The spectroscopy of biophotons in non-local genetic regulation

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Abstract: *This paper describes the phenomenon of broadband radiowave radiation (RR) produced by a special optical quantum generator. It is shown that RR can be used as the basis of polarization/lase/radiowave spectroscopy of substances. The spectroscopy mechanism closely connected with inelastic scattering and photon localization in electronic systems of laser mirrors is physically and mathematically formalized. This differs from the traditional Raman effect of photons. The spectrum of inelastic scattered light is continuous and occupies the full frequency range from 0 up to 2w (w- frequency of scattering photon). The mechanism of an EPR (Einstein-Podolsky-Rosen) effect for localized photons is offered. It is shown that the existence of unique localized photons (rather than EPR-correlated photon couples) is sufficient to transmit signals instantaneously (permissive teleportation). It is shown that RR, read from DNA samples, carries morphogenetic signals. RR of DNA induces in recipient plants morphogenetic modifications and is also capable of repairing radiation-induced genetic damage in plants. It has been proposed that RR transmission from DNA to recipient plants takes place through permissive teleportation.*

I. The general working principles of a laser installation showing the phenomenon of transition of optical photons to radiowaves.

Previously we developed a laser installation with the help of which we have found the phenomenon of transition of red coherent photons to radiowaves of a wide spectrum. We have offered a preliminary explanation of this phenomenon [21]. The present research offered by the authors essentially supplements the positions earlier stated by them and is at the stage of a theoretical-experimental substantiation of a new kind of spectroscopy of substances with the conditional name "polarizing laser-radio frequency spectroscopy" (PLR-spectroscopy). Such spectroscopy is intended for research into previously unknown, rotational-vibrational quantum-molecular characteristics of solid, liquid, gaseous substances, and also plasma states. The variant of PLR-spectroscopy offered uses a narrow optical range red light, but further developments are being planned which will make use of more short-wave spectra in the visible region.

For the purposes of PLR-spectroscopy a special He-Ne laser (λ=632.8 nm) was used to generate two orthogonal optical modes correlated in intensity in such a manner that the sum of their intensities remains constant. Upon interaction of one mode with the target substance, the reflected, or non-local, radiation is returned to the optical resonator, [where] there is a redistribution of intensity of these optical modes, under the law of change of polarization appropriate to a new condition after interaction of a beam with dynamic micropolarizers, which takes place in a cross-section of an illuminated platform of the target substance. One of the laser modes, at a certain mode of generation, is able during interaction with the target substance to cause radiation by our installation of modulated radiowaves of a wide spectrum, correlated with modulations in optical modes of radiation of the laser. These modulations depend on rotary fluctuations of microstructural components (for example, domains of crystals) of the target substances and their optical activity.

The frequency interval of the induced radiowaves, according to the theoretical model (see below), lies in a range from 2ϖ up to 0. The maximum of such radio emission settles down in the 1 MHz region. The radiowave signal after detection is transferred to an analogue numeral transformer on a computer with a special processing program. On a display is registered the Fourier spectrum of a radio emission describing polarization-dynamic properties of the investigated substances with which one of the laser beams interacts, and also the spectral memory of investigated substances. The second beam thus comes back to the laser resonator for creation of resonant interaction with atomic oscillators of the gas mix. The given laser also is able to generate, except for the basic (optical) frequency, a radiowave of a wide range of wave lengths. The reason for this phenomenon is, we believe, the inelastic scattering and localization of light of the basic laser mode on system heterogeneities in the mirrors of the laser resonator. The mechanism of localization (localization in the inelastic channel of dispersion) is described in detail. In particular, the position is put forward, that in the resonator there exists as well a form of elastic, non-local light (see theoretical part).

Radio frequency radiation generated by the laser is able "to read out the information", for example, from DNA preparations (see experimental part). The mechanism of "reading" is similar to the mechanism of usual induced radiation. The opportunity "to open and close" the laser resonator makes it possible "to locate or write down" in itself "spectra" of various tested objects. Radio frequency radiation reads out and relays such spectra. Thus the effect of spectral memory was identified: for a certain macroscopic time, radio frequency spectra of the objects reflecting a beam back into the resonator and then removed from the examination zone, continue to be reproduced. So DNA spectra were registered and their high biological activity, probably connected with wave-type transmission of genetic-metabolic information, was revealed (see experimental part).

Experimental part

II. PLR-spectroscopy of minerals and biostructures. Effect of spectral memory.

In Fig. 1 the circuit of typical experiment with the record of a PLR-spectrum of target substances (for example, mineral crystals), is shown.

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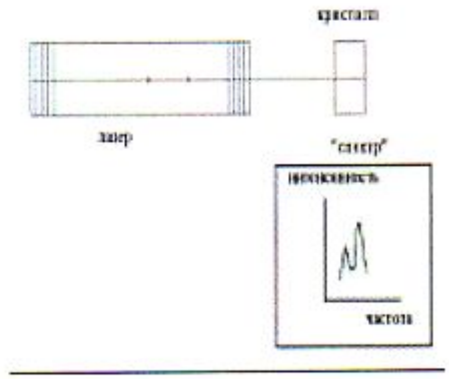

Fig 1. The experimental circuit with a record of a PLR spectrum

Fig2

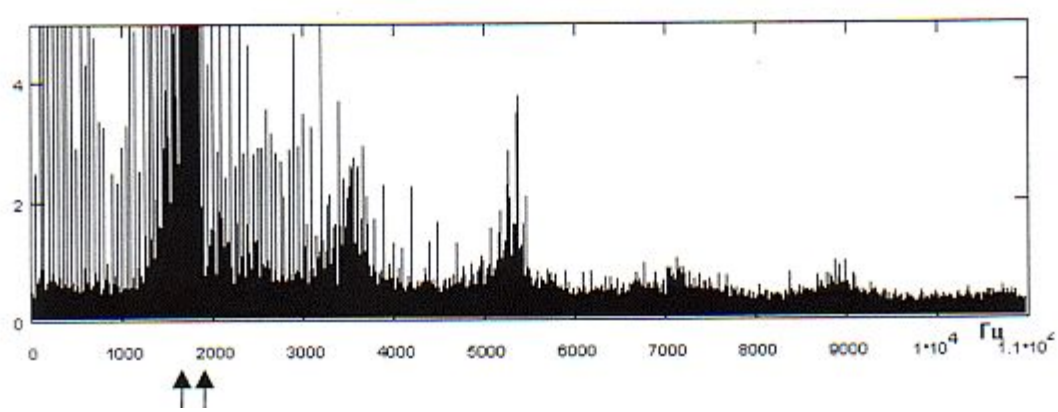

Fig. 2 the PLR-spectrum of a mineral (apofillit). Arrows (pointers) specify area of display of the spectrum, given in Fig. 2a.

Fig2a

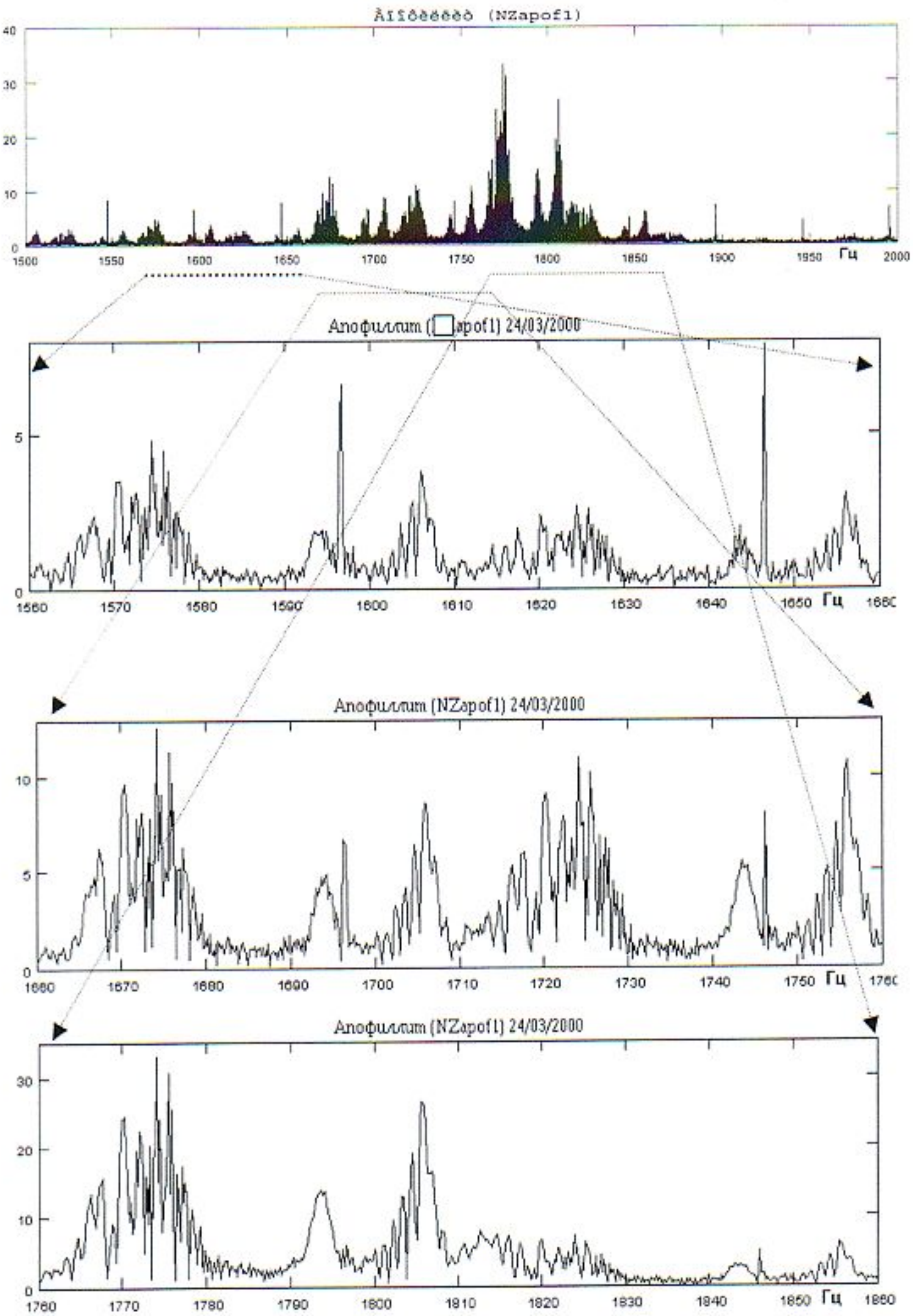
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Fig. 2a. Polarization-Laser-Radiowave display of a spectrum of a mineral apofillit

Frequency of digitization of a signal 44 kHz. Areas 1550-1660 Hz, 1660-1760 Hz, 1760-1860 Hz are developed (unwrapped). It is **clear** that these areas of **the** spectrum have isomorphic structure with differing amplitudes. Such **type** of spectral modulation can be named heterogeneous frequency fractalization modulation.

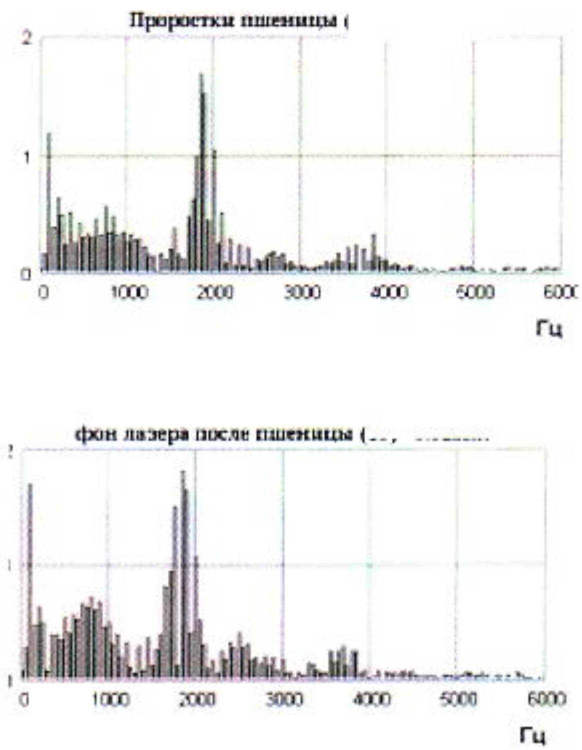

Fig 3: record of a PLR-spectrum (frequency of digitization of a signal - 22 kHz) of a live green [leaf?] of a wheat seed and spectral memory of this object.

Before the experiment, as in the case of the turmalin and apofillit crystals, we fixed a background radio emission of a PLR-spectrometer which was typically noise, and its amplitude was exponentially reduced to 5000 Hz. For live leaves the characteristic expressed frequency areas were identified as 800-900 Hz, 1700-1900 Hz, 2400-2600 Hz and 3600-3800Г Hz . After removal of the wheat seed the PLR-spectrometer continues for some time to generate a radio emission, characteristic for wheat leaves. In it spectral PLR-memory is also shown.

Fig4

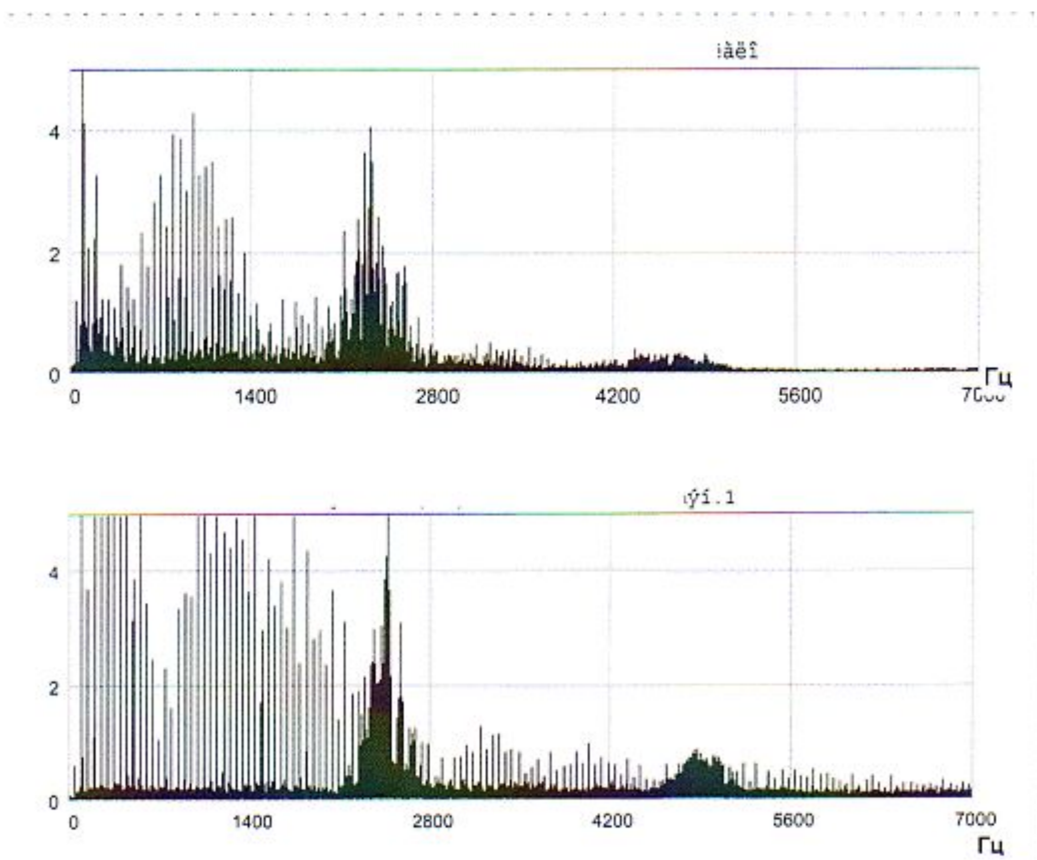

Fig 4: PLR-spectra of high polymerization DNA sample from calf thymus (the top spectrum) and its spectral "trace" on laser mirrors (the bottom spectrum) after removal of a DNA sample from a zone of probing laser beam. As in the case of minerals and wheat seed, the affinity of a spectrum of preparation DNA and a spectrum of its "trace" is visible.

III. Biological activity of PLR-spectra of DNA samples

"Recording" the PLR spectra of DNA samples proved to have a specific effect on the biosystems we used - for example, inducing abnormally fast germination (up to 1cm/day) in a potato plant, or revitalizing seeds of the plant *Arabidopsis thaliana* which had been damaged by radiation from the Chernobil Atomic Power Station accident in 1986-1987. In a typical experiment looking at the effect of three different PLR protocols on such seeds, (1h. 30min., 1h. 40min. and 2h. treatments with a radiation dose of 25 mR/hour) the "DNA-radiowave-radiation" in last two groups was observed to significantly increase the germinating capacity of seeds in comparison with two control experiments ($P < 0.001$). That is, from 300 and 200 sown seeds in the control only 2, respectively 4 seeds germinated - while in the experimental group 16 and respectively 24 seeds germinated. However, after the dose was increased to 170 mR/hour the effect of "seed revival" appeared to reach a plateau.

This shows that the radiowave DNA emission obtained in this way has the ability to restore the genetic control apparatus and vitality of *A. Thaliana* seeds, but within limited intervals of radiation dose capacity. Essentially the seeds were stored for a long time (1987 -1999), and that has resulted in their significant ageing, imposing an additional damage factor. Nevertheless, a "revitalization" effect is observed, and it demonstrates that DNA- radiowave radiation can carry in itself reparative genetic (metabolic) information that confirms our early work on wave biosign reparative influences on X-Ray irradiated wheat and barley seeds [17, 18]. It is likely that the recognition of such wave information is carried out by seed - acceptors on the level of a quantum nonlocality (teleportation) mechanism, as we assumed earlier [5, 19], but here we intend to update the permissive model offered in the previous research.

Before discussing the theoretical-physical analysis of the offered teleportation model (see below), we will state some opinions concerning the importance of this problem for genetics and biology as a whole.

In works [5, 19] the question of genome information quantum teleportation was already discussed. In the present research these ideas are formalized and consequently are more thoroughly supported. Presumably it is possible to interpret the biological experiments mentioned above as a demonstration of the imprinting of genetic information from DNA preparations on biosystem-recipients through the mechanism quantum teleportation in permissive variant. It is proposed that the quantum nonlocality of the genetic (chromosomal) information as displayed in its total continuity in the space of multicellular biosystems, is a special case. Actually, in biosystems, at least, there are six levels nonlocality:

1st level: Level of the organism. Nonlocality here is expressed in the capacity for regeneration, for example of *planarium* worms. After cutting these worms, any part of their body regenerates into the whole organism. Differently stated, in this case there is no binding of the genetic information to any part of the biosystem. The same concerns to vegetative duplication of plants.

2nd level: Cellular. From each cell, and not just from a zygote, it is possible to express the whole organism. For animal biosystems it is complicated, but it is possible. Each cell - a potential continuum of an organism.

3rd level: Cellular - nuclear. Enucleating a nucleus from a somatic or sexual cell, with the subsequent introduction into this cell of another nucleus, does not interfere with the development of a normal organism. Such cloning has already been carried out on higher biosystems, for example, on sheep. Each cellular nucleus is also a potential continuum of the biosystem. Localizations of genetic potentialities on any separate cells are not present.

4th level: Molecular. The ribosome "reads" and interprets the messenger RNA not only through separate codons, but also globally, dependent on a non-local "context".

5th level: Chromosomal/holographic. A gene has holographic memory [26], and it is typically distributed (non-local) associative memory. On this and the subsequent levels nonlocality receives a new quality, a dualistic matter/wave nature - as chromosomal material texts "are read" by the electromagnetic and/or acoustic fields bearing genetic/wave information. For example, the physical field acts as calibrating factor, creating the future space-time development of a potential organism with the help of the holographic memory of the brain cortex - specifying mental, semantic and figurative spaces, calibrating potential actions of the higher (conscious) biosystems. Through this socio-genetic processes are realized.

6th level: Quantum nonlocality of genome. Up to the 6-th level the nonlocality of the genetic information is realized within the space of an organism. The 6-th level has a special character and a new quality. It is shown within the framework of one of the forms of quantum nonlocality, namely permissive, postulated in the above-mentioned work.

In this case nonlocality is realized both in the space of the biosystem, and on its own, "compressed-to-zero", time. Genetic/Wave programs instantly distributed in such ways, (isomorphic material), work in an organism "here and there simultaneously " [17, 18]. This is a strategic factor of extraordinary importance for multicellular biosystems' evolutionary achievement. Billions of cells in an organism should "know" about each other - communicating instantly about their status. Without the phenomenon of "wave information instantaneousness " the huge multicellular continuum of higher biosystems is not capable to completely coordinate the metabolic, physiological and other functions. Intercellular diffusion of messenger substances and nervous processes are too inert for this purpose. Even if we admit that sign electromagnetic fields participate in intercellular transfer with light speed, that is still insufficient. The mechanism of quantum nonlocality is necessary, and it is applicable to the genetic device which can act as instantly distributed quantum (wave) object, isomorphic to material chromosomes [17, 18,

Theoretical part

IV. Localization of light in the elastic channel of scattering. The possible recording and reading of the information located in spatially correlated non-uniform systems.

In the experimental part of this work we have presented results which indicate:

• the possibility of reading the spectrum of excitations of crystals and biological structures;
• the possibility of long-time storage of this information;
• the possibility of the subsequent reading and transfer of this information.

Experiments were carried out in a radio frequency range by means of the device (PLR-spectrometer) described above.

Here we propose a possible theoretical interpretation of these experiments. Its foundation lies in our basic ideas on the theory of localization of light in dispersed spatially correlated systems.

The phenomenon of light localization has enjoyed wide popularity since the 1985 publication of work [1]. Now it is one of most dynamically developing areas of physics, closely bound with such "fashionable" problems as, for example, quantum teleportation, new methods of recording and reading information, etc. [6,12,13].

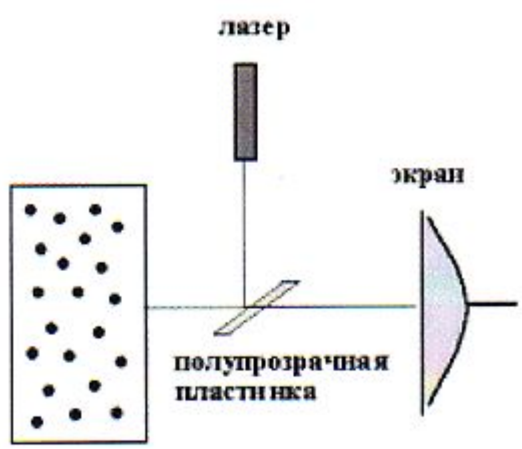

Fig. 5 The scheme of experiment with supervision of weak localization of light

The research described in work [1] investigated the reflection of light from a transparent cuvette, filled with the smallest particles of latex weighed in water, in conditions where the length of a wave of a incident photon
λ is less or equal to δ (δ is the average distance between particles). On a background of **Frenel's** reflections, in a backward direction a very narrow peak of intensity of the scattered light (Fig. 5) was observed. The signal exceeded background values 2 times. For an explanation of this effect it is enough to consider scattering on pair the particles which have appeared for a way of a photon. In this case, the trajectory of a photon reflecting in the backward direction is an infinitely narrow loop. We shall assume, that the photon can pass this loop two ways - clockwise and counter-clockwise.

These two ways are represented in a Fig. 6a. They are indiscernible.

Fig. 6a. Two ways of passage by a photon of a loop on its trajectory in conditions of weak localization. 6b. a turn of a photon between two particles, provided that the photon trajectory is a one dimensional line.

In such cases the quantum mechanics orders to calculate probability P of a turn of a photon is as follows. Each process has the amplitude of probability a associated with it and the probability of a turn $P = |a + a|^2 = 4|a|^2$ (we considered that both amplitudes have identical phases - as features of movement on a loop [14]).

If we had a hypothetical opportunity to distinguish between these ways, the probability of a turn would be considered completely differently and would be twice less: $P = |a|^2 + |a|^2 = 2|a|^2$. The formal reason of peak in a back direction back is this. However, the occurrence of the peak in a back direction is not accompanied at all by the appropriate reduction of scattering of light in any other direction [11]. How do we reconcile this with the law of conservation of energy and whence those additional photons which have formed the peak? A second question is - why is this peak not observed at reflection of light from continuous half-space? And finally - From what we have seen, are there two types of movement of a photon between a pair of particles? If a trajectory of a photon between particles is a one-dimensional line, what can be said about two various ways of its detour?

A turn of a photon between two scatterers - unequivocal image of the certain procedure represented in a Fig. 6b).

So, we would very much like, that there were two ways of passage of a photon of indefinitely narrow loop between two particles. This can be achieved if we assume that the topological dimension of a trajectory of a photon in conditions of weak localization d < 1. Only in this case we can place inside one one-dimensional line of figure 6b. two different "lines" - the topological object similar to a loop, i.e. described by two ways of its detour.

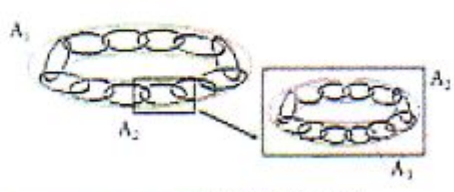

Fig 7. Antoine Necklace

There is a graceful mathematical design which, on the one hand, is very similar to that which in physics is referred to as a line or a trajectory, and on the other hand, its topological dimension d is has a value less than 1. In fact, d=0. This is the so-called chained Antoine set [15]. This object adapts very well to the description of processes of continuous generation of non-uniformly scaled loops on the trajectory of a photon.

The zero-dimensional Antoine set (Antoine necklace) is arranged as follows. At the first stage a "thick" closed loop A1 is observed. In the second - A1 is replaced with a chain of less "thick" parts A2 which is taking place inside A1. Then each part A2 is replaced with a chain of even finer parts A3 ⊂ A2 etc. Continuing this process, we shall obtain the sequence A1 ⊃ A2 ⊃ A3 … (see Fig. 7). Crossing of these sets represents zero-dimensional set Antoine A*. The described design is the elementary variant of Antoine set.

In spite of the fact that Antoine's chain is zero-dimensional, it does not lose some of the properties of a usual one-dimensional line. So, if with usual zero-dimensional set A0 , for example, from finite set of points the "passed" ring through it is easily possible to remove sets A0, anywhere not crossing A0 to do the same with zero-dimensional set A0 it is not possible.

Let's assume, that the trajectory of a photon in conditions of strong and weak localization is an Antoine set with topological dimension d=0. Interesting conclusions follow from this. If the photon goes on Antoine trajectories to leave this set is rather difficult. In a 3-dimensional world, this is analogous to the difficulties of the person who is trying to escape from a room without windows and doors. A physical interpretation of the mechanism of light confinement in the system, caused by unusual topology of Antoine trajectories is also possible. Replacement of a real three-dimensional photon by a zero-dimensional object results in a singular character of distribution of energy along the trajectory of Antoine photon. Such trajectory has a peculiar "mechanical rigidity". The twisted "rigid" parts of Antoine sets resist any attempt of unhooking. It also is the reason of confinement of a photon near to the pair, more precisely, near to itself.

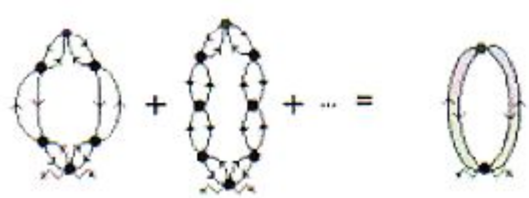

Fig. 8. Antoine rings on a trajectory of a photon

Is the output Antoine photon possible in the real world? The narrow peak in a back direction at scattering of light by dispersed system in conditions of weak localization is also nothing other than the emission of Antoine photons, initiated by light.

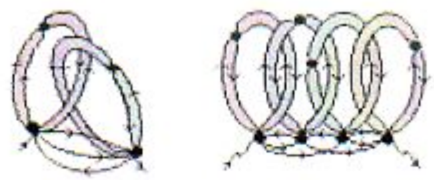

Fig. 9. Interlacing Antoine rings

The analysis of perturbation theory series for photon propagator in a system of particles shows that there are trajectories isomorphic to the Antoine set. These trajectories are similar to a loop, made of two parts as a ring of handcuffs, as shown in Fig. 8. Two half rings (not necessarily identical) are closed at the top particle. The sum of such loops is designated by us as a darkened ring. During the movement these rings of a trajectory can interlace - see Fig. 9. In turn, every propagator consists of a line of twisted rings such as in Fig. 9, and also a set of twisted rings of smaller scale (see Fig. 10). This repeats indefinitely.

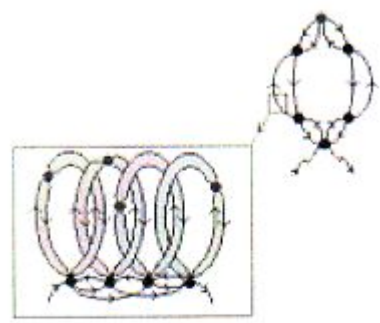

Fig. 10. Structure propagator lines of Antoine rings

A necessary condition for localization is a very strong renormalization or reduction of length of a wave of a photon getting into the system. As is known, in systems with large values of dielectric permeability the length of a wave of a photon λ_{int} becomes much less than the length of a wave of an incident photon λ. The frequency of a photon thus does not change - the effective speed of a photon changes according to a ratio $\varpi=2\pi\nu/\lambda_{int}$. We are interested in a situation in which $\lambda_{int}\to 0$ otherwise the photon "will not go in" on vanishingly small parts Antoine sets. The effective speed of a photon thus becomes zero.

One object where strong renormalization of lengths of a wave of radiation actually is possible, is a fractal cluster, consisting of weak adsorbing particles-monomers. Fractals are heterogeneous systems showing scale invariance. Any small fragment of the system, upon an increase in scale, reproduces the spatial structure of the overall system. Fractal Cluster (FC) usually designate the micron-size clusters consisting of nanometer particles, retained to gether Van-der-Waals forces.

FCs are formed as a result of strong nonequilibrium condensation of vapors of solid substance and the subsequent aggregation of nanometer particles-monomers, or at an initial stage of crystallization of solutions.

Scale invariancy clustering causes the rather slow falling off of pair correlations in an arrangement of its particles. Pair correlation function is arranged as follows

$$g(r) \sim r^{D-3} \exp(-r / L_c)$$

(where D = fractal dimension cluster, L_c = the characteristic size of the correlation block). Fractal dimension determines the number of particles-monomers cluster N, taking place inside an imagined sphere of radius: $N \sim r$^D . The value of D < 3 and is unessentially the whole - in it specificity fractal cluster. In the usual dense packing particles pair correlations fall much faster, disappearing exponentially according to the law on characteristic distances after about several particle radii. Scale FC invariance is reflected visually in its rather friable structure. The density of particles in volume r^3 of FC is not constant, and is proportional to $1/r^{3-D}$.

The reason for wave length renormalization are remote correlations in an arrangement of particles FC, visually expressed in the cluster connectivity and the presence in it of a large number of cavities. This works as follows. Let fall on the cluster a photon with wavelength λ about the characteristic size cluster L, trapped by a large cavity FC (a resonant cavity). This catching results in growth of effective dielectric permeability, which grows near to any electromagnetic resonance [16]). This increase initiates, in turn, a reduction of photon wavelength, since $\lambda_{int} = \lambda / \sqrt{\varepsilon}$. The photon with renormalized wavelength λ_{int} finds another cavity, with smaller size. New trapping again stimulates a permeability increase and new wavelength reduction etc. As a result all cavities of the cluster can become filled with renormalized photons, including when the length of the waveλ_{int}-->0.

The physics of localization of light in fractal systems and the scheme of calculation are these: Between a source and the detector of radiation there is at all times a photon "circulating" on a closed loop (see. Fig. 11). It is kept there by interlacing rigid Antoine rings on its trajectory (see. Fig. 12). Rings are formed as a result of repeated rescattering of photons on monomer particles of FC. Further, the amplitude of interaction of pair virtual photons is calculated, which are inside the area designated as FC, in figure 12. One of them corresponds to top "coast", the second - bottom. The typical processes forming this amplitude can be seen in a Fig. 12 to reject wavy lines of real photons. The amplitude of interaction is searched as the solution of appropriate equation of Bethe-Solpeter. It is possible to show that the imaginary part of this amplitude describes localization of a photon in system.

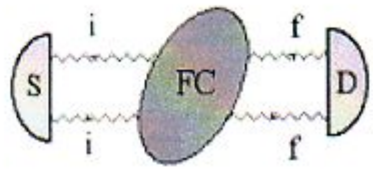

Fig. 11

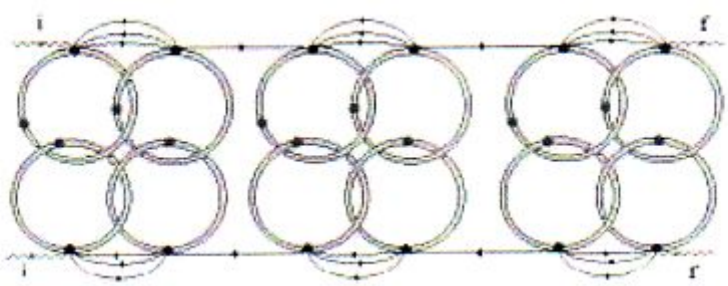

Fig. 12

The appropriate calculation results in the following expression for differential cross-section of elastic scattering of light by FC [8]:

$$\frac{d\sigma}{dn_f} = \frac{1+2\left(e_i e_f\right)^2}{60} N^{\frac{3-2D}{D}\frac{N}{2}} |\varepsilon - 1|^2 \frac{\omega^4 R^6}{c^4}\left[-\frac{1}{\beta}\frac{d}{d\beta}\delta(\beta) + i\frac{4t_0^3}{(3-D)N^2}\frac{\sin\beta t_0}{\beta t_0}\right] \quad (1)$$

where $\beta = 2\frac{\omega L_c}{c}\sin\frac{\theta}{2}$

θ - the angle of scattering, δ(*x)* is the delta - function of Dirac, c is the light velocity in vacuum, e are the unit polarization vectors of incident ( ) i and scattered ( ) photons, ϖ is the frequency of falling light and n_f is the unit vector in a direction of scattered photon, $N >> 1$ is the number of particles in the correlation block, e is the dielectric permeability of a material of particles and R is the radius of particle-monomers. The parameter t_0 too poorly depends from. The imaginary part of cross section describes the "absorption" caused by localization. At $D < 3\ 2$ this cross-section is very great.

At θ different from 0, differential cross-section of scattering becomes only imaginary. It means that, at θ different from 0, any stream of light scattered by the cluster does not exist at all. Any photon which has scattered "sideways" is caught by the cluster and starts to oscillate along appropriate n_f. Not a small surprise of expression (1) for it is singularity scattering forward.

$$J_{n_f} = I \frac{d\sigma}{d\vec{n}_f}$$

Fig. 13 The physical reasons of the stimulated emission of light located in cluster.

Between a stream of scattered radiation in a direction and density of a stream of falling radiation, it is clear that singularity in cross-section means, that in the system a finite "current" of photons is possible even at zero density of a stream of falling radiation. Singularity in a forward direction describes the stimulated emission of light from cluster. It is typically "laser" effect. Coherence of stimulated emission is provided by "zero-dimension" of localized Antoine photons and ability to concentrate their huge number in a small volume. The physical reason of coherent transfer of these photons is simple and evident.

Any photon which has scattered "sideways" is caught by the cluster and starts oscillating along a direction of scattering n without the right of an output from the cluster. On its trajectory are formed Antoine rings twisted with the appropriate rings of localized photons. This interlacing keeps such a photon inside the cluster. Most of all such rings at a photon scattering on a zero angle - the imaginary part has a maximum at (see expression (1)). At the same time only such a photon has the opportunity to escape from the cluster, as described by the real part of cross-section. This photon, having been hooked by the rings for the appropriate rings of the localized photons , extends them outside (see. A Fig. 13). So in the language of Antoine rings it is possible to understand the physics of the stimulated emission of light easily.

We expect that similar types of effects, namely - localization of light, take place in the system of correlated mirrors of the device we describe. Here localization is possible between any pair from among the large number of every possible combinations of mirrors.

Reading and recording of localized light.

The spectrum of excitations of any system is to no small degree determined by its boundary, or surface. A typical example of such excitations are plasmon-polaritons on a surface of metal or surface plasmons in small metal particles. Is there an opportunity "to read" the characteristics of such excitations spectra and to write them down on some form of carrier, or to record the information with the purpose of, for example, long-term storage and the subsequent perusal? Let us talk about the problems and prospects of this research.

As it is known, upon reflection of a photon from a flat surface the state of its polarization does not vary - it is forbidden by isotropy in relation to rotations in a plane of a surface. It would seem that in the case of reflection of light from a flat plate with two walls the situation would not change. However, this is not so if we take into account an opportunity of localization of light between the borders of a plate. Similar types of effects are observed on scattering of light in a direction strictly backward in a homogeneous ensemble of the smallest particles [11]. This is related to an opportunity for "extraction" by back-scattered photons of the photon located in system. In this case the polarization of reflected light can change. The reason for which it "pulls out" the localized photon as we know, is connected not with the photon - photon interaction which in the given conditions can be neglected, but to an interlacing of Antoine rings of scattering and localized photons.

This effect, combined with rotational-vibrational and polarizing characteristics of investigated objects, makes it possible to use for effective extraction from object located in it, its own excitations (its "spectrum"). We shall consider the scheme submitted in Fig. 1. The laser described above, and a crystal whose spectrum appears in it we want "to extend" outside. One more change is brought in the design of the standard laser. The translucent plate located under Bruster angle to an axis of the laser (the purpose of this plate is to cut parasitic light not the basic polarization) is removed from it. This is done in order to not block light reflected from a crystal and changing the polarization in result "extraction" from a crystal of localized photons, again enter in resonator and then repeatedly to repeat the route. We expect that the efficiency of "extraction" of the localized photons which have written down the information on the target object would be high enough in such system for experimental supervision. Further, these delocalized photons again can be located but already in the system of mirrors of the laser. After that we remove the crystal, but its "spectrum" excitations, located in the laser as we expect, can still be shown at will at any time. The system will reproduce the spectral memory of an object which is already removed from the exhibiting area. Any system in which localization of a field is possible can carry out the role of the crystal. For example, it can be a biological object, in particular, genetic structures which have fractal liquid crystal packing. Probably, such effects of spectral memory were observed in our experiments (see above).

Localized light and problems quantum teleportation

A completely unexpected cache of idea on the localization of light is found in the area of quantum teleportation - the instant transfer of a message across large distances. This exotic area of research, since the publication of [2, 3], has been increasingly drawing the attention of physicists and recently biologists. Presently we shall reiterate the basic provisions of the "classical" theory quantum teleportation.

As it is known, any wave function of paired photons (a photon 2 and a photon 3), each of which has two states of polarization (horizontal polarization and vertical polarization), may be expanded on four basic states (on so-called states of Bell) which form full orthonormal system of functions [22]

$$
\begin{aligned}
|\Phi^{+}\rangle &= \left(|\updownarrow\rangle_2|\updownarrow\rangle_3 + |\leftrightarrow\rangle_2|\leftrightarrow\rangle_3\right)/\sqrt{2} \\
|\Phi^{-}\rangle &= \left(|\updownarrow\rangle_2|\updownarrow\rangle_3 - |\leftrightarrow\rangle_2|\leftrightarrow\rangle_3\right)/\sqrt{2} \\
|\Psi^{+}\rangle &= \left(|\updownarrow\rangle_2|\leftrightarrow\rangle_3 + |\leftrightarrow\rangle_2|\updownarrow\rangle_3\right)/\sqrt{2} \\
|\Psi^{-}\rangle &= \left(|\updownarrow\rangle_2|\leftrightarrow\rangle_3 - |\leftrightarrow\rangle_2|\updownarrow\rangle_3\right)/\sqrt{2} \qquad (2)
\end{aligned}
$$

The condition (further from us) will be of most interest to our discussion, as it has a special property: upon detection of one of the photons with a certain polarization, the polarization of the other photon appears to be opposite. The opportunity to experimentally distinguish one of Bell's states from the others is provided by their various symmetries. From four states (2) the first three are boson states (their wave function does not change a sign at rearrangement of particles 2 and 3). The last state is a fermion (at rearrangement 2 and 3 the sign of the wave function changes). This feature of a state allows to allocate it in a number of the experiments well described in the literature using an interference of two prepared light beams special by image [3].

Meaning an opportunity to work further with a state, this experimental scheme [2, 3, 22] has become already a classic. There are two participants in the game - Alice and Bob, and a source of photon pairs described by a state . The task of Alice is to transfer a photon 1 available to her to Bob, who is placed somewhere far from her. However, Alice does not use a usual classical way, and acts as follows. Alice and Bob simultaneously receive a pair of photons 2 and 3, described by a state. Alice receives photon 2, and Bob - photon 3. Alice "mixes" photon 1 and 2. Thus in one case from four she has an opportunity to observe the condition

$$\left|\Psi^{-}\right\rangle_{12} = \left(\left|\updownarrow\right\rangle_1 \left|\leftrightarrow\right\rangle_2 - \left|\leftrightarrow\right\rangle_2 \left|\updownarrow\right\rangle_1\right) / \sqrt{2}$$

As soon as this is found, immediately photon 3 passes in the initial state of a photon 1. The reason is as following. Supervision by Alice of a condition means that for any state of photon 1, photon 2 will be in an opposite state of polarization. But as photons 2 and 3 are also in a mixed state, photon 3 must be able to be orthogonal to state 2, i.e. in the state of a photon 1. Thus teleportation of photon 1 from Alice to Bob can occur, irrespective of the distance between them. Teleportation it is carried out instantly.

The truth is, during such teleportation the polarizing state of photon 1 for Alice is not known, since the photon 1 mixes up with photon 2, forming a mixed state. The described procedure for teleportation is faultless from the point of view of a formalism of quantum mechanics. Nevertheless, in the physical sense of basic conditions Alice remains unclear -also, there is no clear resolution of the Einstein-Podolsky-Rosen (EPR). How can we understand the fact that, upon measurement of the polarization of one of the photons, the polarization of the other photon is instantly determined, in spite of the fact that they are separated by very large distances and any information concerning the state of the first photon is certain to arrive after a certain time interval?

The paired photons described by state (2), or their linear combinations, are usually called EPR-photons or mixed photons. Until we understand the physical reason of instant correlations in properties of these photons, we shall not understand the physics of teleportation, despite of all faultlessness of logic constructions.

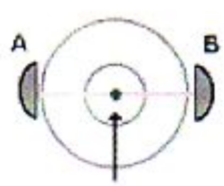

Fig. 14. The circuit of experiment with reading, record and storage of the information

It is not surprising that teleportation and the problem of the EPR paradox can also be approached from the positions of existence of localized light. One of the variants of the EPR-paradox is the following. The s-scattering of a photon by a spherical particle, (i.e. scattering wave is spherical and isotropic) is considered (see Fig. 14). Let the scattered photon approach the detector at a point A (Alice). This act of registration allows us to draw the conclusion, that at the same moment in time this scattered photon reaches the detector located, for example, in a point B

(Bob), outstanding from A by as much as the length of a diameter. Thus any information from B to A can be transferred after the expiration only quite certain time interval. If not considering the possibility of superluminal-velocity propagation of signals, then the situation can be understood as follows. What if the registered act of arrival of light to A is connected not with a scattering photon, but with the "long" photon brought down from "tube" AB? We "catch" its left "end". That at the same moment in time there is "registration" in a point B of its "right" end, it is nothing strange. Superluminal-light propagation of a signal does not occur, as there is no propagation of a signal in general. The "long" localized photon is pulled out from "cavity" due to gearing rigid Antoine rings of the localized and scattering photons. This gearing is similarly considered above in FC.

Let's assume now, that any photon scattering on a particle is not present. And there is a "cavity" between Alice and Bob, filled with the photon located in it. Alice sends in this cavity the photon.

This photon hooks on the localized photon by the mechanism known to us and gives Bob. Thus, as a result of Alice's action, Bob immediately receives some information, the truth it is not known what as many properties of the localized photon to anybody are unknown.

As we see, in this case for instant "transfer" of a signal instead of a pair of EPR-correlated photons it is enough to deal with the unique localized photon. However, if so desired, it is possible to observe it as a pair of virtual photons cooperating among themselves (a photon of the top coast and a photon on the bottom coast of Figures 1 and 2). Besides in [3] the EPR-pair teleported to Bob the unknown photon Alice. In our case photon Alice, having influenced on the left end to anybody of the unknown localized photon, gives its right end to Bob. In this lie all the difference and similarities of the two mechanisms of teleportation.

Does this contradict teleportation on the basis of the special theory of relativity which states that the speed of transfer of information can not surpass the velocity of light? Obviously, no. In the case of Bennet type teleportation [2, 3] the unknown signal is instantly transferred anywhere. Within the framework of our model in general nothing is transferred. Bob receives what already is near to him, but up to 0 up to $2\varpi_i$, where ϖ_i is the frequency of a incident photon.

The physics of the observed inelastic scattering is very simple. We shall establish its basic laws on an example of inelastic scattering with excitation volume and surface plasmons in a small metal particle. Surface plasmons represent the electromagnetic modes of the smallest metal particles [16]. They are connected to own oscillations interacting through coulomb potential electron conductivity of a particle. These modes show themselves as sharp resonances in spectra elastic scattering and absorption of light by small metal particles. Frequencies of surface plasmons depend on concentrations of conduction electrons inside particles belonging to the limit between visible - ultraviolet light and are defined by the following formula:

$$\omega_l = \omega_0\sqrt{\frac{l}{2l+1}},$$

$$\omega_0 = \sqrt{\frac{4\pi n_0 e^2}{m}} ,$$

where n_0 is density of conduction electrons in metal, and e and m are the charge and mass of electron.

Dipole-surface plasmon excitation, and frequency-volume plasmon excitation.

A similar sort of fluctuation also exists in thin metal films which usually model mirror coverings, such as those used in the observed laser. Here their properties are named "plasmon-polariton modes", but at this stage we are interested only in physics of the phenomenon.

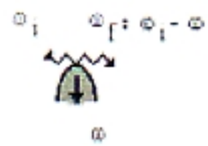

Fig. 15. The classical circuit of inelastic scattering of photons

The classical mechanism of inelastic scattering of light off a particle consists of the following. The photon reaching a particle raises in it the fluctuation of electronic density, transferring to it a part of its own energy. This process is symbolically represented in Fig. 15. The shaded angle represents the fluctuation of electronic density which is a superposition of a large number of the electron-hole pairs excited by the photon. The cross-section of the process is especially great, if the photon manages "to shake" dipole surface and volume plasmons. For a particle whose size is much less than the length of a wave of incident photon, the differential cross-section of inelastic scattering follows [7]

$$\frac{d^2\sigma}{dn_f} = \frac{1}{3\pi} r_0 \lambda_0 \frac{\omega_0^2 R^3}{c^3\left(\omega_i - \omega_f\right)^2} \frac{\omega_f}{\omega_i}\left(\omega_i^2 + \omega_f^2 - 2\omega_i\omega_f \cos\Theta\right)\left[\omega_0 \int \delta\left(\omega_i - \omega_f - \omega_0\right)d\omega_f + \omega_1 \int \delta\left(\omega_i - \omega_f - \omega_1\right)d\omega_f\right]$$

(1),

where n_f is the unit polarization vector in a direction of scattered quantum, θ is the angle of scattering, R is radius of a separate particle of pair, and r_0 and λ_0 are the classical radius of electron and Compton length of an electron wave respectively.

If the energy deposited by a photon, will suffice on excitation plasmons, $\varpi_i - \varpi_f > \varpi_o$

$$\frac{d\sigma}{dn_f} = \frac{r_0\lambda_0}{6\pi}\left(\frac{R}{c}\right)^3 \left\{ \frac{(\omega_i - \omega_0)}{\omega_i}\frac{\omega_o^2}{\omega_0}\left[\omega_i^2 + (\omega_i - \omega_0)^2 - 2\omega_i(\omega_i - \omega_0)\cos\Theta\right] + \right.$$
$$\left. \frac{(\omega_i - \omega_1)}{\omega_i}\frac{\omega_o^2}{\omega_1}\cdot\left[\omega_i^2 + (\omega_i - \omega_1)^2 - 2\omega_i(\omega_i - \omega_1)\cos\Theta\right] \right\} \qquad (2)$$

As we see from the analysis of expression (1), only the discrete transfer of the photon's energy appropriate to excitation volume and **surface dipole plasmons** is possible. This is reflected by the presence of Dirac’s delta functions in the appropriate expression. The cross-section of this process is less than the cross-section of elastic scattering of light by particle in time $r_o\lambda_o\lambda / R^3$

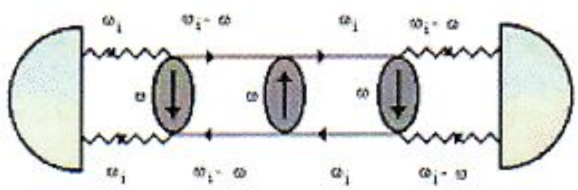

Fig. 16. The offered mechanism of inelastic scattering of photons

The mechanism offered by us is essentially different. We shall assume that between a source of radiation and the detector on a closed loop the photon continuously "circulates", repeatedly exchanging with itself fluctuations of the electronic density raised in some system scatterers, taking place between a source and the detector. This process is represented in Fig 16. The shaded loops describe the propagation of fluctuation of electronic density to system scatterers - so-called irreducible polarization operators density - density or is simple correlators of electronic density [24]. Wavy lines are the wave functions of real photons, horizontal lines are the photon’s propagators. For example, the top of any odd loop describes the birth of fluctuation of electronic density by a photon due to reduction of its energy, and the bottom is compression due to reception by a photon of energy. Our photon exchanges energy with itself an infinite number of times during inelastic scattering. As a result there is an original exchange interaction of a photon with itself, similar to usual exchange interaction of quantum chemistry. This interaction keeps a photon in the "cavity" between a source and the detector, proving our assumption of the possibility of "circulation" of a photon between a source and the detector.

The differential cross-section of the observed process looks like

$$\frac{d\sigma}{dn_f} = \frac{1}{4}\frac{r_0\lambda_0}{6\pi}\left(e_i e_f\right)^2\left(\frac{R}{c}\right)^3\left\{\frac{(\omega_i-\omega)}{\omega_i}\frac{\omega_o^2}{\omega_0}\left[\omega_i^2+(\omega_i-\omega)^2-2\omega_i(\omega_i-\omega)\cos\Theta\right]+\right.$$

$$\left.\frac{(\omega_i-\omega)}{\omega_i}\frac{\omega_o^2}{\omega_1}\cdot\left[\omega_i^2+(\omega_i-\omega)^2-2\omega_i(\omega_i-\omega)\cos\Theta\right]\right\} \tag{3}$$

where e_i also e_f are unit vectors of polarization and ω - deposited frequency.

Between expressions (2) and (3), despite of their external similarity, there is a basic difference.

Within the framework of the classical mechanism, only a discrete transfer of energy of the incident photon, appropriate to excitation volume (with frequency) and dipole surface plasmons (frequency) of particles is possible (any other transfer of energy is forbidden from appearing in (1)]). As to the offered mechanism red shift of frequency of a incident photon can be anyone in an interval from 0 up to ϖ_i. If, result of process is generation of radiowaves observably experimentally.

Alongside with "red" displacement a "blue" shift in frequency of a photon is also possible. Thus, the spectrum of inelastic scattering of light in view of localization should occupy the entire range of frequencies from 0 up to $2\varpi_i$. A similar type of effects is observed in experiments with giant combination scattering of light by the molecules adsorbed on a surface of the smallest metal particles . It has been called "a giant white background", and remains a riddle until now [27].

The processes in Fig. 16 qualitatively explain the increased background of radio emission of the observed laser. Quantitative calculation certainly demands the account of specificity of system.

The biological implications of quantum nonlocality for the understanding of genetic information

Let us propose a possible modification of the central dogma of molecular biology seen from the position of quantum nonlocality of the genome: the emergence of a new semiotic figure - the Einstein-Podolsky-Rosen effect in the activity of the genetic apparatus.

In 1935 A. Einstein and his colleagues B. Podolsky and H. Rosen [4] [EPR]stated an idea, whose essence (by example of fundamental particles) is reducible to the following. The quantum object, which can be, for example, two bound photons, maintains connectivity during the fission of a certain kind of informational link (entanglement effect). Thereby the quantum status of one photon, e.g. the polarization or the spin, can be instantaneously, i.e., in zero time, transmitted to another photon, which becomes analogous to the first one. During this event, the first photon can collapse, disappear, or vice versa. The photons can be at any distance from each other. This purely imaginary experiment was subsequently called an effect, a paradox or channel of Einstein-Podolsky-Rosen (EPR). The term "Quantum NonLocality"[wormhole] [EPR] was also accepted as a synonym of this phenomenon , underlining an instantaneous distribution in space-time of states, bound by means of the quantum-nonlocal channel. The fundamental principle of causality seems to be broken: the consequence and the cause are not divided by time if time is understood as a way of organization of an event sequence. Therefore, Einstein and his co-authors, who at that historical moment did not have knowledge about a complex time structure (for example, about its fractality), estimated their merely theoretical, but, nevertheless, strongly formalized, model as inapplicable to practice and experiment. This status of an antagonism of the theory and the visible physical reality lasted for about 30 years until D. Bell's study was published - which developed, completed and updated the EPR idea. The main difficulty in developing the EPR-idea was the necessity to avoid disturbing through theoretical deliberations the fundamental principle of quantum mechanics as stated by Heisenberg with reference to a dual, material-wave status of quantum objects. This is the principle of uncertainty regarding the impossibility of simultaneous exact measurement of properties, e.g., of the photon as a wave and as a elementary particle. This problem was solved, after the possibility of a simultaneous "entangled" status of fundamental particles was experimentally proven, in which the opposite quantum states of two or more quantum objects coexisted and were not divided by time structures.

Such "confusion" might be an elementary basis for the transmission of genetic (and mental) information between organisms, which can be considered as a continuum of fundamental particles, and in which the properties of a microlevel are peculiarly reflected on a macrolevel. To rephrase, semantic semiotic structures of the genome of multicellular biosystems have the ability to spread instantaneously through the chromosome continuum of biosystems. Being in such an entangled status, both particles remain a part of the same quantum system, so that everything you do with one of them, for example, to measure polarization, predictably influences another. Bennet and his colleagues argued that the entangled particles can serve at their fission in space as mutual "carriers" of their states and then of information to each other, since any state of a particle is already information. However, in this case the information has to be considered in a wide sense, namely as any change. For the experimental proof of the existence of EPR-channel, three photons have to coexist: one entangled and two scattering, as it was realized by research studies of two groups - the Viennese team headed by Anton Zeilinger, and the Rome team of Francesco de Martini. The experiments of Zeilinger [3] and De Martini et al. proved the feasibility of EPR principles in practice for transmission of states of polarization through light guides between two photons by means of a third one at distances up to 10 kilometers. In the aftermath of this discovery, expandable programs of application of this effect to build quantum optical computers, where photons will serve as a medium, are discussed in leading countries. Their operational speed and the information volumes will exceed those of existing computers by a factor of thousands.

We believe that the phenomenon of Quantum NonLocality is used by biosystems on a chromosome level as one of the key factors of self-organization. This is rather attractive both in a philosophical as well as in the pragmatic sense. Such idea correlates very well with our data about the wave sign (semiotic) assignment of gene-information-metabolic and mental areas of biosystems. In this sense the first, however weak, attempt was made to understand an applicability of the EPR concept to biosystems, where a theoretical analysis was undertaken comprising generally the definition, that the perception of a reality by organisms is mainly based on another and, in a particular sense, more effective principle, than one which is used by more formal procedures in sciences. From the authors' point of view, this principle is implemented under particular conditions in "non-physical" intercommunicative and non-statistical sign interactions between spatially disjointed biosystems, i. g. in telepathy. Why they are "non-physical" and how the EPR is related to them, remains unclear, as does the question about their unique appearance in telepathy.

Once again we posit this problem, this time in a more narrow sense and without addressing prematurely the telepathy problem: Is the Quantum NonLocality phenomenon at work through the activity of the genetic apparatus of higher biosystems? If yes, how does it work?

It is clear that even the suppositions here will have a very preliminary character; however, the need for working hypotheses has been due for a long time already. In our field versions of genome activity the EPR-effect is a rather advisable link, which can conclude a chain of reasoning about semiotic-wave chromosome functions quite logically. Those wave principles of cellular nucleus activity, in our argument, explain how the construction of the time-space macrostructure of higher biosystems works along the wave and semantic operational vectors of the genetic apparatus. Such vectors work through mechanisms of a holographic storage of chromosome continuum and through quasi-speech paths of DNA-RNA-structures, which encode the space-time of organisms. The reading or scanning of genome-biocomputer is executed by means of endogenous laser radiation and soliton excitations of gene structures. Genomic NonLocality is already included in its holographic information. Such sort of information is distributed in the genome as in the hologram and/or quasi-hologram, and - as in a fractal structure - is simultaneous. It can take place, if the genome is interpreted from material positions only. At such level of the genetic information the quantum wave NonLocality does not work yet. If the genetic hologram is scanned by the wave method, for example, by means of laser radiation of the chromosome continuum, the substance of chromosomes alienates the semiotic-figurative (sign) wave front sets as directing vectors (programs) of the morphogenesis. Particularly, this is necessary for maintaining a stable time-space structure of the biosystem. With this purpose, the genome generates stage by stage and layer-wise the scheme of potential material frames of an organism through some kind of a "theoretical" (wave) model - a plan of potential material organism structure. This is only one of the wave vectors by construction of multivariate frame of the biosystem. In this view, the model of a material-wave organization of biosystems is not complete yet and needs further development.

As one stage of such development of our notions regarding the genome’s semiotic areas in higher organisms, the EPR-mechanism can function, at least, at the level of photon laser and radio wave processes in the chromosome and proteins of organisms. The EPR-mechanism, which manages the vital processes, gives totally new potencies to cells and tissues, namely the capacity to actually instantaneously transmit huge information pools between all cells and tissues of the biosystem, for example, through the polarization channel of photons and radio waves. If such a way is possible, it would be an explanation for why the strategic sign biomolecules - nucleic acids and proteins - have a L-isomeric composition of elements, spiral curling and, accordingly, extremely expressed ability for dispersion of optical gyration, circular dichroism and birefringence. According to this interpretation, the fact of isomeric quantum nature of bioorganic molecules gains a new quality. The asymmetry of bioorganic molecules (and the isomerism caused by it) means that the biosystem has a possibility for a fast auto-scanning of polarization, of holographic and other material-wave information on the state of its own metabolism and its own current momentary time-space structure. From this point of view, an unexpected importance for the explanation of prion pathogenesis mechanisms (Creutzfeld-Jacob syndrome, family insomnia, mad cow decease, so called "khourou" illness) is gained by the capacity for birefringence of PrPsc (prion proteins) aggregates - i. e. for an abnormal modulation of vectors responsible for the polarization of own informational photon currents through an increasing protein mass of PrPsc in the brain.

The success of experimental quantum teleportation was achieved, in particular, because wave-guides (light-guides), lasers with ultra-violet o pump and polarizers were used to generate photons, spread them in space and "program" them. The above mentioned components have formally bioanalogies in the form of microtubules of the cell nucleus and cytoplasm, coherent DNA and chromosome radiation. Simultaneously, the latter are information biopolarizers of their own laser radiation. The proof, that the DNA and chromosomes is a laser active environment, was given in our direct experiments.

Let us suppose, that the EPR-factor exists *in vivo* as the controlling factor of a current status of an adult organism from the micro up to macrolevel. How it is implemented in embryogenesis? It could serve as an intermediary for the intracellular and intercellular transmission of wave copies of DNA-RNA in different phases of their polysyllabic operation. The wave memory effects, obtained by us in 1985 and 1991 on the basis of DNA preparations and separately by the Pecora group in USA in 1990, might be a result of the local quantum teleportation, which takes place spontaneously at a laser probing of DNA gels during the spectroscopy by a dynamic laser light distributing method. In this variant of interaction between coherent photons and biostructures the latter could probably appear as a mesomorphic system of optically active light guides spreading polarized photons in space and interchanging information subsequently between them. In the same series of experiments, another effect with a new type of genetic structures memory was detected on the basis of an Fermi-Pasta-Ulam-phenomenon [27]. It is accompanied by the emergence of temporarily isomorphous autocorrelation functions of light distribution during the investigation of preparations of DNA, 50S ribosome subunits E.coli and collagen [27].

If the EPR-factor works in biosystems, it is legitimate to question, why the organisms are not restricted to this very efficient form of handling bioinformation and why do they need nervous impulses too, whose velocity (8-10 m/sec) falls far behind the light speed in the DNA quantum biocomputer of living cells? We could only presume that higher organisms need the nervous system to slow down information processes, which are too fast and could not be matched by the level of the biosphere evolution. The functions of the nervous system and the genome's quantum NonLocality are complementary and coexist, sometimes producing surges of paranormal abilities of human "calculation machines", or in telepathy, let alone many other "anomalies" of biosystems which we partially theoretically interpreted earlier [27].

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