

# Population computation suppression through synchrony

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We have recently demonstrated that local activity in human cortex is represented in a broadband cortical spectral power law. Using a PCA based method on sub dural electrocorticographic recordings in humans, we were able to decouple this power law behavior from the classic alpha and beta rhythms, revealing its presence at low frequencies. The projection of the dynamic spectrum to this power law, is able to capture the dynamics of population-level activity on the 5mm spatial scale, with high temporal precision. We examined the relationship of changes in the amplitude of this power law to the phase of intrinsic low frequency rhythms. In motor cortex, it dynamically couples to the phase of the beta rhythm (so called phase-amplitude coupling – PAC) during a simple movement task. Interestingly, during periods of movement, this PAC is less pronounced than during periods of rest.

We then provide a simple, small-scale, model of synaptic organization that may provide intuition for the large scale phase-amplitude correlation we report. In this model: 1) the broadband reflects asynchronous summation of a large number of cortico-cortical inputs between pyramidal neurons. 2) Synchronous, sub-cortical or distant cortical, projections to pyramidal neurons are reflected in the low frequency rhythms. The synchronizing influence of the beta rhythm constrains local computation, and this is the basis for the phase-amplitude coupling. During local computation, the amplitude of the power law goes up, beta goes down, and the PAC decreases. Finally, we show that this principle might generalize to other functions in other areas. In language regions, during a noun production and verb generation speech task, it couples to different low frequency rhythms (e.g. delta, theta, and alpha) in different areas of cortex, and, as with to movement, the degree of PAC is task dependent.

