

## Hierarchical synchronization and complex patterns in the human connectome network

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The spontaneous emergence of coherent behavior through synchronization plays a key role in neural function, and its anomalies often lie at the basis of pathologies. We employ a parsimonious (mesoscopic) approach to study analytically and computationally the synchronization (Kuramoto) dynamics on the actual human-brain connectome network. We elucidate the existence of a so-far-uncovered intermediate phase, placed between the standard synchronous and asynchronous phases, i.e. between order and disorder. This novel phase -similar in essence to a Griffiths phase- stems from the hierarchical modular organization of the connectome. Where one would expect a hierarchical synchronization process, we show that the interplay between structural bottlenecks and quenched intrinsic frequency heterogeneities at many different scales, gives rise to frustrated synchronization, metastable attractors of local coherence, and chimera-like states, resulting in a very rich and complex phenomenology.

[1] P. Villegas et al. (2015). Complex synchronization patterns in the human connectome network. ArXiv Preprint. arXiv:1503.03258.

[2] P. Villegas, P. Moretti and M.A. Muñoz (2014). Frustrated hierarchical synchronization and emergent complexity in the human connectome network. Scientific Reports **4**. DOI:10.1038/srep05990