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Dynamical Phase Transitions and Scaling Laws in the Response of a Rhythmically Perturbed Neuron JAN ENGELBRECHT, RENATO MIROLLO, Boston College — In order to explore how a local rhythm influences the timing of a neuron's spikes, we study the dynamics of an integrate-and-fire model neuron with an oscillatory stimulus. The frustration due to the competition between the neuron's natural firing period and that of the oscillatory rhythm leads to a rich structure of asymptotic phase locking patterns and ordering dynamics. The phase transitions between these states can be classified as either tangent or discontinuous bifurcations, each with its own characteristic scaling laws. The discontinuous bifurcations exhibit a new kind of phase transition that may be viewed as intermediate between continuous and first order, while tangent bifurcations behave like continuous transitions with a diverging coherence scale.

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