ICR effect” to explain Ion transport across cell membranes
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Abstract

There have been many attempts to develop a theoretical explanation for the phenomena of electromagnetic field interactions with biological systems. None of the reported efforts have been entirely successful in accounting for the observed experimental results, in particular with respect to the reports of interactions between extremely low frequency (ELF) magnetic fields and biological systems at ion cyclotron resonance frequencies. A theoretical approach, in an attempt to more closely model the walls of an ion channel, suggests that the inside shape of the channel, plus the ELF magnetic fields at specific frequencies and amplitudes could act as a gate to control the movement of the ion across the cell membrane.

In past, experiments on ions at room temperature have proven that microscopic ion currents can be induced by simultaneously applying two parallel magnetic fields: one rather weak static field, B(0); and, one much weaker alternating field, B(ac), [B(ac) approximately 10^-3 B(0)], whose frequency coincides with the cyclotron frequency v = qB(0)/2πm of the selected ion. (Liboff, Bioelectromagnetics, 1985; Zhadin, Bioelectromagnetics, 1998.) This effect is called the Ion Cyclotronic Resonance (ICR) effect. We have analyzed this problem in the framework of coherent quantum electrodynamics (Preparata, Del Giudice, Fleischmann, Talpo, Bioelectromagnetics, 2002).

This conceptual framework suggests Ca-ion transmembranic currents should be stimulated applying both static and magnetic fields, just modifying the intensity of the alternate magnetic field [B(ac) approximately like B(0)].

The Experimental results, reported below, confirm this theoretical hypothesis.

We have set up a system to produce electromagnetic fields in a controlled system (a magnetic room). (Fig. 1)

A flask with 2 gold external electrodes, containing a glutamnic acid solution (33 g/l) at of acidic pH, was placed in the middle of a little solenoid (detector solenoid) and this was placed in the middle of a big solenoid (3 meters long and 33 cm da); the signal coming from the little solenoid was has been amplified and recorded. The large solenoid
was has been properly alimed in order to continuously generate low EM frequency from 1 to 10 Hz.

At Glutammic acid ICR frequency of 7.1 Hz, an ion current in the glutammic acid solution induced a magnetic field in the detector solenoid.

Fig. 1 - The solenoid where flask are submitted to static and alternate magnetic field within a magnetic room. The solenoid is provided with a micro-climate regulatory system. CNR-INMM Lab, Tor Vergata, Rome.