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# КВАНТОВА ФІЗИКА ЖИВОГО ТА ЇЇ ТЕОРЕТИЧНІ ОСНОВИ

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## PHYSICS OF THE ALIVE — THE NEW TREND OF FUNDAMENTAL NATURAL SCIENCES

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**Abstract.** The new trend of fundamental sciences — Physics of the Alive has been formed. In its base there lies the notion of the alive as of the fourth level of quantum organization of nature (after nuclear, atomic and molecular ones), when self-consistent potential, providing existence of effective long-range force, functions by the type of laser potential in mm-range of electromagnetic waves. In foundation of the physics of the alive there lies direct experiments, huge clinical material, analysis of the achievements of west and ancient-oriental civilisations.

**Keywords:** Physics of the Alive, Quantum Medicine, synergetics, coherence, quantum mechanics, ancient-China medicine, genetic code, short-rang and long-rang forces, macroscopic quantum-mechanic entirety, quantum ladder of nature, mm-range of electromagnetic waves.

Physics of the Alive, as a term, appeared on the 12th of May in 1989 at the Small Conference Hall of the National Ukrainian Academy of Science (Kyiv). Here under the chairmanship of Prof. Fröhlich\* the round-table meeting had been taking place as a part of the International Symposium being devoted to comprehension of the results of the three years research work which had been conducted by the so called Temporary Scientific Collective "Otklick". This Collective was created with the joint decision of the State Committee of the USSR for Science and Technique and Presidium of the Academy of Science of the USSR. The task of "Otklick" was the development (in medical-applied and fundamental-theoretical aspects) of the principles of the discovery, being claimed on the 20<sup>th</sup> of May in 1982, by the physicists of Kyiv State University: Ye.A. Andreyev, M.U. Bely and S.P. Sit'ko. The discovery was formulated in such a way: "The manifestation of characteristic eigenfrequencies of Human body". The application of the fundamental physics terminology to the definition, as it seemed, veritably medical phenomenon (restoring of the functional state of patients with the aid of outward mm-range electromagnetic radiation affected on the special spots of human's skin at the selected frequency) at that time was, rather, consequence of the emotion-intuitive opinion of the obtained experimental results for developing of the notion about Life, than the substantiated scientific conception.

Such a conception has arisen later when it was revealed, that the medical effects and resonance response of protozoa on the outward electromagnetic fields of the mm-range became more and more clear and unambiguous in case of **decreasing** of irradiation level up to the counted number of quanta. Thus, if in the first experiments on protozoa [1,2] and in our investigations upon restoring of the

\* H. Fröhlich (1905–1992) — one of the creators of XX century physics. He has been grounded in theoretical physics by A. Sommerfeld. He is author of five discoveries called by his name. H. Fröhlich was the first who stated the idea about electromagnetic coherence in biological systems.

health with the outward radiation of mm-range it was used intensities in area of  $(5 \div 10) \cdot 10^{-3} \text{ W/cm}^2$ , the modern quantum medicine technology, so called "Sit'ko-MRT" technology (MRT — Microwave Resonance Therapy) deals with monochromatic radiation, integral intensity of which amounts only to  $10^{-11} \div 10^{-14} \text{ W/cm}^2$ . For usually using generating devices it conforms spectral density equal to  $10^{-20} \div 10^{-21} \text{ W/Hz} \cdot \text{cm}^2$ . If in addition, we recollect that the MRT of

even very severe diseases realizes through the distal biology active points (and **never** through the sick organs!), it would be clear that remaining in scope of standard viewpoint on the Alive as the observed in visual band of electromagnetic waves mechanical-chemical system and nothing more, it is unable to explain the over-high efficiency of the MRT-technologies in treatment of hundreds thousands patients.

Everything pointed out that we observed the effects inherent exclusively in the Alive. Just therefore when term "Physics of the Alive" had got into scientific vocabulary and different scientific schools have begun to fill it with the different contents — from biophysics of complex systems to using in biology of the synergetics approaches and up-to-date mathematics (theories of chaos, catastrophes and so on), — I have been impressed with the notion about drastic distinction of Physics of the Alive from biophysics and all other medicine-biology sciences. Under Physics of the Alive I comprehend the science based on the fundamental definition of the notion "the Non-alive" i.e. "the Dead". This idea was brilliantly formulated by Prof. L.I. Sidorenko in May of 2000 at the International Methodological Seminar in Kyiv: Biophysics studies biological objects and Physics of the Alive — living ones.

Before giving the definition of the Alive that, as to me, could be the base of the Physics of the Alive, I should like to state the opinions which I has been guided formulating this definition and, by the way, to clarify the meaning of the notion "fundamentality".

What leaps to the eye of somebody, who more than 30 years has been professionally occupied in fundamental (nuclear) physics (theoretically and experimentally), and after this the one has sunk deep enough into problems of biology, biophysics and medicine? It is that my colleagues-physicists, thrown in their scientific lot with biology (and after them everybody), look at the biological objects as the area of **application** of fundamental notions, received in studying of inanimate nature. Nobody (at least, on the level of solving scientific problem) are interested, that they study **living** systems: they apply approaches used in physics of liquid or solid, difficulties are connected with non-solution (in general case) of the many-bodies task and so on. Therefore in books, dissertations, articles, where it's considered the solution of this or that (often interested) mathematics or physics task, frequently you could find mention about its biological application in the rank of other **technical applications**. But technical application is quite not a science, or rather, not an original science. That's why during the mention of biological application, venerable scientists (luckily, being not ill yet) shyly smile or crack jokes under common laugh, type of: "Would we soon even ordinary cold guess as an object of **our** investigation? " and so on. That's why it's considered as an outstanding achievement that, for example, some processes in the Alive (!) came to be modeled with the chains consisting of the several resistors and capacities. In other words, it's assumed, that the Alive is primitive one and its complexity is only

seeming one, connected exclusively with the large amount of particles (molecules, cells and so on).

But at the same time nobody tries to imitate indeed primitive (as compared with even simplest living organism) TV or radio-set with the aid of a few passive RC-four-poles. It means that the view on the Alive as the simple object, or, at any rate, object, which does not contain anything new, takes root not only among scientists, but is spread also between common people who, watching themselves, other people, animals and plants, guess that about the alive they know everything, or almost everything. Therefore, if on a street you stop some tens of passers-by and ask them, how does TV (for example) work, then the overwhelming majority of them (if, of course, you are not near the radio institute) answer you that they don't know and advise you to get a touch with the specialist or read the suitable book; but if you ask the same people about extrasenses, Juna, Koshpirovsky and so on, I guess all or almost all of them will have on that score certain opinion, proving by this that in the common mentality the watching Alive also seems incomparable comprehensible that... television set!

In reality, behind all of this "**pride and arrogance**" are disguised, because it's implied that the Man has created and creates something which is beyond Nature's and God's power. Tremendous achievements of XX-century's science: quantum nature of the world, electrodynamics (including quantum and nonlinear ones), theory of field, theory of superconductivity and superfluidity, holography, theory of fractals, thermodynamics of nonlinear and opened systems, synergetics and so on — it looks like they have not touch of the standard chemistry-mechanical notion about the Alive. And this is despite the fact, that, remaining in scope of chemical paradigm, it is unable in principle to form macroscopic stable heterogeneous structure in accordance with concrete genetic code due to short-range character of the chemical force. This is the same as if you force the painter to draw picture, setting his nose in touch with canvas. In this situation even genius does not make a picture: he ought from time to time to move away on a few steps and look at the picture from some distance.

There is no chemical force between fundamental forces of nature. There is only variety of electromagnetic interaction, in its nature long-range one, but in real condition of solid or liquid generally due to screen-effect this interaction gains short-range character and was called as chemical interaction.

The effective long-range forces appear in all synergetic's objects — from Belousov-Zabotinsky reaction to reverberators in a heart, ball lightning and stable plasm. Thus, for recognizing of the life phenomenon or, as a minimum, for understanding of the mechanism of tissue differentiation, morphogenesis and form-creation, in other words for comprehension of genetic code mechanism realization on the macroscopic level biology and medicine ought to refuse from the idea of exceptionality of chemical interaction in the Alive. As a matter of fact, the chemical paradigm is closely connected with the idea of visualization, i.e. it was considered (and is considered), that the serious biology and medicine may deal only with **watching chemical transformation**, and all beyond it is hocus-pocus. Just therefore during many centuries west medicine has not accepted the ancient

\* For fairness sake one ought to say that gradually on the pages of biological and biophysical publications the materials of quantum and synergetics effects have become to leak out but in the traditional microscopic niche, (for example, on the level of cell's membranes).

China one, having based, as it's known, on the morphologically undistinguishing "Channels". In reality, this view, putting mildly, is primitive and returns us back to the same comparing of the Man with a television — or radio-set, which "see" tens invisible to our eye stations and it's guessed natural due to illusion of human being might in comparison with God.

We have succeeded in establishing of the channels' electromagnetic nature, having showed that they are the structure of eigen coherent field of human body in the mm-range of electromagnetic waves. But about this some later.

The ability of organism to react practically on the separate quanta of the outward electromagnetic radiation, the energy of which is 100 times lower than the thermal background (kT), is a formidable argument in favour of hypothesis of quantum-mechanics entirety of the living macroscopic objects. In favour of this notion it's pointed out also the analysis of stability of existence of the systems in our world.

Let us begin from the Table of elements (Mendeleev Table).

Does it not seem marvellous the very being of the Table, in other words the existence of definite chemical elements, which give themselves to be separated from chaos of the continuously varying and self interaction at all levels of the world?

The same miracle exists not only at the atomic level of nature organization. It exists also at nuclear and molecular levels. We say: nuclei of iron, atom of hydrogen, molecule of water, and know that these notions will have got the definite sense not only on any continent of earth, but in space and on the any star of the universe. What is the reason of such confidence? And here we recollect that just the nuclear, atomic and molecular objects form three steps of quantum ladder of nature, so called Weisskopf's Quantum Ladder. What does it mean? It means that just to these three levels of nature organization the Quantum Mechanics notions could be applied explicitly.

All objects of material universe, settled at the every step of quantum ladder, have their own potential well, filled with the levels in accordance with Schrödinger's equation. After excitation of the object between these levels arise the transitions (due to photons or  $\gamma$ -quanta), intensity distribution of which is defined by the rules of forbidden. As a result, each object at every (from three) steps of quantum ladder possesses individual spectrum, which was called as the spectrum of characteristic eigenfrequencies of the specific nucleus, atom or molecule. Just these spectra are the universal, I should like to say even absolute, characteristic (passport) of every elements at all three steps of quantum ladder of inanimate nature. Their existence is stipulated by the quantum-mechanical laws and precisely therefore the application of quantum mechanics to the object explicitly (at the level of principle possibility of decision of Schrödinger equation) defines attribution it to the area of fundamental science.

Over-molecular structures (solid and liquid) in general case have not got characteristic eigenfrequencies and in this sense cannot be attributed to the objects of fundamental science. And, indeed, properties of solid and liquid don't change if you, for example, cut off bit of metal from a bulk or pour out a mug of water from a bucket. But if we separate one atom from molecule or one nucleus from atom, the properties of remained structure will change drastically. And the matter here is not in the size of the object of investigation as it could be seemed at the first sight.

The point is that at the nuclear, and atomic and at molecular levels the fragments that composed them (at the first level nucleons, at the second — nuclei and electrons, at the third one — atoms) form for every object entire potential (in nuclear and molecular physics in absence of power centre it's called self consistent one). In solid in general case the creation of such potential is impossible, because screening and strong bond of structures (molecules) hinder to create long-range interaction. It reveals in spectra by broadening of the lines and in the end they become broader than the distance between lines. The spectrum turns out to be continuous, characteristic eigenfrequencies are lacking, object (solid or liquid) are losing ability to get the universal passport.

The ability of quantum mechanics to endow the three levels of quantum organization of nature with the property of fundamentality is laid with the two **principles** of quantum mechanics — the principle of identity and the principle of discreteness. Just they define the diverse differential stability of the world. Therefore when we say: "Nucleus of iron" — the specialist occupied in the nuclear spectroscopy are imagining for himself the spectrum of characteristic eigenfrequencies of this nucleus. The spectrum is the universal characteristic of iron, i.e. all its nuclei in the Universe must have precisely the same spectrum and experimental revealing of any distinction in spectrum will mean that we are studying not a nucleus of iron. The same affirmation is correct for all objects of the three steps of Weisskopf's quantum ladder. For the over-molecular structures, as it was noted, such affirmation (in general case) is not valid for the absence of possibility in forming of self-consistent potential.

But why we say: "in general case"? The point is that in some situations there arises the possibility to create for the short time in the solids the efficient long-range interaction. It happens, for example, in case of spreading of sound or waves of excitation and as a result it's noted the peculiarities (peaks) in the spectrum, but very broad, that stipulated with the brief time of existence of such quasi particles (phonons, excitons and so on). In definite conditions (low temperature, materials with special properties) there is turned out well to eliminate the strong-bond effect in solid and provide conditions for self-consistent potential formation, i.e. to endow by artificially the sample with quantum-mechanical properties as an entirety. They are superconductivity and super-fluidity states. The characteristics of such macroscopic quantum-mechanics objects in their nature don't differ from ones for microscopic objects at the three non-artificial levels of the Nature quantum organization (Josephson's effect). The recollection about these exotic states of matter — superconductivity and super-fluidity — is important because it confirms our thesis, that the quantum mechanical property of the object is defined by not its size, but ability to form self-consistent potential, i.e. by the existence of the efficiency long-range forces.

But what is the relation of all these discussions to the problem of the Alive? The very direct. Mentioned above the diverse differential stability is observed not only at levels of nuclei, atoms and molecules, but in the animate world. It is the very existence of genera, species, individual specimens. The huge diversity of plant and animal life is discreteness. Even ability of classification in the plant and animal world is the confirmation of the stated above. Cats and dogs are recognized on the every continent. Every man, being classified as one of the people has, at the same time, his own peculiarities, which are preserved if not for whole life but at least, for a long time. This fact together with the revealed "the

manifestation of the characteristic eigenfrequencies of human body" had led me to the conclusion that any living organism had been entire quantum-mechanics entirety and the alive as a whole had been the fourth level of the nature quantum organization (the fourth step of Weisskop's Quantum Ladder).

'We have drawn attention, that macroscopicity itself has not been obstacle for consideration of the object as a quantum-mechanical entirety.' As a matter of fact, the absence of common for all components potential in solid and liquid is the obstacle for such consideration. This limitation is stipulated, as it was said, with the short-range character of the force in common cases. Does the Alive differ from the Dead in this relation? Yes, it does. They differ because the Alive is an active medium as a whole and in every cell contained in it.

P. Mitchell was awarded Nobel prize (1978) for revealing of proton's transport through the protoplasmic membranes, having shown that the greater part of metabolism energy any live cell has spent not for accumulation of chemical energy as it's guessed before, but for creation and sustaining on the membranes of the huge electric force, about  $10^5$  V/cm. And, if the necessity of such force for nerve excitation transmission is enough obvious, then the question about expediency of this for the other cells up to now has been opened.

H. Fröhlich was the first who paid attention to the fact, that frequencies of eigen-vibration of protoplasmic membranes of cells in accordance with their physically properties lie in the range of  $(10^{10} \div 10^{11})$  Hz [3]. Being under electric force these membranes in the answer of any perturbation become the source of electromagnetic waves in the mm-range.

The spectrum of electromagnetic radiation of every membrane is defined with character of its perturbation. The main perturbation of membranes is connected with the mechanical movements inside a cell accompanying the processes of its division and realization of gene information in the chain: DNA  $\rightarrow$  amino acids  $\rightarrow$  proteins. Keeping in mind the identity of gene code of every somatic cells of the concrete live organism, we conclude that there is created prerequisites to look at its every cells as active centre in potential ability for creating of the coherence electromagnetic field of the entire organism (multimode laser), which realizes in such a way the gene information at macroscopic level. But it's necessary to remind that the considered active centres (cells) are in the absorbing water medium and therefore a priori it is impossible to say would it be enough of metabolic pumping up of membrane's potential for system to overcome the threshold of the non-equilibrium phase transition and be supported after this threshold in the regime of laser generation during whole object's life. One had to have evidences that such a regime was indeed realized. Such evidences have been obtained experimentally and with the analysis of the notions of ancient-China medicine through a prism of synergetics notions.

In foundation of ancient-China medicine (and, if to be precise, not only medicine but philosophy too) it has been laid the notions about "meridians" — certain channels, connecting internal organs of the human body with the tips of fingers and toes and further with the Cosmos. Twelve pair and two odd channels, according to the notions of ancient-China medicine, penetrate by their inside tracks all human

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\* Once more emphasize that we are talking not about quantum-mechanics effects, for a long time having studied in living and non-living objects, but precisely about quantum-mechanics entirety.

body and outside ones are projected on the body's surface, selecting in addition some hundreds of biology active points — points of acupuncture in which in traditional China medicine one puts in needles. In spite of effort of many generations of specialists these channels has not been picked out morphologically, they are "invisible" and, as I have noted, it has been enough for West medicine not to accept of ancient-China medicine during many centuries regarding its methodology as hocus-pocus, quackery and successes in treatment (from acknowledgement of which it's impossible to refuse) as the irritation of nervous ends of skin. Particularly it had been prospered in such approach of over-idealized Soviet medicine, that even had invented new term for acupuncture — "needle-reflex-therapy" — having eliminated in such a way any discussion on the theme of its action mechanism.

We have succeeded in "visualization" of channels and showing their electromagnetic nature in the experiments which have come to the discovery of so called Rudenko's effect [4].

How could we look at the meridian's system of ancient-China medicine through the prism of synergetics notions?

The lasers were the first object of synergetics as a new universal science about self-organization [5]. The potential of Landau-Haken type:

$$V(q) = \frac{kq^2}{2} + \frac{k_1 q^3}{4}$$

is the simplest form for providing of nonlinearity in the medium. In addition the equation of motion  $\dot{q} = -kq - k_1 q^3$  with  $k < 0$  and  $k_1 > 0$  accepts the decision which under transition to the two-dimensions task could be interpreted as a limit cycle. According to the Poincaré's classification a limit cycle is one of the decision of nonlinear differential equation, that in phase plane is represented with a closed curve and which characterizes the stable periodic decisions along certain trajectory. It's necessary to emphasize that the limit cycle decision is enough unique decision of differential equations, describing in general case the behaviour of the open nonlinear medium. Other decisions (saddles, knots, focuses) are not-stable and with time they have gone to infinity or have assembled to the point. So it seems to me natural to look at the meridian's system of the Alive, having, as it was shown, an electromagnetic nature, as the projection on the three-dimensions space just the limit cycles — periodic and stable in time and in space decisions. In accordance with the synergetics notions the existence of such decisions means the existence of self-consistent potential, entire for whole system, the same type as it's arisen in a laser behind the threshold of non-equilibrium phase transition. Quantum-mechanics entirety of the living organism finds out in such a way its substantiation in the framework of synergetics interpretation of the ancient-China medicine notions [6].

\* Patient Rudenko, having suffered with chronic stomach ulcer, has differed from other ones by his reaction on therapeutic resonances in time of treatment with the MRT technology. When we approached to the resonances through any acupuncture point his both legs began to jump on the high about (20÷25) cm and with frequency (1÷2) Hz. It was important not only the fact that such reaction was realized only on special frequencies (with the quality of resonance about 1000), but the possibility of blocking such reaction with the school magnet while we put it near outside track of any meridians (channels). Moving the magnet above Rudenko's body on the distance about (1÷2) cm from the surface and scanning it along the presuming tracks of channels, we succeeded in location of the whole outside track of stomach's channel and the fragments of other meridians. Everything these were shot on cinema film.

Thus, Physics of the Alive gives the following definition of the Alive.

**The Alive is the fourth (after nuclear, atomic and molecular) level of quantum organization of the Nature, when self-consistent potential, providing the existence of the efficient long-range force, functions by the type of laser's potential in mm-range of electromagnetic waves.**

It's easy to see that such look on the Alive gives non-contradictory explanation not only of all phenomena, lying in the base of quantum medicine, but makes the science about the Alive a fundamental science with all followed consequences.

The Alive crucially distinguishes from the non-Alive (The Dead). But in addition it's created the methodological clarity in valuation of this distinction. The Alive has got the self-consistent potential. The Dead has not got one, though there may be no drastic difference on the molecular level. It is the same as with the water's molecule ( $H_2O$ ). We can study atoms of oxygen and hydrogen in detail but can say nothing about the water's molecule, because the water's molecule, formed up from two atoms of hydrogen and one atom of oxygen, possesses the quality new self-consistent potential with its own levels, with its own rules of forbidden for transitions between them and, in the end, with its own spectrum of characteristic eigenfrequencies, which is the universal passport of water's molecule.

Stated above notions of Physics of the Alive put the Alive on the hierarchical top of our knowledge of the Nature. It means that the approach to the problem of the life claims from the scientists of comprehension of all knowledge stored by the mankind. In this connection it looks naive the speculations connected with the deciphering of man's gene code. There asserts that knowing gene code we know everything about Man and can do everything: breed geniuses, grow up the people's organs into the animals and so on. The gene code indeed defines the heredity, but not on the primitive-mechanical levels but by the way of forming up the individual self-consistent potential, characteristic eigenfrequencies of which characterize the organism.

The fundamental science about the Alive is only beginning. The existent methodological canons claim the direct experimental confirmation of the main position of the hypothesis for its converting into the theory. On the 9 of December, 1997 we were succeeded in direct registration of non-equilibrium fraction of electromagnetic radiation of a human body just in mm-range. It was done owing to unique radiometric systems, created in the Scientific Research Centre of Quantum medicine "VIDHUK" (Kyiv, Ukraine). This non-equilibrium fraction of electromagnetic radiation of a human body was equal to  $(10^{-21} \div 10^{-20}) W/Hz$ . On this day the hypothesis about physics of the alive was converted into the scientific trend "Physics of the Alive" [7].

## ФІЗИКА ЖИВОГО — НОВИЙ НАПРЯМОК ФУНДАМЕНТАЛЬНОГО ПРИРОДОЗНАВСТВА

С.П. СІТЬКО

Сформувався новий напрямок фундаментального природознавства — фізика живого. В її основі лежить уявлення про живе як про четвертий рівень квантової організації природи (після ядерного, атомного і молекулярного), коли самоузгоджений потенціал, що забезпечує існування далекодійючих ефективних сил, функціонує по типу лазерного потенціалу в мм-діапазоні електромагнітних хвиль. Експериментальною основою фізики живого є: прямі виміри, величезний клінічний матеріал, аналіз десятилень західної і древньосхідної цивілізацій.



**ФИЗИКА ЖИВОГО — НОВОЕ НАПРАВЛЕНИЕ ФУНДАМЕНТАЛЬНОГО  
ЕСТЕСТВОЗНАНИЯ**

С.П. СИТЬКО

Сформировалось новое направление фундаментального естествознания — физика живого. В её основе лежит представление о живом как о четвёртом уровне квантовой организации природы (после ядерного, атомного и молекулярного), когда самосогласованный потенциал, обеспечивающий существование эффективных дальнедействующих сил, функционирует по типу лазерного потенциала в мм-диапазоне электромагнитных волн. Экспериментальной основой физики живого являются: прямые измерения, огромный клинический материал, анализ достижений западной и древневосточной цивилизаций.

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