

# The Balanced State: The Standard Model and Beyond

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Strong temporal irregularity and right-skewed, long-tailed distributions of firing rates are distinctive features of cortical spiking activity. Both features are quite puzzling upon consideration of the large number of synaptic inputs a cortical cell receives and the weak correlations among these inputs. A minimal theoretical framework accounting naturally for these features – the balance hypothesis – was proposed by van Vreeswijk and Sompolinsky in two seminal papers at the end of the 1990s. In fact, we showed recently that *log-normal* distributions of mean firing rates as reported in cortex *in-vivo*, emerge naturally in the balanced regime. I will summarize the general phenomenology of the balanced regime. I will then address two limitations of the balance hypothesis in its “standard” formulation: 1) it precludes multi-stability and thus the *persistence* of neurons activity (*e.g.*, delay activity in working memory tasks) 2) it does not account for temporal fluctuations observed in the neuronal activity on time scales on the order of 100 ms-1s as observed in cortex. I will describe possible solutions to these limitations.