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Neural inhibition and the statistical mechanics of asynchronous states

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Neural networks are shaped by the combined action of excitatory and inhibitory interactions. Here we show that inhibition solves the problem of the all-or-none type of response that comes about in purely excitatory networks, allowing the network to operate at low activity, between quiescent and saturated regimes. In particular, the low activity phase is generated by a noise-induced effect that we call "Jensen's force"–stemming from the combined effect of excitation/inhibition balance and network sparsity .The phase reproduces relevant features of asynchronous states in cortical networks, which are characterized by low, uncorrelated and highly-irregular activity. Our approach provides a simple understanding of asynchronous states and of the phase transitions to other phases, putting asynchronous-state and critical-state hypotheses, within a unified framework. We argue that Jensen's forces could be measurable experimentally and might be relevant in contexts beyond neuroscience.

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