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**Interaction of Hippocampal Ripples, Theta Oscillations and Pontine-Geniculo-Occipital waves leading to brain wide metastates related to learning and memory consolidation**

Short-lasting patterns of neural activity, including single- or multiple-cycle oscillatory episodes, such as Theta-Bursts, Spindles, Sharp-Wave-Ripples (SWR) & Pontine-Geniculo-Occipital (PGO) waves, likely reflect state changes of self-organizing large-scale networks. Although such neural events, which are critical for the synaptic and system consolidation of memory, were studied in detail with neurophysiological methods, the brain-states related to them remain elusive, primarily due to a dearth of methodologies permitting concurrent recordings in various structures and mapping of whole-brain activity.

In my lecture, I will briefly describe our multidisciplinary and multimodal approaches, and subsequently present results related to the interaction of SWR and PGO waves, questioning the global nature of sleep-states. Lastly, I'll show novel results related to the Multi-Structure-Activity (MSA) - precisely traced with functional MRI - the clusters of which may provide important information related to intrinsic neural events and their sequences. Extending such research by implementing multi-site Microendoscopic Calcium Imaging (MCI) and Electro-Neuro-Chemical (ENC) methodologies, which allow concurrent measurements of electrical activity and neurotransmitter/neuromodulator concentration changes, are likely to largely decrease the MRI-signal ambiguity and permit an excellent interpretation and prediction of the brain-states underlying the MSA pattern-clusters.