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Changes In Phase Synchronization During Sleep/Wake Conditions

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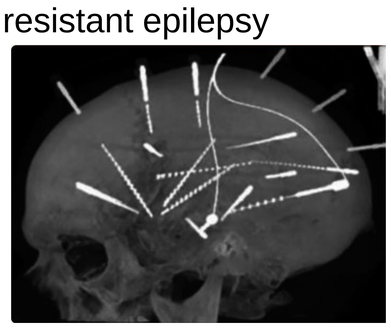
Objective

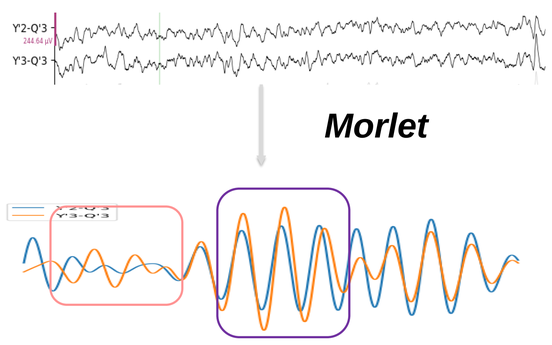
This work aims to investigate how sleep affects synchrony of the spontaneous neuronal oscillations in humans

Methods and Results

SEEG data from subjects affected by focal drug-resistant epilepsy



Raw data



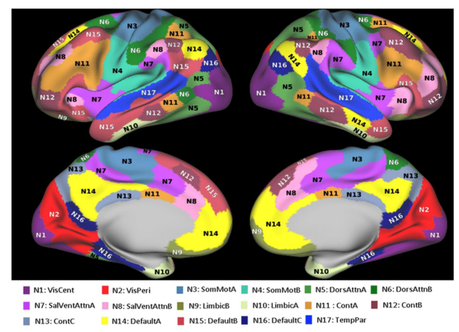
Phase Locking Value

$$PLV = \left| \frac{1}{N} \sum_{k=1}^{N} e^{j(\varphi_X(t) - \varphi_Y(t))} \right|$$

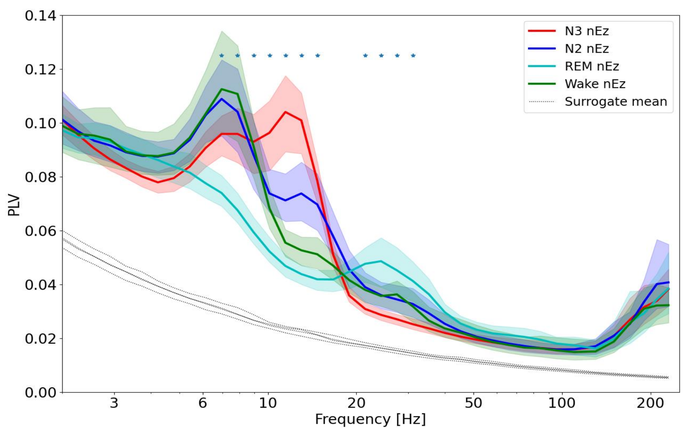
$Lower\ \Delta\varphi_{XY} \rightarrow$ Higher PLV

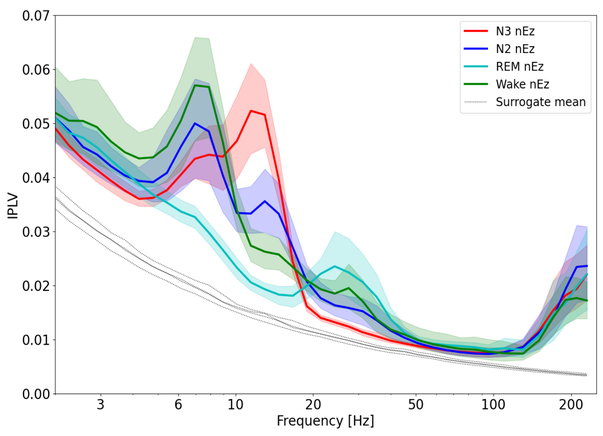
$Higher\ \Delta\varphi_{XY} \rightarrow$ Lower PLV

17 functional networks



A characteristic synchronization profile for each stage



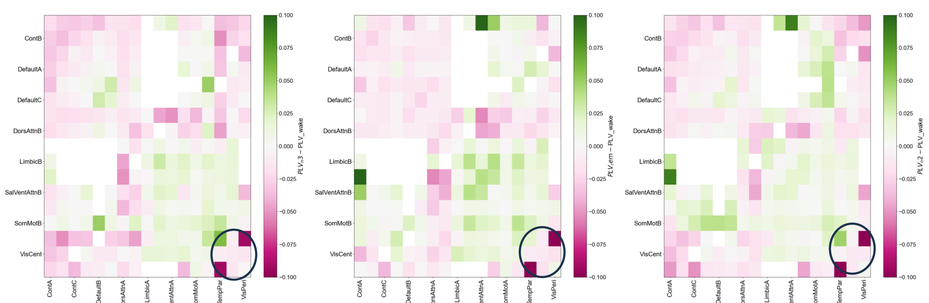


- Strong synchronization in sigma band in N3 stage with respect to other condition
- Wake and N2 reach maximum synchronization value in delta range
- N2 shows another peak of synchronization in sigma band
- REM in beta band has a higher PLV value compared to NREM sleep and wake

No influence of volume conduction

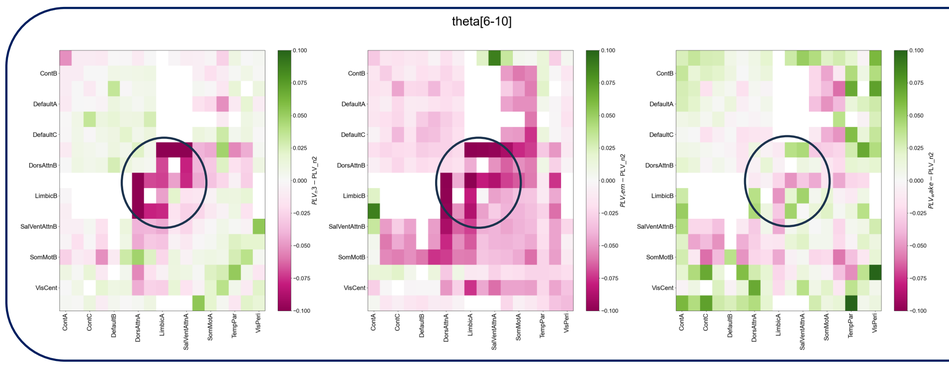
Networks synchronization depends on frequency band and stage

delta[2-5]



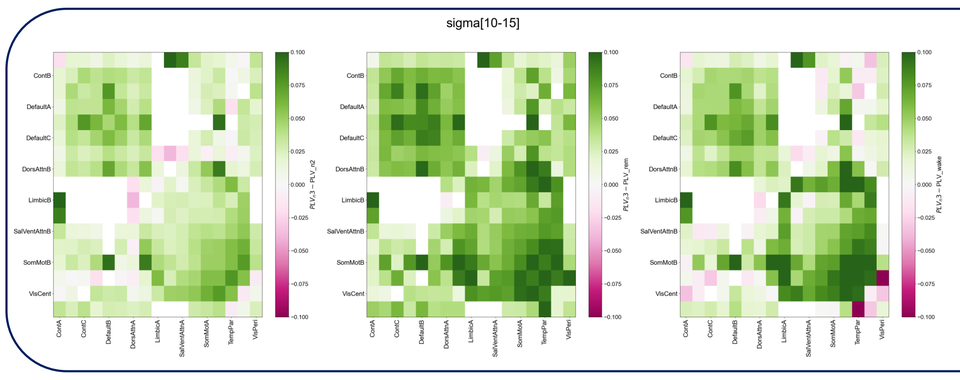
WAKE>>NREM&REM between Temporal Parietal and Visual Peripheral networks

theta[6-10]



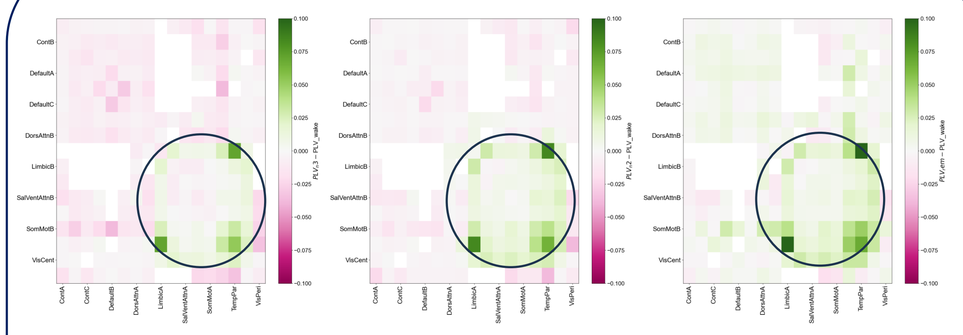
N2>>N3,REM&WAKE In Limbic systems with Salience/Ventral Attention and Somatomotor networks

sigma[10-15]



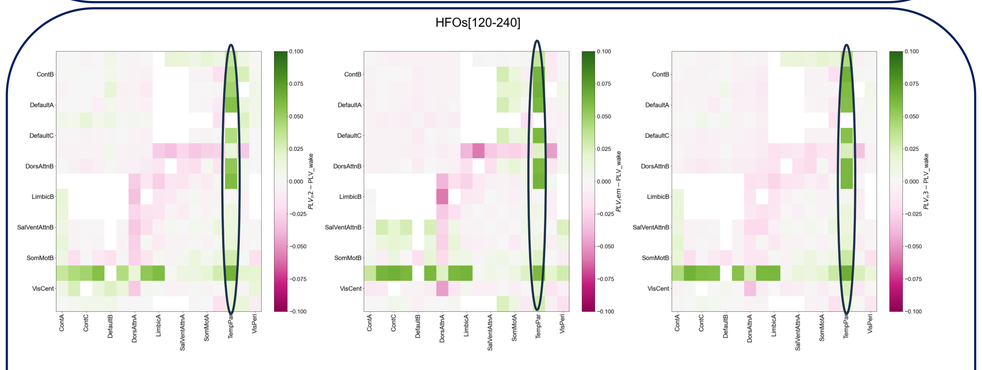
N3 >> N2,REM,WAKE between Control, Default, Dorsal Attention and even in Limbic, Salience/Ventral Attention and Temporal Parietal

beta[19-50]



Sleep stages >> WAKE in Limbic, Salience/Ventral Attention and Temporal Parietal

HFOs[120-240]



Sleep stages >> WAKE between the Temporal Parietal and the other networks

Conclusions

1. Deep sleep shows higher levels of synchronization in the sigma band, associated with thalamus-cortical spindles and supporting memory consolidation and synaptic plasticity through the synchronization of large cortical areas.
2. Large-scale synchronization in theta, beta, and in HFOs bands is more evident in wakefulness, presumably indicating information processing of wakefulness.
3. During sleep stages, the Temporal Parietal network shows a large synchronization with the other networks in particular in beta and HFOs correlated to memory functions

Contacts

References

https://esleepeurope.eu/

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