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ON THE DYNAMICS OF SELF-ORGANIZATION IN LIVING ORGANISMS

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Running title: Dynamics of self-organization

Abstract

We show that in nonlinear systems the dynamical order can be reached through the flows of matter, energy and information, which can be non-uniformly spread over the organism due to self-trapping induced by the correlated coherence domains of interfacial water. Endogenous electromagnetic field is self-trapped in these domains and forms the dynamical pathways as wave-guides, along which these flows can occur via soliton mechanism. Solitons in the pathways can be stimulated either by intrinsic dynamics or by external stimuli and can be visualized in the infrared range as bright or dark solitons. The formation of such pathways is the consequence of coherence - noncoherence transitions occurring in the biological cycle of the organism. A rational therapy appears then to be the induction of conditions for soliton existence necessary for maintaining the coherence of the system.

Introduction

The living systems as open, dissipative non-linear systems are far from thermal equilibrium, and nevertheless they manifest structural and dynamic stability with the orderly functioning provided as a holistic property. Where this holistic property can arise from? The most probable origin can be related to the appearance of a coherent regime in matter, supplied by random metabolic energy (Froehlich, 1969,1986,1988). As it has been indicated by G. Hyland,

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the statement that "… an influx of energy can, after a sufficient interval of time, actually impose a **dynamical order** (rather than simply increasing the degree of disorder, as might be expected intuitively) is now a rather well-established, quite general feature of non-equilibrium systems, reflecting their "self-organizing" ability in the non-linear regime" (Hyland, 2002). Here we show that in that way the concept of electro-dynamical coherence (Preparata, 1995) gets correlated with the general dynamics of self-organization, as conceptualized by thermodynamics of irreversible processes (Prigogine, Nicolis, 1977; Tiezzi, 2002, 2005). This dynamical order can be reached through the flows of energy and information, which are non-uniformly spread over the organism forming the dynamical pathways as wave-guides in nonlinear optical systems. These pathways can be compared with the Eastern system of energy meridians, and can be visualized in the infrared range.

The meridian theory, formulated in East Asia and integrated with the acupuncture, is one of the prominent components of the traditional eastern medicine (Cheng, Deng, 2005). Recent development of the fundamental science, available experimental data and novel experimental set-ups stimulate the further research in this area within the conventional scientific methods, both experimental and theoretical.

In particular, it has been shown experimentally, that the acupuncture points on the human body differ by their electric conductivity properties from the surrounding matter (Overhof, 1960; Wang, Liu, 1985; Zhang, 1968; Popp, 2007). New medical treatments have been developed during the last two decades, which are based on the combination of the two medicines, so called western and eastern. For instance, microwave resonance therapy, when applied to the corresponding acupuncture points, turned out to be very powerful in treatment of numerous diseases (Wang, Liu, 1985; Grubnik, et al., 1998). Another novel method to study the state of the organism, known as the regulation technique, is described in (Popp, 2007) and is based on statistical analysis of the measured conductivity of the acupuncture points, located, in particular, on palms.

Several models, including atomic physiological and electro-magnetic field-based ones, have been suggested to explain the mechanisms of these diagnostics and treatment, though the deep understanding of the underlying processes and universally acceptable models are still missing. Here we suggest that self-organization of the living organism implies the appearance of an array of quasi-one-dimensional coherent domains that behave as the pathways where a flow of matter, energy and information is self-confined. This array is dynamically maintained and disappears when the organism dies so that it can not be detected in any investigation post-mortem. This array can be linked with functioning of energetic channels known as meridians in the Eastern medicine.

Observed Properties of Energy Pathways

The acupuncture points have distinctive electrical and optical properties matter (Overhof, 1960; Wang, Liu, 1985; Zhang, 1968; Popp, 2007) and are widely used in various complementary medicine schemes as the points of the body where the external stimuli are delivered. According to the eastern medicine, these points are linked with the system of energetic channels, known as meridians. Recently it has been reported by various groups of researchers, that such meridians can be visualized on the human body by various techniques (Wu, et al., 1996; Schlebusch, et al., 2005; Popp, et al. 2006; Brizhik, 2008; Maric-Oehler, 2008). The meridians can be compared with electrical transmission lines (Reihmannis, et al., 1976; Tiller, 1987), and can be visualized, for instance, by means of IR camera in the range 3.4 to 5 μm (Popp, et al., 2006). The appearance of these IR patterns is investigated either by an external stimulation of the body (moxibustion, i.e., stimulation by a herbal cigar, acupuncture technique, etc) or by a simple recording of a physiological activity, going on during some therapeutic, physical or psychic, treatment. This array plays a similar role to the cytoskeleton in a biological cell.

The accumulated experimental data show that unhealthy patients have very non-homogenous radiation distribution, which can be measured in absolute units or in terms of “effective temperature”, over their body. The patterns of the distribution of the nonequilibrium radiation, observed with the IR camera, sometimes produce elongated meridian-like areas of the excess or deficiency radiation, equivalent to the difference of the “temperature” up to 10 centigrades. Such patterns can be stimulated by external stimuli or by psychic influence. According to the experimental data (Popp, et al., 2006), there is a real excess of the radiation above the conventional reflection from the body. And namely this excess of the radiation excited by special conditions, can constitute manifestation of the meridians. In some other cases, in particular, in the case of chronic diseases, the patterns show the areas of much lower intensity (“temperature”), which can be interpreted as the blockade of the energy distribution in the body. Some of characteristic patterns of the two types are shown in Figs.1-2. Should the measurement show the presence of “warmer” zones only, one could suspect that the phenomenon could be traced back to the reflection of the light from the body. However, this simultaneous existence of “warmer” and “cooler” zones shows that the phenomenon is more complicated than mere reflection. In many cases the formation of the pattern occurs quite far from the area where the stimuli are delivered. This not only diminishes the reflection and thermal inputs into the pattern formation, but also reflects the non-thermal non-local feature of the living dynamics. One of such cases is shown in Fig. 1(b): the moxibustion stimulus was located some distance from the feet; while the bilateral “spleen channel” was excited on the legs and the feet showed the significant deficiency of the radiation. Moreover, the experiments were also performed when the organism was excited by non-thermal stimuli, like, for instance, by using needles or psychic influence (Popp, et al., 2006). These non-homogenous quasi-one-dimensional patterns of non-equilibrium radiation can last for a few minutes and more. The patterns are dynamical and vary with time during the session, as, for instance, it can be seen comparing Fig. 2a and Fig.2b. This shows that IR imaging can be used also to control objectively the effectiveness of the particular treatment. This control is fast and can be carried during the very treatment.

Taking into account the fact that these patterns are visible in the IR range, have a relatively large life-time and can be excited only by special conditions, it has been suggested in (Popp et al., 2006; Brizhik et al., 2008) that such meridians are the optical pathways for the propagation of the corresponding electronic excitation in the body similar to optical waveguides along which electromagnetic pulses are propagated in the form of solitons. Recall, the general term ‘soliton’ means a solution of the nonlinear wave-type equation(s) in the form of the nonlinear localized solitary wave which propagates with a constant (in average) velocity without energy dissipation and does not spread during its propagation (Davydov, 1985). For the first time the concept of solitons used regarding biological systems, was the explanation of the energy transfer in macromolecules (Davydov, Kislukha, 1973; Davydov, 1985). Later on this concept explained the mechanism for muscle contraction (Davydov, 1985), charge transport during oxidation (Brizhik, Davydov, 1984), unwinding of DNA (Dauxois, Peyrard, 2006), proton transport in water chains (Antonchenko, et al., 1983), etc. (for reviews see (Scott, 1992; Brizhik, 2003; Dauxois, Peyrard, 2006).

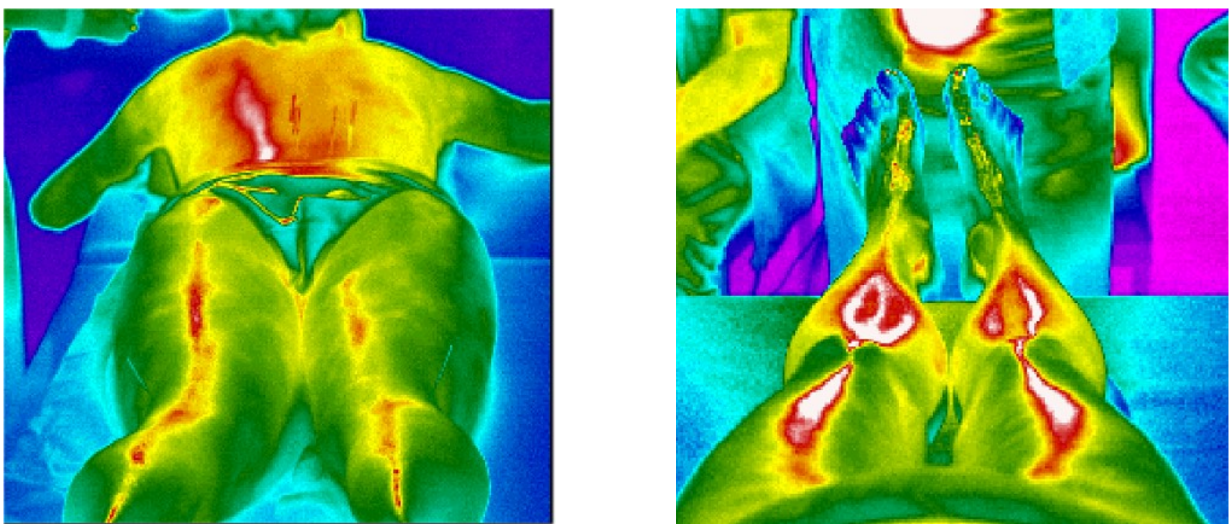

Fig.1. (a) Parts of bladder meridian bilateral stimulated by moxibustion, and (b) parts of spleen meridian bilateral stimulated by moxibustion.

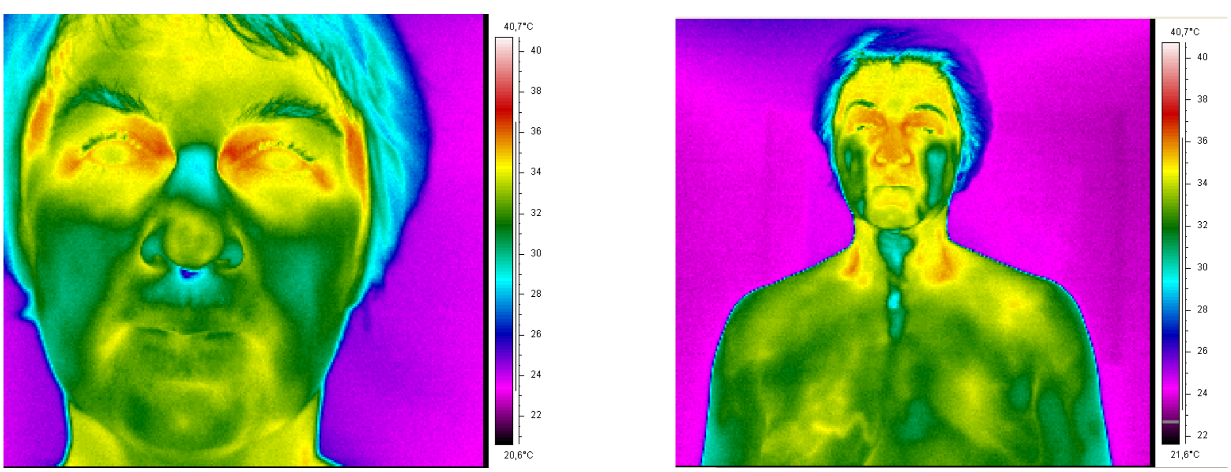

Fig.2. (a) The IR pattern of the patient before psychic session and (b) stomach meridian and conception vessel after the psychic intervention.

Where such excess or deficiency radiation can come from? It has been shown in (Brizhik, Eremko, 2003), that charged solitons in macromolecular systems (proteins, DNA) emit electromagnetic radiation of characteristic frequencies (corresponding to wavelength up to several millimeters) and that by its properties this radiation can be described as the radiation emitted by the system of coherent dipoles. Thus, the soliton concept supports the hypothesis of H. Froehlich (Froehlich, 1986) about the existence and role of the coherent electromagnetic field in living matter, later on supported by experimental measurements of such a field (Pohl, 1980; Pokorny, et al., 2001; 2005; Kucera, 2006; Jellinek et al., 2007). It is known, that in nonlinear media, for instance, in nonlinear optical crystals, in liquid crystals, etc., electromagnetic field can be self-focused and propagate in the form of solitons (Zakharov, Shabat, 1971). This phenomenon is widely used now in modern technologies (Dauxois, Peyrard, 2006). In its turn, it has been suggested that living matter can be also described as a meso-phase liquid crystal (Kreis, Boesch, 1994; Ho, et al., 2006), in which liquid crystalline collagen fibres of the connective tissues play very essential role (Ho, Knight, 2001). It is worth to mention that biological macromolecules are widely used in molecular electronics, and are expected to improve drastically information nanotechnologies. No wonder, their nonlinear properties play fundamental role in living matter. Moreover, water in biological systems plays as a very essential component of cells, is highly structured around the macromolecules in the interfacial state. According to (Del Giudice, et al., 1988; 2006), water forms coherence domains that contain macroscopic amount of almost free electrons, available for the biochemical reactions in a cell and contributing to the general coherence of the system. High level of macromolecular organization leads to the appearance of collective processes, as it has been shown in (Brizhik, et al., 2008), similar to the appearance of crystal energy bands due to their structures in solid state physics, formation of excitons, etc. In their turn, the collective electron processes under certain conditions lead to the development of spontaneous coherence (Froehlich, 1986) which produces mesoscopic units. One of the components of the biological coherence can be electromagnetic radiation of charged solitons (Brizhik, Davydov, 1984), as it has been mentioned above (Brizhik, Eremko, 2003). Another one can originate from the water structures (Del Giudice, et al., 1988, 2006; Arani, et al., 1995).

Therefore, here we develop further the model, suggested in (Brizhik, et al., 2008), according to which a human body can be described as a nonlinear liquid medium, similar to a liquid crystal, in which various pathways can be formed for the propagation of the electromagnetic signals. These pathways, obviously, have a very specific structure, formed by the interplay of spatial distribution of the nonlinearity properties and boundary conditions, and can play the role of meridians. Moreover, in the area close to the skin, they possess some special nodes like acupuncture points. One can imagine, that in such a complex system there are also more general nodes belonging to and responsible for the whole organism, instead of individual pathways.

Dynamics of Self-Organization in the Alive

One of the main problems of the physics of the alive is to justify the global approach starting from the molecular level. In a living organism molecules are not independent objects, interacting in a random way according to diffusive motions. On the contrary, they perform in a highly correlated way and their encounters are not at all random, but obey to "organic codes" (Barbieri, 2004), that prescribe what are the molecular partners of each encounter and where and when the encounter should occur. Thus, biomolecules are governed by a complex array of long-range signals that, according to the list of physical agents known so far, could be the electromagnetic field only. Moreover, the pattern of the electromagnetic signals should be able to adjust itself to the changes occurring in the molecule organization. A close interplay between molecular organization and electromagnetic field structure appears a necessary condition for making the living process possible. According to (Del Giudice, et al., 1988, 2006; Arani, et al., 1995), a fundamental role should be played by water that accounts for the large majority (70 % in weight, 99 % in molar weight) of the living organisms. In a pure water, according to (Arani, et al., 1995; Preparata, 1995), at the density of molecules exceeding some critical value and temperature lower of some threshold, the minimum energy state corresponds not to the gas phase state of the ensemble of water molecules, in which molecules are independent, but to the coherent state, where water molecules and electromagnetic field are simultaneously present. This coherent state has energy lower than the noncoherent state, and the transition from a coherent to a noncoherent state is possible by providing the energy, necessary to overcome the energy gap.

In the coherent state all molecules oscillate in unison between the two configurations where (i) all electrons are tightly bound within the molecule by an ionization potential of 12.60 eV, and (ii) excited state with the energy E_{ex}=12.06 eV, just 0.54 eV below the ionization potential, when one electron is quasi-free. The collective oscillations of molecules occur in tune with the electromagnetic mode having the wavelength $\lambda=hc/E_{ex}$=0.1 µm and a frequency $\nu_r< \nu=c/\lambda$. The renormalization of frequency is spontaneously produced by the dynamics and allows the field to resonate with the molecules. As a consequence, according to the general principle of quantum field theory, the photons acquire negative squared mass, $m^2 = h^2(\nu_r^2- c^2/ \lambda^2)/c^4< h^2(\nu^2- c^2/ \lambda^2)/c^4=0$, that makes them unable to propagate and traps them in the "coherence domain" (CD) having the size of λ. In particular, in the case of water, $h\nu_r$=0.26 eV.

At nonvanishing temperature, T, thermal fluctuations couple with the electromagnetic fluctuations, and as a result, the system oscillates between the states, when molecules are put in tune by electromagnetic coherent attraction, and out of tune by thermal collisions. Therefore, at each time moment there is a certain number of coherent and noncoherent molecules, or, equivalently, coherent and noncoherent fractions, $F_C(T)$ and $F_{NC}(T) =1- F_C(T)$, of molecules, respectively (comp. with the Landau model of superfluidity of liquid helium). At interfaces coherent water could get stabilized in the vicinity of the hydrophilic surfaces. In particular, around macromolecules water is almost coherent and shows the peculiar properties (Voeikov, 2003; Voeikov, 2007; Antonchenko et al., 1983; Ling, 2003; Zheng, Pollack, 2003). In the case of quasi-linear molecules made up of electric dipoles, water molecules get aligned (Del Giudice, et al., 2006) and can oscillate in the longitudinal direction, so that CDs become quasi-one-dimensional and form a coherent surrounding around the macromolecular chain, able to trap and self-focus electromagnetic field. In our view namely this is the mechanism which supports the hypothesis on possibility of the self-focusing of electromagnetic field in crystalline structures of collagen (Ho, Knight, 2001).

The ensemble of quasi-free electrons, present in each CD of water, can be excited by externally supplied energy, producing electron vortices, that are “cold” since electrons are in a coherent state. Thus, the excitation energy of vortices cannot be released neither thermally, nor electromagnetically (in the latter case because photons are trapped within CDs and cannot get out). These vortices should then last as long, as CDs last. Under further excitation the vortices increase their energy, giving rise to the storage of energy up to the level of ionization. A pivotal role is played by external magnetic field that aligns the vortices, that, being made up of electrons, give rise to vortex magnetic moments. The CD of water becomes a machine able to collect the energy of the noise from the surrounding, and transform it through its inner coherence into the energy, able to produce electron excitations. Since CD is able to collect also small quanta of energy: a single excitation can be as small, as 10 kHz, according to (Del Giudice, 2006), the energy spectrum of the collected excitations is quasi-continuous and almost flat, according to thermodynamics and principle of the maximum of entropy (see (Popp, 2002), in particular, the section “Thermodynamics of the biophoton field”). The field, produced by this stored energy, could be connected with the biophoton field (Popp, 1998: Popp, et al., 2002).

Water coherence domains can coopt a small number of “guest” molecules (different than water), provided that they are able to resonate with the frequency of the CD, ν_r. This number can not be too large, since the difference between their radiative transition dipoles and the water radiative dipoles would disrupt the coherence of the electromagnetic field. Conceivably a small number of “guest” molecules is unable to do that, so they can be admitted into as coherent partners in the CD with a well defined phase relationship. In this way they become co-owners of the energy stored in the CD. When this energy matches the chemical activation energy of the coherent array of “guest” molecules, it gets transferred in a one stroke to them (in a CD correlations are kept at the phase velocity that can exceed the velocity of light, (Del Giudice, Vitiello, 2006)) and the CD is able to discharge, similar to a multi-mode laser. The array of the chemical reactions allowed by the above scheme, produces a chemical output energy, that, in principle, shifts the balance of energy and can destroy the coherence. In order to restore the coherence, the system should get rid of this excess energy. If the transmission of energy occurs via linear mechanisms, then it is spent to excite thermal vibrations and cannot be used on biological purpose. On the contrary, if this excess energy occurs via nonlinear mechanism, as it is in the case of solitons (Davydov, 1985), then it does not dissipate in the environment, instead it is propagated in the form of a soliton as a localized stable wave package to the place where it can be utilized to perform the biological need.

The formation and stability of solitons depend on the initial condition and on the physical parameters of the system. For instance, in the case of Davydov's solitons in macromolecular systems, the corresponding parameters are the electron-phonon coupling, the exchange interaction energy and elasticity of the macromolecule due to the hydrogen bonds. Of these three parameters one can get two dimensionless parameters, which usually are the dimesionless coupling constant and nonadiabaticity parameter. Depending on the value of each of this parameter, the ground state of an electron (or molecular excitation, vibrational excitation, etc.,) can be either a small polaron, or almost free electron, or soliton state. Therefore, one can plot the "phase diagram of the ground electron state", which shows which state of an electron corresponds to the minimum energy of the system (Brizhik, Eremko, 2000). It turns out, that the soliton regime corresponds to the intermediate values of the coupling and nonadiabaticity parameters, and is realized as the crossover from the small polaron regime to the almost free electron state regime. The physical properties of the system in each of these regimes are drastically different. For instance, the transport properties in the small polaron regime are determined by the hopping mechanism, which depends on the non-equilibrium parameters and is very sensitive to the non-homogenities in the system (aperiodicity, inclusions of other molecules, etc). In the case of the almost free electron state the propagation of energy is possible only by forming wave packages, which spread out in time and emit phonons (elementary excitations of lattice vibrations), and therefore, loose the energy in a dissipative way. The most effective regime is the soliton one, in which dispersion of the wave package is compensated by the nonlinearity of the system.

Therefore, under the changes of the values of the physical parameters of the system, which can be described as some pathology, or inclusions of some "foreign" molecules, etc, the system can undergo transition from one ground state regime to the other one, which, according to the above, affects the energy storage and transfer properties. On the initial stage of such abnormality, the system can synchronize itself via the self-synchronizing mechanism, or upon application of the external stimuli. For instance, by applying the pressure (Brizhik, 1995), moxibustion, weak electromagnetic resonant radiation in the microwave therapy, etc., which change the parameters of the system that undergoes the transition to the soliton ground state regime. In the case of the extreme pathology or chronic disease the changes can attain very big relaxation time or even can become irreversible which makes treatment less effective and more difficult. Solitons propagate with the velocity, determined by the initial conditions (this velocity is lower than the velocity of the sound), without any significant loss of energy. At the terminal end of the system this energy can be utilized to perform the biological task. Moreover, during the propagation, charged solitons emit electromagnetic radiation, whose main harmonic is determined by their velocity. Via the exchange by this radiation solitons synchronize their velocity, and, as a result, the frequency of the emitted electromagnetic radiation, which leads to the “antenna” effect. The radiation of electrosolitons is of the dipole-type and contributes to the total electromagnetic field in the system (Brizhik, Eremko, 2003).

The interplay between chemistry and electromagnetic field produces a collective oscillation of all the CDs, that, according to the general theorem of quantum electrodynamic coherence, gives rise to an extended coherence, where the CDs of water and “guest” molecules become the components of much more extended “superdomains”, that could just be the various organs. This oscillating system is able to transform a noncoherent ambient energy into the energy, able to get organized according to the non-linear dynamics of self-organization of the living system. In this way the superdomain is a candidate to be the dissipative structure (Del Giudice et al., 2008), as described by (Prigogine, 1977), (Froehlich 1969, 1986), (Tiezzi, 2002; 2005). Therefore, the biological organism goes across a set of local minimum energy states, and in each cycle there are two steps (Del Giudice, et al., 1982): (i) a step of the extended coherence, where the system accumulates energy and “guest” molecules and transforms them in a coherent array where it produces chemically an output of energy and new molecules that break the coherence of the state; and (ii) a step, where the system tries to recover a new coherence by getting rid of the excess energy. Here the possibility of pathology emerges. The release of energy by formation and propagation of solitons could be made impossible due to appearance of high energy “barriers”, able to trap or destroy solitons in a resonant way. On this stage the energy gets stuck which prevents the recovering of the coherence. Thus, an external intervention is needed to remove the barriers or to restore the conditions necessary for soliton existence and stability.

The coupling of the quasi-one-dimensional CDs formed by the water shells, surrounding long macromolecular chains present in the connecting tissues (e.g., collagen fibres) produces long pathways, whose array might be the meridian-like system. This array evolves with time according to the evolution of the coherent structure, i.e., according to the metabolic activity of the system, as it is confirmed by the time dependence of the frequency and amplitude of the field in yeast cells (Pelling, 2005). Via the interaction between the coherence domains, joined by Josephson-type junctions, the coherence on a bigger scale can be attained as a coherence of the coherence domains. Thus, the whole organism is a quantum system with the multi-well energy profile. The lowest energy (ground) state corresponds to the healthy state of the organism. In the stable healthy state the system functions in the optimal balanced way without any excess or lack of the energy in the energetic channels, since it corresponds to the ground energy state of the whole organism. In the case, some disease or pathology has developed in the organism, the system is in one of the higher lying meta-stable states which is separated by the potential barrier from the lowest energy ground (healthy) state. Therefore, in the metastable state the excess energy is accumulated in the system that cannot be released because of the violation of the dissipative structures of the system. To transit to the ground state, this extra energy has to be released out, for instance, in the form of the fever. In other cases this excess of energy can be released via stimulating the energetic pathways (meridians). In particular, observing the excess radiation (in the form of the patterns) with the IR camera means that there is an extra energy which dissipates outward. To overcome the barrier and to allow the system to transit to the ground state, one has either to excite such a system by supplying necessary amount of energy, or by recovering the coherence of the system via some resonant mechanism. In a nonlinear system this energy has to be delivered in a specific way: it is known that solitons can be excited by special initial conditions only, and are sensitive to the external effects under resonant conditions. For the efficient excitation of solitons these initial conditions should be supplied not far from the terminal points of the molecular system, to minimize the energy necessary for creation of the corresponding deformation of the system. In particular, they can be excited by some special procedures like moxibustion, acupuncture treatment, microwave resonance radiation, etc, supplied to the nodes of the energetic channels. This treatments provide locally specific initial conditions which can launch excitations in the form of solitons that can either supply extra energy or remove the excess energy (so called bright and dark solitons, that correspond to bright and dark meridians, respectively). These solitons propagating along the energetic channels, clear-up “energetic pipes”, restore the coherence between the coherence domains and allow the energy to flow freely. The initial stage of initiation of solitons and their storage and/or propagation along the meridians is manifested in the IR patterns. This mechanism explains also why it is much more difficult to excite such patterns in healthy patients, than in ill patients. It also explains in a self-consistent manner the mechanisms of the microwave resonance therapy, acupuncture therapy and other non-conventinal treatments. Moreover, within the given frame it becomes clear why such treatments are efficient when applied to special points of the body. Also it is clear, why these treatments show the best results when the corresponding influence is applied not directly to the problematic zones, but to a distant ones, which are “healthier”, and, therefore, possess the ability to be synchronized upon the external excitation to the corresponding eigen-frequency and launch the process of “self-healing” via reconstruction of the extended coherence. This nonlocality is a general property of the living system and is also manifested in the soliton radiation (Brizhik, Eremko, 2003) and the biophoton emission (Del Giudice, et al., 1982; Cohen, Popp, 1997; Popp, 2002).

Conclusions

The examination of big number (several tens of thousands) of IR pictures allows to conclude that the non-homogenous radiation distribution patterns (characteristic emission zones) correlate with the health state. In the theoretical framework outlined in the present paper, the appearance of these patterns visible in the infrared (3.4 - 5μm), is the consequence of coherence - noncoherence transitions occurring in the biological cycle of the organism**.** It is dependent on the source of constructive and destructive interference of endogenous coherent electromagnetic field (Popp, 2002). Vanishing of the IR patterns manifests optimum destructive interference as manifestation of the optimum dynamical balance of the matter and field. In a pathological state coherence - noncoherence transitions are obstructed by some barriers in the energy and information pathways. A rational therapy appears then to be the stimulation of solitons able to clean the pathways and recover the coherence of the system. This stimulation can be achieved by several methods, e.g., local mechanical pressure, microwave radiation, local heating, etc. Such stimulation is the most effective provided it is supplied to the nodes in the energy pathways, which correspond to the acupuncture points. In the healthy state such stimulation is useless, because solitons are formed spontaneously during the "normal" metabolism and without any jamming of energy, so that healthy organism is "transparent" to such external stimuli. The outlined scheme allows distinguishing between the acute and chronic diseases. In the acute case the excess energy is released through the suitable channels, but if the excess energy release overcomes some critical amount, it can cause transition of the system to a chaotic state with the following decay of the system itself. In the chronic case the energy gets stuck within the corresponding area and produces a reorganization of the coherent regions on smaller scale, that reduces the efficiency of the organism**.** In the extreme case the changes in the coherence – noncoherence transitions can be so strong that they become irreversible, which results in the break of the self-regulated balance between matter and field and, finally, death of the system itself. The very fact that the type and extent of the IR patterns is always indicative for the physiological and psychological state, and that these patterns can be visualizied within no time delay, makes IR imaging a promising tool not only for diagnostics, but also for the control of the effectiveness of a particular treatment.

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