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A continuous phase transition in neocortical slice networks[1]

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Recent experiments demonstrate that activity in neocortical circuits can propagate in the form of avalanches whose sizes follow a power law distribution, suggesting that these circuits operate near a continuous phase transition point. Computational models indicate that this critical point may be optimal for information processing. However, the existence of a power law is not sufficient to establish critical behavior because stochastic processes that do not undergo phase transitions can also produce power laws. We recorded power law distributions of neuronal avalanches from neocortical slices and then pharmacologically perturbed network activity. We then measured deviations from power law behavior. Here we show that these deviations covaried systematically with a control parameter, as would be expected for a continuous phase transition. A critical branching model captures this transition, while stochastic models do not. Our findings imply that the physical theory underlying continuous phase transitions can be fruitfully applied to neocortical circuits.

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