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The dynamics of temporal ordering in driven integrate-and-fire-neurons. JAN ENGELBRECHT, RENATO MIROLLO, Boston College — Spike-timing neural codes involve the development of some kind of temporal order (synchrony) between a neuron's spike times and timing features in either the stimulus, local field potentials or the average activity in a population of synchronizing neurons. In order to explore the dynamics of temporal ordering we study an integrate-and-fire neuron with a (small) oscillatory component in its input. Tuning the frustration due to the interplay between the neuron's natural firing time and the oscillatory rhythm's period, leads to a rich structure of asymptotic phase locking patterns and ordering dynamics controlled by a correlation time that diverges at phase boundaries – quite analogous to diverging correlation lengths in equilibrium phase transitions. Our results can be understood in terms on an extension of the theory of circle maps. In addition, they address how fast synchronous behavior can emerge in biological or artificial neural networks.

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