



PERSPECTIVES

# Light as a Trigger and a Probe of the Internal Dynamics of Living Organisms

Rajendra Bajpai<sup>1,2</sup>, Larissa Brizhik<sup>1,3\*</sup>, Emilio Del Giudice<sup>1,4</sup>,  
Filomena Finelli<sup>5</sup>, Fritz-Albert Popp<sup>1</sup>, Klaus-Peter Schlebusch<sup>6</sup>

<sup>1</sup>International Institute of Biophysics, Neuss, Germany

<sup>2</sup>Sophisticated Analytical Instrument Facility, North Eastern Hill University, Shillong, India

<sup>3</sup>Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

<sup>4</sup>Istituto Nazionale Fisica Nucleare, Milano, Italy

<sup>5</sup>Centro Bluegreen, Cantù, Italy

<sup>6</sup>ZDN Gesellschaft zur Dokumentation für Naturheilverfahren mbH, Essen, Germany

Received: Sep 9, 2010  
Accepted: Oct 14, 2010

**KEY WORDS:**

acupuncture points;  
coherence;  
coherence domain;  
electromagnetic field;  
light-based therapy;  
meridians

**Abstract**

It has been reported that the colors perceived behind closed eyes provide an indication of the psychophysical state of a subject. We discuss this phenomenon in the light of recently developed approaches to living organisms, based on the interplay between matter organization, biochemistry and electrodynamics.

*“When there is no energy, there is no color, no shape, no life.”*  
Caravaggio (1571–1610)

## 1. Introduction

Tests and therapies based on color and light perception have been developed during the last few decades. In the 1980s, a psychological test was suggested by the Swiss psychotherapist Max Lüscher [1–3] and this is widely known now as Lüscher-Color-Diagnostic. In this test, patients are invited to choose color preferences from a given selection and the choice is then used as a probe of psychophysical state, showing psychosomatic and emotional condition and how patient feels about themselves. This method is based on the hypothesis that the color

selections, being guided by the unconscious, reveal the person as he/she really is, not only how he/she perceives himself/herself or would like to be perceived [4]. This method uncovers the cause of psychological stress, which can lead to physical symptoms, and measures the ability to withstand stress, perform, and communicate. The selections from among 5015 test colors allow measurement of the state of 34 personality traits, some of which lie outside the realm of consciousness. The color choice apparently varies as psychological and individual situation changes and the Lüscher-Color-Diagnostic results contain indications pertaining to

\*Corresponding author. Department of Nonlinear Condensed Matter Physics, Bogolyubov Institute for Theoretical Physics, Metrologichna Street, 14-b 03680 Kiev, Ukraine.  
E-mail: brizhik@bitp.kiev.ua

personal assessment and influence professional recommendations as how to avoid psychological stress, thus preventing the possible resulting physical symptoms. The method is widely used in modern medicine not only by psychologists and doctors [5–7], but also by government agencies and universities to screen candidates, and corresponding software has been developed [8]. Other methods, known as phototherapy and chromotherapeutics, have been developed [9]. Some doctors use gemstones of certain colors or aura soma bottles. Colors are used in Tibetan medicine in various ways, in particular in mental focusing on a chakra and visualizing a color or in a breathing technique including color visualization for cleaning energy channels. The healing effects of colors are used in Ayurveda, according to which the basic colors of the rainbow are related to body tissues and constitution.

A novel method of dynamical color diagnosis has been developed recently by a member of this group [10]; it is based on individual observations and information collected from patients over several years. This phenomenological method suggests a treatment based on the dynamics of the colors perceived by the patient after closing his/her eyes. The method stipulates that the inability of the patient to see a color with closed eyes is a manifestation of a certain disease or pathology. The mechanism of this diagnostic technique and its related treatment, as well as the mechanisms behind the Lüscher-Color-Diagnostic, chromotherapy, and similar methods has not been understood to date. Here, we suggest that these mechanisms can be linked with the functioning of energetic channels formed as waveguides for the endogenous electromagnetic fields in a living system.

## 2. Description of the Model

In this section, we briefly describe the method. After a few minutes of relaxation with open eyes in not too bright surroundings, the subject is asked to close his/her eyes and to follow the time evolution of colors possibly appearing in their closed eyes over several minutes. Short or early time color manifestations coming from direct excitation by external source(s) are discarded. It is observed that the long range evolution of colors always follows the gradual change from red to violet. After a while, the picture evolves to a certain dominating color. In the case of a healthy patient, the picture evolves to blue (violet), while this sequence of colors stops at some color for a patient who has a disease or disorder. For instance, patients with severe depression cannot visualize any color at all; they see black only with closed eyes. Severe depressions are often described as having a potential degeneracy in a patient having

a lack of coherence. The color at which the evolution stops indicates the problematic biochemical/physiological level of activity. For instance, patients with stomach problems see only up to the yellow color. This technique allows not only diagnosis, but can also be used as a treatment. It has been shown that regularly repeating observations of color evolution after a few minutes' observation of a not very bright light (in the best case, natural sunlight at dawn or sunset), patients can see, with time, more colors with shorter wavelength (toward violet) and can improve their health. This plan also offers additional information for verbal and homeopathic therapy, as well as can be used to check how successful the treatment by this or another method has been. Such treatment has a very important advantage—it provides an immediate feedback because it can be controlled by the ability to see colors. It is essentially a noninvasive and self-regulated (self-consistent) technique, which does not lead to any complications and, as it does not imply any technical equipment, it can be used by anyone able to relax their emotional resistance and skepticism.

In the Lüscher-Color-Diagnostic, the subject is asked to choose a color instantly. We think that the subject makes this choice according to the color he/she visualizes subconsciously. This could be the connection between this method and the model described above. The mechanisms of color-based diagnosis and treatment are not yet known and, here, we suggest that these methods could be linked with the functioning of energetic “channels” of a living system, which could be compared, possibly, with the meridians of Chinese and Japanese medicine.

Living organisms in general, and human beings in particular, have been regarded thus far in at least two different ways. One is based on a molecular approach, according to which living matter is split into its component molecules, whose properties are thoroughly investigated by biologists, microbiologists, and biochemists. The other is a holistic approach which considers life as a global coherent phenomenon indicated by agents such as the chi (*Qi*), the prana, the vital force, and the functioning of meridian channels [11]. Correspondingly, Western and Eastern medicines have been developed, and both have achieved significant success in the treatment of many diseases. Unfortunately, a huge gap still exists between the two approaches but, nevertheless, because of recent successes in the fundamental sciences and experimental techniques, new medical treatments have been developed which are based on combinations of the two medicines. New developments include microwave resonance therapy, in which ultraweak microwave radiation is delivered to the certain set of acupuncture points [12]; regulatory technique, based on measurement

of acupuncture point electroconductivities [13]; and color based techniques, described above [1–3,9,10]. These developments indicate that these two medical approaches in describing living systems appear to be gradually merging.

One of the essential elements of Eastern medicine is the notion of meridians and, tightly integrated with meridians, a system of acupuncture points and chakras. It has been shown experimentally that the acupuncture points on the human body differ from the surrounding matter by their electroconductive properties [14–16]. Although the meridians and their acupuncture points and chakras have no permanent morphological structure, and, possibly, they have none at all, acupuncture points have distinctive electrical and optical properties [15–17]. There are some indications that the electrical and optical properties of meridians are also different from the surrounding tissues, and that meridians can, to a certain extent, be compared with electrical transmission lines [16–17]. Notably, under certain conditions quasi-stable elongated patterns of excess or deficiency of radiation from the body can be visualized by means of an infrared camera in the range of 1.4–5  $\mu\text{m}$  [18]. It has been suggested that such elongated patterns are manifestations of optical pathways for the propagation of electronic excitation in the body similar to optical waveguides along which electromagnetic pulses propagate as solitons [19,20]; the general term “soliton” means a nonlinear, localized, solitary wave which propagates at a relatively constant velocity without energy dissipation and does not spread out during propagation, unlike conventional linear waves [21]. It is currently generally accepted that solitons play an important role in biological systems; in particular, they transfer energy along macromolecules [22], are responsible for muscle contraction [23], transport charges during oxidation processes [24], and participate in intercellular communication [23,25–26].

It has been shown that charged solitons propagating along macromolecules, such as proteins and DNA, emit electromagnetic radiation of characteristic frequencies (up to millimeter wavelengths) [27]. Thus this radiation forms an ensemble of electro-solitons that can be characterized as the radiation emitted by a system of coherent dipoles, which agrees with the hypothesis of Fröhlich regarding the existence and role of coherent electromagnetic fields in living matter [28]. This hypothesis is supported by recent experimental measurements of this kind of field [29,30]. It is known, that in nonlinear media, such as nonlinear optical crystals and liquid crystals, an electromagnetic field can be self-focused and propagate in the form of solitons [31]. This phenomenon is now widely utilized in modern technologies [21]. In turn, as the concept has developed,

living matter can now also be described as a mesophase liquid crystal [32,33], in which liquid crystalline collagen fibers of connective tissues play an essential role [34]; the fibers can support the existence of solitons as well [35]. Finally, water is one of the essential components of living matter, constituting up to 70% in mass (almost 99% by molar ratio) of the human body, is in the interfacial state [36], and is highly structured, due to the presence of macromolecules and membranes and can also support solitons.

According to a quantum-field theoretical approach [37–42], liquid water is not made up of independent molecules, but includes large assemblies known as coherence domains (CDs) of molecules, kept phase-correlated by electromagnetic coupling. Within a CD, molecules oscillate in unison between their individual ground state, where all electrons are tightly bound, and an excited state, where one electron is almost free, and this oscillation is in tune with the oscillation of a self-trapped electromagnetic field whose wavelength is the size of the CD. The excited state is found 12.06 eV above the ground state, giving rise to a wavelength of 0.1  $\mu\text{m}$ , the actual size of the CD; the oscillation's excited state lies just below the ionization threshold of the water molecule, which is 12.60 eV. The superposition of the two states in the coherent state occurs with the weight 0.87 for the ground state and 0.13 for the excited state, which means that, in each CD, the number of quasi-free electrons is 13% of the molecules [38]. At the normal density of liquid water, a CD includes about  $6 \times 10^6$  molecules and, correspondingly,  $8 \times 10^5$  quasi-free electrons.

In bulk water, these coherent dynamics are counteracted by thermal collisions that place some molecules out of tune. Consequently, as in the Landau model of superfluid liquid, He, at each specific temperature molecules split into coherent and non-coherent fractions. The noncoherent fraction, made up of the molecules out of tune, fills the interstices between the CDs. Molecules move continuously between the two fractions, such that the total number of coherent molecules is constant, but the spatial structure of the CDs changes continuously over time. Every experiment having a resolution time longer than the life-time of these spatial structures probes water as a homogeneous liquid, whereas water's two-phase structure could be revealed in experiments having a relatively short resolution time. A recent experiment [43] using a fast probe has detected an inhomogeneous structure of water based on aggregates much larger than predicted by the conventional calculations [44]. Near an interface of two CDs, the attraction between water molecules and the coherent “wall” shields molecules from the effect of thermal collisions between them. Interfacial water is then permanently

coherent, and, therefore, can exhibit the long-range consequences of coherence. In a biological organism, no water molecule is farther from a surface than a few hundred Angstroms, such that all water in a living organism is interfacial and, therefore, coherent. For a long time, it has been well-known that the physical properties of water at interfaces are quite different than those in bulk water [45].

When, as in living organisms, water CDs become stabilized, important consequences arise from the presence of a reservoir of quasi-free electrons. First, it is possible for quantum tunneling or small external excitations to yield electrons available to perform redox reactions. Second, it is possible to excite a CD via external energy sources, producing coherent excitations of the ensemble of quasi-free electrons that could be viewed as vortices. In order to have a coherent excitation, the excitation energy should be smaller than the energy gap. No individual constituent of a coherent ensemble can accept energy smaller than the energy gap. Consequently, such excitations could be accepted only by the coherent system as a whole. Moreover, the vortices are "cold", because their coherence prevents collisions and, thus do not exhibit internal friction induced by collisions. Consequently, these vortices have a long life-time (days, weeks and even longer), such that it is possible to accumulate many of them in a CD. In the presence of the Earth's magnetic field, these vortices can become aligned. Moreover, the circumstance exists that, in living matter, CDs surround molecules having helical structures and windings, giving the vortices a definite preference or bias of circulation, facilitated as well by the existence of local magnetic fields in some macromolecules having ions with large magnetic momentum. The combination of these effects allows vortices having parallel magnetic momenta to add up, so that the energies of these vortices sum up, making it possible to reach high energy values starting as very small energies of elementary excitation. Living systems are able to combine  $n$  photons of frequency  $\nu$  into one photon of frequency  $n\nu$ . Consequently, nonaqueous molecules present on these energized CD surfaces could acquire by resonance the stored energy when the CD energy value matches an activation energy of the corresponding molecule. The above dynamic accounts for the selective character of the interaction between these electromagnetic fields and biomolecules. In particular, should a molecular species be present on the CD surface in large amounts, this would put an upper limit to the the energy storage capacity of CD. The type of biochemical reaction in a cell determines the maximum frequency of electromagnetic field which can be stored in the cell, and the shape of a CD in a living organism, such as a cell, depends on the shape of the surface to which it adheres.

The process of charge and discharge of energy in CDs could give rise to a common oscillation capable of inducing coherence among them, so that higher structures (CDs of CDs) can emerge producing hierarchical scales of nested structures, such as CDs, then cells, tissues, and organs [42].

In short, there is an interplay between electrodynamics and chemistry which is responsible for the organization of matter. Here, the energy stored in the electromagnetic fields trapped in CDs induces, through a resonance mechanism, a selected set of chemical reactions which, in turn, through their output of chemical energy, change the frequency of the trapped electromagnetic fields, then changing the set of possible chemical reactions. In this way, we have a biochemical scheme able to evolve with time. The engine of this dynamics is electromagnetic fields whose frequency changes with time, starting from small values and reaching values in the infrared or visible range that, in turn, can activate biomolecules. A hypothetical look within a CD structure would reveal this trapped light. Changes of the spatial structure of the coherent fraction, produced by the crossover of molecules across the two fractions, give rise to leakage of the trapped electromagnetic field, which would then appear outside as photons observable by sensitive detectors. We conclude this survey by observing that, as the correlations among molecules are phase correlations, they are mediated by the electromagnetic vector potential [41]. As a matter of fact, the intuitive idea of the role of electromagnetic vector potential in pattern formation in biological systems had been long ago proposed by Ho et al [46].

Thus, parallel to material structures made up of molecules, a corresponding electromagnetic structure is present in a living organism. CDs of water extract energy from outside environment and store it in electromagnetic form and the subsequent slow decay and relaxation of CDs provides energy for chemical activity. The exchange of energy occurs via biophotons, which cannot ordinarily be seen from outside, as they occur within the CDs [47]. Emission of biophotons to the outside occurs only when coherence breaks down, which explains the low intensity of biophotons from biosystems. A further corroboration of the above theoretical scheme has been provided recently by experiments reported by Nobel Prize winner Luc Montagnier, in which electromagnetic signals were detected emerging from aqueous microscopic structures surrounding macromolecules [48]. These signals have been shown to be correlated with specific biological cycles of microorganisms.

Based on these facts, a model has been suggested in which in a human body possesses a set of pathways along which endogenous electromagnetic fields are self-trapped and propagate as solitons [20]. The



form of these pathways is shaped by the interplay of the spatial distribution of the nonlinearity properties of the biological tissues and boundary conditions, and can play the role of waveguides. In certain areas, these pathways approach the skin, where they constitute special “nodes” known as biologically active points or 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, rather than only for individual pathways. We can afford here the daring hypothesis that the meridians, acupuncture points and their chakras, postulated in the Eastern medicine, could be just those hierarchical levels of the above described electromagnetic structure of a living organism and, therefore, they reflect energetic organization of the living system. The elongated coherence domains form quasi-one-dimensional arrays, bound by Josephson-like junctions between the domains, and electromagnetic signals can propagate along such arrays in the form of nonlinear soliton-type pulses. Such networks can be excited from outside at particular nodes (acupuncture points) by external stimuli. The energy absorbed at the node triggers energy propagation along the corresponding waveguide in the form of solitons. Energy absorbed or leaking out the pathway(s) excites the CDs, increasing their energy. Thus CDs are devices able to collect low-grade (high entropy) energy from the environment in whatever form and transform it into high-grade (low entropy) energy, which can reach the frequency of the visible light interval. The source of the externally supplied energy could be whatsoever, yet the stored energy assumes the form of *internal light* able to govern the self-organization of the organism.

Of course, external energy could also be supplied by photons, which are then the triggers for the autonomous production of the internal light. The fact that one can visualize colors a long time after eyes are closed means that the colors are produced by the internal activity of the body as a manifestation of the trapped electromagnetic fields, subsequently interacting with light sensitive structures in the body and exciting pulses (solitons) which then propagate along their waveguides. In the healthy state, one has photons of all wavelengths circulating along the respective pathways and no photons are emitted out. Disease implies an energy imbalance, or blockage in the energy flows in a human system, causing what doctors call “disharmonic states,” which in physical terms means partial loss of coherence. This loss is connected with the interruption in functioning of some pathways, jamming of some waveguide(s), or the leaking of photons of some wavelengths to the outside. It is worth noting here that, according to Eastern traditions, each chakra (or element assigned

to it) is associated with certain colors, so that the higher the chakra, the higher frequency colors are associated with it, starting with the low frequency red color of the root chakra. Although various Eastern traditions vary on the colors of upper chakras, they all have in common that the colors vary from red to blue, and that, respectively, chakras transform the frequency of the electromagnetic field from low to high.

Regularly repeating the exercise of visualizing colors with closed eyes, a person stimulates the internal optical pathways (a sort of optical massage) and relaxes the blockages, restoring the energy flow. To a certain extent this is identical to stimulation of the acupuncture points, with the only difference that the wavelength of visible light is very small and acts like a very sharp needle, exciting very precisely the corresponding junction. Scanning of the colors in closed eyes (red to violet) follows the process of the storage of energy which piles up in the CDs. A very significant characteristic of this method, compared with conventional phototherapy methods, is the absence of the heat effect in view of the extremely low light intensity and the absence of complications or detrimental effects due to the wrong choice of external light wavelength. This is because this method is intrinsically self-correlated by the organism itself. It is interesting that many patients, when treated with other techniques, such as microwave resonance therapy, and asked to describe their feelings during or immediately after a session, have reported that seeing blue light with closed eyes (Dr. B.P. Grubnik, private communication). To conclude this section, we quote here Sitko’s comment on microwave resonance therapy [49]: “At the moment of resonance which ensures returning of quantum system from metastable state to the ground state, the patient feels that his pain disappears practically instantly, the feeling of lightness, of imponderability, complete delight arises, *in the closed eyes there appear dark blue, light blue, violet green colors or bright white radiance.*” (Authors’ italics).

### 3. Discussion and Outlook

It is known that long-wavelength visible light (red, orange, and yellow) causes sympathetic action, short-wavelength light (blue and violet) parasympathetic action, and green light normalizes—the latter bringing a balance to sympathetic and parasympathetic activities. External light entering through the eye acts on the hypothalamus and pineal body, decreases melatonin levels, and increases serotonin levels; serotonin is very important for relaxation and for long, restful sleep. The intrinsic photons, which one sees with closed eyes, act in a

similar way. Of course, the intensities of light in the two cases (open and closed eyes) differ by several orders of magnitude. The extraordinary effect of very tiny stimuli, as internal light, is consistent with the general physiological law, discovered in 19th century by Weber and Fechner, which states that the physiological effect is proportional to the logarithm of the stimulus. An evanescent stimulus, therefore, produces a very large effect having a minus sign, meaning that the effect is not outbound, or directed outwards, but inbound. An inbound effect corresponds to a change of the internal organization of the organism. We think that this quantum feature of the above phenomenon is of paramount importance and requires further study. It might be the case that there are some features of this phenomenon and method in common with the physical mechanisms of such methods as homeopathy and low-intensity microwave therapy.

In a disease state and in the periods preceding the appearance of a pathology in various tissues and organs, redox processes and, thus charge transport are suppressed, blood circulation worsens, and CDs break down. This results in changes in the electromagnetic field intensity and patterns; we are referring here to recent experimental measurements of the electromagnetic signals of characteristic frequencies at specific biological activities in organisms [48]. A change in the electromagnetic fields leads to a change of states in the reflexogenic zones and biologically active points and vice versa. That is, a change of state of the reflexogenic zones and biologically active points results in a change of activity in corresponding organs and tissues. This relationship is widely used in reflexotherapy, when external stimuli applied to acupuncture points cause improvement in remote organs/tissues. This would be why regular observation of color dynamics leads to health improvement and can be used as a treatment. In this respect, the eye, absorbing light of a given wavelength, plays the role of a very sensitive “acupuncture point”, not only reacting to a well defined energy value (corresponding to the light wavelength), but also absorbing extremely weak light. This indicates that the corresponding mechanism belongs to the class of resonant phenomena, as is suggested here. Therefore, light is a trigger and a probe of the internal dynamics of living organisms.

## Acknowledgments

We acknowledge the stimulating atmosphere of the annual summer schools on biophotonics at IIB (Neuss, Germany) and, in particular, we thank Dr. B.P. Grubnnik and Prof. V. Voeikov for their illuminating comments. We thank also Patrizia Stefanini

and Sonja Krenger for having introduced us to some features of Eastern medicine. One of us, L.S.B. acknowledges partial support from the Ukrainian Special Program for Fundamental Research.

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