EDITORIAL

Disease Transmission by Spin Supercurrent

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Abstract

At present only one way of transmission of disease from an ill body organ to a healthy body organ is known: by means of living pathogenic microorganisms. It is shown in this work that there exists one more way of disease transmission from an ill body organ to a healthy one: by means of spin supercurrent. Spin supercurrents may not only play the role of microorganisms in transmission of diseases but transmit as well the diseases that are absolutely non-contagious from the standpoint of medical science. It is remarkable that spin supercurrent may transmit the peculiars of structure of DNA from one biological system (BS) to another. The effect of spin supercurrent is especially pronounced if the interacting body organs have some common characteristics, for example, in the case of organs of identical twins.

Keywords: medicine, biology, disease transmission, spin supercurrent, virtual photon, quantum mechanics

1. Introduction

At present only one way of transmission of disease from an ill body organ of a biological system (BS) to a healthy body organ of another BS is known: by means of living pathogenic microorganisms. It is shown in this work that there exists one more way of disease transmission from an ill body organ to a healthy one: by means of spin supercurrent. The consideration of this way is based on two conceptions of quantum mechanics.

The first conception: between the objects having spin, besides the well-known interactions such as magnetic, electric and gravitation ones, spin supercurrent may emerge. Spin supercurrent was studied in experiments with superfluid ^{3}He-B, and Yuri Bunkov, Vladimir Dmitriev and Igor Fomin were awarded the Fritz London Memorial Prize in 2008 for this investigation [1-3].

The second conception: a quantum object (object whose state is described by wave function) which is a singularity in electric or magnetic fields (electric charge or/and magnetic dipole) creates a pair of oppositely charged electric particles, a so-called virtual photon having precessing spin [4]. Since virtual photons have spins, spin supercurrent may arise between them. As all bodies consist of quantum objects, consequently spin supercurrents may emerge between all bodies, living and non-living.

The value of spin supercurrent depends on the difference in the values of respective precession characteristics of spins of objects between which the spin supercurrent arises; these characteristics are: the angles of precession and deflection. The action of spin supercurrent tends to equalize the values of respective angles. That is, one may say that spin supercurrent transmits the properties of one object to another object.

One of the conditions of effective action of spin supercurrent, that is the condition of maximum decrease in the difference between the characteristics of precession of spin is the fulfillment of the following condition:

$$\Delta\boldsymbol{\omega} \to 0, \tag{1}$$

where $\Delta\boldsymbol{\omega} \to 0$ is the difference in the values and orientations of precession frequencies of spins of interacting quantum objects. If spin supercurrent arises between virtual photons, then, according to [5], the value of the precession frequency ω of virtual photon spin is determined by the energy of quantum object creating this virtual photon; orientation $\boldsymbol{\omega}/\omega$ of the precession frequency is determined by the direction of velocity $\mathbf{u}$ of the quantum object. Thus, for fulfillment of condition (1) the following must hold:

$$\Delta U_q \to 0, \tag{2}$$

$$\Delta(\mathbf{u}/u) \to 0, \tag{3}$$

where ΔU_q and $\Delta(\mathbf{u}/u)$ are the differences between the energies and between the directions of velocities of quantum objects creating the interacting virtual photons. If spin supercurrent arises between body organs, then conditions (2) and (3) will hold for quantum objects that constitute those organs if the latter belong to biological systems (BSs) having common characteristics: for example, belong to relatives (in particular, identical twins) or to the people who were together for a long time. In the latter case, the action of spin supercurrent between them for a lot of years may have equalized the values of some characteristics of the BSs.

The change in characteristics of spins of virtual photons influences the orbital angular momentum of quantum objects creating these virtual photons [6], which in turn may influence the structure of molecules containing those quantum objects. Based on the works [7-9] (in detail see Section 2) it may be supposed that the molecule whose structure may be affected by the action of spin supercurrent may be a DNA macromolecule.

The disease transmission by spin supercurrent may take place not only between body organs belonging to different BSs but between organs of the same BS as well. The most pronounced changes occur in the organs similar in their functions to those where the initial changes occurred (for these organs condition (1) must be fulfilled). We may suppose that in such a way, for example, metastases emerging from neoplasms may spread.

Below the peculiars of disease transmission by spin supercurrent will be considered in more detail.

2. Some Properties of Spin Supercurrents

1) Spin supercurrent arises between spin structures having precessing spin. The precessing spin **S** has the following characteristics: the frequency of precession, the angles of precession and deflection. Figure 1 shows the schema of two spin structures with the following characteristics: α_1 and α_2 are precession angles, β_1 and β_2 are deflection angles, $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ are precession frequencies oriented along axis z. The spin supercurrent $(I_{ss})_z$ oriented along axis z is determined as

$$(I_{ss})_z = g_1(\alpha_1 - \alpha_2) + g_2(\beta_1 - \beta_2), \quad (4)$$

where g_1 and g_2 are coefficients depending on β_1 and β_2.

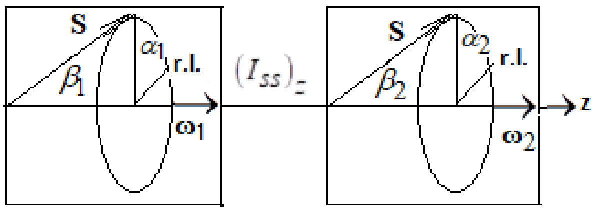

Figure 1. The schema of spin structures. $(I_{ss})_z$ is spin supercurrent between the spin structures with the following characteristics: α_1 and α_2 are precession angles, β_1 and β_2 are deflection angles, $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ are precession frequencies oriented along axis z, **S** is spin, r.l. is a reference line.

The values of precession angles at arbitrary time t, $\alpha_1(t)$ and $\alpha_2(t)$, are related to precession frequencies $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ respectively as:

$$\alpha_1(t) = \omega_1 t, \quad (5)$$

$$\alpha_2(t) = \omega_2 t. \quad (6)$$

It is assumed that at *t*=0 the values of precession angles are equal to zero.

2) The spin supercurrent tends to equalize the respective characteristics of spins of interacting spin structures. As a result of action of spin supercurrent, the following inequalities take place:

$$|\alpha_1 - \alpha_2| > |\alpha_1' - \alpha_2'|, \tag{7}$$

$$|\beta_1 - \beta_2| > |\beta_1' - \beta_2'| \tag{8}$$

where α_1' and α_2' are the values of precession angles α_1 and α_2 of spins of interacting spin structures after the action of spin supercurrent, β_1' and β_2' are the values of deflection angles β_1 and β_2 of spins of interacting spin structures after the action of spin supercurrent. The maximum difference between the right and left parts of conditions (7)-(8) takes place under two conditions: first, the orientation of frequencies $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ is in one direction; secondly, there is a negligible difference between values of these frequencies. That is, the following inequalities must hold:

$$\boldsymbol{\omega}_1 / \omega_1 - \boldsymbol{\omega}_2 / \omega_2 \to 0, \tag{9}$$

$$\omega_1 - \omega_2 \to 0. \tag{10}$$

The latter condition follows as well from the requirement of absence of precession phase slippage (drop), in detail see below.

3) At a definite difference $\Delta\alpha_c = \alpha_1 - a_2$ in the precession phases of spins of interacting spin structures, a precession phase slippage (drop) takes place. The critical spin supercurrent $(I_{ss})_z^c$ corresponds to the value $\Delta\alpha_c$. Figure 2 shows the possible variants of dependence of spin supercurrent between two spin structures with respective precession frequencies ω_1 and ω_2 on the hypothetical difference in the precession angles, $\Delta\varphi$, which is determined as $\Delta\varphi = (\omega_1 - \omega_2)t$. Up to the value of $\Delta\varphi$ equal to $\Delta\alpha_c$, the hypothetical difference in the precession angles is equal to the precession angles difference $\Delta\alpha$ ($\Delta\varphi = \Delta\alpha$) determining the spin supercurrent, according to Eq. (4). We assume that at *t*=0 $\Delta\alpha = 0$.

In figure 2, the line *a* – *b* corresponds to the change in the supercurrent in the process of phase slippage. Variants (a) and (b) correspond to two cases of changes in spin supercurrent during the precession phase slippage: with a change in the sign and without a change in the sign.

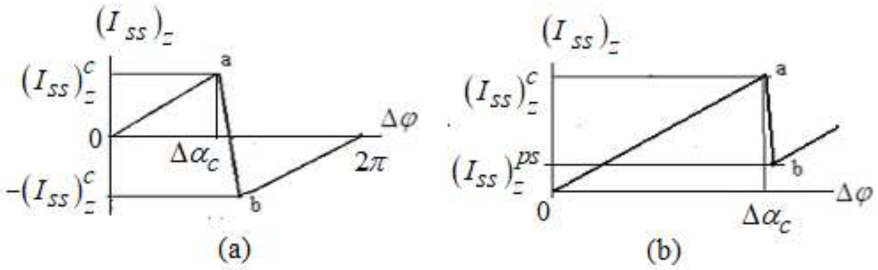

Figure 2. The character of dependence of spin supercurrent $(I_{ss})_z$ between two spin structures on the hypothetical difference in the precession angles $\Delta\varphi$. $(I_{ss})_z^c$ is the critical spin supercurrent. The line $a-b$ corresponds to the phase slippage, $(I_{ss})_z^{ps}$ is the residual current, $\Delta\alpha_c$ is the phase difference at which the phase slippage takes place.

As a result of phase slippage, the drop in the value and change in the sign of spin supercurrent may take place. Consequently, Eq. (4) holds true in the absence of phase slippage. From Eqs. (5)-(6) it follows that the possibility of phase slippage is negligible if the difference between precession frequencies ω_1 and ω_2 satisfies condition (10).

4) The effectivity of action of spin supercurrent between spin structures does not depend on the distance between them. For example, the action of spin supercurrent in superfluid ^{3}He-B, where the investigation of spin supercurrent was conducted [1-3], was limited only by the volume of superfluid.

5) That the spin supercurrent is a process equalizing the order parameter in the quantum liquid described by a single wave function (superfluid ^{3}He-B) testifies that this process is dissipation-free and its speed y_{ss} theoretically equals infinity, that is greater than the speed of light. (The dissipation-free process is not accompanied by emergence of mass; consequently, the spin supercurrent is an *inertia free process* and consequently the postulate of special relativity concerning the speed of light does not apply to spin supercurrent, because the postulate is valid for *inertial systems* only [10]).

6) Spin supercurrent is not an electric or magnetic process and, consequently, it is not screened by electromagnetic screens.

3. Quantum Correlations of Quantum Objects

According to postulates of quantum mechanics, a quantum object (object whose state is described by wave function) which is a singularity in electric or magnetic fields (electric charge or/and magnetic dipole) creates a pair of oppositely charged virtual particles, a so-called virtual photon [4]. The virtual photon has precessing spin that is characterized by frequency of precession and angles of precession and deflection. As virtual photons are spin structures, spin supercurrent may arise between them and affect their characteristics. The values of characteristics of virtual photons are determined by the characteristics of quantum objects creating these virtual photons [5]. For example, the frequencies of precession (respectively $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$) and angles of deflection (respectively β_1 and β_2) are determined as:

$$\omega_1 = \left(U_q\right)_1 / \hbar , \tag{11}$$

$$\omega_2 = \left(U_q\right)_2 / \hbar , \tag{12}$$

$$\boldsymbol{\omega}_1 \uparrow\uparrow \mathbf{u}_1 , \tag{13}$$

$$\boldsymbol{\omega}_2 \uparrow\uparrow \mathbf{u}_2 , \tag{14}$$

$$\sin\beta_1 = u_1 / c , \tag{15}$$

$$\sin\beta_2 = u_2 / c , \tag{16}$$

where $\hbar$ is the Planck constant, $\left(U_q\right)_1$ and $\left(U_q\right)_2$, $\mathbf{u}_1$ and $\mathbf{u}_2$ are respectively energies and velocities of the first and second quantum objects creating interacting virtual photons.

As a result of action of spin supercurrent, according to (7)-(8), the difference between the values of characteristics of interacting virtual photons decreases, then, in accordance with Eqs. (4)-(5) and (11)-(16), the difference between the values of respective characteristics of quantum objects creating these virtual photons also decreases. Consequently, one may say about a distant transfer of properties of one quantum object to another. The phenomenon of distant transfer of properties between quantum objects with the properties satisfying conditions (2)-(3) are well-known and has been studied for almost a century, being termed as quantum correlation [11-14]. At present in quantum mechanics this phenomenon is frequently called “teleportation” as well.

All experimentally observed properties of quantum correlations are in accordance with the properties of spin supercurrent. The unique experiments were conducted in 2017 by Ren JG et al. They conducted the first quantum teleportation of independent single-photon from a ground observatory to a low Earth orbit satellite - through an up-link channel (sputnik channel) at a distance of up to 1400 km [15].

Below we shall consider the peculiars of the quantum correlations (teleportations) between BS.

4. Some Features of the Quantum Correlations Between Biological Systems

Let us consider some experimental facts showing that disease transmission between BSs may be classified as quantum correlations between these BSs.

1) In 1991, Yu. Tyagotin carried out the following experiment [16]. The cells grown in the same medium (the cells containing chromosomes of normal splenocyte of mice were used) were divided into two parts. After that one of the parts was placed in noxious conditions. As a result, not only the cells of that part perished, but also perished the cells of other part that were in favorable conditions.

2) The author of this work knows that two nine years old twins had an appendicitis attack an hour apart and both boys were subjected to urgent operation.

3) The investigation of great number (~500) of identical twins showed that only near 40% of diseases have a genetic component though identical twins share 100 percent of their genetics. The special notation was introduced: Twin Correlation [17].

4) In the book by Paolo Bellavite and Andrea Signorine “The Emerging Science of Homeopathy” [18] we find: “There is some preliminary evidence demonstrating a homeopathic effect not only of solutions but also of closed ampoules containing solutions and placed in contact with the system to be regulated (human or animal)." It should be noted that the solution "demonstrating a homeopathic effect" is a biologically active substance and, according to research by Boldyreva [19], condition (1) for the spin precession frequencies of virtual photons created by quantum objects of BS, on the one hand, and those created by quantum objects of biologically active substance, on the other hand, hold true. Consequently, in this case the quantum correlations take place between these virtual photons and, according to the properties of quantum correlations, they cannot be shielded by electromagnetic screens and by molecular substance.

Let us consider some features of the quantum correlations in transmission of characteristics between BSs. As it was proved in Section 3, quantum correlations are accomplished by spin supercurrent.

1. Transmission of characteristics of one BS (BS1) to another BS (BS2) by means of spin supercurrent $(I_{ss})_z$ may be illustrated by a diagram in figure 3.

BS1 and BS2 in this figure have respectively the following characteristics: $\mathbf{S}_1$ and $\mathbf{S}_2$ are spins, $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ are the precession frequencies, β_1 and β_2 are the deflection angles, α_1 and α_2 are the precession angles relative to a reference line (r.l.), $(I_{ss})_z$ is the spin supercurrent component aligned with axis **z.**

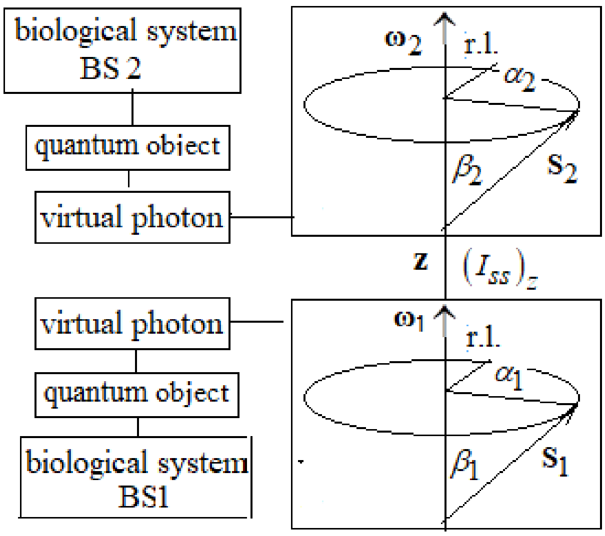

Figure 3. The scheme of interaction of two biological systems BS1 and BS2 with the following characteristics of virtual photons created by quantum objects of these BSs: $\mathbf{S}_1$ and $\mathbf{S}_2$ are spins, $\boldsymbol{\omega}_1$ and $\boldsymbol{\omega}_2$ are the precession frequencies, β_1 and β_2 are the deflection angles, α_1 and α_2 are the precession angles relative to a reference line (r.l.), $(I_{ss})_z$ is the spin supercurrent component aligned with axis **z.**

Let us consider the case where a disease influences the energy characteristics of BS, that is, the changes in values of $(U_q)_1$ and $\mathbf{u}_1$ of quantum objects of ill body organ take place. Then the following stages of disease transmission may be outlined:

- according to Eqs. (5), (11), (13), and (15), changes in the values of precession angle α_1 and deflection angle β_1 of spin of virtual photons created by those quantum entities take place;
- according to Eq. (4), the change in α_1 and β_1 influences the value of spin supercurrent $\left(I_{ss}\right)_z$ (it is supposed that $\boldsymbol{\omega}_1 \uparrow\uparrow \mathbf{z}$ and $\boldsymbol{\omega}_2 \uparrow\uparrow \mathbf{z}$) between ill body organ of BS1 and healthy body organ of BS2;
- according to (7)-(8), as a result of action of spin supercurrent $\left(I_{ss}\right)_z$ changes in the values of angle of precession α_2 and angle of deflection β_2 of spins of virtual photons created by quantum objects of healthy body organ of BS2 take place;
- according to Eqs. (6), (12), (14) and (16), the changes in the values of α_2 and β_2 result in changes in the energy characteristics, $\left(U_q\right)_2$ and $\mathbf{u}_2$, of quantum objects of healthy body organ of BS2.

Thus, the healthy body organ of BS2 acquire the properties of ill body organ of BS1: that is, changes in the energy characteristics take place.

Let us consider a concrete example of changes in energy characteristics: an increase in the temperature of BS1 by Y degrees at t=0. Let us introduce the following denotations: $(\omega_1)_0$, $(\alpha_1)_0$, $(\beta_1)_0$ are respectively the frequency of precession, angle of precession and angle of deflection characterizing BS1 before the increase in temperature; $(\omega_2)_0$, $(\alpha_2)_0$, $(\beta_2)_0$ are similar characteristics of BS2. (For simplicity sake we do not mention here that these characteristics are characteristics of spins of virtual photons created by quantum objects of BS1 and BS2). If the energy of BAS1 equals the energy only of thermal motion and before the increase in temperature the temperature was equal to T_0 (that is, the energy was equal to kT_0), then the speed $(u_1)_0$ of quantum object of BS1 before the increase in temperature was determined as:

$$(u_1)_0 = \sqrt{2kT_0 / m_q}\,, \tag{17}$$

where k is the Boltzmann constant, m_q is the mass of quantum object.

According to Eqs. (15) and (17), temperature T_0 of BS1 at t=0 can be expressed through the angle of deflection $(\beta_1)_0$ as:

$$T_0 = m_q c^2 \left(\sin\left(\beta_1\right)_0\right)^2 / (2k) \tag{18}$$

Let us determine the spin supercurrent performing transmission of disease from BS1 to BS2 at arbitrary time $t=\tau$ supposing that during time interval $0-\tau$ the changes in the characteristics frequencies and deflection angles of BS1 and BS2 as a result of action of spin supercurrent are negligible. With this aim let us determine some characteristics of BS1 and BS2 at $t=\tau$.

The speed $(u_1)_\tau$ of quantum object of BS1 (taking into account that the energy of BS1 at $t=\tau$ equals $k\left(T_0+Y\right)$) is determined as:

$$(u_1)_\tau = \sqrt{2k\left(T_0+Y\right)/m_q}\,, \tag{19}$$

According to Eqs. (15) and (18-19), at $t=\tau$ the angle of deflection for BS1, $(\beta_1)_\tau$, equals:

$$(\beta_1)_\tau = \arcsin\left(\sqrt{1+\frac{2kY}{m_q c^2\left(\sin(\beta_1)_0\right)^2}}\cdot\sin(\beta_1)_0\right). \qquad (20)$$

According to Eqs. (5) and (11),

$$(\alpha_1)_\tau = (\alpha_1)_0 + \tau\left((\omega_1)_0 + kY/\hbar\right). \qquad (21)$$

According to Eq. (6),

$$(\alpha_2)_\tau = (\alpha_2)_0 + \tau(\omega_2)_0 \qquad (22)$$

According to Eq. (4), spin supercurrent $(I_{ss})_z$ at time $t=\tau$ is determined as:

$$(I_{ss})_\tau = g_1\left((\alpha_1)_\tau - (a_2)_\tau\right) + g_2\left((\beta_1)_\tau - (\beta_2)_0\right). \qquad (23)$$

The values of $(a_1)_\tau$, $(a_2)_\tau$, $(\beta_1)_\tau$ are determined by Eqs. (20)-(22). As follows from Eqs. (7)-(8) and (20)-(21) after the action of spin supercurrent the changes in the values of characteristics of BS2 will contain the term *Y*.

2. According to Eqs. (9)-(14), the effectivity of action of spin supercurrent between BSs is maximum if the "energy characteristics" (energy, velocity) of quantum objects of one BS are similar to those of quantum objects of another BS. This condition may hold if these organs belong to biological systems (BSs) having common characteristics: for example, belong to relatives (in particular, identical twins) or to the people who were together for a long time. In the latter case, the action of spin supercurrent between them for a lot of years may have equalized the values of some characteristics of the BSs.

3. The spin supercurrent changing the angles of precession and deflection of spins of virtual photons (Eqs. (7)-(8)) affects the orientation of these spins. The latter is due to spin-orbit interaction [6] that changes angular momentum of quantum objects creating these virtual photons, which in turn may influence the structure of molecules containing these quantum objects. Thus, the transmission of forms of molecules from one BS to other BSs by means of spin supercurrents is possible. It is an experimental fact that 3D nanoparticles while penetrating into a DNA molecule having a spiral shape deform and even unwind the spiral. Examples of such nanoparticles are fullerenes (computer simulation has shown that fullerenes, namely, spherical C60 molecules, are potentially dangerous to DNA molecules [7]) and dendrimers (dendrimers of the 3D and higher generations have the form close to a sphere) [8]. It is shown in [9] that nanoparticles influence body organs by spin supercurrents as well.

4. Self-infection by means of spin supercurrent

The spin supercurrent arises not only between the virtual photons created by quantum objects that constitute different BSs, but also between the virtual photons created by quantum objects that constitute the same BS. If a change in the spin characteristics of a virtual photon (for example, with precession frequency $\boldsymbol{\omega}_1$) created by a quantum object of BS takes place, then the action of spin supercurrent may lead to similar changes in virtual photons created by other quantum objects that constitute the same BS. The changes will be most pronounced for the virtual photons whose spin precession frequency ω_2 satisfies conditions (9)-(10). In this view, it may be said that the so-called long-range frequency coherence [20] of BS at frequency ω_1 takes place. (The size of area of coherence at any frequency depends on the properties of BS.)

In such a way a change in one organ of BS may spread onto adjacent or distant organs, the most pronounced changes occurring in organs similar in their functions to the organ where the initial changes occurred. We may suppose that in such a way, for example, metastases emerging from neoplasms may spread.

5. According to inequalities (7)-(8), as a result of action of spin supercurrent changes in characteristics of both interacting BSs take place. It means that simultaneously two processes are connected with spin supercurrent: the disease transmission from ill body organ to healthy body organ, and inverse process performing therapeutic effect. The therapeutic effect may be strengthened if spin supercurrent will emerge simultaneously between ill BS and many healthy "related" BSs.

(It is interesting that many peoples have had ceremonies consisting of honoring singing and dancing in a circle. The person being honored stood at the center of the circle; initially these ceremonies were intended to exert a certain therapeutic action on the person).

Conclusion

1. The Disease Transmission may be performed by spin supercurrent. Spin supercurrent emerges between virtual photons created by quantum objects that constitute ill body organ, on the one hand, and healthy body organ, on the other hand.

The effect of spin supercurrent is especially pronounced if the interacting body organs have some common characteristics, for example, in the case of organs of identical twins or organs of people who were together for a long time. In the latter case the action of spin supercurrent during this time equalizes the values of many characteristics of body organs.

2. As the action of spin supercurrent influences orbital angular momentum of quantum objects between which spin supercurrent arises, the deformation of molecules containing these quantum objects is possible. Thus, spin supercurrent may transmit the peculiars of structure of a DNA macromolecule from one biological system to another. It is an experimental fact that 3D nanoparticles while penetrating into a DNA molecule having a spiral shape deform and even unwind the spiral (nanoparticles affect body organs by spin supercurrents).

3. The disease transmission by spin supercurrent may take place not only between body organs of different biological systems but between organs of the same biological system as well. Thus, self-infection of BS may take place. The most pronounced changes occur in organs similar in their functions to the organ where the initial changes occurred. We may suppose that in such a way, for example, metastases emerging from neoplasms may spread.

4. As the action of spin supercurrent changes the characteristics of both interacting BSs, two processes take place simultaneously: disease transmission from ill body organ to healthy body organ and the inverse process performing a therapeutic effect.

References

1. Borovic-Romanov AS, Bunkov YuM, Dmitriev VV, Mukharskii YuM, Sergatskov DA. 1989. Investigation of Spin Supercurrents in ^{3}He-*B*, Phys Rev Lett 62(14):1631.

2. Bunkov YuM. 2009. Spin Superfluidity and Coherent Spin Precession. J Phys Condens Matter, 21(16):164201.

3. Dmitriev VV, Fomin IA. 2009. Homogeneously precessing domain in ^{3}He-B: formation and properties. J Phys Condens Matter 21(16):164202.

4. Mandl F, Shaw G. 1984/2002. Quantum Field Theory. John Wiley & Sons, Chichester UK, revised edition, 56. 176.

5. Boldyreva LB. 2018. Spin System of Physical Vacuum as a Source of Energy. International Journal of Physics, 6(4):128-138. DOI:10.12691/ijp-6-4-5.

6. Boldyreva LB. 2017. Theory of Virtual Particles as an Alternative to Special Relativity. International Journal of Physics, 5(4):141-146. DOI:10.12691/ijp-5-3-1. http://pubs.sciepub.com/ijp/5/4/6/.

7. Zhao X, Striolo A, Cummings PT. 2005. C60 binds to and deforms nucleotides. Biophys J. 89:3856-3862.

8. Nanjwade BK, Bechra HM, Derkara GK, Manvia FV, Nanjwade VK. 2009. Dendrimers: emerging polymers for drug-delivery systems. Eur J Pharm Scie. 38(3):185–196.

9. Boldyreva LB. 2014. The Physical Aspect of the Effects of Metal Nanoparticles on Biological Systems. Spin Supercurrents. Nanomaterials and Nanosciences, 2(issue 1).

10. Born M. 1962. Einstein's Theory of Relativity. Dover Publications, New York.

11. Einstein A, Podolsky B, Rosen N. 1935. Can quantum-mechanical description of physical reality be considered complete? Phys Rev, 47:777.

12. Klyshko DN. 1994. Quantum optics: quantum, classical, and metaphysical aspect. Physics Uspekhi, 37:1097–1122.

13. Boldyreva LB. 2014. Quantum correlations–Spin supercurrents. Int J Quantum Inf, 12(1):1450007 (13 pages).

14. Boldyreva LB. 2019. Spin supercurrent in phenomena of quantum non-locality (quantum correlations, magnetic vector potential) and in near-field antenna effect. Journal of modern physics, 10:128-144, http://www.script.org./journal/jmp.

15. Ren JG, et al. 2017. Ground-to-satellite quantum teleportation. Nature, 549:70-73.

16. Tyagotin YuV. 1993. Communication delivered at the Transregional Scientific Conference Problems of Biofield. A.S. Popov Scientific and Technical Society, Rostov-Yaroslavsky, Russia.

17. Chirag M. Lakhani, et al. 2019. Repurposing large health insurance claims data to estimate genetic and environmental contributions in 560 phenotypes. Nat Gen, 51:327–334.

18. Bellavite P, Signorine A. 2002. Emerging Science of Homeopathy. North Atlantic Books, Berkeley, California, 6-9.

19. Boldyreva LB. 2011. An analogy between effects of ultra-low doses of biologically active substances on biological objects and properties of spin supercurrents in superfluid ^{3}He-B. Homeopathy. 100(issue 3):187-193, doi: 10.1016/j.homp.2010.08.007.

20. Fröhlich H. 1988. Theoretical Physics and Biology. In: Fröhlich H. (ed.) Biological Coherence and Response to External Stimuli. Springer-Verlag Berlin: Heidelberg, 1-24.

