Carmen Canavier, PhD
Associate Professor of Ophthalmology and Neuroscience

Education

1987-1991	PhD , Rice University, Houston TX
1975-1979	BE, Vanderbilt University, Nashville TN

Positions

2005–present	Associate Professor of Ophthalmology and Neuroscience, Neuroscience Center, LSU Health Sciences Center, New Orleans, LA
2001-2005	Associate Professor, University of New Orleans
1999-2001	Assistant Professor, University of New Orleans
1997-1999	Associate Professor/Research, University of New Orleans
1995-1997	Research Assistant Professor, UT Health Sciences Center, Houston TX
1994-1995	Postdoctoral Fellow, UT Health Sciences Center, Houston TX
1993-1994	Research Fellow, Baylor Medical School, Houston TX
1991-1993	Postdoctoral Fellow, UT Health Sciences Center, Houston TX

Current Research

The work in my lab is computational in nature. Funded collaborations, generally use the Dynamic Clamp to integrate theory and experiment, and currently include the following experimental labs:
Dr. Robert Butera (Georgia Tech), Dr. Astrid Prinz (Emory), Dr. Paul Shepard (Maryland Psychiatric Research Institute), Dr. Edwin Levitan (Pittsburgh Medical School), and Dr John A. White (University of Utah). Synchronization of neural activity is one unifying theme of the research conducted in my lab. Synchronization in its broadest sense encompasses the generation of the phase locked patterns exhibited by the central pattern generators responsible for rhythmic activity such as respiration and locomotion. Hence we have developed general criteria under which such lockings can occur in oscillators in which the duration of the postsynaptic potential is short compared to a cycle period. Synchronized oscillations are also thought to underlie many aspects of cognition. Rapid, internally generated synchronization between distal regions in the brain that relies on intrinsic oscillation has been shown to be important for encoding, retention, and retrieval of information and proposed to underlie binding and conscious perception. Cross frequency synchronization between theta and gamma has been suggested to match the information stored in working memory with incoming sensory information, and synchronization between alpha and theta has been suggested as a mechanism for retrieving items from long-term memory and loading them in working memory. Synchronization of brain rhythms is known to be affected in most psychiatric disorders. We have recently produced a novel proof that synchrony is a generic solution of identical pulse coupled oscillators separated by a conduction delay, and shown that the robustness of the near synchronous solution in the presence of heterogeneity increases with coupling strength. We have also recently established existence and stability criteria for N:1 cross frequency lockings for pulse coupled oscillators.

Another focus area is the oscillatory dynamics of bursting and pacemaking rhythms. The dopaminergic neurons of the mammalian midbrain have been extensively modeled in my lab. The coupled oscillator theory of the dopamine neurons holds that the spiking rate is usually driven by slow calcium oscillations in the soma and larger dendrites but during bursting the activation of distal NMDA receptors allows the smaller dendrites to dominate. Recently we have shown that in the presence of spiking activity, the intuition that the natural frequency of the

smaller dendrites is faster does not hold. We have also recently suggested critical roles for the L-type calcium current and the SK potassium current in bursting activity, as well as a role for the ether a-go-go related potassium current in relieving depolarization block. Abnormal dopaminergic signaling has been implicated in Parkinson's, schizophrenia, and drug abuse.

Research Interests and Goals

Oscillations and Synchrony: How do neurons synchronize their activity? How are pacemaking and bursting oscillations generated and modulated?

Awards/Recognitions/Lectures

2003 Visiting Fellow, Mathematical Biosciences Institute, Columbus, Ohio
2000 Visiting Fellow, Centre de Recherches Mathematiques, Montreal
1998 Visiting Fellow, Institute for Mathematics and its Applications, Minneapolis, MN
1975 National Merit Scholar

Recent Papers

Canavier CC, Sieling FH and Prinz AA. Dynamic-clamp constructed hybrid circuits for the study of synchronization phenomena in networks of bursting neurons In: Dynamic Clamp. Destexhe A and Bal T, eds, Springer, New York, in press.

Migliore M, Cannia C and **Canavier CC.** A modeling study suggesting a possible pharmacological target to mitigate the effects of ethanol on reward-related dopaminergic signaling. *J. Neurophys*. 2008 May;99(5):2703-7. Epub 2008 Mar 19.

Maran SK and **Canavier CC**. Using phase resetting to predict 1:1 and 2:2 locking in two neuron networks in which firing order is not always preserved., *J. Computational Neuroscience*, 24(1):37-55, Feb 2008 Epub 2007 Jun 19.

Shepard PD, **Canavier CC,** and Levitan ES. Ether-a-go-go Related Gene (ERG) Potassium Channels: What's All the Buzz About? *Schizophrenia Bulletin*, 2007 Nov;33(6):1263-9. Epub 2007 Sep 28. Review.

Canavier CC, Oprisan SA, Callaway JC, Ji H and Shepard PD. Computational model Predicts a Role for ERG Current in Repolarizing Plateau Potentials in Dopamine Neurons: Implications for the Modulation of Neural Activity. *J Neurophysiol*, 2007 Nov;98(5):3006-22. Epub 2007 Aug 15.

Canavier CC. Phase Response Curve. Scholarpedia, p.6796, 2006.

Canavier CC and Landry RS. An increase in AMPA and a decrease in SK conductance increase burst firing by different mechanisms in a model of a dopamine neuron in vivo *J Neurophysiol* (August 2, 2006). doi:10.1152/jn.00704.2006.

Canavier CC and Achuthan SR. Pulse Coupled Oscillators, Scholarpedia, p. 11641, 2007.

Canavier, C.C. The application of phase resetting curves to the analysis of pattern generating circuits containing bursting neurons. In Bursting: The Genesis of Rhythm in the Nervous System, series in Mathematical Neuroscience, Stephen Coombes and Paul Bressloff, eds., World Scientific, Singapore, pp. 175-200, 2005.

Funding

"Intrinsic currents modulate synaptic integration in dopamine neurons"
Principal Investigator: Carmen C. Canavier, PhD
Agency: NIH-NINDS (R01NS061097) Period: 01/01/2009-12/31/2013

"Phase resetting predicts synchronization in hybrid hippocampal circuits"
Principal Investigators: Carmen C. Canavier, PhD and John A White, PhD
Agency: NIH-NIMH (R01MH085387) Period:08/20/2008-06/30/2011

"Collaborative Research in Computational Neuroscience: Analysis of synchronization in hybrid neural circuits"
Principal Investigator: Carmen C. Canavier, PhD
Agency: NIH-NINDS (R01NS054281) Period: 09/15/2005-05/31/2009