along with the corresponding charge valence. The phosphorylation states are specified through charges assigned to the serine amino acids of the Lys-Ser-Pro (KSP) repeat motifs of the side-arms. The equilibrium structure of the neurofilament brush has been studied via the model that maintained the proper charge distributions and grafting density of neurofilament side arms. It has been found that in spite of extensive phosphorylation sites present on NF-H, the tails of the medium sized neurofilament subunit (NF-M) is more elongated than NF-H tails. This suggests that NF-M protrusions are more critical in regulating neurofilament spacings and axonal caliber.

2475-Pos Board B445
Efficient Coding in the Olfactory Receptor Neuron Signaling Pathway
Andrew Laitman.
University of Cambridge, Cambridge, United Kingdom.
The efficiency of neuronal coding has been studied extensively within the context of spike trains. Significantly less attention has been paid towards coding efficiency in biological signaling pathways. This study applies Shannon information theory to the olfactory receptor neuron signaling pathway to determine under what conditions the olfactory system can code most efficiently. We explore which types of odor stimuli the vertebrate olfactory system is most proficient at encoding by analyzing simulated data from a computational model of the pathway. We focus on odor stimuli of constant length but of varying concentration. This study concludes that the olfactory system's ability to encode such stimuli decreases significantly when presented with odor pulses of length greater than one second. We further explore the roles of particular signaling molecules in contributing to this decrease in coding efficiently. Finally, we perform a parameter sensitivity analysis on our information-theoretical calculations to identify the mechanisms responsible for information bottlenecks. We found that variations in upstream mechanism rate coefficients such as the G-protein activation rate have a significant effect on the transmission of information over stimuli longer than one second. In addition, parameter variations of the calcium extrusion rate through the sodium-calcium exchanger had a significant effect on information transfer over all pulse lengths.

2476-Pos Board B446
Reptitive Firing In Neurons - Analysing The Interaction Between Channel Density And Kinetics In Membrane Models
Hugo Zeberg[1], Clas Blomberg[2], Peter Arhem[1].
[1]Nobel Institute for Neurophysiology, Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden, [2]Department of Physics, KTH-Albanova, Stockholm, Sweden.
More than sixty years after Alan Hodgkin presented his classification of firing patterns in the axons of the crab Carcinus maenas, the underlying mechanisms of the firing patterns are still only fragmentarily understood. Two main types have been discerned in neurons and dynamical membranes models. Type 1 shows a continuous frequency-stimulation current (f-I) relationship and thus an arbitrarily low frequency at threshold current, while Type 2 shows a discontinuous f-I relationship and a minimum frequency. Type 1 obtains rhythmicity via a saddle-node bifurcation, thus requiring three stationary potentials at subthreshold stimulation current. Type 2 obtains rhythmicity via a Hopf or double-orbit bifurcation. In a previous investigation of a hippocampal neuron model we showed that the membrane density of critical ion channels could regulate the bifurcation type and consequently the threshold dynamics. In the present study we extend our previous analysis to other quantitatively well-described excitable membranes. These studies show that not merely the channel density, but the overall structure of the phase space around the stationary potentials determine the onset frequency. We show, by means of techniques from nonlinear dynamical system theory, that this phase space is altered both by changes in channel density and channel kinetics. Understanding these interactions is an important step towards understanding global oscillatory activity in brain networks.

2477-Pos Board B447
How Can BK Channels Increase Excitability of Central Neurons and Decrease Excitability of Nodose Neurons?
Vladislav Snitsarev[1], Elena Petroff[2].
[1]UMDNJ, Newark, NJ, USA, [2]Montclair State University, Montclair, NJ, USA.
K^+ currents are generally known to hyperpolarize cells and to inhibit neuronal excitability. Thus, in nodose neurons, BK channel inhibition *increases* excitability (Snitsarev et al. J.Physiol. 582, 177). In central neurons, however, *increased* BK activity leads to *increased* excitability (Brenner et al. Nat.Neurosci. 8, 1752). To gain an insight into this opposing physiological effect of BK channel, we used Simulink (Mathworks) to perform mathematical modeling of action potential (AP) generation:
http://www.mathworks.com/matlabcentral/fileexchange/loadFile.do?objectId=18812&objectType=file.
In response to simulated depolarization with 0.04 nA current injection, the simulation generated 4 APs adapting within 200 ms. Doubling BK conductance from 0.0065 to 0.013 microS resulted in 12 APs adapting within 600 ms, and halving BK conductance to 0.00325 microS resulted in 3 APs adapting in less than 200 ms. Thus, contrary to our expectations, an increase in excitability resulting from increased BK current was obtained in the nodose neuron model system. This behavior is reminiscent of central neurons. Other K^+ conductances and their effects on excitability in the nodose neuron model were also tested. In line with current experimental and theoretical knowledge, an increase in A-, K-, or D-current resulted in expected decrease in excitability (Schild et al. J. Neurophysiol. 71, 2338). To reconcile the experimental data from nodose neurons, central neurons and mathematical models of these neurons, we are introducing into our models recently discovered endogenous inhibition of BK current by a toxin-like domain of acid-sensing ion channels (Petroff et al. PNAS 105, 3140) and its competition with experimentally added scorpion toxins.
Mathematical models of neuronal excitability, and especially involvement of K^+ channels, may help our understanding of altered excitability of central neurons in epilepsy, neurodegenerative and psychiatric diseases, and decreased excitability of baroreceptor nodose neurons in hypertension and heart failure.

2478-Pos Board B448
New Metrics of Intrinsic Axonal Excitability from a Computational Model of Demyelination
Jay S. Coggan, Thomas M. Bartol, Terrence J. Sejnowski.
The Salk Institute, La Jolla, CA, USA.
In white matter, oligodendrocytes tightly wrap axons at regular intervals to form the myelin sheath, the primary attribute of which is conduction velocity acceleration. Axonal demyelination diseases represent a devastating group of neurological disorders that affect more than 2 million people annually worldwide. The process of unraveling the periodic insulation causes axon conduction dysfunction in many diseases of the central nervous system (CNS), as in multiple sclerosis (MS) and infectious encephalomyelitis, or the peripheral nervous system (PNS) as in Guillain-Barré or Charcot-Marie-Tooth syndromes. Although the etiology of these diseases in most cases is thought to be immunological, the mechanisms of the diverse neurological symptoms are just as poorly understood. These confounding symptoms can present intermittently, resolving and returning in a way that is desynchronized from re-myelination. Symptoms include spasticity, dysfunction of somatic sensation, motor control, impairment of vision and other modalities. But these multiple neuropathies cannot be understood by conduction velocity changes alone. Physiological features are accompanied by anatomical and cellular perturbations in affected neurons that include changes in voltage-gated ion channel densities.
Here we present a compartmental model of a partially demyelinated axon using the NEURON simulator (http://www.neuron.yale.edu/neuron/) that sheds light on the function of normal, healthy axons as well as those undergoing demyelination. The model suggests a simple set of rules that could explain the wide range of intermittent symptoms observed during demyelination. The rules that govern these destabilized excitability patterns are critically dependent on ion channel densities and the anatomical parameters of the axon. Support: HHMI, NIH R01-MH079076.

2479-Pos Board B449
Light-dark Cycle Memory In The Mammalian Circadian Clock
Ben Coffey.
U. of Memphis, Memphis, TN, USA.
The mammalian circadian oscillator, or superchiasmatic nucleus (SCN) contains several thousand clock neurons in its ventrolateral (VL) part, many of which are spontaneous oscillators with periods that range from 22 to 28 hours. In complete darkness this network synchronizes through the exchange of action potentials which release the neuropeptide VIP, striking a compromise, free-running period (FRP) that is close to 24 hours long. We lock Siberian hamsters to various light-dark cycles and then track their activity into the dark to show that they retain a memory of the particular cycle to which they were entrained before returning to their own FRP. Then using model clock neurons (1) we model the VL SCN network and show that strong rythmicity of the VIP oscillation can account for both synchronization in darkness and the light-dark cycle memory which we observe. Additionally, light is known to initiate a MAP kinase cascade that induces transcription of both per and mkp1 phosphatase. We show that the phosphatase-kinase interaction can account for the dead zone in the mammalian Phase Response Curve. Finally, we hypothesize that the SCN acts like a lock-in amplifier to reject noise and to entrain the light edges of the circadian day.