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Abstract Book

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Abstract collection

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molecular simulation analysis has been performed in order to obtain a conformational analysis of the host-guest system to compare this energetic mapping with the energy associated to the field. To apply experimentally the exposure conditions, we have used an automated triaxial Helmholtz coil system that allows us to control in real time all the components of the static and dynamic magnetic field [2]. We have measured the degree of terminal and biochemical differentiation in cultures of C2C12 cells, a murine myogenic cell line, by evaluating myoblast fusion and the expression of muscle specific proteins at the end of a 72-96 hrs period of exposure. On the basis of the obtained results we have improved the comparison between theoretical and experimental data with a first simulation of the cadherins docking, that represents the initial step of the cellular adhesion.

1. G. D'Inzeo, A. Galli, A. Palombo, "Further investigation on non thermal effects referring to the interaction between ELF fields and transmembrane ionic fluxes", *Biochem. &. Bioener* 30 pp. 93-102, 1993.
2. S. Aguanno, M. Zago, A. Palombo, G. D'Inzeo, A. D'Agostino, "Effects of ELF electromagnetic exposure on Sertoli cells protein synthesis", submitted to *Biochem. &. Bioener*, 1997.

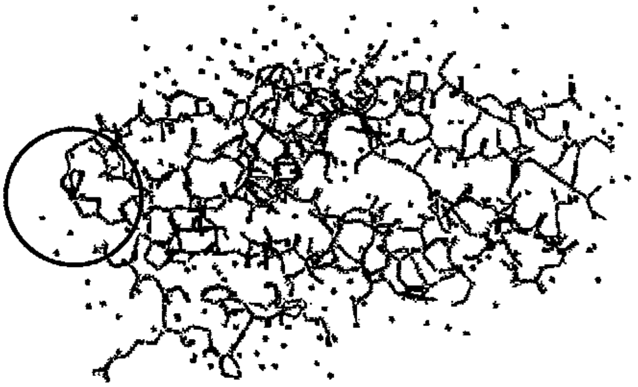

Figure 1. Cadherin and its calcium binding site (circled).

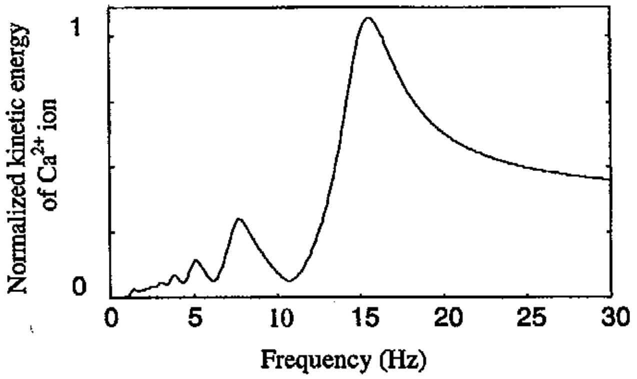

Figure 2. The energetic coupling between ELF magnetic fields and Ca^{2+} ions moving in the extracellular environment is a function of the field frequency. The curve represents the theoretical results for the following values of magnetic field: B_{static}=22.9 μT, $B_{dynamic}$=22.9 μT_{peak}. We can notice that the maximum energetic transfer is at 16 Hz.

A-5-5

PHYSICAL CONSTRAINTS SPECIFYING POSSIBLE PRIMARY MECHANISMS WHEREBY TECNO AO AND SUPERWEAK EMFs AFFECT BIOLOGICAL SYSTEMS.

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OBJECTIVE: Much of investigations have shown that weak nonthermal EMFs affect biological systems [1]. The EMF effects have been observed within many frequency and power ranges. The effects of frequently used weak ELF EMFs gradually find a physical explanation based on a quantum interference phenomenon [2]. This explanation is adequate if MFs greater than approximately 0.1G. At the same time, an increasing number of works demonstrate that much smaller EMFs can also affect biology. These data, schematically depicted in the Figure, are of significant concern because they are hardly consistent with any of proposed mechanisms. This raises the question of physical constraints defining possible fundamental nature of those effects.

RESULTS: Figure shows several theoretical limits defining different mechanisms/descriptions of EMF bioeffects. The kT and thermal limits are well known. The last was derived repeatedly in many scientific researches and works on EMF standardization. The quantum electrodynamics (QED) limit needs further comment. Interaction between EMF and a substance is classified within the different types of description, classical or quantum, of EMF and field of matter. The most of supposed primary mechanisms applies classical material particles interacting with classical EMF, a wave field. Recently, predictive mechanisms were proposed that provide an explanation of EMF bioeffects based on a quantum description of ion particles in a classical EMF [2]. It is the so-called semiclassical approximation. QED sets conditions for a classical EMF description to be valid: populations of states of EMF oscillators must be sufficiently large [3]. It follows the relation that links a frequency and a classical amplitude of a magnetic EMF component: $H > (\hbar c)^{1/2}(2\pi/c)^2 f^2$. This limit, the lower line, is shown in Figure. As is seen, all "low frequency" effects but the superweak MM radiation effects do require only classical EMF description. However, this does not set a minimal intensity of EMFs detectable by biological systems. The natural constraint on the electromagnetic susceptibility of a biological reception, as well as any receiver of a physical nature, relates to general QM lows. There is the relation $et > \hbar$ between the minimal energy change e and the time t required for its registration. Consequently, for example, an ELF EMF photon of the frequency f to be registered by any system, including biological one, the time $t=1/f$ is to be spent, at least. At the same time, this relation does not set a lower limit of the susceptibility to EMFs. The most profound theoretical physics along with many experimental findings show existence of a so-called torsion fields, see refs in [4,5]. They propagate singly and accompany EMFs too. Therefore, a possible explanation for the hypersensitivity relates to torsion fields. They are not obligatory as small as EMFs generating these fields [5]. Apparently, there is no general theoretical constraint, which defines a lower limit for the intensity of EMFs affecting biological systems. All the physical constraints suggested to date are based on the proposed specific primary mechanisms of EMF signal transduction, not on the first physical principles. *The first physical principles do not forbid biological hypersensitivity to EMF radiation.* Only the microscopic design of a biological receptor and a time of its coherent interaction with EMF define the level of hypersensitivity in each specific case.

[1] W.R. Adey // *J. Cell Biochem.*, 51, 410, 1993;
[2] V.N. Binhi // *Electro and Magnetobiology*, 16(3), 203, 1997.
[3] L.D. Landau, E.M. Lifshitz. *Quantum Mechanics*. Pergamon, Oxford, 1965.
[4] A.E. Akimov *et al* // Abstracts of 2 World Cong. on EMBM, Bologna, 185, 1997.
[5] G.I. Shipov. A Theory of Physical Vacuum, 2-nd ed., 'Nauka' Publisher, Moscow, 1997.

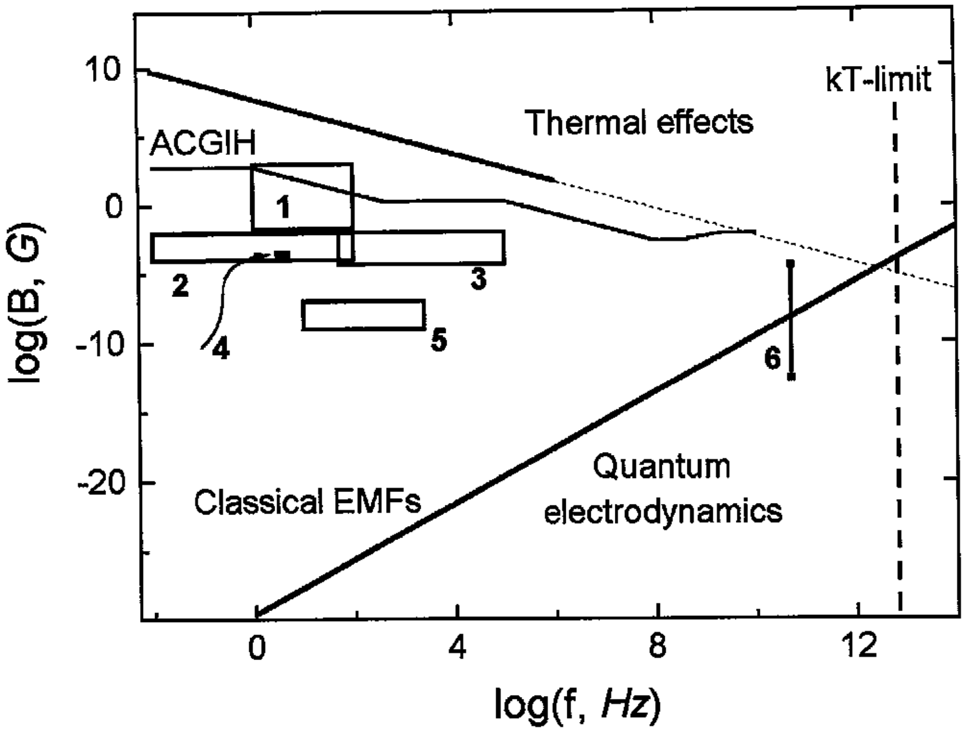

Figure. The figure illustrates various limits and areas of EMF biological effects as functions of two variables, EMF frequency *f* and amplitude *B*. The large scale of both the variables is chosen to show qualitatively different cases of the effects and theoretical approaches. A quantum of EMF energy is less than *kT* to the left of the dashed vertical line. This line defines a paradoxical area, wherein the biological effects are not possible from the orthodox viewpoint. The top downward line separates very approximately areas of thermal and nonthermal EMF bioeffects. The lower upward line is the QED limit. EMFs are to be described as a quantum object below this line. The step-inclined line is the ACGIH limit for the safe levels of the EMF exposure. Six areas marked by digits mean ranges of parameters of: **1** – ELF EMFs used in most of magnetobiological experiments; **2** – EMFs produced by magnetic storms that are known to correlate in time with peaking of cardiac-vascular diseases; **3** – background EMFs produced by the variety of home appliances, video display terminals such as TV and computer monitors; **4** – MFs that affect some amino-acid solutions (V.V. Novikov *et al // Biofizika*, 42(3), 733, 1997); **5** – MFs calculated at 0.5 m from the TecnoAO protective device, Tecnosphere, France, patent #93/00546 (see also M. Bastide *et al,* Abst. Book 20th BEMS Ann. Meeting, 1998; B.J. Youbicier-Simo *et al // Bioelectromagnetics*, 18, 514, 1997), which protects against harmful VDT irradiation; **6** – EMFs below a quantum electrodynamics limit, used in (I.Ya. Belyaev *et al // Bioelectromagnetics, 17*, 312, 1996), that significantly affect cell culture.