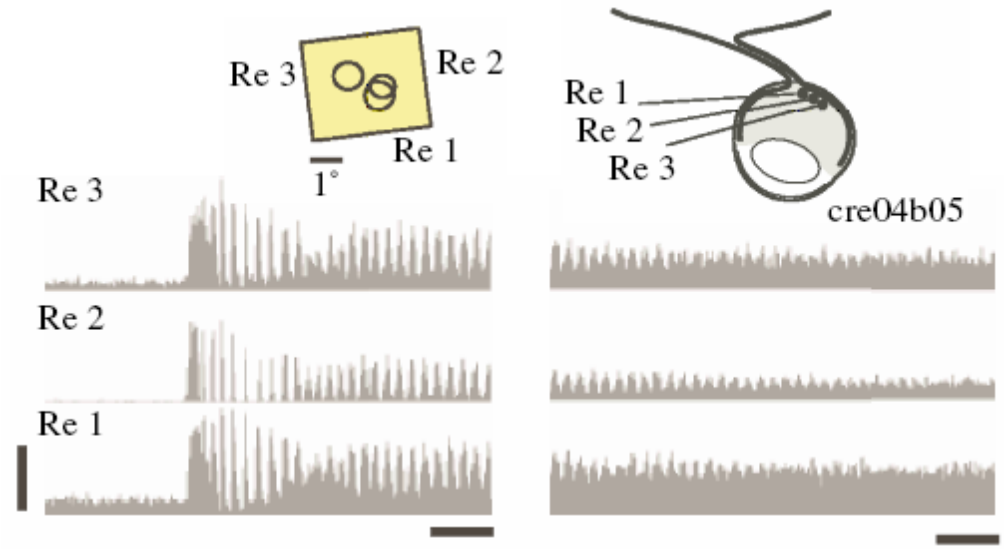
1 of 10

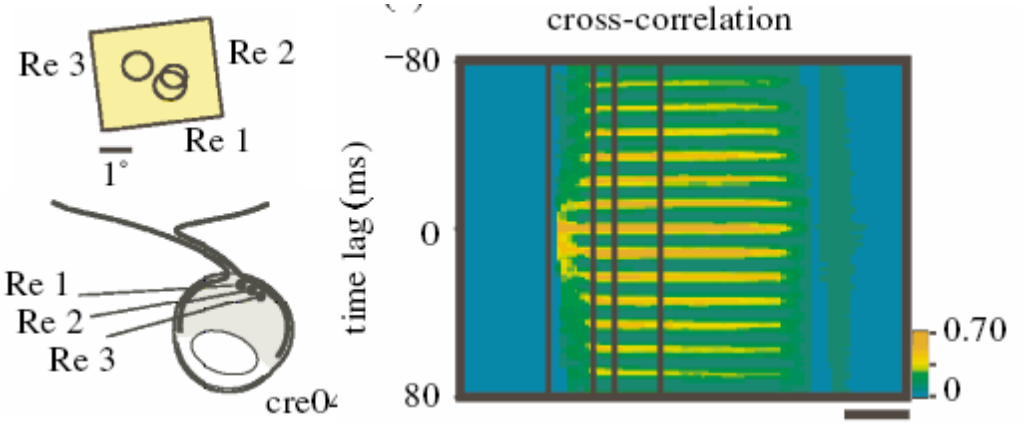
Retina: Oscillatory activity



Retina cells synchronize (80-90Hz) when stimulus (yellow) is large (>4°) [Singer'96]

2 of 10

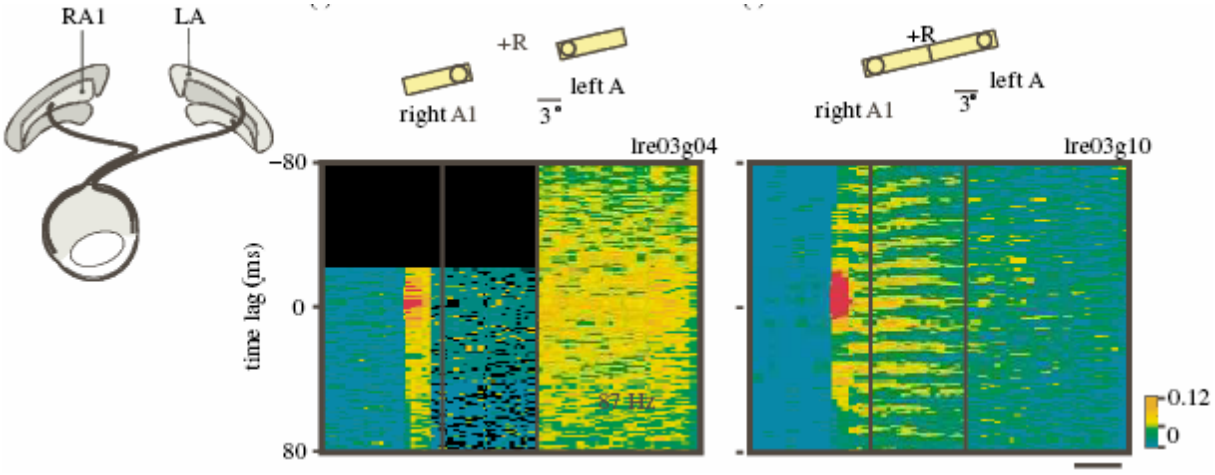
Retina: Synchrony is not stimulus-locked



The two marked regions (400ms) correspond to the two histograms (previous slide)

3 of 10

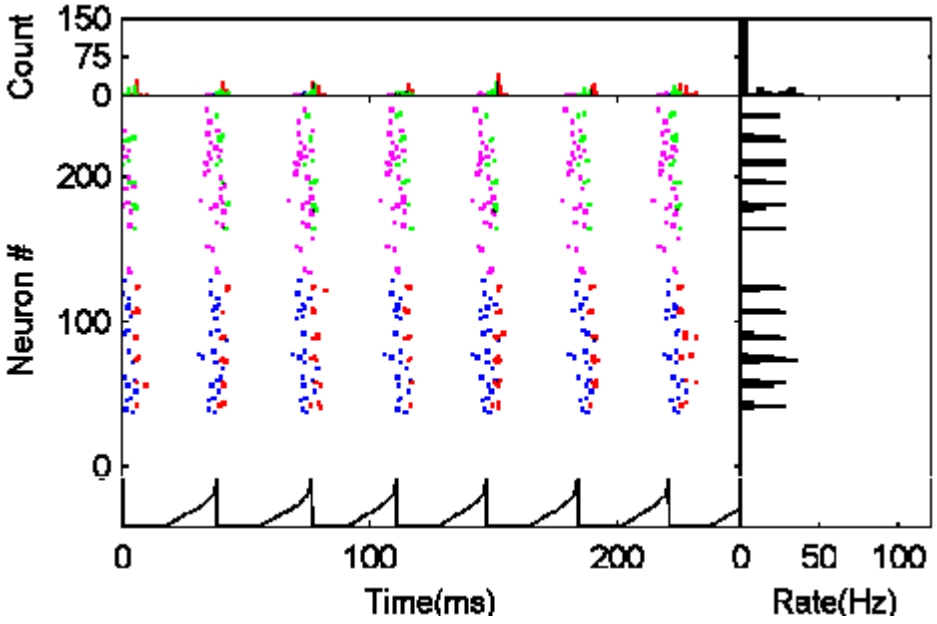
LGN: Synchrony is preserved



LGN cells synchronize (87Hz) when stimulated by a contiguous bar [Singer'96]

4 of 10

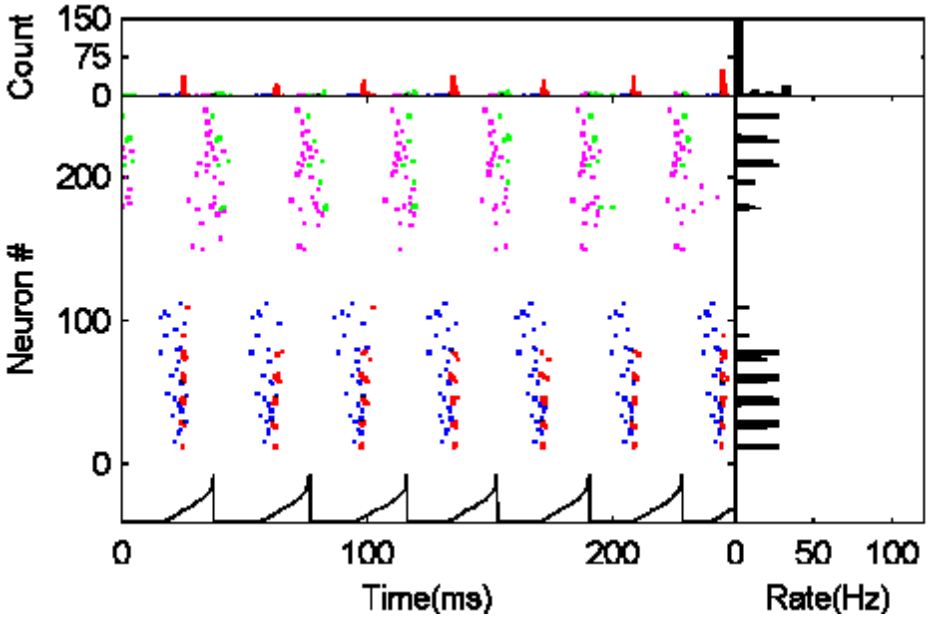
Excitatory–Inhibitory Net: Two close patches



Excitatory cells (purble,blue) drive inhibitory ones (green,red), which inhibit both types.

5 of 10

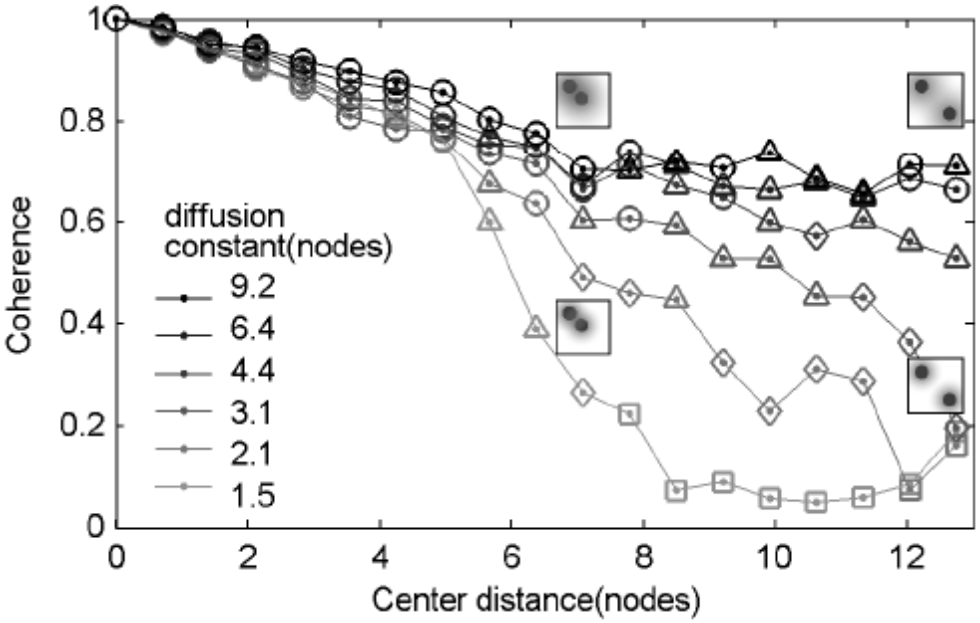
Excitatory–Inhibitory Net: Two distant patches



Patches are out-of-sync: Cells only synchronize with others in their patch.

6 of 10

Synchrony falls with patch spacing (r=3.4 nodes)



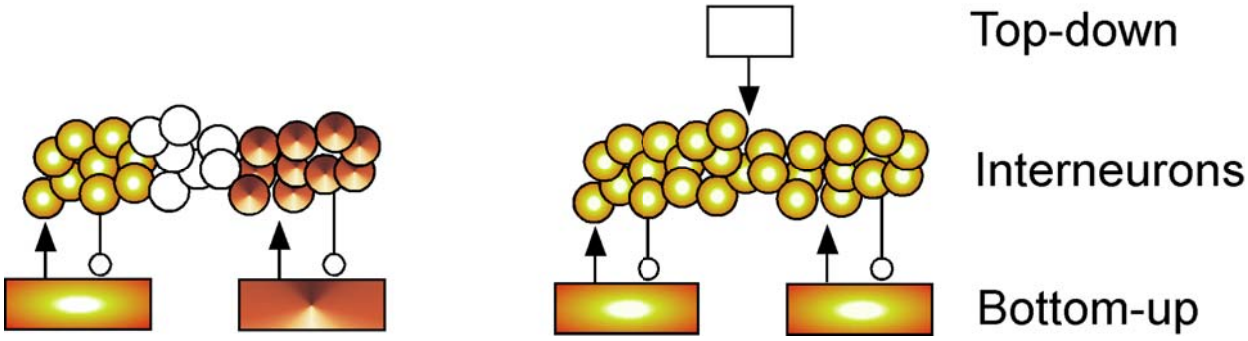
Coherence decreases with patch spacing and increases with inhibitory spread

The coherence index is defined as the normalized dot-product of the patches' (interneuron) population histograms:

$$CI = \frac{\sum_{i=1}^{N} u_i v_i}{\left(\sum_{i=1}^{N} u_i^2\right)^{1/2} \left(\sum_{i=1}^{N} v_i^2\right)^{1/2}}$$

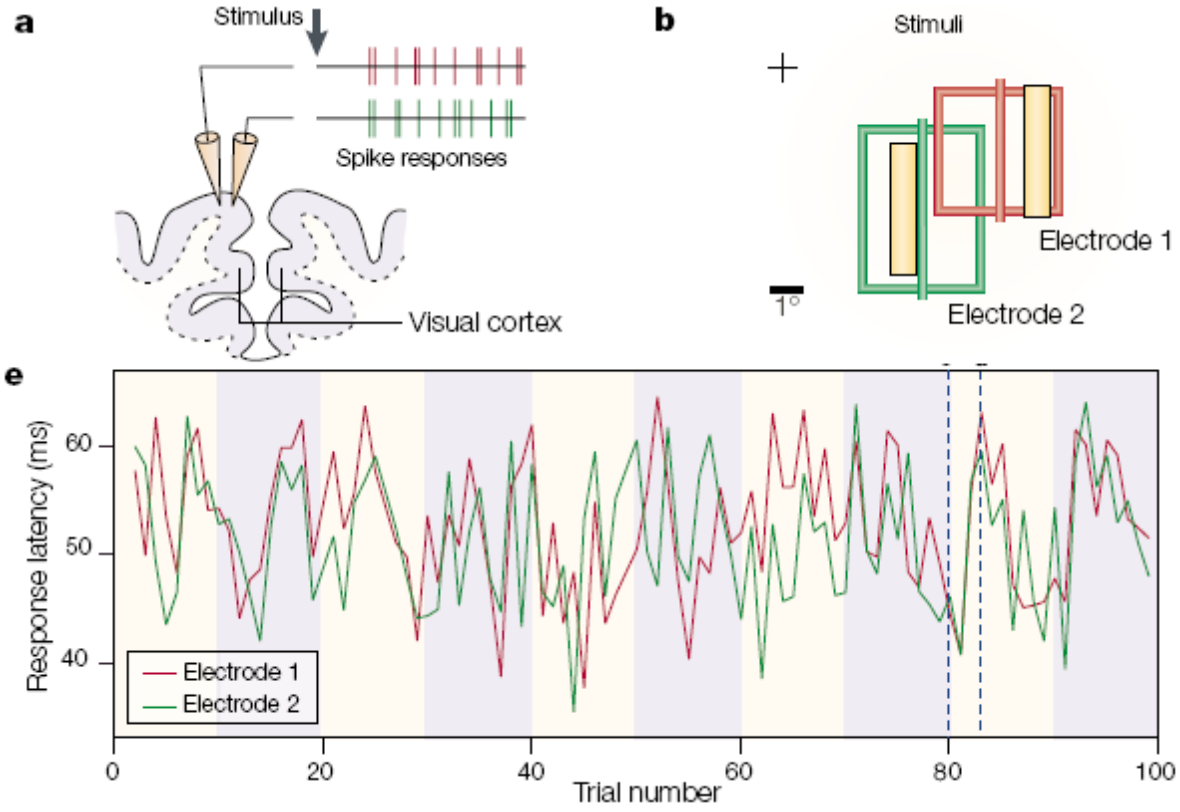
where u_i and v_i are the histograms' spike counts.

Top-down inputs and binding



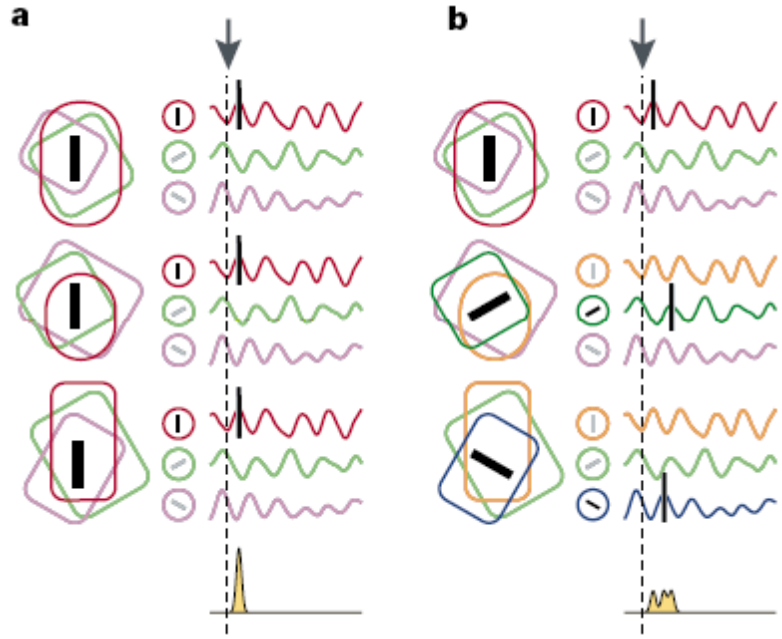
Activating the undriven interneurons synchronizes the patches

Cortex: Covariations in response latency



Latencies (a) covary (e) when stimulated with flashed light bars (b) [Singer'01]

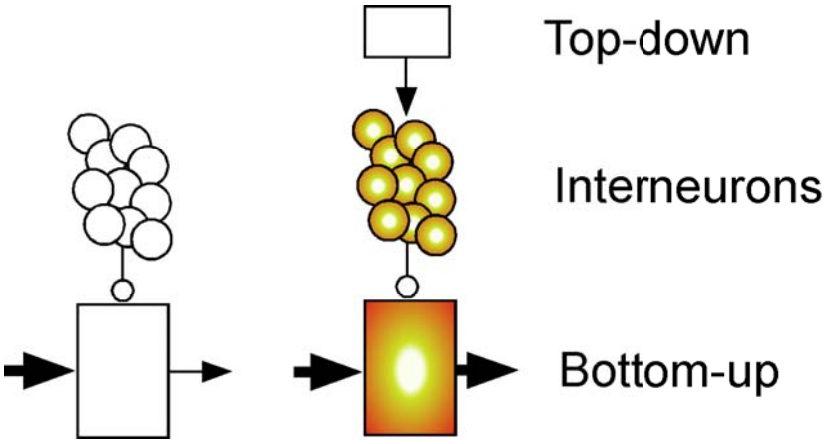
Subthreshold oscillations can explain covariations



Latencies match when membrane oscillations are coherent; else they do not [Singer'01]

10 of 10

Top-down inputs and feedforward synchrony



Activating interneurons preserves synchrony in input