

Plenary lectures

1. BIOELECTRODYNAMICS OF CELLULAR ORGANIZATION AND INTERACTIONS

M. Cifra

Institute of Photonics and Electronics, Academy of Sciences of the Czech Republic, Prague, Czech Republic.

Endogenous cellular electrical charge dynamics gives rise to electrodynamic field in multiple bands in broad spectral region. Various cellular electrically polar structures can undergo vibrations which will generate oscillating electric field. Nature of these vibrations is acousto-electric, i.e. the wave length of the vibration corresponds approximately to the wavelength of the acoustic wave. Nonlinear coupling between the modes (such as proposed e.g. in Fröhlich model) enables channeling of the energy between modes with different frequencies.

Microtubules, an important part of cytoskeleton, fulfill all conditions for generation of cellular electrodynamic field. They are electrically polar and have vibration modes from kHz – GHz region. Energy for vibrations in microtubules may be provided from GTP-hydrolysis; motor protein–microtubule interactions; and energy efflux from mitochondria. Microtubules are spatially correlated with the mitochondria and we see interplay of these two systems as crucial for cellular electrodynamics.

There are multiple roles of mitochondria in cellular function and especially in cellular electrodynamics. Additionally to production of ATP, mitochondria themselves are source of weak optical and UV electromagnetic field due to the production of electronic excitations in the form of reactive oxygen species and their consequent interaction with biomolecules. Water near the functional mitochondria is strongly organized, which is probably related to strong (few MV/m) static electric in the vicinity of mitochondria. Organized water plays an important role in damping and coherence of cellular vibration states. Endogenous cellular electrodynamic field of various frequencies can play important role both in internal cellular organization and cellular interactions.

2. SUPERPARAMAGNETICS IN THE HYPERTHERMIC TREATMENT OF CANCER - HOPES AND LIMITS

L. Kubisz

Department of Biophysics, Poznan University of Medical Sciences, Poland.

Magnetic hyperthermia is a method for precisely controlled temperature increase in tissues. This method uses the phenomenon occurring in superparamagnetic materials located in a variable magnetic fields. In contrast to the conventional ferromagnetic materials, the temperature increase is caused by the Neel relaxation process and the Brown relaxation process instead of a phenomenon of magnetic hysteresis. The progress of this method is associated with the development of nanotechnology, because a working medium is administered to the tissue in the form of liquid or gel contains superparamagnetic particles. Sizes of particles are so small that no sedimentation takes them, and no hysteresis loop is observed. Application superparamagnetics allows the required temperature increase, exclusively in the volume occupied by the working medium, protecting the surrounding tissues. Simultaneously, the magnetic induction is kept on the safe level for patients.

Hyperthermia using magnetic superparamagnetics can serve not only the local temperature rise by increasing the effectiveness of chemo- and radiotherapy, but can also be used as an independent method of destroying cancer cells.

3. THE EFFECT OF AC MAGNETIC FIELDS ON THE GERMINATION OF SEEDS.

**L. Kubisz^{1,2}, R. Holubowicz³, M. Gauza¹, H. Li⁴,
D. Hojan-Jeziarska^{1,2} F. Jaroszyk^{1,2}.**

¹Department of Biophysics, Poznan University of Medical Sciences, Poland,

²Higher Vocational State School, Piła,

³Department of Horticultural Seeds Science and Technology, Poznan University of Life Sciences,

⁴Cotton Research Center, Shandong province, Jinan, P.R.China.

Magnetic field is one of the natural factors affecting the evolution of all organisms on Earth. Even though the interaction between magnetic field and animated matter is not fully understood, magnetic field is widely used in therapy and diagnosis. The lack of specific magnetoreceptors in animals and plants requires two types of experiments, where either a concentration of specific substances or change in the behavior of single individuals are taken to be a bio-indicator. In the case of experiments on plants, usually energy and capacity of germination, length of the received germs along with their masses are taken as a measure of the effectiveness of magnetic field.

Influence of magnetic fields on growth and developments of plants has been an object of

numerous research carried out for many years. From the practical point of view, especially interesting is a possibility to use it to stimulate germination of seeds of cultivated plants. On this issue, literature reports are contradictory. Some of the cultivated plants, like onion, are burden with insufficient germination of their seeds. Physical pre-treatment by means of magnetic field can be the alternative and attractive method for the improvement in germination.

Commercial seed lots of onion (*Allium cepa* L.) of the cultivars Octavia and Eureka were used in the experiment. Seeds were exposed to magnetic field generated by a standard device for medical magnetic stimulation applied in human treatment. Seeds were evaluated for energy and capacity of germination, length of the received germs as well as masses of the obtained seedlings.

For the seeds of cultivar Eureka, the magnetic field did not affect on length of germs and masses of the received seedlings and increased their speed of germination, germination energy. For the seeds of cultivar Octavia, the field did not affect their energy of germination, however, it did improve, in all tested treatments, their germination capacity.

4. EFFICACY OF HOMEOPATHIC REMEDIES ON MAGNETIC FIELDS IN THE MHZ-REGION BY MAGNETIC RESONANCE.

K. Lenger¹, R. P. Bajpai² M. Spielmann¹

¹Institute for Scientific Homeopathy International ²Institute for Biophysics, Kapellener Str., DE-41472 Neuss and North Eastern Hill University, 47, Teachers Quarters NEHU, Permanent Campus Shillong 793022, India.

Lenger detected photons in the MHz-region using homeopathic remedies on sugar globules by two magnetic resonance methods: 1) by the Tesla-flatcoil system and 2) by the modified Photomultiplier-Method. The magnetic field was attenuated by the highly potentized remedies Argentum metallicum CMf and Cantharis in CMf. This was only possible by resonance if the remedies used had the same frequency as the Tesla-flatcoil system. The degree of the potencies could be measured by very softly enhancing the input Voltage (μV). A distinct magnetic field separating the photons from the sugar globules is characteristic for the remedy and each degree of the potency. Each remedy showed different resonance frequencies: e.g. Argentum metallicum CMf and Cantharis CMf had resonance frequencies at 2.06 and at 6.9 MHz, Arnika CMf at 2.06 and 1,823 MHz, Bovista at 2.06 MHz and 4.77 MHz. Stimulation of one of their resonance frequencies allowed to measure the other ones. Using the modified Photomultiplier-method which means that a copper coil connected with 2.06 MHz/50V of a generator was put around the measuring chamber resulted that the yield of photons being separated from the sugar globules was much

higher than by stimulation with visible light. The photons of the remedies had holistic coherent behaviour expressed by the B_2 -coefficient of Bajpai's equation. Using the above mentioned methods it is possible to discriminate a homeopathic remedy or a placebo for the first time.

Lenger developed a biophysical, biochemical model of homeopathic function. In a healthy state before an enzyme reaction photons from the sun or universe are attracted by resonance to stimulate the enzymes to higher energy levels by lowering their activation energy; after the enzyme reaction the enzyme specific photons will be emitted. During illness other energy terms of the enzymes are involved, either too many higher ones by up-taking too many photons or ground states are achieved by emitting too many photons (Popp). Homeopathic healing means that the remedies having the necessary resonance frequency do either attenuate the excess photons or perform quantum jumps to reach the normal energy level of the healthy enzymes. The magnetic fields of the homeopathic photons and of the patient are assumed to be polar. Therefore, in a disease state, substances and inhibitors of the biochemical pathways being involved can be given in high potencies to cure the patient. Lenger showed that the laboratory-values of the patients became better or even normal using this therapy.

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[2] Lenger K, RP Bajpai, Drexel M, Delayed luminescence of high homeopathic potencies on sugar globuli. Homeopathy 2008; 97, 134-140

[3] Lenger K., A new biochemical model of homeopathic efficacy in patients with chronic diseases. Subtle Energies & Energy Medicine 2010, 19(3), 9-41.

[4] Lenger K, RP Bajpai, Spielmann M. Stability and Quality Control of Homeopathic, Remedies. Homeopathy in press, 2011.

5. THE FUNDAMENTALS FOR THE EXTRA-CELLULAR AND INTER-ORGAN ELECTROMAGNETIC COMMUNICATION IN THE KHZ RANGE.

K. P. Michalak

Biophysics Department, Poznań University of Medical Sciences, Fredry 10, 61-701 Poznań,

The electromagnetic transfer of energy in the range of kHz must be considered with respect to the properties of the living tissues to conduct these frequencies through the extra-cellular space and through the cell membranes.

The resonance is phenomenon of the energy transfer between two objects vibrating with the same

frequency. If many objects vibrating with the same frequency lie close each to other (at the distance being significantly shorter than the wavelength), the phase synchronization can occur between the vibrating objects due to the decrease of the total energy of the system. The objects possessing the higher energy of the vibration of a given frequency can transfer their energy to the objects possessing the lower energy of this vibration. As a result, the energy of a given frequency will tend to be equally spread inside the system.

The kHz alternating electric fields possess the exemplary wavelengths equal to about $l = 300\text{km}$ for $n=1\text{kHz}$ and $l = 300\text{m}$ for $n=1\text{MHz}$. The wavelengths are strongly higher the size of the human body. It makes possible to synchronize the phases of vibrations of all the objects in the human body possessing the excited states in the range of kHz's and even up to about 10 MHz. The phase synchronization of these vibrations should be rather the total body phenomenon rather than the local one.

The ability of the kHz-electromagnetic fields to be conducted through the human body depends mainly on the capacitive resistance of the tissues. This resistance is relative high for these frequencies due to high capacity of the lipid membranes building the cells and cell structures. The total mass of the lipid membranes in the human body is equal to about 10kg and they constitute about 15% of the total mass of the body. They behave like the capacitors of relative high capacity equal to about 10mF/m^2 . One can conclude that the lipid membranes are the objects that strongly dump the kHz vibrations. The extra-cellular space is however the better milieu making possible to conduct the electromagnetic fields from this range. One can conclude that phase-synchronization energy transfer between the different parts of the human body is possible at least at the level of the extra-cellular fluid.

The Quantum Field Theory applied to the water structure points to the possibility for the coherent domains (CD) of the water to possess the quasi-excited states of the electrons in CD's at the energy levels equal to $7\text{kHz} \cdot i$ ($i=1,3,5,7,\dots$). This phenomenon concerns 13% of all the electrons building the hydrogen bonds in the water molecules. The precise frequency depends probably on the detailed local water structure that should be connected with the different neighboring molecules. One can suppose that the trans-membrane kHz-energy transfer can occur due to the local trans-membrane electromagnetic interactions between the water clusters lying on the both sides of the membrane or by using the water channels making possible for the water to move across the membrane.

All the presented information let us to advance the hypothesis that the inter-organ energy transfer in the kHz range is possible.

6. QUASI-QUANTUM EFFECTS IN BIOLOGICAL SYSTEMS

M. Molski

Institute of Chemistry, Theoretical Chemistry Department
Adam Mickiewicz University of Poznań

A new class of macroscopic, quasi-quantum effects, which play an important role in the biological domain, has been presented. According to the Leggett's classification, one may distinguish the macroscopic quantum phenomena of the first kind - superfluidity, superconductivity, and the second kind - quantum interference of macroscopically distinct states, macroscopic tunnelling via Josephson junction. The quasi-quantum model permits introduction, in the Leggett's classification, of a new class of the effects: macroscopic quantization, uncertainty, coherence and nonlocality appearing in the biological systems whose growth is characterized by the Gompertz, West-Brown-Enquist or universal growth functions. It has been proven that the aforementioned functions are special solutions of the space-like quantum Horodecki-Feinberg equation for the time-dependent anharmonic oscillators described by the Morse, Hua Wei and Hulthen potentials. The coherent states of the biological growth have been derived. They are eigenstates of the annihilation operator and minimize the time-energy uncertainty relation. Such states propagate along the well-defined time trajectory, hence they are coherent in the space. This property explains the phenomenon of biocoherence - the long-range coordination of different biological functions appearing on macroscopic scale in biological systems. The most intriguing aspect of the model presented is eigenvalue of the Horodecki-Feinberg equation, which represents the momentum of biological growth, associated with a space-like material component whose properties resemble those attributed by vitalists to the life momentum or vital impulse. Its physical characteristics and connection with the concept of zero-point momentum of vacuum are presented.

7. ENERGY PRODUCTION AND FRÖHLICH'S POLAR VIBRATIONS IN CANCER CELLS

J. Pokorný

Institute of Photonics and Electronics ASCR, Chaberská 57, 182 51
Prague 8.

Suppression of mitochondrial oxidative energy production in cancer cells was disclosed by Warburg who predicted that this disturbance results in decreased structural order. Fröhlich formulated hypothesis that due to nonlinear interactions between elastic and electric polarization waves coherent electrodynamic vibration state is created and that cancer disturbs the coherent state. Physical processes

in healthy cells are essential for biological activity. Cancer transformation pathway is not only a sequence of altered chemical reactions and genetic defects but also of disturbances of cellular physical processes.

A key process in a functional mitochondrion is transport of protons across the inner membrane into the intermembrane space. Proton transport from the matrix space is a basic condition for production of ATP and GTP (adenosine and guanosine triphosphate). Mitochondrial efficiency of energy transformation is of about 40%. The rest – the non utilized energy is liberated from mitochondria to the surroundings and may excite oscillations in microtubules. As the oscillations are polar, electrodynamic field is generated. In a non linear structure oscillations may be coherent. Generated electromagnetic field has a fundamental role in physical work exerted by the cell, transport and organization of molecules and structures, their interactions, and information transfer.

Proton transport affects water properties in the cell. Diffusion of positively charged protons from the intermembrane space to the ambient medium generates a layer of a strong static electric field around each mitochondrion. The strong static electric field together with hydrated protons forms conditions for high level water ordering and enhances conditions for nonlinear processes in the cell, in particular in microtubules (basic interfacial water ordering depends on the surface charge of macromolecules and structures). Organized water may be assumed to be a special phase, whose properties differ from normal bulk water. In particular, the viscosity effects are diminished, for instance damping of oscillation in microtubules. Mitochondria are boundary elements between chemical and genetic processes on the one side and physical processes on the other side.

Physical processes in cancer cells are pathologically modified. Mitochondrial activity is reduced. Dysfunction of mitochondria leads to decreased proton transport across inner membrane, diminished static electric field around the outer membrane, smaller amount of liberated non utilized energy, resulting in lowered water ordering, diminished excitation of microtubule oscillations, increased damping, and diminished coherence of the electrodynamic vibration states. The cellular activity is deteriorated.

Mitochondrial dysfunction is caused by cancer kinases blocking pyruvate dehydrogenase enzymes on the pyruvate pathway in the matrix. After inhibition of the cancer kinase the mitochondrial function is restored, cancer cellular exuberance “tamed”, and the cell could restore normal function or trigger apoptosis. Targeting mitochondria in cancer treatment opens a new way in the fight against this disease.

8. MODIFICATION OF THE SURFACE OF COLLAGEN FILMS BY UV RADIATION

A. Sionkowska

Faculty of Chemistry, N. Copernicus University, Gagarin 7, 87-100 Toruń.

UV-irradiation can cause the alterations of the primary and secondary structure of collagen. For thin collagen films photochemical reactions usually occur at the surface of the film. As a result of photochemical reactions the surface can be modified. The size of the modifications depends on the wavelength and energy of UV light. Laser energy can be used for deep modification of the surface properties of collagen films.

The surface properties of collagen films before and after UV-irradiation ($\lambda=254$ nm and 248 nm from low intensity UV lamp and the KrF excimer laser, respectively) were investigated using the technique of Atomic Force Microscopy (AFM), scanning electron microscopy (SEM) and by means of contact angle measurements allowing the calculation of surface free energy. In order to study the chemical and structural changes during UV irradiation FTIR-ATR spectra were recorded.

The microscopy images showed that the KrF excimer laser irradiation caused deeper damages on the surface of collagen film in comparison to the surface of collagen films exposed to the mercury UV lamp. The analysis of Raman and FTIR-ATR spectra showed that UV laser light induced conformational changes in the irradiated collagen films, mainly as a result of breaking of the hydrogen bonds network and the loss of water molecules, responsible for the maintaining the structure organization. Fluorescence measurements showed characteristic bands assigned to tyrosine aromatic compound and also to the products of its photochemical degradation caused by laser irradiation.

9. FROM MITOGENETIC TO NECROTIC RADIATIONS – TOWARD THE PHOTON CYCLING IN BIOLOGICAL SYSTEMS AND ELECTROMAGNETIC EXISTENCE

J. Sławiński

State Higher Vocational School, Institute of Environment Protection
Ks. Kard. Wyszyńskiego Street 38, 62-200 Gniezno.

SUMMARY

Electromagnetic endogeneous radiations associated with biological activities are named ultraweak photon emissions (UPE) or “biophotons”. They cover the photon flux from 10^{-20} to 10^{-14} W/cm² or a few to 10^4 photons/s/cm² and the spectral range 180 – 1500 nm ($1.6 - 2$) 10^{14} Hz. UPE has no specific sources such as

e.g. enzymatic luciferase – luciferin bioluminescence systems. It occurs universally in nature in conjunction with physiological processes. The mechanisms that lead to UPE are due to the endogenous production of electronically excited states of molecules in metabolic processes.

MITOGENETIC RADIATION

Mitogenetic radiation (MGR) was discovered by A.G. Gurwitsch in 1923 in his famous but controversial “onion experiments”. Ultraweak photon emission having the mitogenetic (stimulatory effects) belongs to the UV region (~5eV). Similar experiments were performed with a more reliable biological detector – yeast culture grown on agar plates. Later, modified Geiger – Muller counters sensitive in the range 190 – 280 nm showed MGR from alive nerve excitation. More convincing results were obtained using spectral analysis of MGR with quartz optic spectrographs. Nova days (2001 – 2011) still more advanced experiments have been performed using contemporary single photon counting (SPC) technique and model biochemical systems.

However, it has been a great surprise that the biological system where intensive cell division takes place, emits mitogenetic radiation, called “degradative MGR”. Probably it arises from excited macromolecules kept together with different types of chemical bonds and is feed with illumination.

NECROTIC RADIATIONS

In the second part of this work, results of UPE observed at the time of death, i.e. an irreversible perturbation of homeostasis are described. This necrotic radiation reflects the intensity and duration of dying processes. Results of hundreds experiments with plant and animal organisms exposed to lethal chemical and physical factors – poisons, high temperature, mechanical damage, osmotic shock are described. The photon emission response to lethal factors manifests itself as a rapid strong (10 – 1000 times) increase in the intensity and total number of the emitted photons – the “light sum”.

The intensity and duration time of necrotic radiations are related to the rate of dying, type of organism, physicochemical properties of its tissue and spatial structure, the rate of the toxin penetration through tissues.

The emission spectra ($I = f(\lambda)$) of necrotic radiation cover a very broad spectral range from $\lambda = 200 - 900$ nm, i.e. the spectral bandwidth of frequency modulation (FM) mode $\Delta\nu = 1.2 \cdot 10^{15}$ HZ, i.e. extremely capacious information conveyer. An electromagnetic, holographic model of information conservation related to cosmologic and eschatologic recent hypotheses is proposed.