Abstract View

INTERACTION OF SUB-THRESHOLD OSCILLATIONS WITH SYNAPTIC INPUT IN THE CORTEX.

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A high proportion of cortical pyramidal cells and interneurons show intrinsic sub-threshold oscillations in the voltage range just below firing threshold. We studied the interactions of these oscillations interact with afferent synaptic inputs.

Because these oscillations can be modulated by acetylcholine we also studied how this interaction is affected by different levels of cholinergic modulations.

We recorded from layer II/III pyramidal neurons and interneurons in the slices of the mouse (P28 to P35) visual cortex and evoked the subthreshold oscillations. We then used small negative current pulses and extracellularlly evoked IPSPs to perturb the oscillations. The change in phase and power of the oscillation as well as the change in amplitude, voltage integral and slope of the IPSPs was recorded as a function of power, median voltage and phase of the oscillation at the time of the pulse or IPSP. A phaseshift, which lasted for several hundred miliseconds, was induced by pulses or IPSPs at all phases . We also observed a phase-dependent increase in power, with the largest increase occurring when the pulse/IPSP occurred near the trough of the oscillation.

We supplemented these recordings with biophysical simulations. Single and multi-compartemental models of cortical pyramidal neurons were used to reproduce the observed effects and investigate the quantitative role of individual currents. A model containing a fast sodium current (INa fast), a delayed rectifier potassium current (IKDR) and a slow potassium current (IKslow) was sufficient to explain our experimental observations.

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