BMC Neuroscience

POSTER PRESENTATION Open Access

An interlocked oscillator model for firing of the mesencephalic dopaminergic neuron

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From Nineteenth Annual Computational Neuroscience Meeting: CNS*2010
San Antonio, TX, USA. 24-30 July 2010

Dopaminergic (DA) neurons display two functionally distinct modes of electrical activity: low- and high-frequency firing. We suggest a new minimal computational model that unites data on these firing modes obtained under different experimental conditions. The model reproduces the separation of maximal frequencies under NMDA synaptic stimulation vs. other treatments. In accord to recent experimental data, NMDA stimulation restricted to the soma effectively evokes high-frequency oscillations in the model. We have also reproduced low- and high-frequency oscillations under blockade of the SK current. Thus, the new model suggests a way that overcomes all major limitations of the switching dominance mechanism for controlling the frequency of the DA neuron. We explain recent experimental facts and make further predictions.

Published: 20 July 2010

doi:10.1186/1471-2202-11-S1-P151
Cite this article as: Ha and Kuznetsov: An interlocked oscillator model for firing of the mesencephalic dopaminergic neuron. *BMC Neuroscience* 2010 **11**(Suppl 1):P151.

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