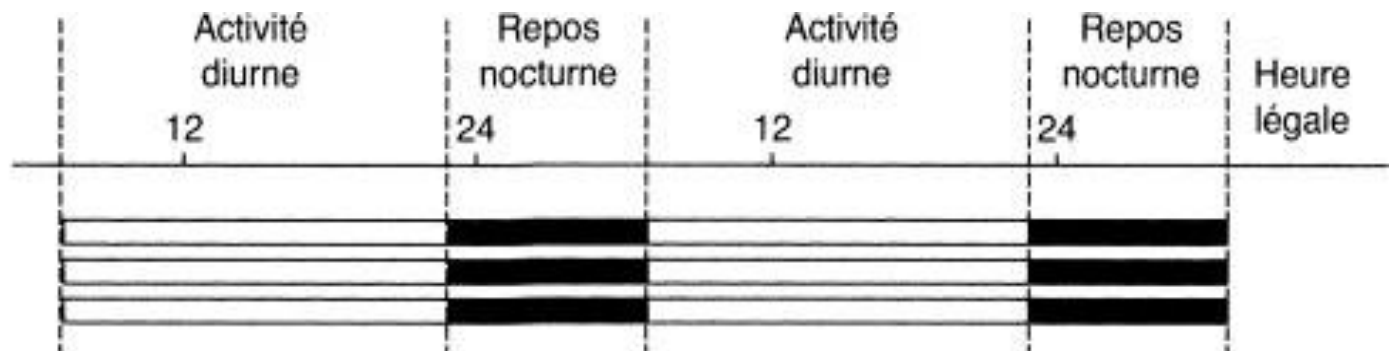
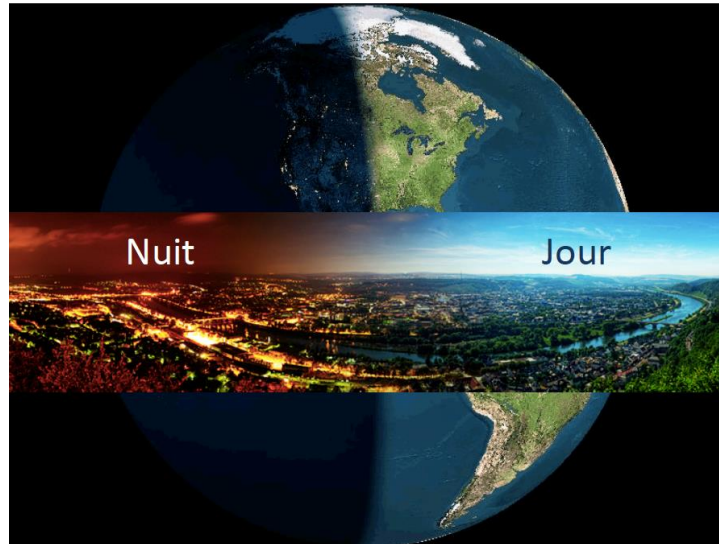
CORTEX DRIVE & Alerting signal



# Neurobiologie du sommeil



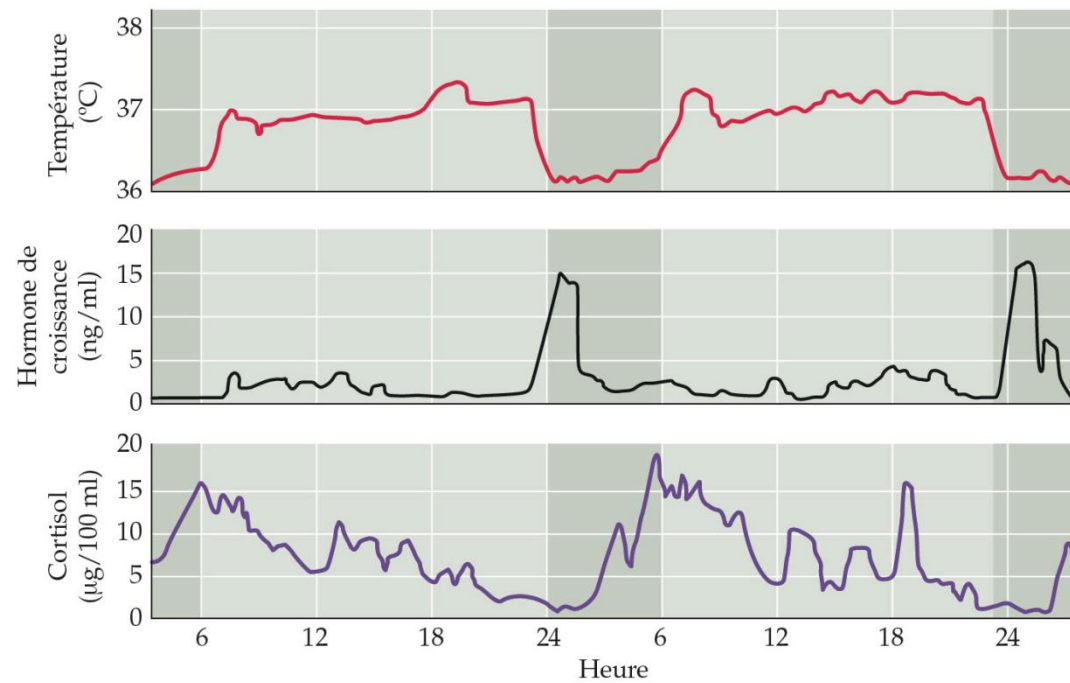
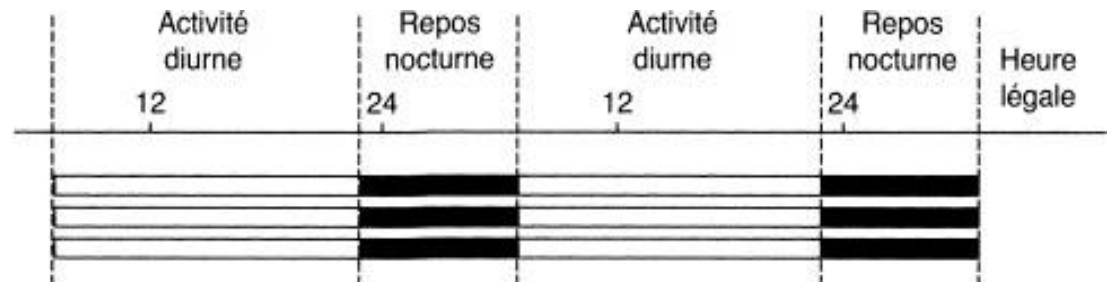
# Biorythmes



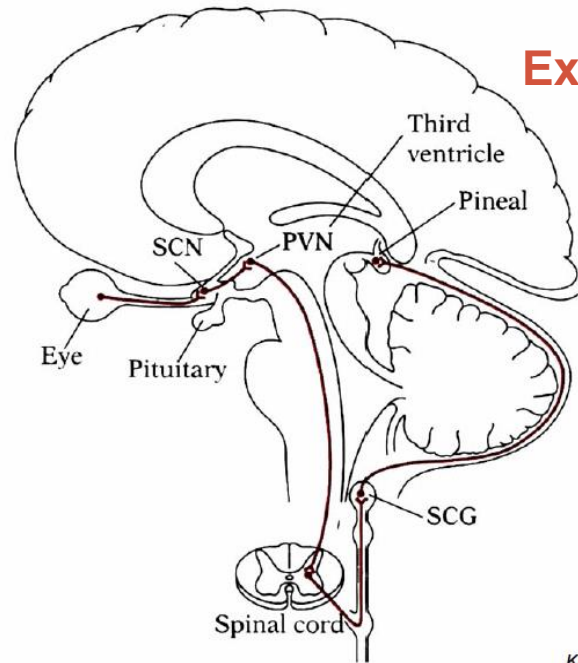
■ sommeil

□ éveil

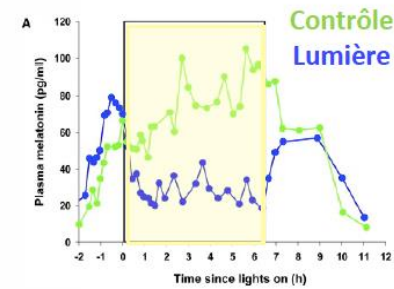
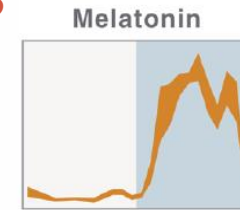
# Biorythmes



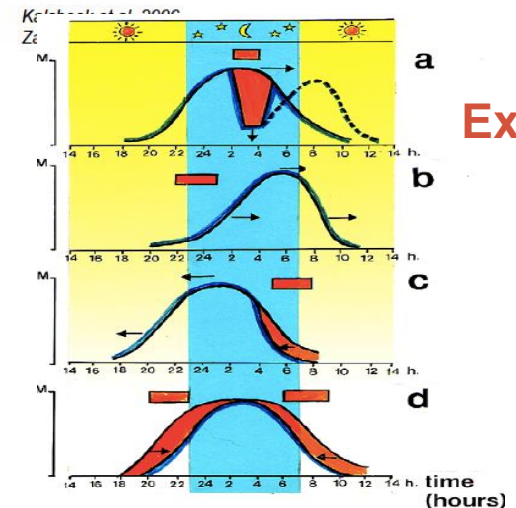
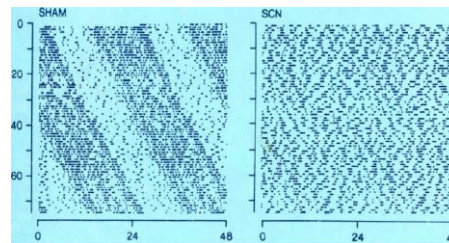
# Expérience 4 : entrainement par la lumière



Exp 3

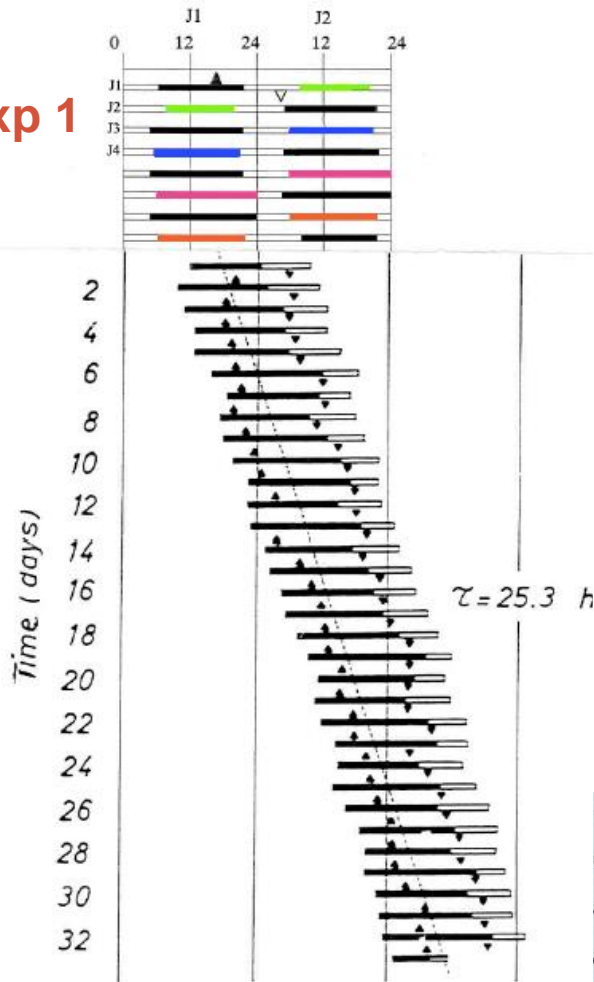


Exp 2



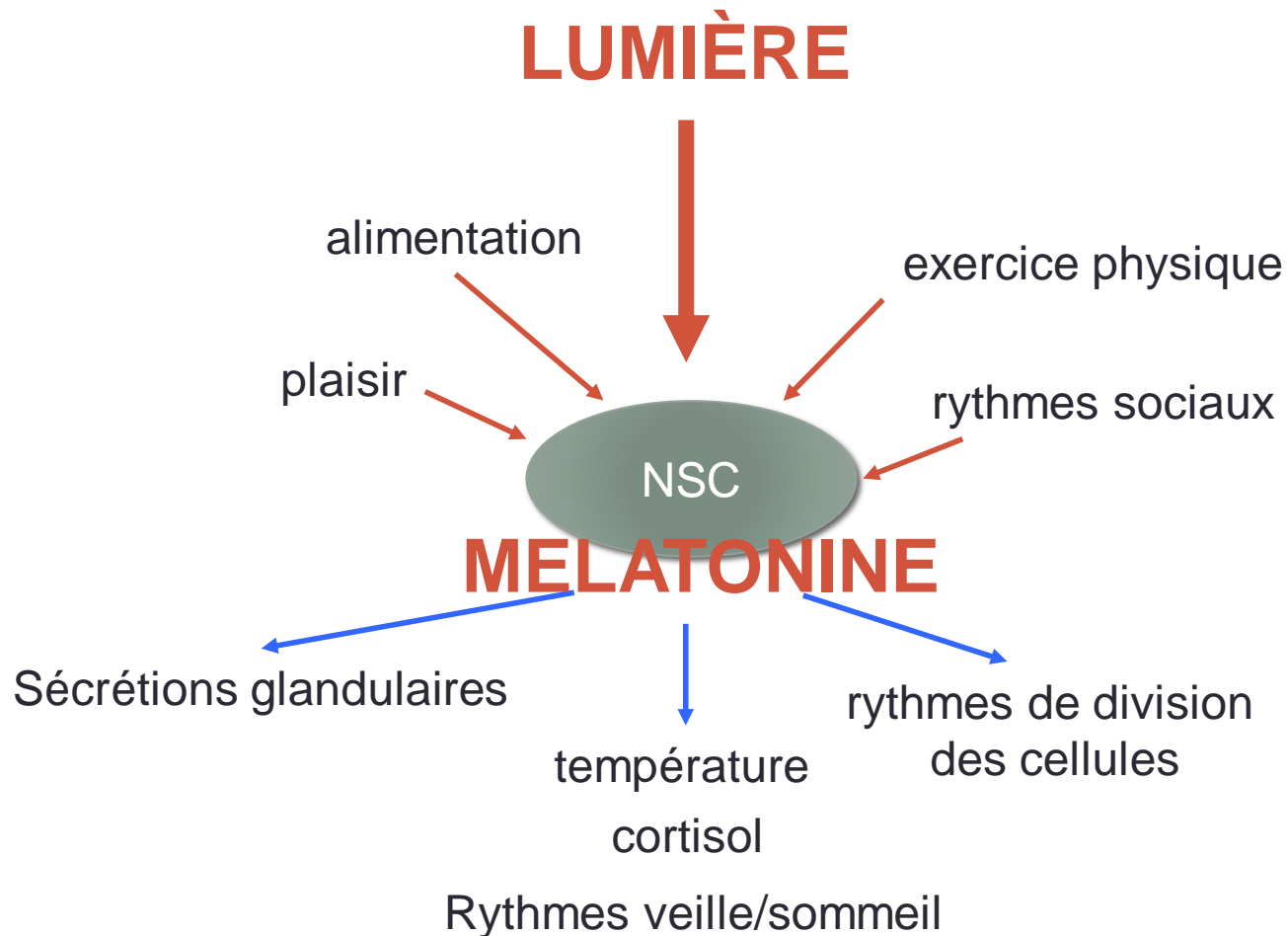
Exp 4

Exp 1



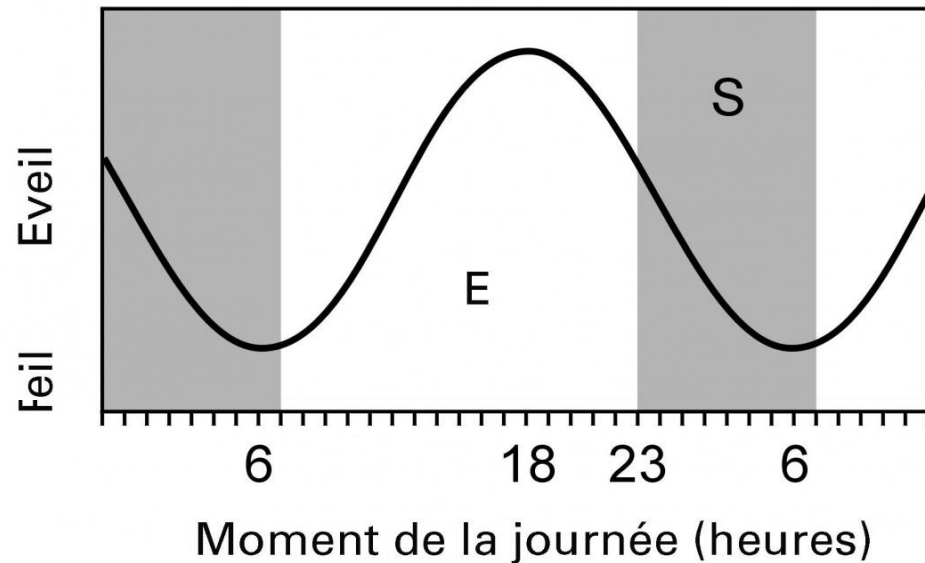


# Processus circadien



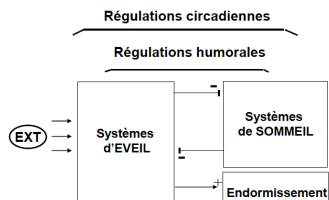
# Processus circadien

- Modélisation du processus circadien C

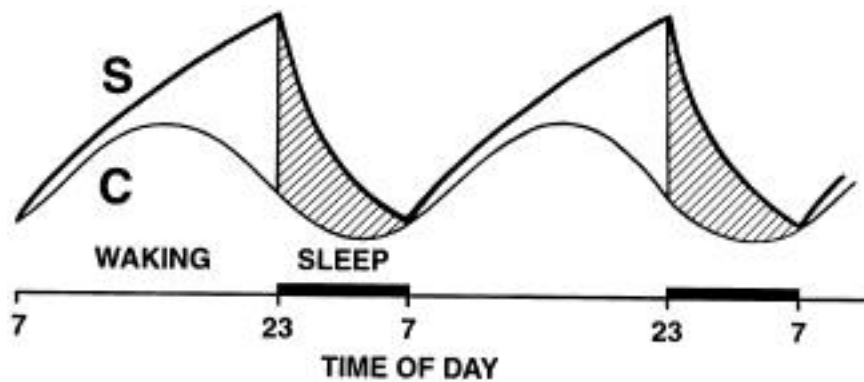
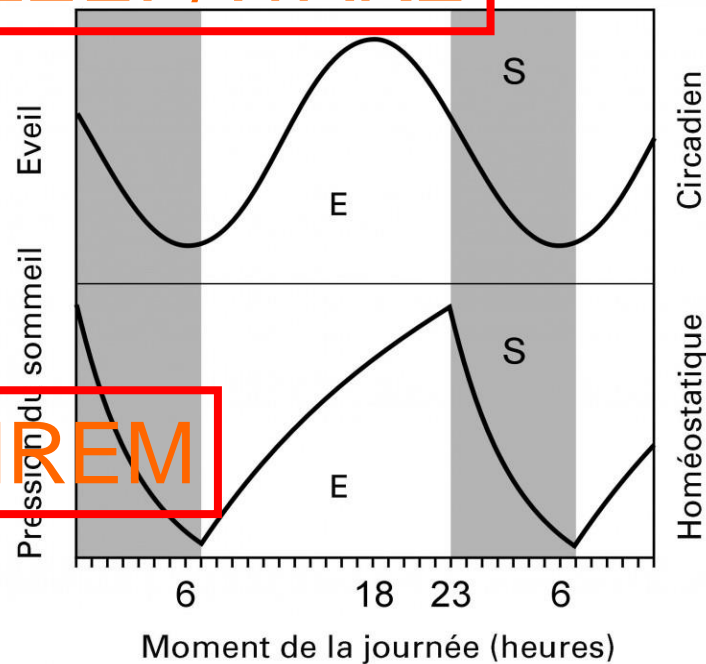




**SLEEP/WAKE**



**NREM**



Borbély, 1981

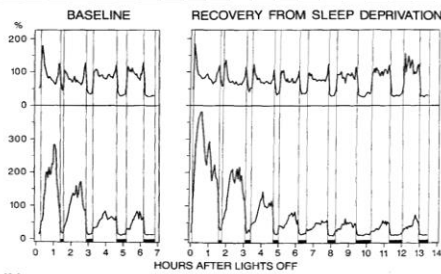
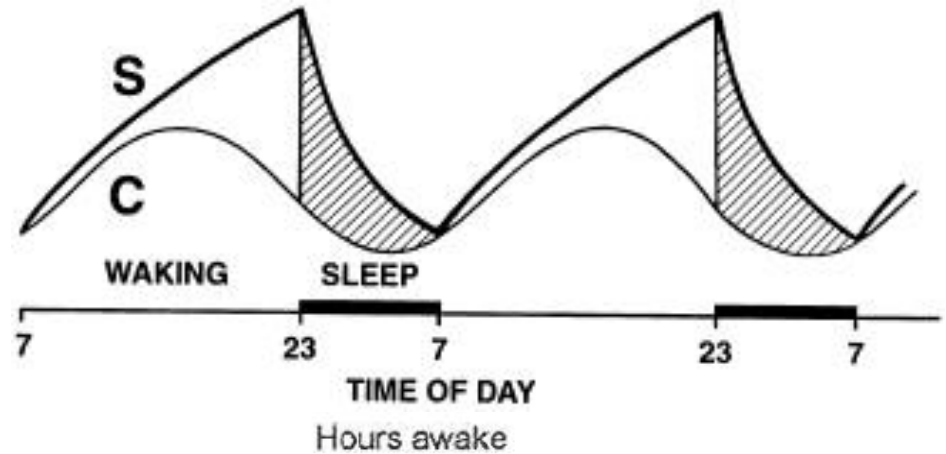
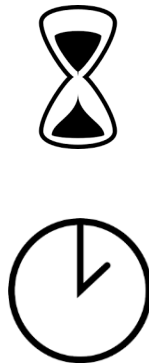
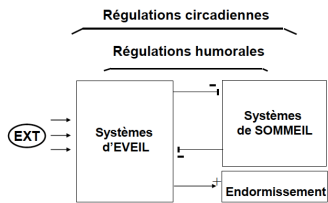
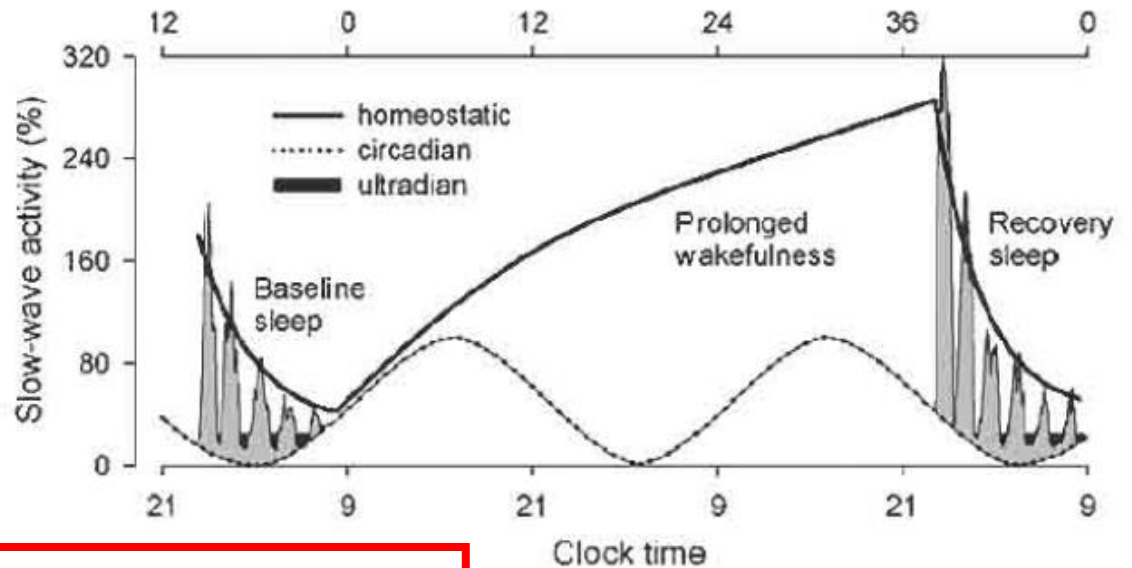


Figure 29-3. Time course of slow wave activity (power density in the 0.75- to 4.5-Hz band; lower curves) and activity in the spindle frequency range (13.25- to 15.0-Hz; upper curves) recorded under baseline conditions and after sleep deprivation (26 h) of wakefulness. The NREM sleep episodes were divided into 20 equal parts, the REM sleep episode into five equal parts. The curves represent mean percentile values NREM sleep (100%) and REM sleep (100%). The mean timing of REM sleep episodes is denoted by vertical lines and horizontal bars above the abscissa. (Reanalysis of the data from Dik, DE, Bugner DB, Borbély AA. Time course of EEG power density during long sleep in humans. *Am J Physiol* 1990;258:R509-513, by D. Achermann.)



**NREM/REM**

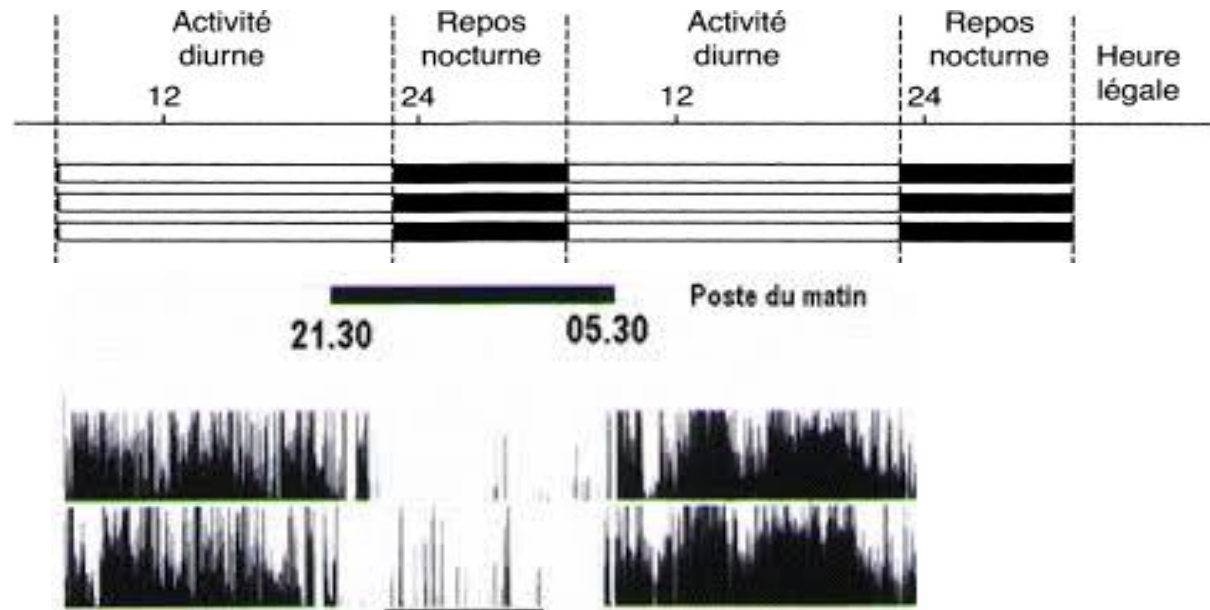
Folkard, 1987

# TECHNIQUES D'EXPLORATION DU SOMMEIL ET DE LA VIGILANCE

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# Actimétrie



Handwritten text, likely a report or log, showing a grid of data points. The text is written in a cursive script and is organized into columns and rows, possibly representing a schedule or a data log. The text is somewhat faint and difficult to read, but it appears to be a structured document.

# Classification des dispositifs

Catégorie	Supervision	EEG	Signaux cardio-respiratoires
Type I	en laboratoire	> 6 voies EEG 2 EOG 1-3 EMG menton	Flux respiratoire (canule et thermistance), effort respiratoire (sangles thoraco-abdominales), oxymètre, ECG, microphone (parfois capnographe) EMG jambiers
Type II	À domicile	> 6 voies EEG 2 EOG 1-3 EMG menton	Flux respiratoire (canule et thermistance), effort respiratoire (sangles thoraco-abdominales), oxymètre, ECG, microphone (parfois capnographe) EMG jambiers,
Type III	À domicile	Non	Flux respiratoire, effort respiratoire, oxymètre, ECG (ou fréquence cardiaque)
Type IV	À domicile	Non	Oxymètre, fréquence cardiaque (rarement, flux respiratoire seul)

POLYSOMNOGRAPHIE

POLYGRAPHIE VENTILATOIRE

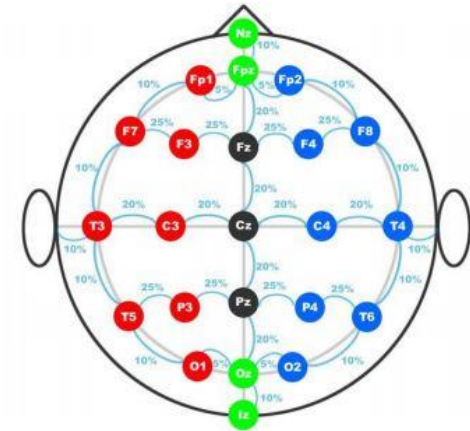
OXYMETRIE NOCTURNE



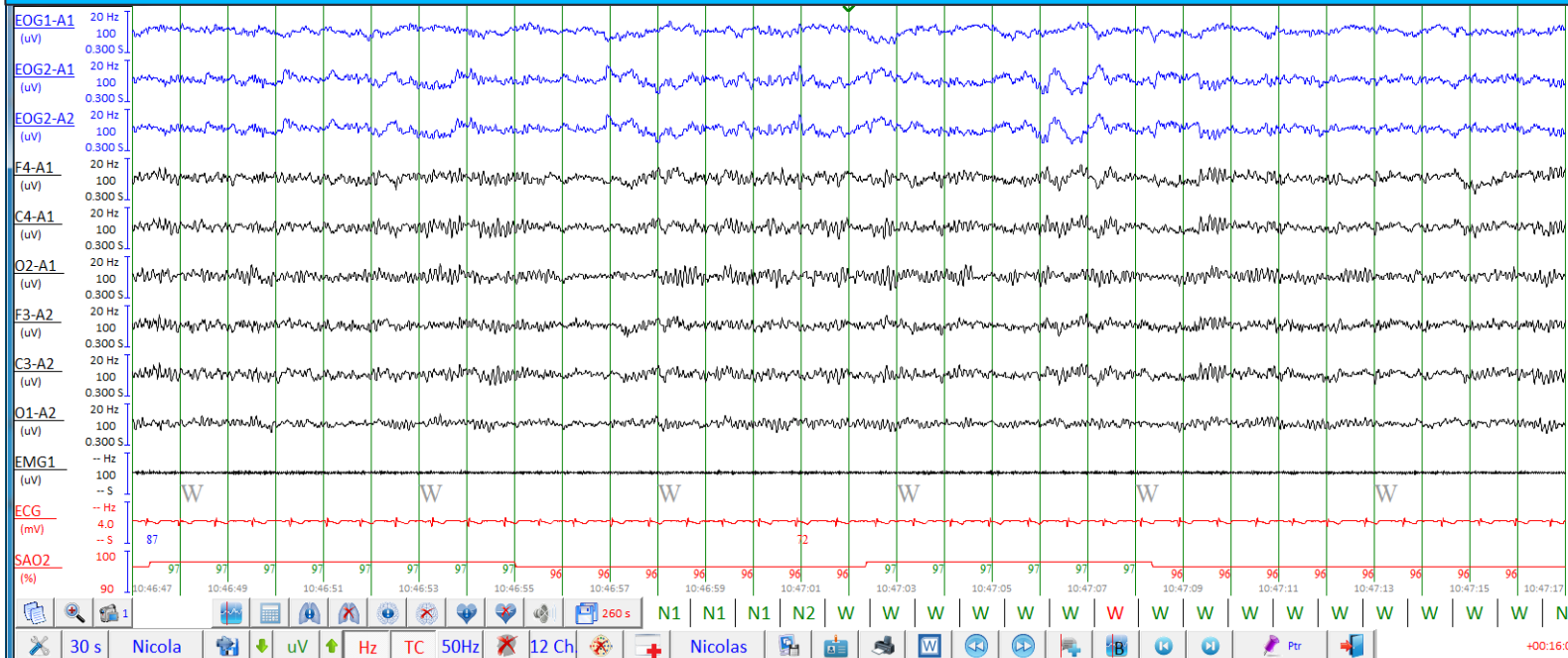
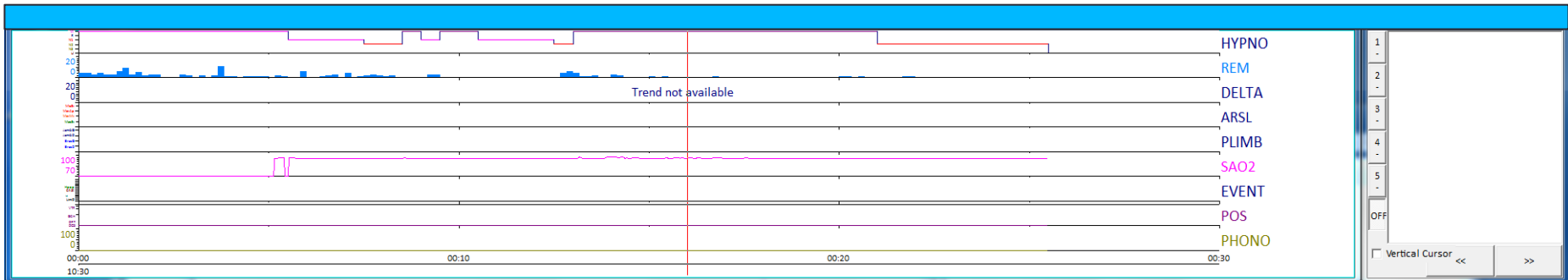
# Polysomnographie

## Exemple de spécifications d' un dispositif de PSG :

- 12 canaux de référence bipolaires / communs sélectionnables
- 12 canaux de référence communs fixes
- 1 capteur de position du corps
- 2 canaux DC
- 2 capteurs de pression de flux d' air
- 2 entrées de ceinture respiratoire (thorax, abdomen)
- 1 port série
- Pléthysmogramme, SaO<sub>2</sub>, canaux de fréquence cardiaque
- Jusqu' à 8192 Hz Taux d' échantillonnage par canal
- Écran LCD pour un examen immédiat des traces
- Contrôle d' impédance automatique



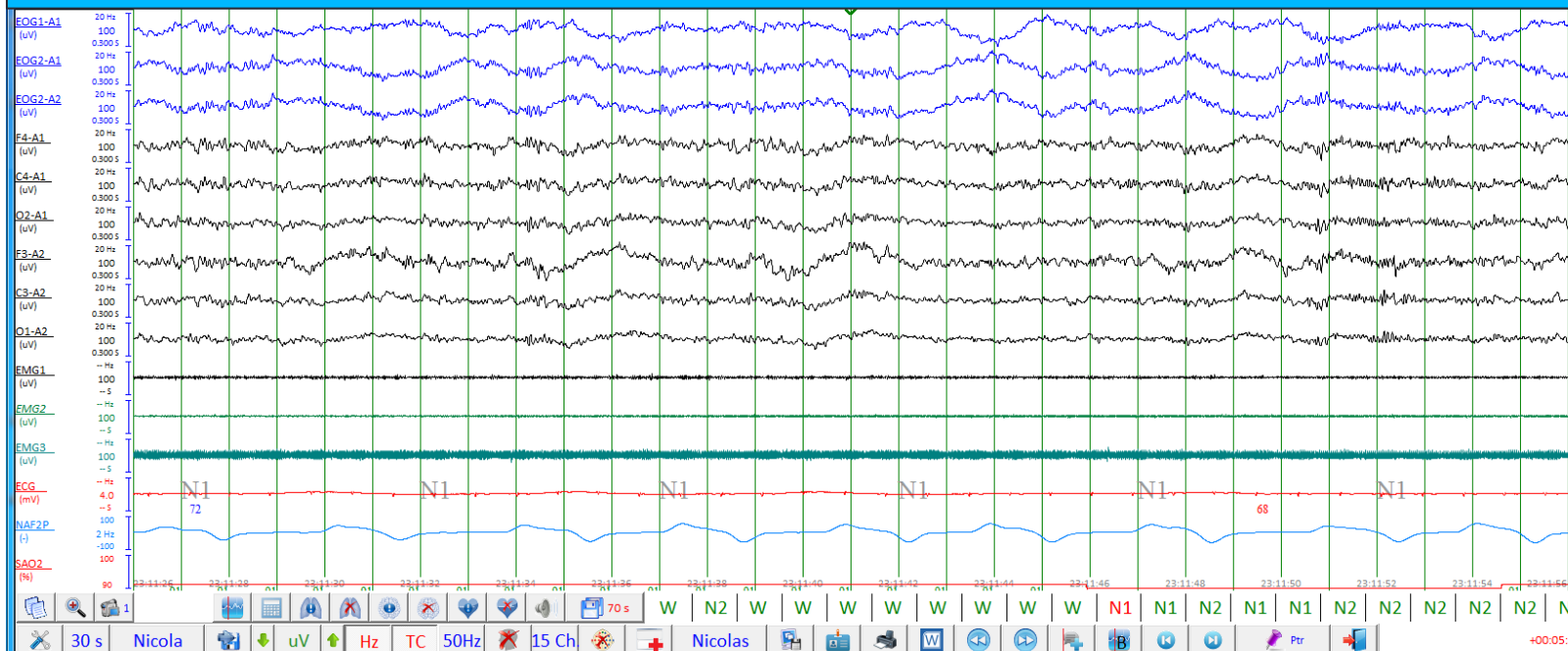
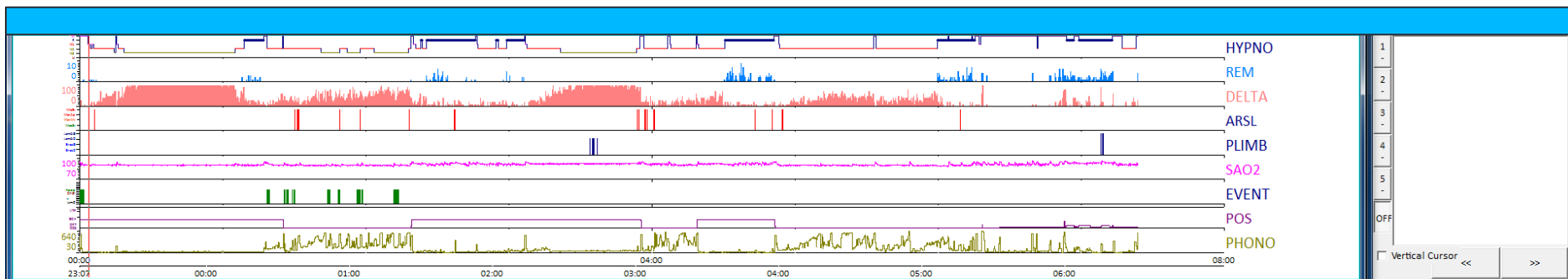
# Polysomnographie



## Résultats en temps réel

SLEEP	
TST (min)	10.5
Sleep efficiency (%)	40.4
Sleep Stage 1 (min)	4.5
Sleep Stage 2 (min)	6.0
Sleep Stage 3 (min)	0.0
Sleep Stage REM (min)	0.0
WASO	9.5
Latency Stage 1	5.5
Latency Stage REM	--
Arousal Index	0.0
NEURO	
PLM index	0.0
DESAT	
DI/TST without Wake	5.7
PNEUMO	
AHI/SLEEP	0.0
Obstructive Apnoeas	0
Central Apnoeas	0
Mixed Apnoeas	0
Hypopnoeas	0

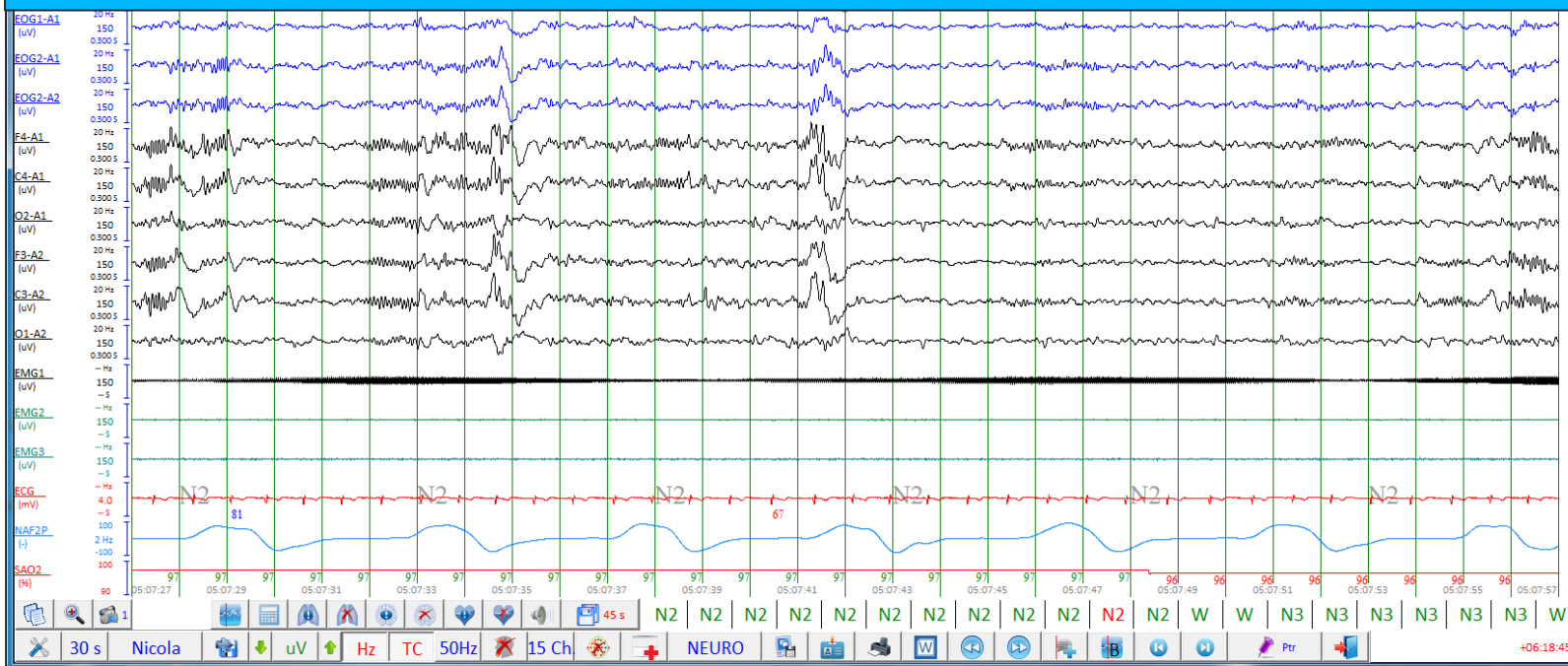
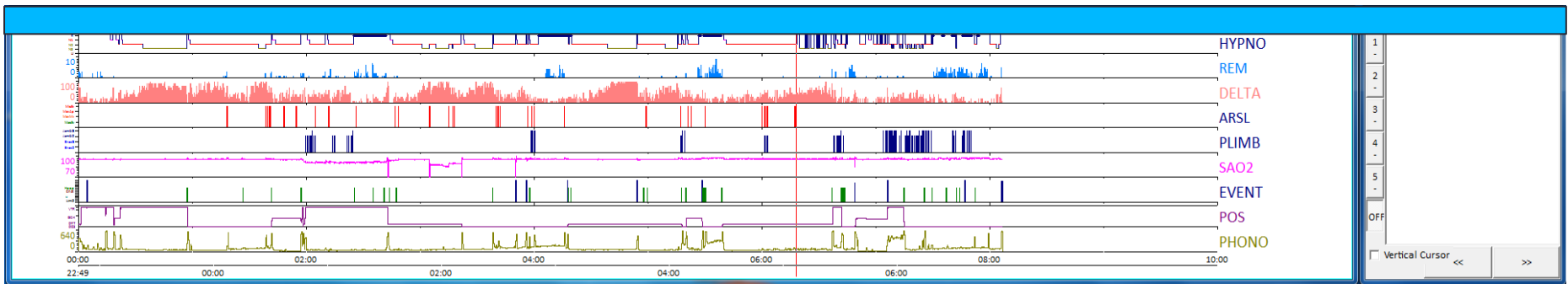
# Polysomnographie



## Résultats en temps réel

SLEEP	
TST (min)	385.0
Sleep efficiency (%)	86.7
Sleep Stage 1 (min)	7.0
Sleep Stage 2 (min)	181.0
Sleep Stage 3 (min)	107.0
Sleep Stage REM (min)	90.0
WASO	55.5
Latency Stage 1	3.5
Latency Stage REM	69.0
Arousal Index	2.8
NEURO	
PLM index	1.6
DESAT	
DI-TST without Wake	7.3
PNEUMO	
AHI/SLEEP	2.0
Obstructive Apnoeas	0
Central Apnoeas	0
Mixed Apnoeas	0
Hypopnoeas	13

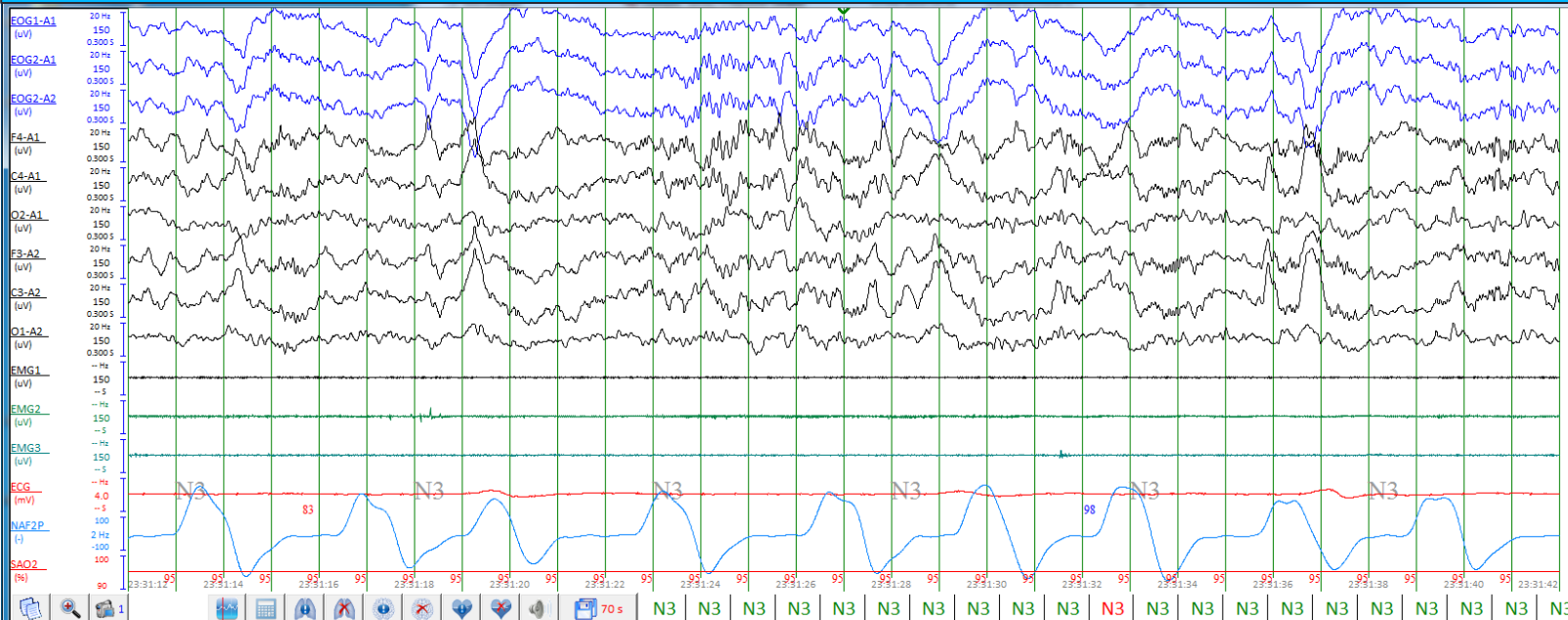
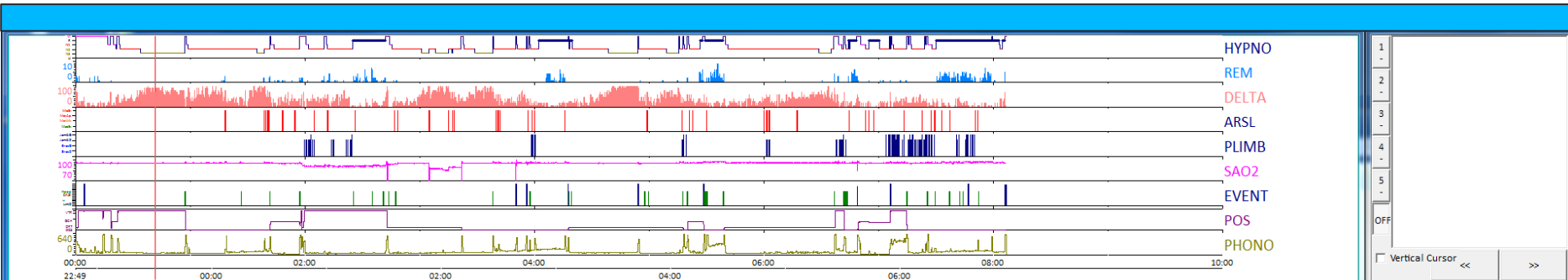
# Polysomnographie



## Résultats en temps réel

SLEEP	
TST (min)	410.0
Sleep efficiency (%)	84.2
Sleep Stage 1 (min)	14.5
Sleep Stage 2 (min)	248.0
Sleep Stage 3 (min)	81.0
Sleep Stage REM (min)	54.5
WASO	60.5
Latency Stage 1	16.5
Latency Stage REM	145.0
Arousal Index	5.3
NEURO	
PLM index	17.4
DESAT	
DI/TST without Wake	0.7
PNEUMO	
AHI/SLEEP	5.9
Obstructive Apnees	8
Central Apnees	1
Mixed Apnees	1
H <sub>2</sub> Code 97	30

# Polysomnographie



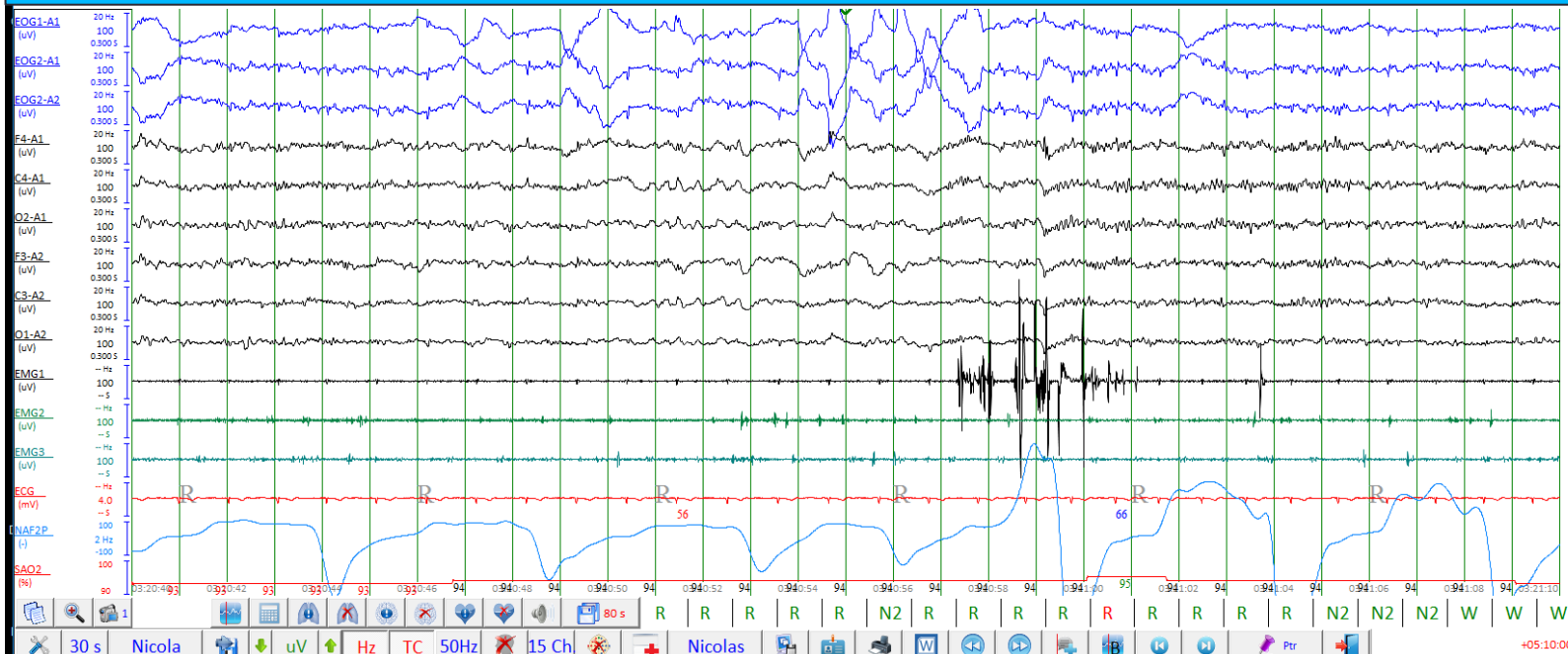
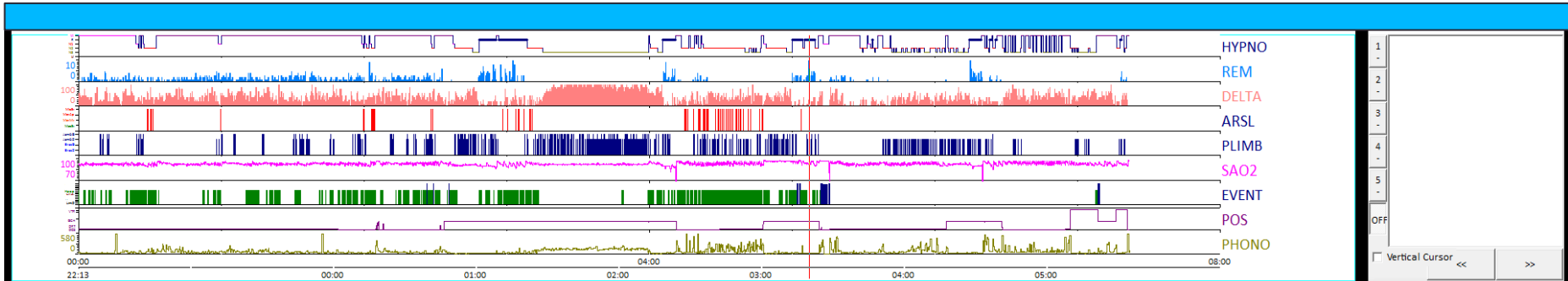
Vertical Cursor << >>

Résultats en temps réel

SLEEP	
TST (min)	441.0
Sleep efficiency (%)	90.6
Sleep Stage 1 (min)	21.5
Sleep Stage 2 (min)	255.5
Sleep Stage 3 (min)	76.0
Sleep Stage REM (min)	88.0
WASO	29.5
Latency Stage 1	16.5
Latency Stage REM	145.0
Arousal Index	6.5
NEURO	
PLM index	15.9
DESAT	
DI/TST without Wake	0.8
PNEUMO	
AHI/SLEEP	5.4
Obstructive Apnoeas	8
Central Apnoeas	1
Mixed Apnoeas	1
Hypopnoeas	30

30 s Nicola uV Hz TC 50Hz 15 Ch NEURO +00:42:30

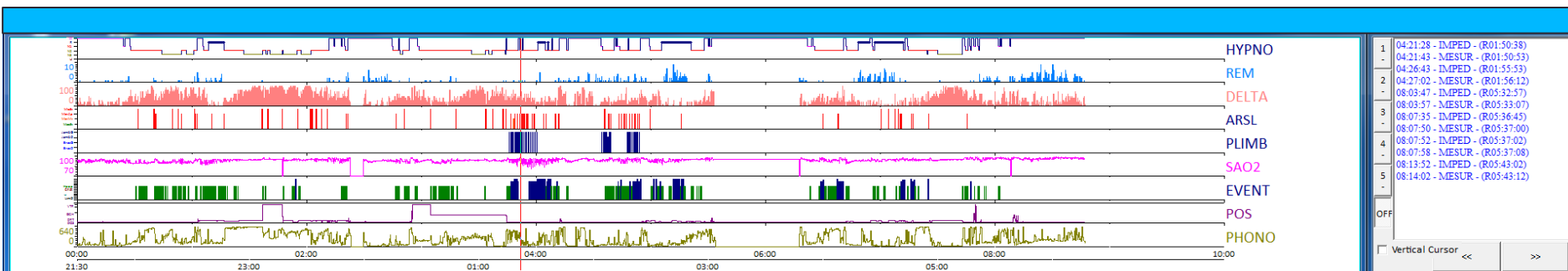
# Polysomnographie



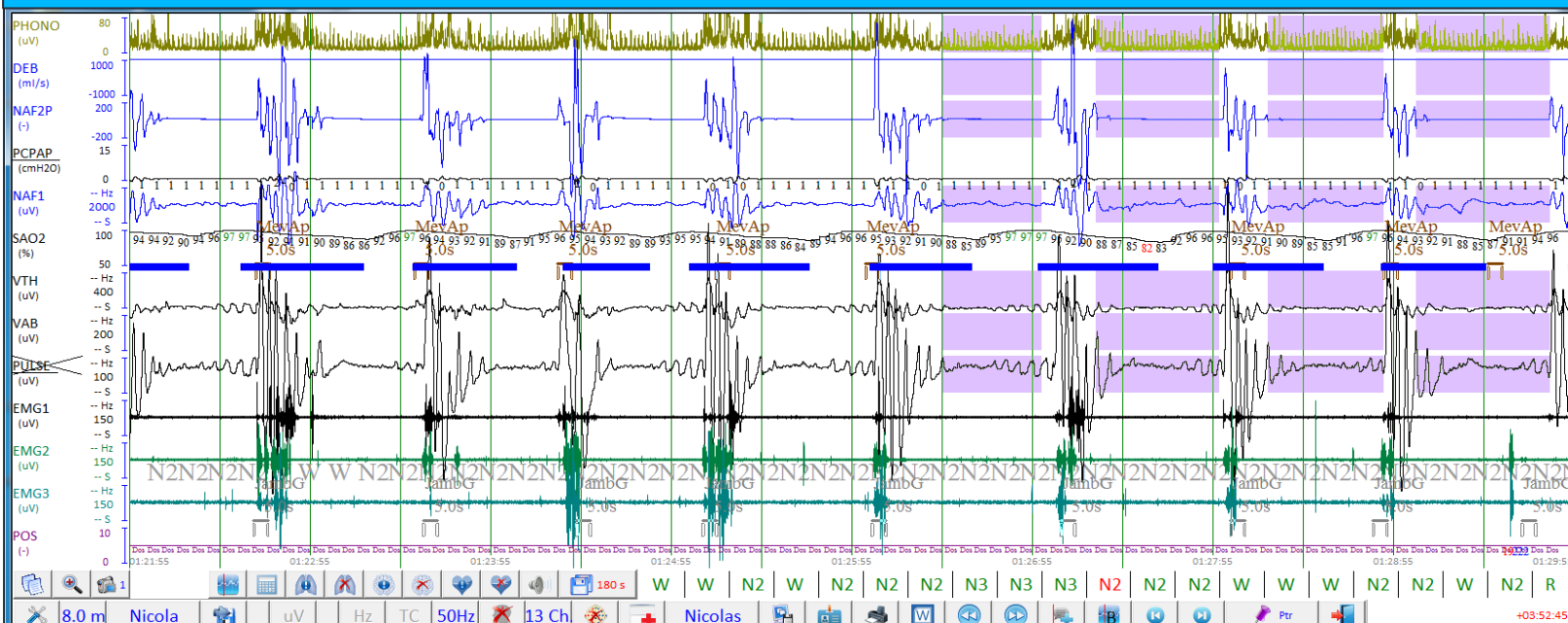
## Résultats en temps réel

SLEEP	
TST (min)	246.5
Sleep efficiency (%)	55.8
Sleep Stage 1 (min)	11.5
Sleep Stage 2 (min)	94.0
Sleep Stage 3 (min)	31.5
Sleep Stage REM (min)	41.0
WASO	171.5
Latency Stage 1	24.0
Latency Stage REM	168.5
Arousals Index	11.9
NEURO	
PLM index	136.8
DESAT	
DI/TST without Wake	34.1
PNEUMO	
AHI/SLEEP	57.7
Obstructive Apnees	8
Central Apnees	1
Mixed Apnees	0
Hypopnees	228

# Polysomnographie



1	04:21:28 - IMPED - (R01:50:38)
-	04:21:43 - MESUR - (R01:50:53)
2	04:26:43 - IMPED - (R01:55:53)
-	04:27:02 - MESUR - (R01:56:12)
-	08:03:47 - IMPED - (R05:32:57)
3	08:03:57 - MESUR - (R05:33:07)
-	08:07:35 - IMPED - (R05:36:45)
-	08:07:50 - MESUR - (R05:37:00)
4	08:07:52 - IMPED - (R05:37:02)
-	08:07:58 - MESUR - (R05:37:08)
5	08:13:52 - IMPED - (R05:43:02)
-	08:14:02 - MESUR - (R05:43:12)

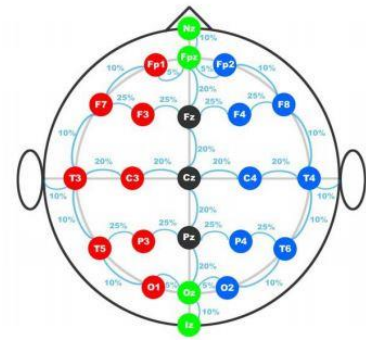


Résultats en temps réel

SLEEP	
TST (min)	317.0
Sleep efficiency (%)	60.2
Sleep Stage 1 (min)	16.0
Sleep Stage 2 (min)	183.5
Sleep Stage 3 (min)	68.5
Sleep Stage REM (min)	48.5
WASO	186.0
Latency Stage 1	24.0
Latency Stage REM	68.5
Arousal Index	15.0
NEURO	
PLM index	7.2
DESAT	
DI/TST without Wake	26.9
PNEUMO	
AHI/SLEEP	39.7
Obstructive Apnees	27
Central Apnees	5
Mixed Apnees	25
Hypopnees	153

# Tests de vigilance

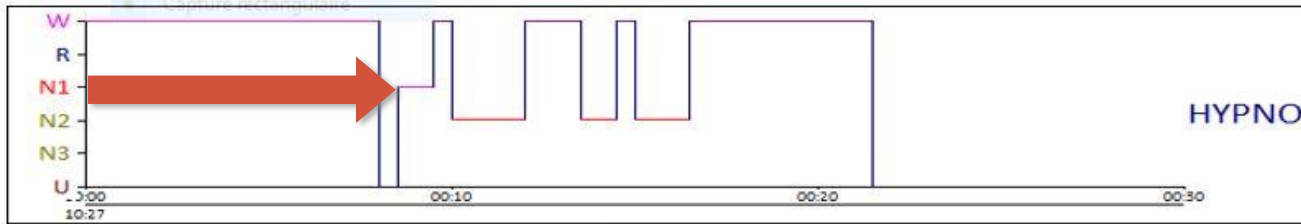
- Conditions de réalisation strictes et standardisées
- **Tests itératifs de latence d'endormissement (TILE) :**
  - > 6 voies EEG, éventuellement EOG et EMG menton
  - 4 à 5 tests de **20 minutes**
  - Consignes : « **Laissez-vous gagner par le sommeil.** »
  - Mesure de la latence d'endormissement : durée entre le début du test et la première époque de sommeil
- **Tests de maintien d'éveil (TME) :**
  - > 6 voies EEG, éventuellement EOG et EMG menton
  - 4 à 5 tests de **40 minutes**
  - Consignes : « **Résistez au sommeil !** »
  - Mesure de la latence d'endormissement : durée entre le début du test et la première époque de sommeil



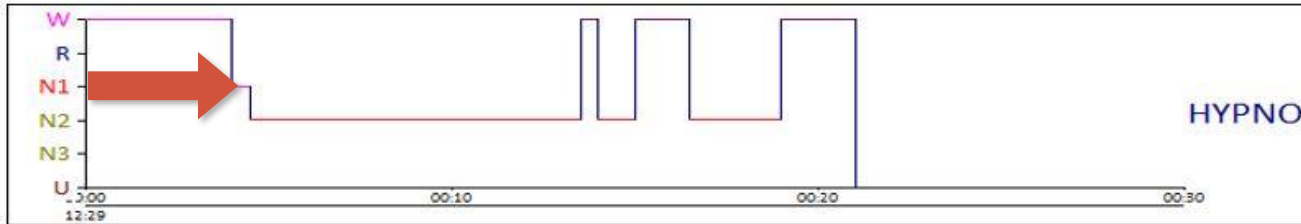


# Tests de vigilance

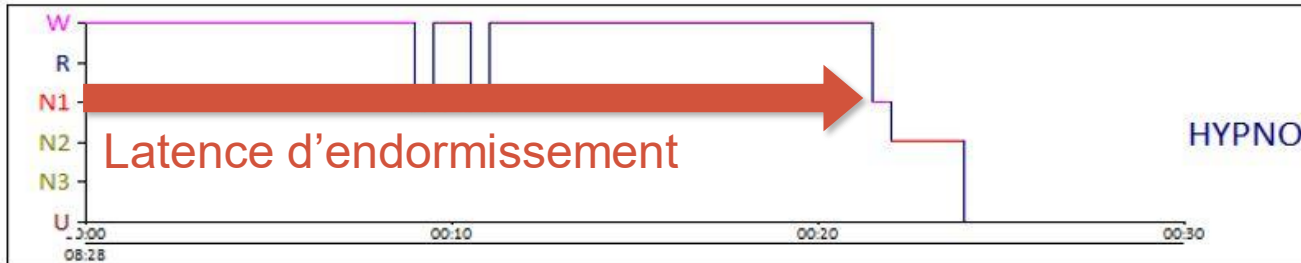
TEST 1  
08:30



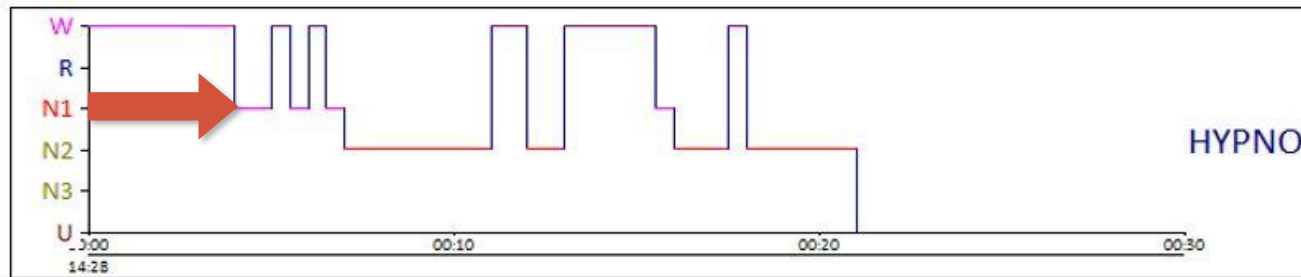
TEST 2  
10:30



TEST 3  
12:30



TEST 4  
14:30



# Merci pour votre attention



## CMRS – CHRU NANCY



Situé à l'Hôpital Central, au 3e étage du bâtiment Lepoire, le Centre de Médecine et de Recherche sur le Sommeil (CMRS) du CHRU de Nancy dispose de 7 chambres individuelles accueillant les patients 24h/24, 7j/7 et 2 chambres individuelles du lundi au vendredi.

Le CMRS s'appuie sur l'expertise d'une équipe médicale composée de neurologues et de pneumologues spécialisés dans les maladies du sommeil et d'une équipe soignante ayant reçu une formation spécifique.

Grâce au regroupement des activités de Neurologie et de Pneumologie, l'exploration et le traitement des troubles du sommeil et de la vigilance chez l'adulte sont assurés de façon pluridisciplinaire, avec un parcours patient personnalisé.

Pour l'adulte : prendre rendez-vous au CMRS (secrétariat) : 03 83 85 23 77 ou [ide.parcours.neurosciences@chru-nancy.fr](mailto:ide.parcours.neurosciences@chru-nancy.fr)

Pour l'enfant : les troubles du sommeil sont pris en charge à l'hôpital d'enfants : 03 83 15 48 70

