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**Input-dependent Suppression of Chaos in Recurrent Neural Networks** K. RAJAN, Lewis-Sigler Institute of Integrative Genomics, Princeton University, L.F. ABBOTT, Department of Neuroscience, Columbia University College of Physicians and Surgeons, H. SOMPOLINSKY, Racah Institute of Physics, Interdisciplinary Center for Neural Computation, Hebrew University — Neuronal responses arise from an interaction between spontaneous activity and responses driven by external inputs. Experiments studying cortical circuits reveal a striking similarity between the magnitude and complexity of intrinsic and input-generated activity. How does a network generating complex activity remain sensitive to external inputs? This seems unlikely for a network in which input-driven responses add linearly to ongoing activity generated by stochastic noise generators. We developed a mean-field theory and used recurrent network models to distinguish between this type of external noise and chaotic background generated by strong coupling within the circuit. As a result of a highly nonlinear relationship between input- and internally generated activity, we show that intrinsic ***noise*** is sensitive to the amplitude and the spatiotemporal structure of the input. We find that input not only drives responses, it also actively suppresses spontaneous activity, leading to a phase transition in which the chaotic background is absent. Although the power spectrum of the spontaneous activity falls exponentially from zero, the phase transition reveals a ***resonant*** frequency at which relatively a weak input suppresses chaos. As long as the input drives the system across the phase transition, a spontaneously active network can work with coupling strong enough to allow large signal amplification and selectivity without the complex background interfering with sensory processing.

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