POSTER PRESENTATION



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Recurrence of spatio-temporal patterns of spikes and neural avalanches at the critical point of a non-equilibrium phase transition

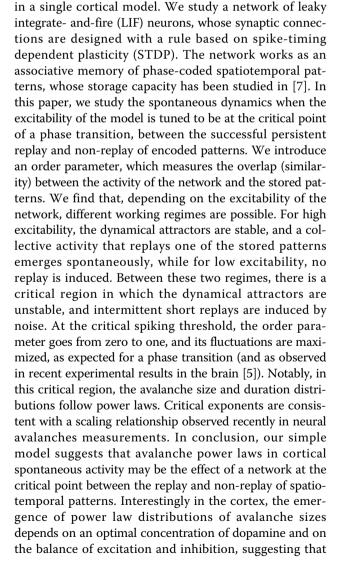
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Recently, many experimental results have supported the idea that the brain operates near a critical point [1-5], as reflected by the power laws of avalanche size distributions and maximization of fluctuations. Several models have been proposed as explanations for the power law distributions that emerge in spontaneous cortical activity [6,5]. Models based on branching processes and on selforganized criticality are the most relevant. However, there are additional features of neuronal avalanches that are not captured in these models, such as the stable recurrence of particular spatiotemporal patterns and the conditions under which these precise and diverse patterns can be retrieved [4]. Indeed, neuronal avalanches are highly repeatable and can be clustered into statistically significant families of activity patterns that satisfy several requirements of a memory substrate. In many areas of the brain having different brain functionality, repeatable precise spatiotemporal patterns of spikes seem to play a crucial role in the coding and storage of information. Many in vitro and in vivo studies have demonstrated that cortical spontaneous activity occurs in precise spatiotemporal patterns, which often reflect the activity produced by external or sensory inputs. The temporally structured replay of spatiotemporal patterns has been observed to occur, both in the cortex and hippocampus, during sleep and in the awake state, and it has been hypothesized that this replay may subserve memory consolidation.

Previous studies have separately addressed the topics of phase-coded memory storage and neuronal avalanches, but our work is the first to show how these ideas converge

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particular parameters must be appropriately tuned. This may suggest that the cortex operates near the critical point of a phase transition, characterized by a critical value of excitability.

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