

Abstract Archive: 2000-2005

Neuroscience 2005 Abstract

Presentation Number:	705.8
Abstract Title:	Millisecond timescale optical control of neural computation via channelrhodopsin-2.
Authors:	Boyden, E. S. ^{*1} ; Zhang, F. ¹ ; Bamberg, E. ² ; Nagel, G. ² ; Deisseroth, K. ¹ ¹ Dept. of Bioengineering, Stanford Univ., Stanford, CA ² Germany, 318 Campus Dr., 94305,
Primary Theme and Topics	Techniques in Neuroscience - Molecular and Genetic Techniques
Session:	705. Optical Methods for Vital Imaging and Manipulation II Slide
Presentation Time:	Tuesday November 15, 2005 2:45 PM-3:00 PM
Location:	Washington Convention Center - Room 154A
Keywords:	OPTICAL IMAGING , ION CHANNEL , CONTROL , CODING

A temporally precise, genetically-targeted method of controlling neural spiking and synaptic transmission would enable elucidation of the spike patterns subserving coding, dynamics, and plasticity in specific neurons. Despite progress towards methods for photic neuron stimulation, the temporal resolution of existing genetically encoded tools is too slow (seconds-minutes) to control activity at the timescale of the neural code (milliseconds). We have devised a strategy to overcome this key limitation, using a rapidly-gated light-sensitive cation channel encoded by the gene Channelrhodopsin-2 (ChR2). Lentiviral delivery of ChR2 to hippocampal neurons allowed depolarization with 10 mW/mm² blue (x470/40) light. ChR2 mediated rapid photocurrents (~500 pA peak). In order to evoke spike trains with millisecond precision, we took advantage of the fact that rapid depolarization can evoke precisely timed spikes (Mainen and Sejnowski, 1995). We used high-speed optical switching to deliver naturalistic sequences of brief (5-15 ms) light pulses, evoking spike trains with low (1-2 ms) jitter. Heterogeneous neuron populations could be programmed to fire the same precise spike pattern (3 ms across-neuron jitter; Figure). Finally, we show temporally precise ChR2-evoked excitatory and inhibitory synaptic transmission. This powerful technology will yield a widely applicable tool for systems neuroscience and biomedical engineering.

Supported by Helen Hay Whitney Foundation, Dan David Prize Foundation, NIH

Sample Citation:

[Authors]. [Abstract Title]. Program No. XXX.XX. 2005 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2005. Online.

Copyright © 2005-2009 Society for Neuroscience; all rights reserved. Permission to republish any abstract or part of any abstract in any form must be obtained in writing by SfN office prior to publication.

[Return to the Previous Page](#)

[Home](#)