

Relaxation phenomena in the (in)activation gates of the voltage-gated ion channels

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Abstract

We previously proposed a method for the study of the relaxation phenomena in the activation and inactivation gates of ion channels present in the excitable membranes of neurons. In order to study the relaxation phenomena, the assumption is made that the activation and inactivation gate order parameters can be treated as fluxes and forces. In the present paper, we extend the previous model as including an ensemble of gating particles, and apply it for T-type calcium channel in thalamic relay neurons. It is found that kinetic equations are characterized by two relaxation times. The kinetic coefficients are determined for its empirical model. We also determine the kinetic coefficients of linear and nonlinear thermodynamic models for the same T-type calcium channel, and compare them with the empirical ones.