

## Functional role of quantum coherence in interfacial water

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Many have been puzzled to the point of incredulity by claims of exceedingly weak electromagnetic field (EMF) effects of low-energy photons that have insufficient energy to influence the chemistry or temperature of a cell. How can non-thermal effects of such tiny EMFs possibly occur? Becker described how EMFs can be a double-edged sword, with very promising applications in electromedicine, while posing serious health threats from fields from common household appliances, power lines, computers and cell phones [1]. A widely studied therapeutic example uses applied or induced microcurrents to stimulate healing of bone fractures. To be effective, the energy levels must be very small: power levels of  $10 \text{ } \eta\text{W}/\text{cm}^2$ ; magnetic field strengths of 2-20 Gauss; Currents of  $\eta\text{A}-\mu\text{A}$ ; thermal effects of  $0.01\text{-}0.001^\circ$ . Induced electrical power of more or less than these levels was less effective [2].

In 2013 Pall summarized twenty-three studies demonstrating that voltage-gated calcium channels are responsible for effects of weak EMFs [3]. In this presentation I will discuss an entirely different explanation that is gaining strength because of recent discoveries about the quantum properties of water. Study of quantum coherence in living systems led Fröhlich to realize that liquid crystalline components of the living body can produce Bose-Einstein condensation of strongly excited longitudinal electric modes, long range coherence and energy storage [4]. Recent applications of quantum field theory reveal coherence domains of millions of molecules [5]. Finely tuned metastable energized states within arrays of spinning water molecules enable responses to exceedingly weak electromagnetic fields of appropriate frequency, releasing an amount of energy within the organism that is far in excess of that contained in the original EMF. It is suggested that this amplification enables coherence domains in physiological systems to function in a manner comparable to the oscillatory instabilities found in some sensory systems [6]. Due to Larmor precession and quantum coherence, frequency becomes a more important parameter than intensity in terms of extremely weak field effects and regulatory standards.

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<sup>1</sup> Becker R.O. Cross Currents: The pearls of electromagnetic pollution and the Promise of Electromedicine. Tarcher, 1990.

<sup>2</sup> Rubin C.T, et al. Optimization of electric field parameters for the control of bone remodeling: exploitation of an indigenous mechanism for the prevention of osteopenia. J. Bone Miner Res Suppl 2:S573, 1993.

<sup>3</sup> Pall M.L. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med. 17(8):958, 2013.

<sup>4</sup> Fröhlich H., Long-range coherence and energy storage in biological systems. Int J Quant Chem 2:641, 1968.

<sup>5</sup> Del Giudice E. et al. Water Dynamics at the Root of Metamorphosis in Living Organisms. Water 2, 566, 2010.

<sup>6</sup> Camalet S. et al. Auditory sensitivity provided by self-tuned critical oscillations of hair cells. Proc Nat Acad Sci USA 97(7): 3183, 2000.