Physics – Uspekhi **37** (10) 1041 – 1043 (1994)

ANNOUNCEMENT

PACS numbers: 01.10.Cr; 01.30.–y

A new physics journal

The advances made by modern life sciences are well known: the structure and functions of the majority of biomacromolecules have been described, the paths of synthesis of biological materials have been determined, the genetic code has been identified, and the mechanisms of elementary biological processes have been agreed. These successes have also been helped by achievements of modern physics and biology, particularly in spectroscopy, and in the physics of molecules and crystals. The ideas on living matter treated as a physical object have proved very fruitful and have become the basis of many successful biophysical models. For example, the concept of solitons — localised exciton – photon excitations in molecular chains — has been used to account for the mechanisms of energy transport in metabolic processes [1]. Theoretical calculations of the excitation energy of solitons in alpha-helical proteins [2] have shown good agreement with studies of Raman scattering spectra of live cells [3, 4].

Overall, the physics of the alive is about to make the next step in the understanding of living beings, even ahead of modern biophysics. Until now, physicists investigating (within the limits of their capabilities) a live organism have made no clear distinction between the physics of the alive and nonalive. Physics seems to seek out its interest in the existence of living organisms and to treat the subject by physical methods. This has made it possible to retain the universality of the physical laws, but has ignored the specific nature of life. Life has been treated as some deviation from the nonalive; for example, a strange stability of the thinnest cell membranes that can withstand high electrical potentials.

Among the stimuli for the development of *new ideas on the structure of functioning of living organisms* have been the results of investigations of the effects of millimetre electromagnetic radiation on biological objects. In 1968 a group of scientists at the Kharkov Institute of Radioelectronics of the Academy of Sciences of the Ukrainian SSR was awarded the Lenin Prize for the development of generators of millimetre radiation and soon after that the first thesis describing the work on the biological effects of millimetre waves was defended at the Kharkov State University [5]. S J Webb in Canada has been working independently on similar topics [6]. Investigations of these topics have continued in Russia [7], Germany [8], and elsewhere. In 1982 E A Andreev, M U Belyi, and S P Sit'ko at Kiev State University [9, 10] contesting the reports of unusual 'side effects' observed by Odessa doctors I S Cherkasov and S V Nedzvetskii [11], discovered the effect of resonant interaction of millimetre radiation on the human body. The new effect has opened up fundamentally new opportunities for medical diagnostics and therapy, and has become the starting point of a new scientific direction: *physics of the alive*. An Institute of the Physics of the Alive is now operating in Kiev at the Interdisciplinary Scientific – Engineering Centre 'Vidguk' ('Response'), which coordinates the work of the scientists in these and related fields.

Research at this Centre has demonstrated an important difference between the biological effects of millimetre radiation from other effects on living organisms, including the effects of electromagnetic fields with different wavelengths. Specifically, the following effects of millimetre radiation are observed:

Uspekhi Fizicheskikh Nauk **164** (10) 1127 – 1128 (1994)
Translated by A Tybulewicz

(1) *The very low level of power density of electromagnetic radiation producing complex* (biochemical, physiological, etc.) *reaction of an organism*. Highly reproducible biological effects can be observed at power density levels of 10^{-20} W cm^{-2} Hz^{-1}, i.e. not only below the thermal noise level, but even below the level of thermal radiation fluctuations.

(2) *The narrow-resonant nature of the interaction*. The effects appear at frequencies which are quite definite for each organism and they disappear when the detuning from the frequencies is only 0.1% – 0.01%.

(3) *The macroscopic distance between a region of an effective interaction and an ailing part of an organism*. It has been found that the regions of the optimal effect coincide with the acupuncture points, the majority of which are distributed along specific channels known as 'meridians'. As is known, there are no stable morphological features along 'meridians' or at the points themselves. What is happening is that the signal is transmitted over distances of tens of centimetres although the intensity of millimetre radiation is attenuated by a factor of 1000 in a 1 mm thick layer of biological tissue.

(4) *The unidirectional nature of the biological effects of electromagnetic radiation tending to restore a disturbed functional state and the fall of the effectiveness of the response reaction during therapy*. An organism with restored functions does not in practice react to electromagnetic radiation with the same parameters, which makes it possible to introduce the criterion of a 'healthy' organism.

A rethinking of conventional ideas on the physical nature of liv-ing organisms is possible only on the basis of the latest achievements in modern physics, including nonlinear electrodynamics, nonlinear thermodynamics, quantum field theory, synergetics, and physics of dissipative structures. Above all, the stress should be on the thermodynamically 'open' (nonequilibrium) and nonlinear nature of living systems. In systems of this kind a nonequilibrium phase transition may give rise to qualitatively new and dynamically stable spatiotemporal structures [12]. In view of the spatiotemporal ordering (coherence) of such structures [13 – 17], effective long-range forces may appear in them [18].

A theoretical approach in which a living organism is regarded as a hierarchy of dissipative structures, which appears and is self-maintained by self-organisation processes that ensure the global coherence of the living organism, allows us to treat it as the physics of the alive. Its subject is the phenomenon of life itself in its integrity and with its self-development. This does not mean that physics can account fully for this phenomenon and can replace all the other sciences of living organisms. However, if a living organism is integral, then this integrity not only manifests itself in but is also based on the physical aspect of the existence of life. Theoretical and experimental investigations of biophysics of complex systems and of physics of living organisms have shown that many problems, insoluble when tackled on the basis of short-lived chemical interactions, can be solved if the integrity of macroscopic mechanism is taken into account (see Refs [17 – 18]). Instead of considering such short-lived interactions, we can assume the existence of a self-consistent potential of an integral organism on the basis of the ideas of limit cycles, which are periodic in time, and of stable structures that appear in dissipative media, i.e. in open systems with active cell centres. This concept provides a natural explanation of the Chinese acupuncture meridians as the paths of propagation of travelling electromagnetic waves in the human body. *These meridians form an 'electromagnetic framework' of an organism,*

which is created by each of its cells and at the same time ensures its multifaceted differentiated stability.

Without going into details of the proposed concept, it should be stressed that the results of numerous experiments support its postulates. The fundamental ability of cells and subcell structures to participate in the formation of a unique electromagnetic field of an organism is supported by the discovery of the activity in the millimetre range (based on resonances in the spectra of the effects) of some 'prelife' forms: water [20], amino acids [21], DNA [22]. Resonant absorption bands of cells (see Ref. [3]) and cell membranes [23] have been detected in this range. Intrinsic narrow-band microwave radiation emitted by cells has been detected [24]. There are reports of direct experimental confirmation of the existence of macroscopic quantisation effects in living systems: at the moment of their division the cells exhibit the properties of a Josephson junction, i.e. a system of two superconductors separated by an insulator layer [25]. The Josephson behaviour of biological objects has been reported also by other researchers [26, 27].

The physics of the alive has been recognised in the world scientific community: there are annual conferences and symposia devoted to this subject. Beginning from this year, a new journal has begun to appear: ***Physics of the Alive (Biophysics and Beyond)***. It is a theoretical and practical scientific publication designed to provide information on the development of the physics of living organisms.

The main purpose of this journal is the publication of papers and reports demonstrating the trend to cross over from the traditional biophysics to the 'physics of the alive'. This crossover is based on combination of synergetic and quantum principles in a theoretical description of a living organism at all levels of its hierarchical organisation.

The journal is of interdisciplinary nature and is intended for specialists in theoretical physics, biophysics, biology, and medicine.

English is the preferred language of publication.

One volume with four issues per year is the intended periodicity.

The publisher of the journal is the Interdisciplinary Scientific–Engineering Centre on the Physics of the Alive and Microwave Resonance Therapy 'Vidguk' attached to the Cabinet Office of the Council of Ministers of Ukraine.

Subscriptions to the journal should be sent to:
Physics of the Alive,
ul. Vladimirskaya 61b, 252033 Kiev, Ukraine
Tel. +7 (044) 244-44-59, +7 (044) 227-11-26

The subscription for the 1994 volume of the journal in the territory of the Commonwealth of Independent States is the equivalent of 80 US dollars, including postage. The journal will not be sold as separate issues.

S P Sit'ko

References

1. Davydov A S *Solitony v Bioenergetike* (Solitons in Bioenergetics) (Kiev: Naukova Dumka, 1986)
2. Scott E ''Davydov solitons in alpha-helicals protein molecules'', in *Sovremennye Problemy Fiziki Tverdogo Tela i Biofiziki* (Modern Problems in Solid-State Physics and Biophysics) (Kiev: Naukova Dumka, 1982) p. 176
3. Webb S J ''Nonlinear phenomena in bioenergetics and oncology as seen in 25 years of research with millimeter microwaves and Raman spectroscopy'', in *Nonlinear Electrodynamics in Biological Systems* (New York: Plenum, 1984)
4. Artamonov V V, Lisitsa M P, Litvinov G S, et al. ''Raman scattering spectra of *E. coli B* bacteria in various metabolic states'' *Dokl. Akad. Nauk Ukr. SSR Ser. A* (9) 42 (1988)
5. Zalyubovskaya N P ''Estimates of the effects of millimetre and submillimetre microwaves on various biological objects'', Author's Abstract of Thesis for the Degree of Candidate of Biological Sciences (Kharkov, 1970)
6. Webb S J, Dodds D D ''Inhibition of bacterial cell growth by microwaves'' *Nature (London)* **218** 374 (1968)
7. Devyatkov N D ''Influence of millimetre electromagnetic radiation on biological objects'' *Usp. Fiz. Nauk* **110** 452 (1973) [*Sov. Phys. Usp.* **16** 568 (1974)]
8. ''Nonthermal effects of millimeter microwaves on yeast growth'' *Naturforschung* **15** 33 (1978)
9. Andreev E A, Belyi M U, Sit'ko S P ''Manifestation of intrinsic characteristic frequencies of the human organism'', Patent Application No. 32-OT-10609, 22 May 1982, Committee on Inventions and Discoveries of the USSR
10. Andreev E A, Belyi M U, Sit'ko S P ''Manifestation of intrinsic characteristic frequencies of the human organism'' *Dopov. Akad. Nauk Ukr. RSR Ser. B* (10) 56 (1984)
11. Cherkasov I S, Nedzvetskii S V ''Method for treating damaged biological tissues'', Author's Certificate No. 733 697 (1980)
12. Haken H *Synergetics: An Introduction* (Berlin: Springer, 1978)
13. Prigogine I *Time and Complexity in Physical Sciences* (San Francisco, CA: W H Freeman, 1980)
14. Sit'ko S P, Gizhko V V ''Towards a quantum physics of the living state'' *J. Biol. Phys.* **18** 1 (1991-
15. Sit'ko S P, Gizhko V V ''On the microwave coherent field of an organism and the nature of the Chinese meridians'' *Dopov. Akad. Nauk Ukr. RSR Ser. B* (8) 73 (1989)
16. Sit'ko S P, Andreyev E A, Dobronravova I S ''The whole as a result of self-organization'' *J. Biol. Phys.* **16** 71 (1988)
17. Sit'ko S P ''Physical meaning of Schrodinger formalism from the standpoint of quantum physics of the alive'' *Dopov. Akad. Nauk Ukrainy* (10) 98 (1993)
18. Frohlich H ''Theoretical physics and biology'', in *Biological Coherence and Response to External Stimuli* (Ed. H Frohlich) (New York: Springer, 1988)
19. Chinarov V A, Gaididei Y B, Kharkyanen V N, Sit'ko S P ''Ion pores in biological membranes as self-organized bistable systems'' *Phys. Rev. A* **46** 5232 (1992)
20. Andreev Ye A, Barabash J M, Zabolotny M A, Sologub V S ''Using spontaneous noise for rheological parameters determination of thin melting polymer films'', in *Fluctuation Phenomena in Physical Systems* (Vilnius: 1991) p. 212
21. Litvinov G S, et al. ''Effects of millimetre radiation on the infrared reflection spectrum of β-alanine single crystal'' *Biopolim. Kletka* **7** (3) 77 (1991)
22. Belyaev I Y, Alipov Y D, Shcheglov V S ''Chromosome DNA as a target of resonant interaction between *Escherichia coli* cells and low-intensity millimeter waves'' *Electro-Magnetobiol.* **11** (2) 97 (1992)
23. Blinowska K J, Lech W, Wittlin A ''Cell membrane as a possible site of Frohlich's coherent oscillations'' *Phys. Lett. A* **109** 124 (1985)
24. Bannikov V S, Vvedenskii O Yu, Ermak G P, et al. ''New highly efficient method for monitoring the functional state of biological objects'', in *Issledovaniya Vzaimodeistviya Elektromagnitnykh Voln Millimetrovogo i Submillimetrovogo Diapazonov s Biologicheskimi Ob'ektami* (Investigations of Interaction of Millimetre and Submillimetre Electromagnetic Waves with Biological Objects) (Kiev: Naukova Dumka, 1989) p. 15
25. Del Giudice E, Doglia A, Milani M, Smith C W, Vitiello G ''Magnetic flux quantization and Josephson behaviour in living systems'' *Phys. Scr.* **40** 786 (1989)
26. Aleksandrov A S, Arinitsev A D, Samedov V V ''Possible realisation of biological superconductivity'', Preprint No. 040 (Moscow: Institute of Engineering Physics, 1990)

27. Yakunov A V ''Spectroscopic approach to the problem of primary mechanism of the interaction of millimetre electromagnetic radiation with biological systems'', Author's Abstract of Thesis for the Degree of Candidate of Physicomathematical Sciences (Kiev, 1992)