

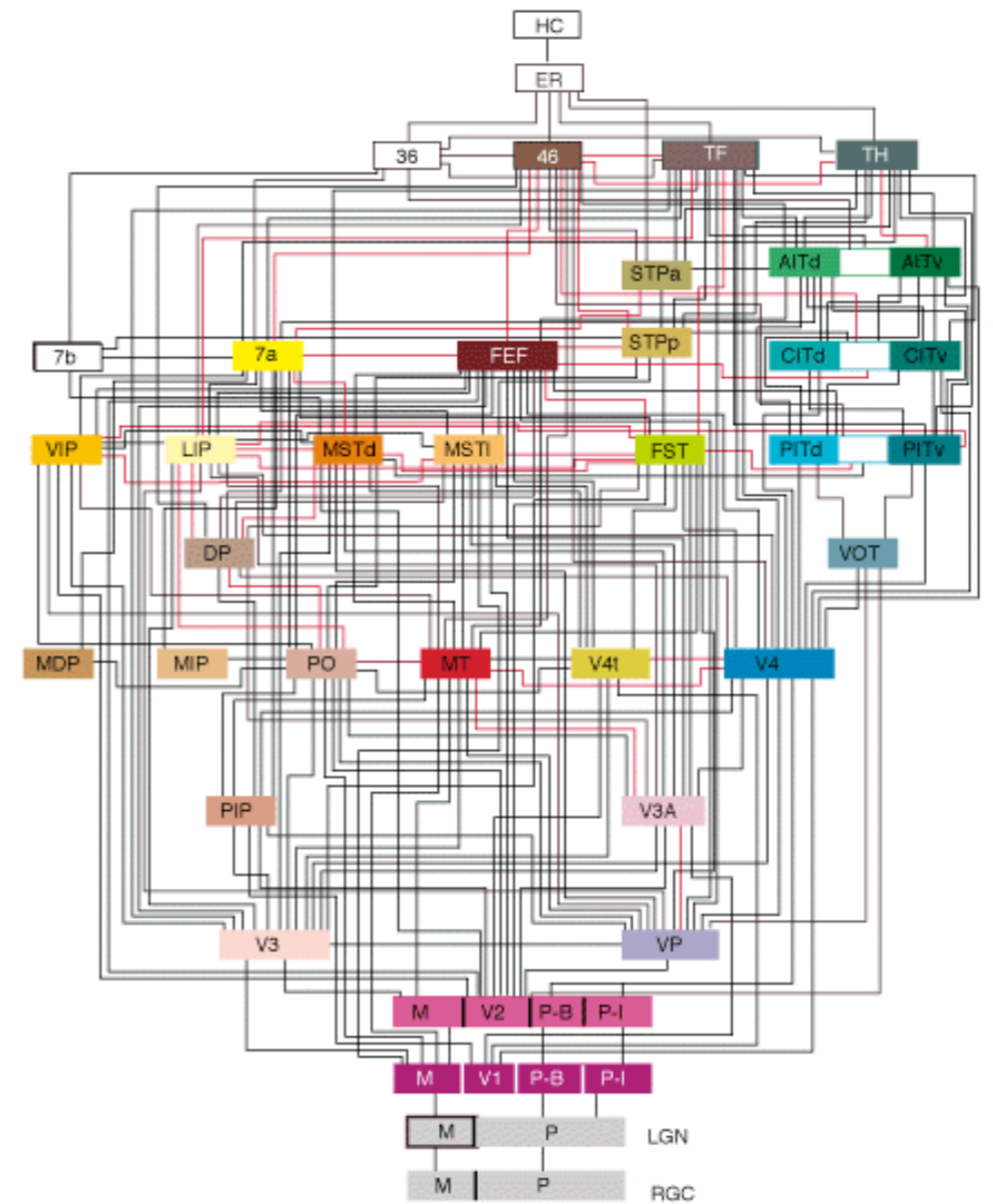
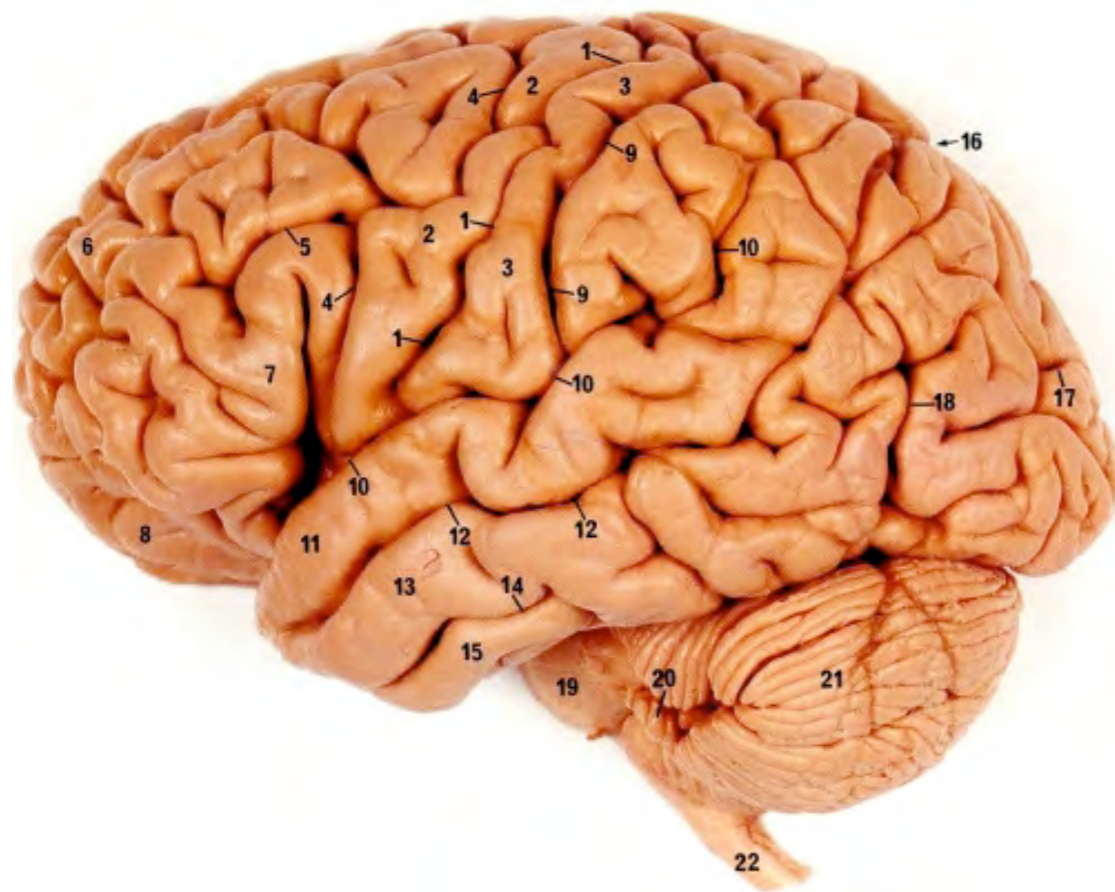
Noisy “Clocks” & Information Processing In The Brain



David A. Markowitz
Princeton University

DOE CSGF Annual Meeting
7/14/09

The brain is a parallel computer

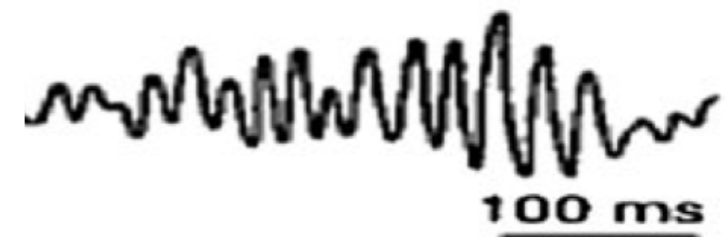


Noisy Oscillations In The Brain

Locust Antennal Lobe (20 Hz)



Rat Hippocampus (50 Hz)



Macaque V4 (60 Hz)

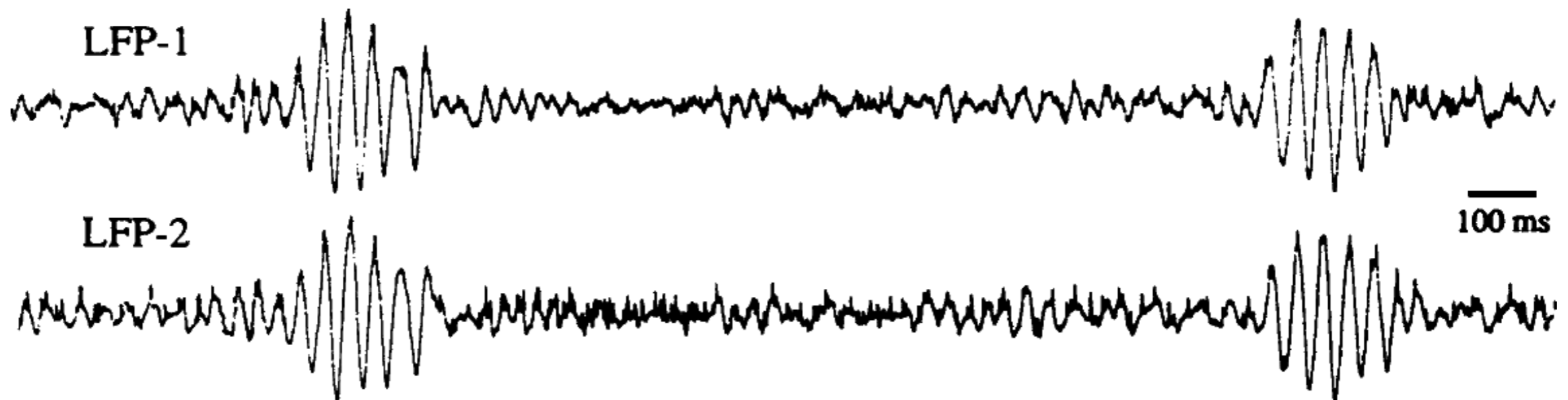


Macaque Motor Cortex (30 Hz)



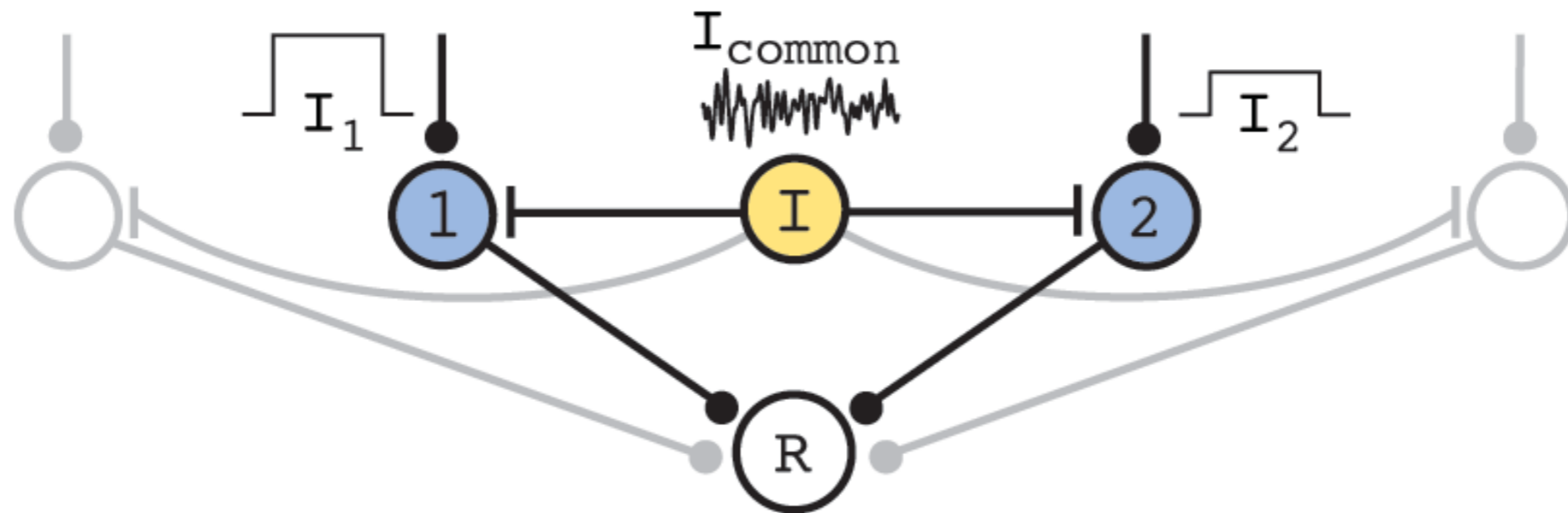
Gamma Oscillations

- *noisy*, 30-100 Hz, locally ***spatially coherent***



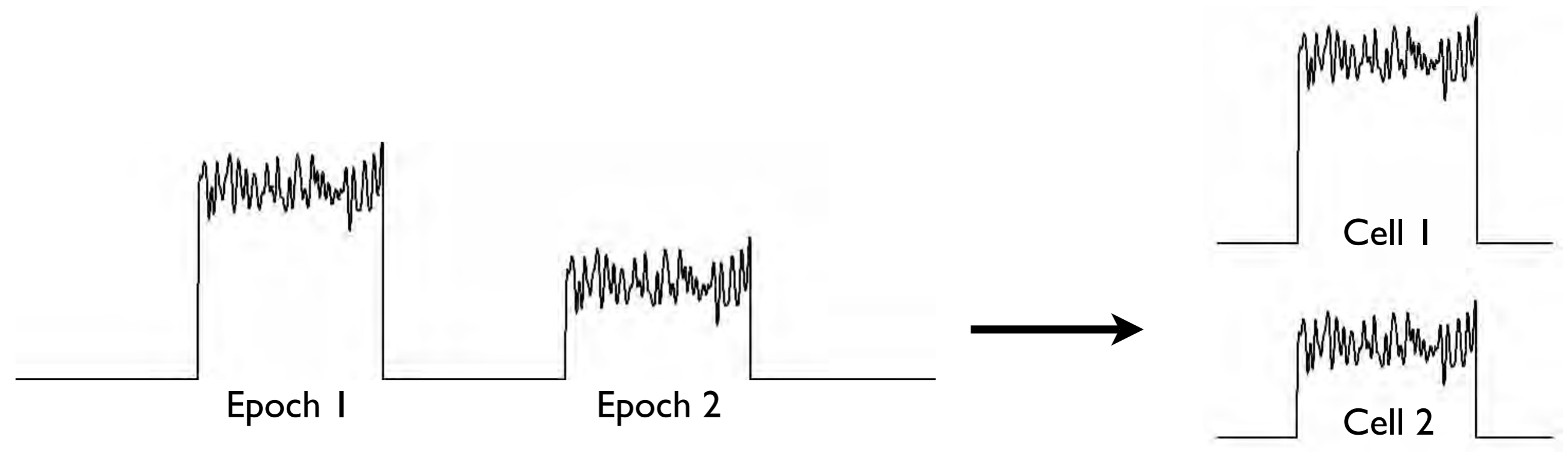
- associated with cognition and behavior
- generated by inhibitory interneuron networks

Network Architecture

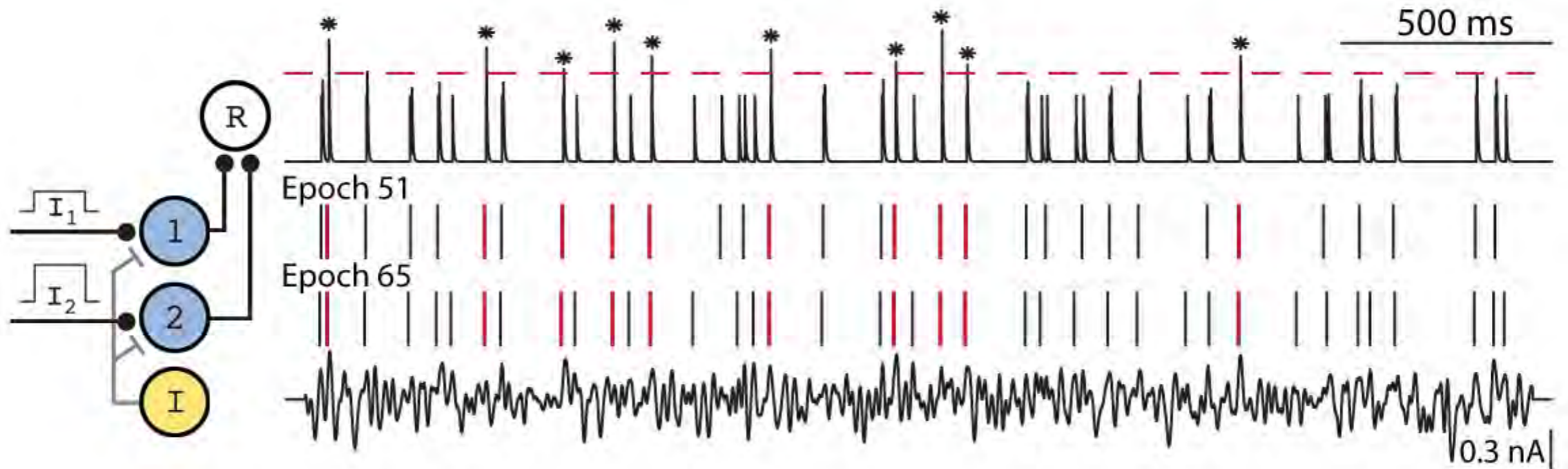


Stimulus Protocol

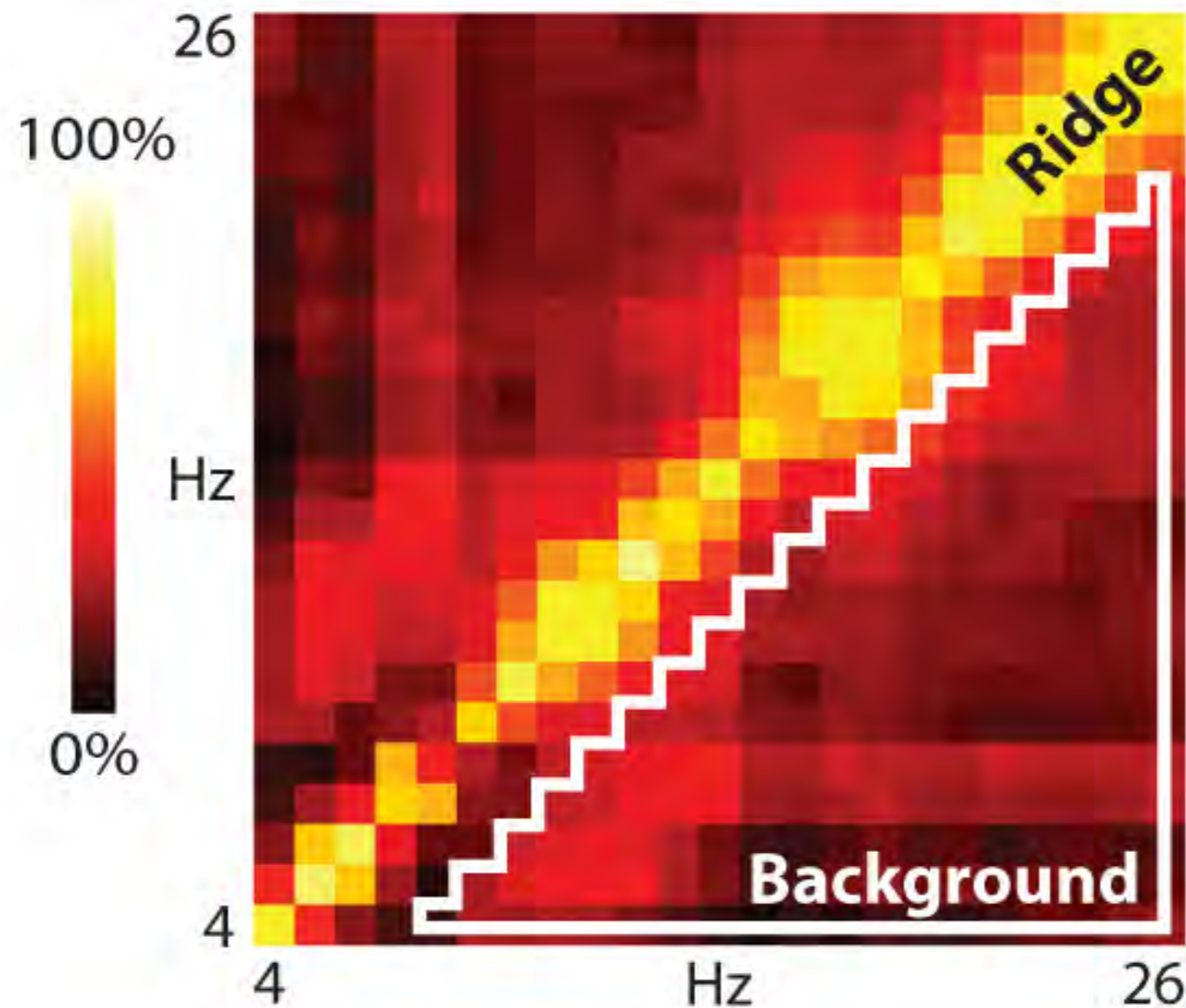
- Sequential stimulus epochs (DC step + “frozen” gamma)
- Compare neural response to different epochs



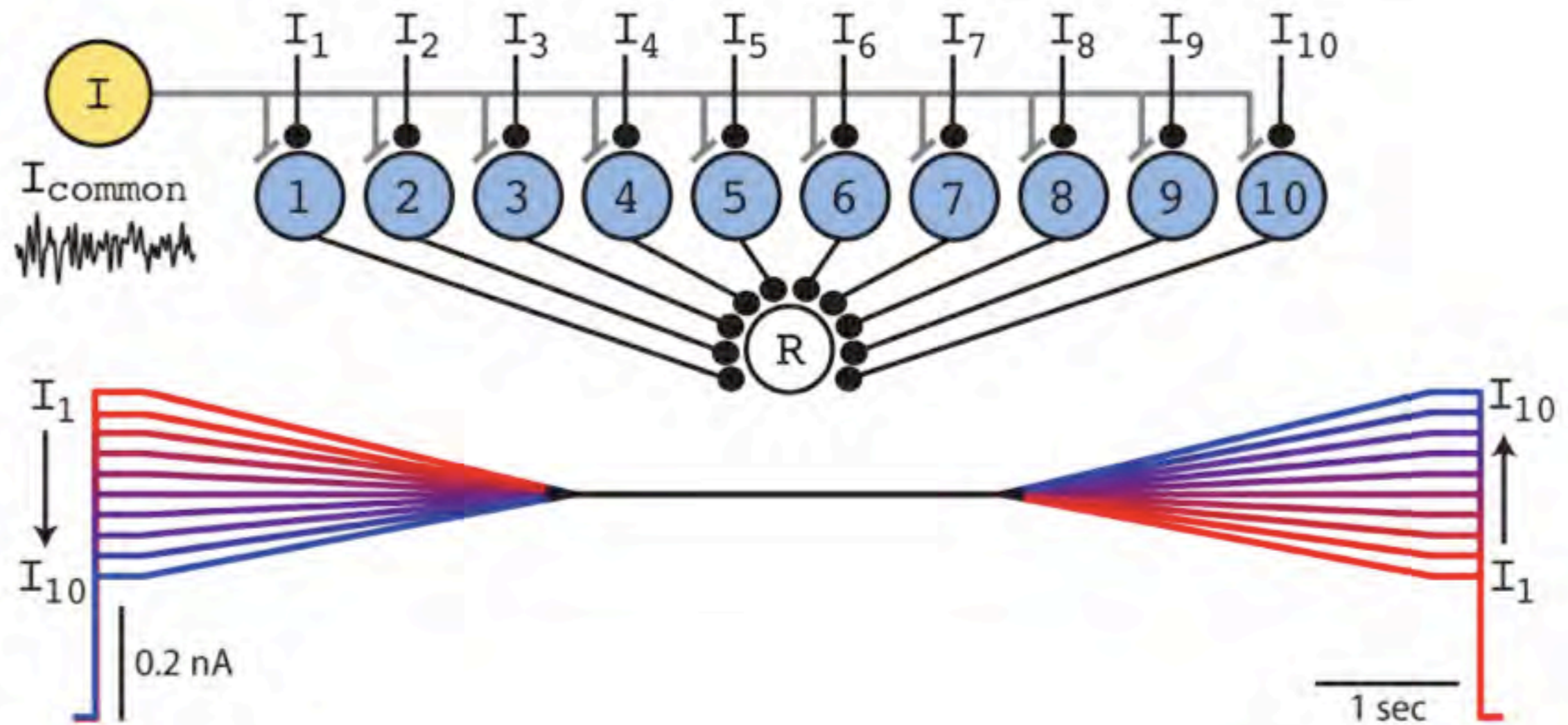
Synchrony Analysis



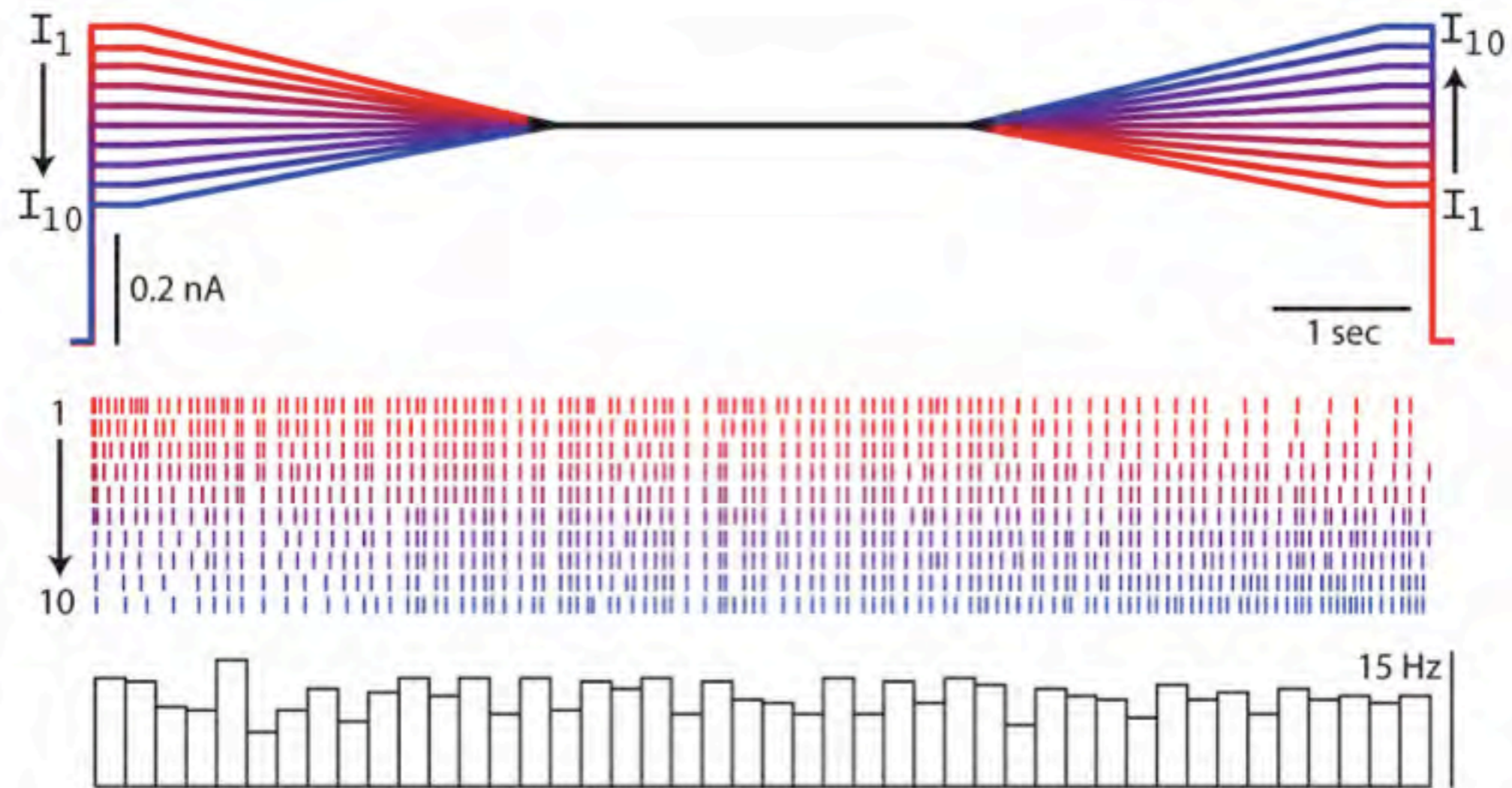
Rate-Specific Synchrony



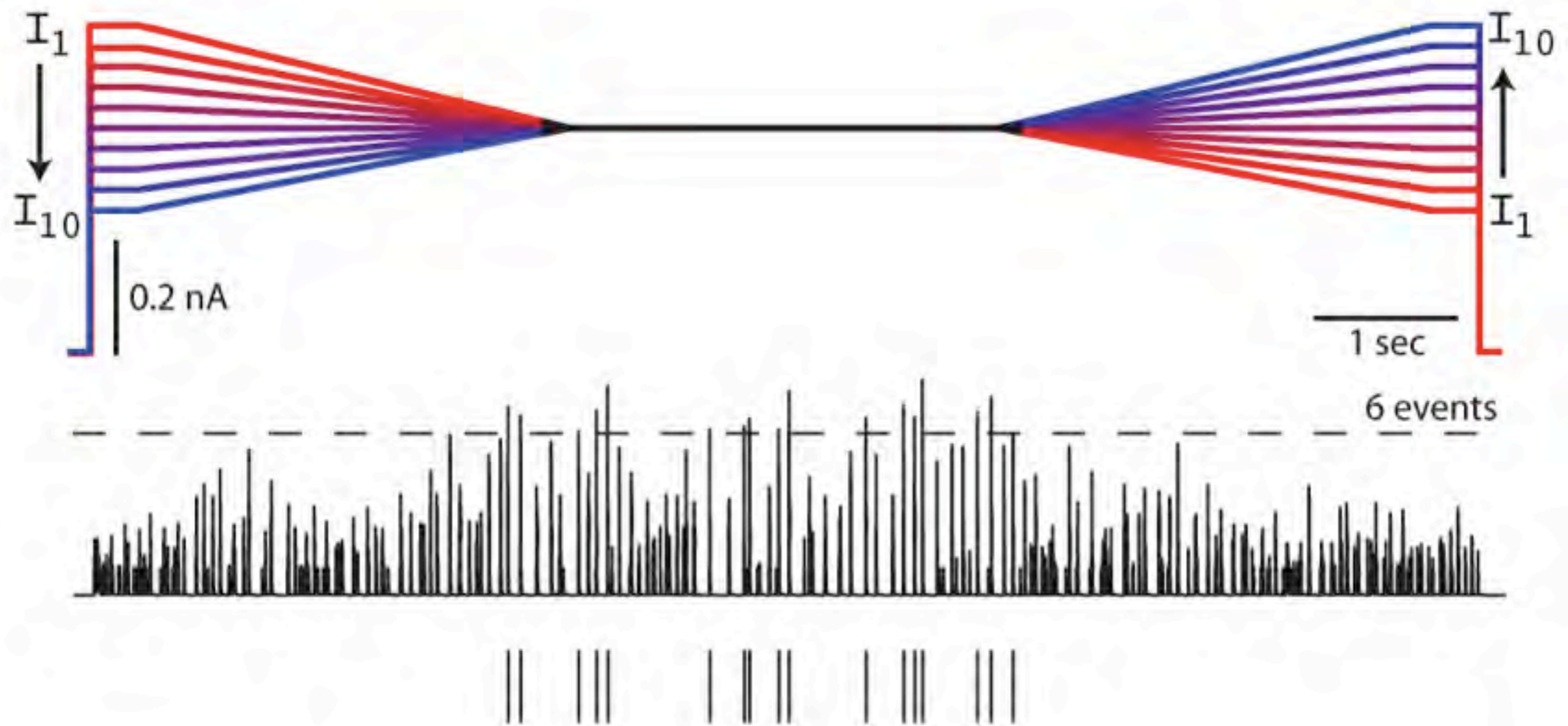
Many Are Equal Computation



Many Are Equal Computation

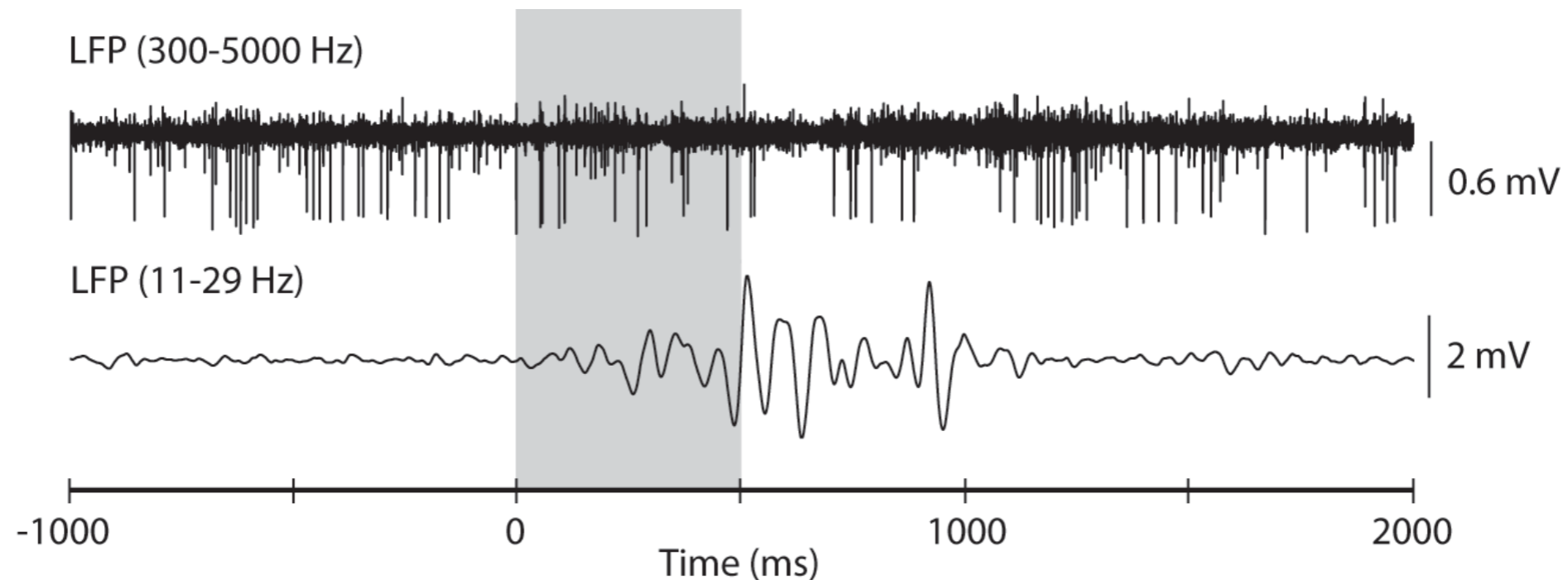
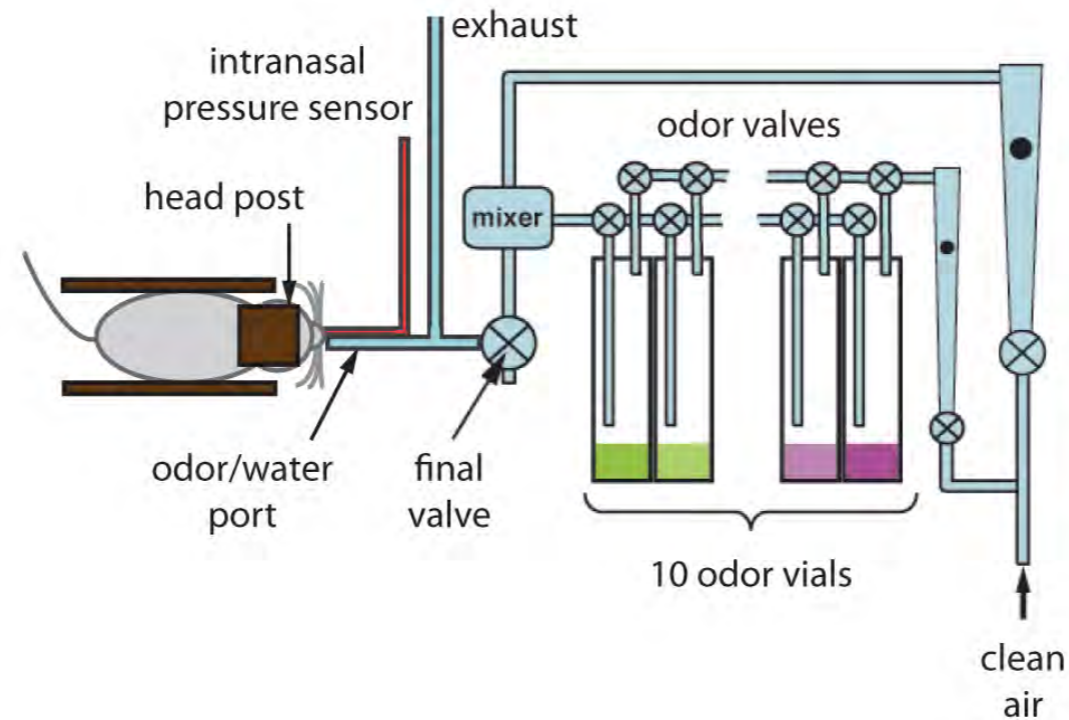


Many Are Equal Computation



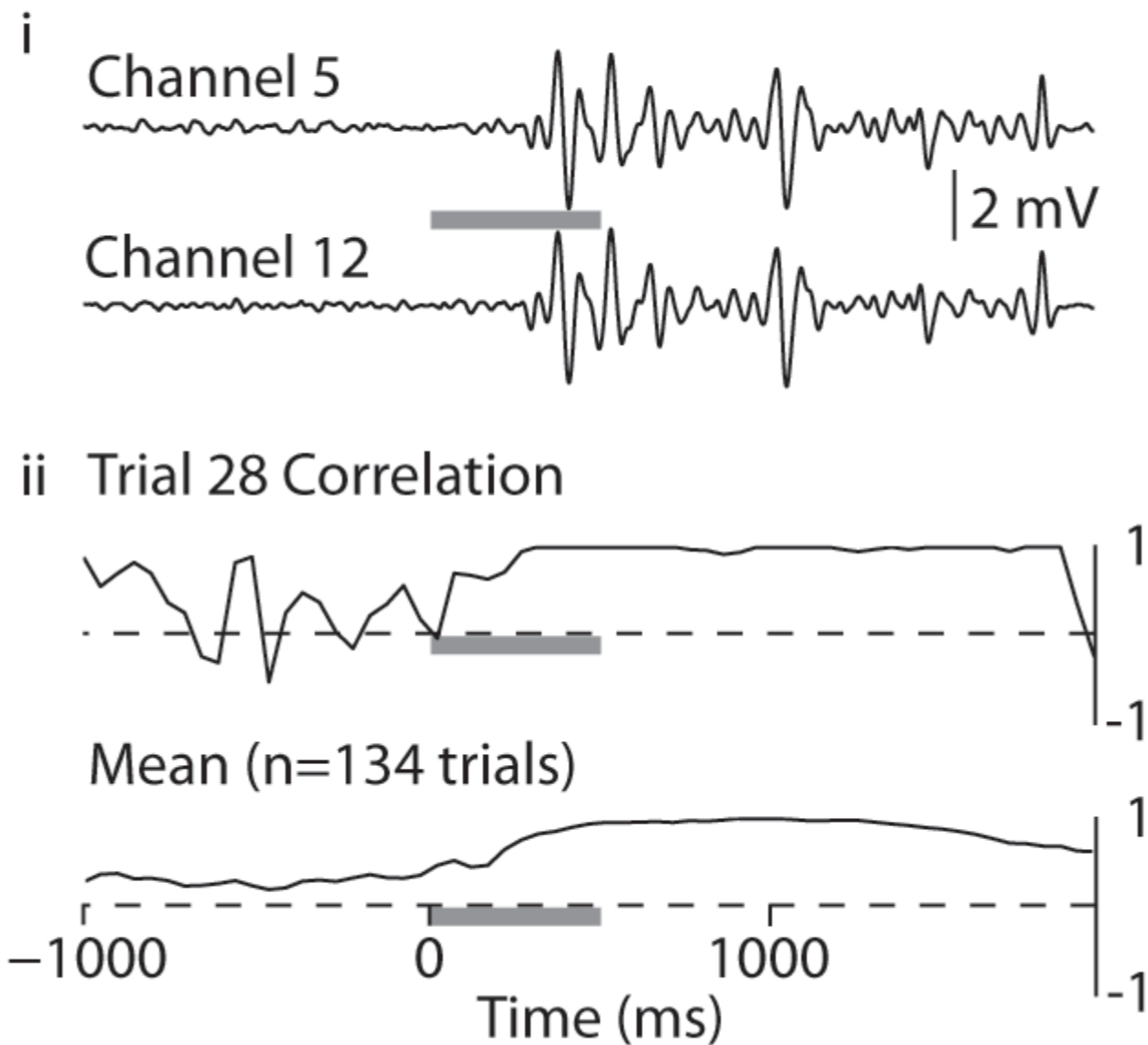
Does RSS Occur In the Brain?

Awake Mouse Olfactory Bulb

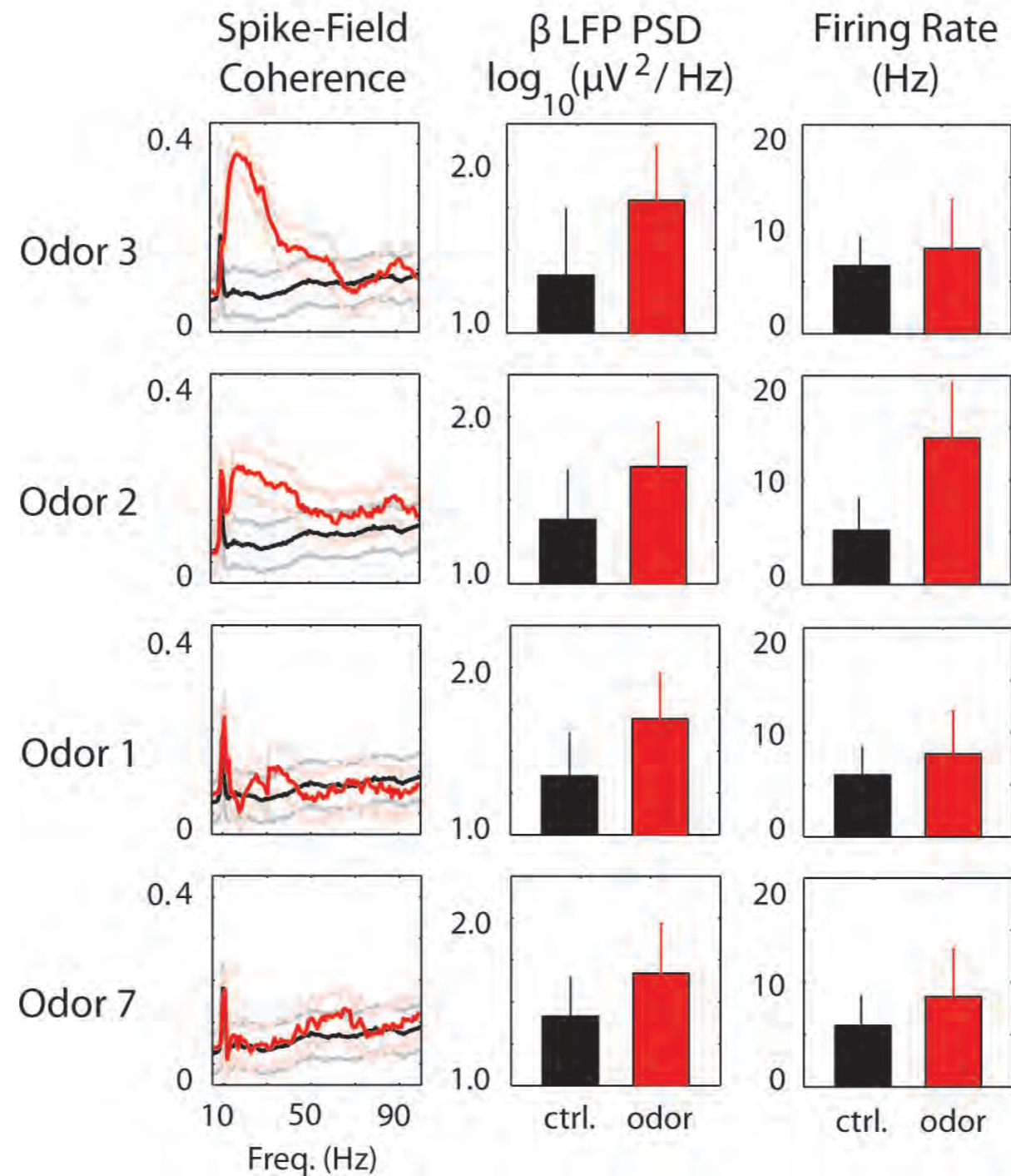


Spatially Coherent Oscillations

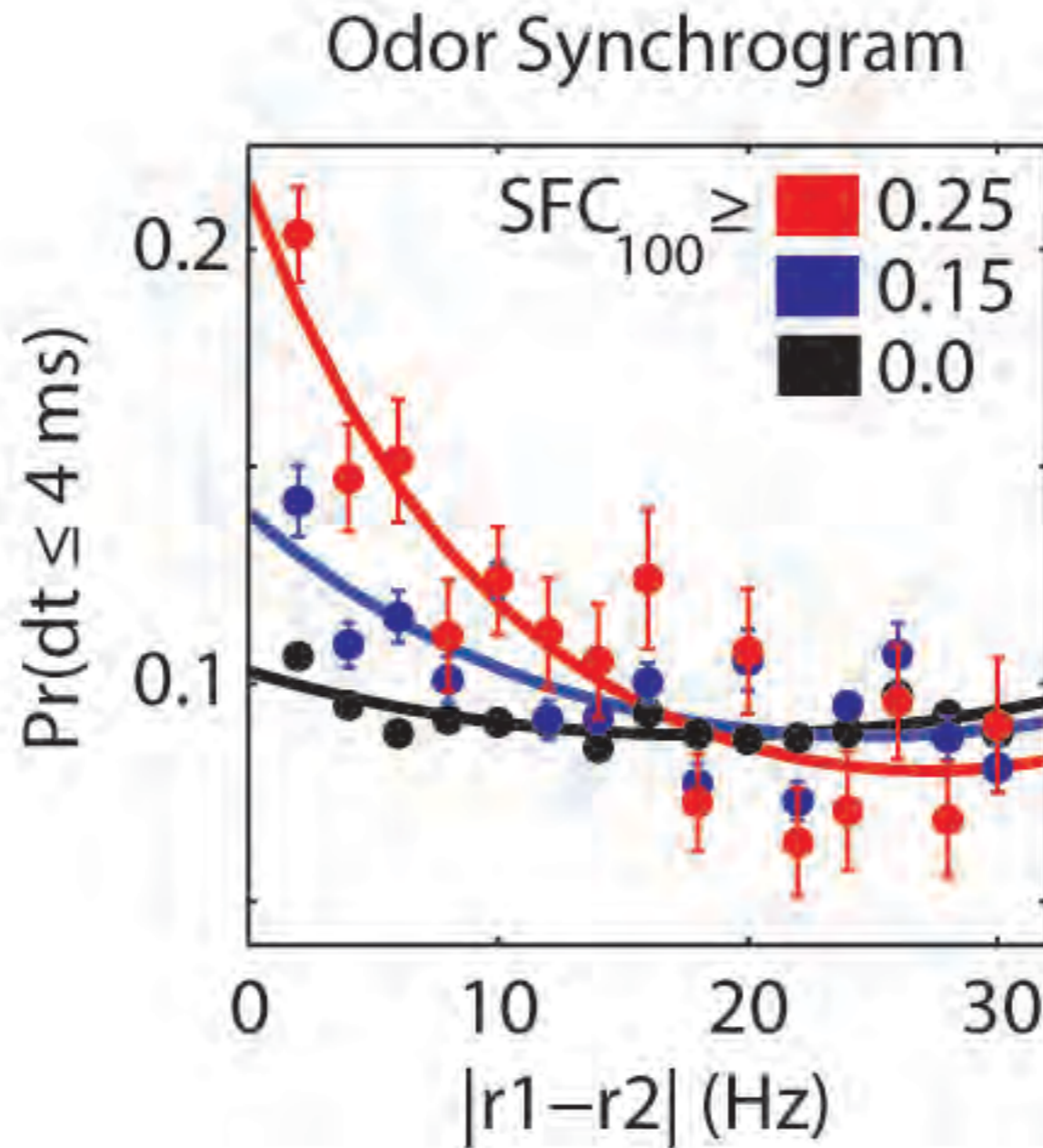
LFP Correlation (β -band, 11-29 Hz)



Odor-Specific Spike-Field Coherence



Rate-Specific Synchrony



Conclusions

- Noisy “clock” is global, but only some neurons are allowed to “see” it
- Neurons that “see” the clock exhibit RSS, which may be used for MAE computation

Future Directions

- Record from large populations, $O(100-1000)$
- Refine our understanding of population coding
- Long-term: Better brain-machine interfaces?

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