Abstract Submitted
for the SES09 Meeting of
The American Physical Society

Control of epileptiform bursting in the leech heart interneuron WILLIAM BARNETT, MARTIN ANQUEZ, TORREY HARRIS, Physics and Astronomy, GENNADY CYMBALYUK, Neuroscience Institute — The network controlling heartbeat in the medicinal leech contains leech heart interneurons (HNs). We modeled them under specific pharmacological conditions. The Ca^{2+} currents were blocked by Co^{2+}. The K^+ currents, apart from the non-inactivating current, I_{K2}, were blocked by 4AP. The hyperpolarization-activated current, I_h, was blocked by Cs^+. Under these conditions, epileptiform bursting characterized by long interburst intervals (IBI) has been shown. We considered three distinct cases. Model 1 included I_{K2}, I_h, and the fast Na^+ current, I_{Na}. Model 2 was characterized by I_{Na}, I_{K2}, and the persistent Na^+ current, I_{NaP}. Model 3 consisted of I_{Na}, I_{K2}, I_h, and I_{NaP}. We also investigated the bi-stability of bursting and silence as the leak conductance, g_{leak}, was varied. We showed that in 1 and 3, model HNs demonstrated bi-stability of silence and bursting. We analyzed how IBI and burst duration are controlled by the manipulation of I_h and I_{NaP}. In 1, as $V_{1/2}$ of I_h decreased, IBI grew towards infinity one over the square root of the parameter difference. In 2, we showed that as g_{NaP} decreased from 6.156 nS to 6.155 nS, IBI grew in accordance with the one over square root law. The system underwent a saddle-node bifurcation just below 6.155 nS. Supported by NSF PHY-0750456.

William Barnett
Physics and Astronomy

Date submitted: 17 Aug 2009 Electronic form version 1.4