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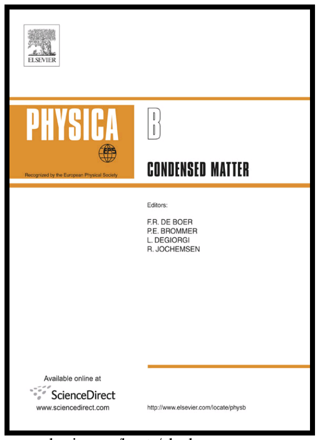

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Effect of surface bilayer charges on the magnetic field around ionic channels

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Abstract.

In this work, we present a physic-mathematical model for representing the ion transport through membrane channels, in special Na^+ and K^+-channels, and discuss the influence of surface bilayer charges on the magnetic field behavior around the ionic current. The model was composed of a set of equations, including: a nonlinear differential Poisson-Boltzmann equation which usually allows to estimate the surface potentials and electric potential profile across membrane; equations for the ionic flux through channel and the ionic current density based on Armstrong's model for Na^+ and K^+ permeability and other Physics concepts; and a magnetic field expression derived from the classical Ampère equation. Results from computational simulations using the finite element method suggest that the ionic permeability is strongly dependent of surface bilayer charges, the current density through a K^+-channel is very less sensible to temperature changes than the current density through a Na^+- channel, active Na^+-channels do not directly interfere with the K^+-channels around, and *vice-versa*, since the magnetic perturbation generated by an active channel is of short-range.

Keywords: Ion channels; Magnetic field; Surface charge; biological membrane; Finite Element Method.

1. Introduction

In studies on ionic transports across biological membranes, attention has been concentrated on the effects generated by electrolytes [1,2]. The ion movement across membrane has been considered mainly driven by diffusion and electrostatic interactions