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Non-Hermitian q-Deformed

Physical Aspect of Some Magic

Highlights

Bending Dynamics of DNA

Physical and Methodological

Discovering Thoughts, Inventing Future

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Physical and Methodological Errors in the Works of Landau

By F. F. Mende

Abstract- By all is well known this phenomenon as rainbow. To any specialist in the electrodynamics it is clear that the appearance of rainbow is connected with the dependence on the frequency of the phase speed of the electromagnetic waves, passing through the drops of rain. J. Heaviside R. Vul assumed that this dispersion was connected with the frequency dispersion (dependence on the frequency) of the dielectric constant of water. Since then this point of view is ruling. However, this approach is physical and methodological error, that also is shown in this article. This error occurred because of the fact that during the record of current in the material media they were entangled integral and the derivative of the harmonic function, which take the identical form and are characterized by only signs.

Keywords: plasma, dielectric, dielectric constant, the dispersion of dielectric constant, harmonic function.

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Strictly as per the compliance and regulations of:

Physical and Methodological Errors in the Works of Landau

F. F. Mende

Abstract- By all is well known this phenomenon as rainbow. To any specialist in the electrodynamics it is clear that the appearance of rainbow is connected with the dependence on the frequency of the phase speed of the electromagnetic waves, passing through the drops of rain. J. Heaviside R. Vul assumed that this dispersion was connected with the frequency dispersion (dependence on the frequency) of the dielectric constant of water. Since then this point of view is ruling. However, this approach is physical and methodological error, that also is shown in this article. This error occurred because of the fact that during the record of current in the material media they were entangled integral and the derivative of the harmonic function, which take the identical form and are characterized by only signs.

Keywords: plasma, dielectric, dielectric constant, the dispersion of dielectric constant, harmonic function.

I. Introduction

By all is well known this phenomenon as rainbow. To any specialist in the electrodynamics it is clear that the appearance of rainbow is connected with the dependence on the frequency of the phase speed of the electromagnetic waves, passing through the drops of rain. Since water is dielectric, with the explanation of this phenomenon J. Heaviside R. Vull assumed that this dispersion was connected with the frequency dispersion (dependence on the frequency) of the dielectric constant of water. Since then this point of view is ruling [1-6].

however very creator of the fundamental equations of electrodynamics Maxwell considered that these parameters on frequency do not depend, but they are fundamental constants. As the idea of the dispersion of dielectric and magnetic constant was born, and what way it was past, sufficiently colorfully characterizes quotation from the monograph of well well-known specialists in the field of physics of plasma [1]: "J. itself. Maxwell with the formulation of the equations of the electrodynamics of material media considered that the dielectric and magnetic constants are the constants (for this reason they long time they were considered as the constants). It is considerably later, already at the beginning of this century with the explanation of the optical dispersion phenomena (in particular the phenomenon of rainbow) of J. Heaviside R. Vull showed that the dielectric and magnetic constants are the functions of frequency. But very recently, in the middle of the 50's, physics they came to the conclusion that these values depend not only on frequency, but also on the wave vector. On the essence, this was the radical breaking of the existing ideas. It was how a serious, is characterized the case, which occurred at the seminar I. D. Landau into 1954. During the report A. I. Akhiezer on this theme of Landau suddenly exclaimed, after smashing the speaker: " This is delirium, since the refractive index cannot be the function of refractive index". Note that this said I. D. Landau - one of the outstanding physicists of our time" (end of the quotation).

It is incomprehensible from the given quotation, that precisely had in the form Landau, voicing this point of view; however, its subsequent publications speak, that it accepted this concept [2].

Looking ahead, it should be noted that Maxwell was right,, who considered that the dielectric and magnetic constant of material media on frequency they do not depend. However, in a number of fundamental works on electrodynamics [2-6] are committed conceptual, systematic and physical errors, as a result of which in physics they penetrated and solidly in it were fastened such metaphysical concepts as the frequency dispersion of the dielectric constant of material media and, in particular, plasma. The propagation of this concept to the dielectrics led to the fact that all began to consider that also the dielectric constant of dielectrics also depends on frequency. These physical errors penetrated in all spheres of physics and technology. They so solidly took root in the consciousness of specialists, that many, until now, cannot believe in the fact that the dielectric constant of plasma is equal to the dielectric constant of vacuum, but the dispersion of the dielectric constant of dielectrics is absent. There is the publications of such well-known scholars as the Drudes, Vull, Heaviside, Landau, Ginsburg, Akhiezer, Tamm [1-6], where it is indicated that the dielectric constant of plasma and dielectrics depends on frequency. This is a systematic and physical error. This systematic and physical error became possible for that reason, that without the proper understanding of physics of the proceeding processes occurred the substitution of physical concepts by mathematical symbols, which appropriated physical, but are more accurate metaphysical, designations, which do not correspond to their physical sense. But if we examine the purely mathematical point of view, then Landau, and following

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it and other authors entangled integral and derivative of harmonic function, since they forgot, that the derivative and integral in this case take the identical form, and they are characterized by only signs.

II. Plasmo-Like Media

By plasma media we will understand such, in which the charges can move without the losses. To such media in the first approximation, can be related the superconductors, free electrons or ions in the vacuum (subsequently conductors). In the absence magnetic field in the media indicated equation of motion for the electrons takes the form:

of
$$m\frac{d\vec{v}}{dt} = e\vec{E}, \qquad (1)$$

where m - mass electron, e - the electron charge, $\vec{E}$ - the tension of electric field, $\vec{v}$ - speed of the motion of charge.

In the work [6] it is shown that this equation can be used also for describing the electron motion in the hot plasma. Therefore it can be disseminated also to this case.

Using an expression for the current density

$$\vec{j} = ne\vec{v} \qquad (2)$$

from (1) we obtain the current density of the conductivity

$$\vec{j}_L = \frac{ne^2}{m}\int \vec{E}\ dt. \qquad (3)$$

In relationship (2) and (3) the value of n represents electron density. After introducing the designation of

$$L_k = \frac{m}{ne^2} \qquad (4)$$

we find

$$\vec{j}_L = \frac{1}{L_k}\int \vec{E}\ dt. \qquad (5)$$

In this case the value L_k presents the specific kinetic inductance of charge carriers [7-11]. Its existence connected with the fact that charge, having a mass, possesses inertia properties. Pour on $\vec{E} = \vec{E}_0 \sin\omega t$ relationship (5) it will be written down for the case of harmonics:

$$\vec{j}_L = -\frac{1}{\omega L_k}\vec{E}_0 \cos\omega t \qquad (6)$$

For the mathematical description of electrodynamic processes the trigonometric functions will be here and throughout, instead of the complex quantities, used so that would be well visible the phase relationships between the vectors, which represent electric fields and current densities.

From relationship (5) and (6) is evident that $\vec{j}_L$ presents inductive current, since. its phase is late with respect to the tension of electric field to the angle $\frac{\pi}{2}$.

If charges are located in the vacuum, then during the presence of summed current it is necessary to consider bias current

$$\vec{j}_\varepsilon = \varepsilon_0 \frac{\partial\ \vec{E}}{\partial\ t} = \varepsilon_0 \vec{E}_0 \cos\omega t.$$

is evident that this current bears capacitive nature, since. its phase anticipates the phase of the tension of electrical to the angle $\frac{\pi}{2}$. Thus, summary current density will compose [8-10]

$$\vec{j}_\Sigma = \varepsilon_0 \frac{\partial\ \vec{E}}{\partial\ t} + \frac{1}{L_k}\int \vec{E}\ dt,$$

or

$$\vec{j}_\Sigma = \left(\omega\varepsilon_0 - \frac{1}{\omega L_k}\right)\ \vec{E}_0 \cos\omega t. \qquad (7)$$

If electrons are located in the material medium, then should be considered the presence of the positively charged ions. However, with the examination of the properties of such media in the rapidly changing fields, in connection with the fact that the mass of ions is considerably more than the mass of electrons, their presence usually is not considered.

In relationship (7) the value, which stands in the brackets, presents summary susceptance of this medium σ_Σ and it consists it, in turn, of the the capacitive σ_C and by the inductive σ_L the conductivity

$$\sigma_\Sigma = \sigma_C + \sigma_L = \omega\varepsilon_0 - \frac{1}{\omega L_k}.$$

Relationship (7) can be rewritten and differently:

$$\vec{j}_\Sigma = \omega\varepsilon_0\left(1 - \frac{\omega_0^2}{\omega^2}\right)\ \vec{E}_0 \cos\omega t,$$

where $\omega_0 = \sqrt{\frac{1}{L_k \varepsilon_0}}$ - plasma frequency.

And large temptation here appears to name the value

$$\varepsilon^*(\omega)=\varepsilon_0\left(1-\frac{\omega_0^2}{\omega^2}\right)=\varepsilon_0-\frac{1}{\omega^2 L_k},$$

by the depending on the frequency dielectric constant of plasma, that also is made in all existing works on physics of plasma. But this is incorrect, since. this mathematical symbol is the composite parameter, into which simultaneously enters the dielectric constant of vacuum and the specific kinetic inductance of charges. It is clear from the previous examination that the parameter $\varepsilon^*(\omega)$ gives the possibility in one coefficient to combine derivative and the integral of harmonic function, since they are characterized by only signs and thus impression is created, that the dielectric constant of plasma depends on frequency. It should be noted that a similar error is perfected by such well-known physicists as Akhiezer, Tamm, Ginsburg [3-5].

This happened still and because, beginning to examine this question, Landau introduced the determinations of dielectric constant only for the static pour on, but he did not introduce this Iopredeleniya for the variables pour on. Let us introduce this determination.

If we examine any medium, including plasma, then current density (subsequently we will in abbreviated form speak simply current) it will be determined by three components, which depend on the electric field. The current of resistance losses there will be [sinfazen] to electric field. The permittance current, determined by first-order derivative of electric field from the time, will anticipate the tension of electric field on the phase to $\frac{\pi}{2}$. This current is called bias current. The conduction current, determined by integral of the electric field from the time, will lag behind the electric field on the phase to $\frac{\pi}{2}$. All three components of current indicated will enter into the second Maxwell equation and others components of currents be it cannot. Moreover all these three components of currents will be present in any nonmagnetic regions, in which there are losses. Therefore it is completely natural, the dielectric constant of any medium to define as the coefficient, confronting that term, which is determined by the derivative of electric field by the time in the second Maxwell equation. In this case one should consider that the dielectric constant cannot be negative value. This connected with the fact that through this parameter is determined energy of electrical pour on, which can be only positive.

Without having introduced this clear determination of dielectric constant, Landau begins the examination of the behavior of plasma in the ac fields. In this case is not separated separately the bias current and conduction current, one of which is defined by derivative, but by another integral, is written as united bias current. It makes this error for that reason, that in the case of harmonic oscillations the form of the function, which determine and derivative and integral, is identical, and they are characterized by only sign. Performing this operation, Landau does not understand, that in the case of harmonic electrical pour on in the plasma there exist two different currents, one of which is bias current, and it is determined by the dielectric constant of vacuum and derivative of electric field. Another current is conduction current and is determined by integral of the electric field. these two currents are antiphase. But since both currents depend on frequency, moreover one of them depends on frequency linearly, and another it is inversely proportional to frequency, between them competition occurs. The conduction current predominates with the low frequencies, the bias current, on the contrary, predominates with the high. However, in the case of the equality of these currents, which occurs at the plasma frequency, occurs current resonance.

Let us emphasize that from a mathematical point of view to reach in the manner that it entered to Landau, it is possible, but in this case is lost the integration constant, which is necessary to account for initial conditions during the solution of the equation, which determines current density in the material medium.

The obviousness of the committed error is visible based on other example.

Relationship (7) can be rewritten and differently:

$$\vec{j}_\Sigma=-\frac{\left(\frac{\omega^2}{\omega_0^2}-1\right)}{\omega L}\ \vec{E}_0\cos\omega t$$

and to introduce another mathematical symbol

$$L^*(\omega)=\frac{L_k}{\left(\frac{\omega^2}{\omega_0^2}-1\right)}=\frac{L_k}{\omega^2 L_k\varepsilon_0-1}.$$

In this case also appears temptation to name this bending coefficient on the frequency kinetic inductance.

Thus, it is possible to write down:

$$\vec{j}_\Sigma=\omega\varepsilon^*(\omega)\ \vec{E}_0\cos\omega t,$$

or

$$\vec{j}_\Sigma=-\frac{1}{\omega L^*(\omega)}\ \vec{E}_0\cos\omega t.$$

But this altogether only the symbolic mathematical record of one and the same relationship (7). Both equations are equivalent. But view neither

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$\varepsilon^*(\omega)$ nor $L^*(\omega)$ by dielectric constant or inductance are from a physical point. The physical sense of their names consists of the following:

$$\varepsilon^*(\omega)=\frac{\sigma_X}{\omega} ,$$

i.e. $\varepsilon^*(\omega)$ presents summary susceptance of medium, divided into the frequency, and

$$L_k^*(\omega)=\frac{1}{\omega\sigma_X}$$

it represents the reciprocal value of the work of frequency and susceptance of medium.

As it is necessary to enter, if at our disposal are values $\varepsilon^*(\omega)$ and $L^*(\omega)$, and we should calculate total specific energy. Natural to substitute these values in the formulas, which determine energy of electrical pour on

$$W_E=\frac{1}{2}\varepsilon_0 E_0^2$$

and kinetic energy of charge carriers

$$W_j=\frac{1}{2}L_k j_0^2, \qquad (8)$$

is cannot simply because these parameters are neither dielectric constant nor inductance. It is not difficult to show that in this case the total specific energy can be obtained from the relationship

$$W_\Sigma=\frac{1}{2}\cdot\frac{d(\omega\varepsilon^*(\omega))}{d\omega}E_0^2 , \qquad (9)$$

from where we obtain

$$W_\Sigma=\frac{1}{2}\varepsilon_0 E_0^2+\frac{1}{2}\ \frac{1}{\omega^2 L_k}\ E_0^2=\frac{1}{2}\varepsilon_0 E_0^2+\frac{1}{2}L_k j_0^2 .$$

We will obtain the same result, after using the formula

$$W=\frac{1}{2}\ \frac{d\left[\frac{1}{\omega L_k^*(\omega)}\right]}{d\omega}\ E_0^2 .$$

The given relationships show that the specific energy consists of potential energy of electrical pour on and to kinetic energy of charge carriers.

With the examination of any media by our final task appears the presence of wave equation. In this case this problem is already practically solved. Maxwell's equations for this case take the form:

$$rot\ \vec{E}=-\mu_0\frac{\partial\ \vec{H}}{\partial\ t}, \quad rot\ \vec{H}=\varepsilon_0\frac{\partial\ \vec{E}}{\partial\ t}+\frac{1}{L_k}\int\vec{E}\ dt , \qquad (10)$$

where of and - dielectric and magnetic constant of vacuum.

System of equations (6.10) completely describes all properties of nondissipative conductors. From it we obtain

$$rot\ rot\ \vec{H}+\mu_0\varepsilon_0\frac{\partial^2\vec{H}}{\partial\ t^2}+\frac{\mu_0}{L_k}\vec{H}=0 . \qquad (11)$$

For the case pour on, time-independent, equation (2.11) passes into the equation of London [12]

$$rot\ rot\ \vec{H}+\frac{\mu_0}{L_k}\vec{H}=0 ,$$

where $\lambda_L{}^2=\frac{L_k}{\mu_0}$ - London depth of penetration.

Thus, it is possible to conclude that the equations of London being a special case of equation (11), and do not consider bias currents on medium.

Therefore they do not give the possibility to obtain the wave equations, which describe the processes of the propagation of electromagnetic waves in the superconductors.

Pour on wave equation in this case it appears as follows for the electrical:

$$rot\ rot\ \vec{E}+\mu_0\varepsilon_0\frac{\partial^2\vec{E}}{\partial\ t^2}+\frac{\mu_0}{L_k}\vec{E}=0 .$$

For constant electrical pour on it is possible to write down

$$rot\ rot\ \vec{E}+\frac{\mu_0}{L_k}\vec{E}=0 .$$

Consequently, dc fields penetrate the superconductor in the same manner as for magnetic, diminishing exponentially. However, the density of current in this case grows according to the linear law of

$$\vec{j}_L=\frac{1}{L_k}\int\vec{E}\ dt .$$

The carried out examination showed that the dielectric constant of this medium was equal to the dielectric constant of vacuum and this permeability on frequency does not depend. The accumulation of potential energy is obliged to this parameter. Furthermore, this medium is characterized still and the kinetic inductance of charge carriers and this parameter determines the kinetic energy, accumulated on medium. Thus, are obtained all necessary given, which characterize the process of the propagation of electromagnetic waves in conducting media examined. However, in contrast to the conventional procedure [2-4] with this examination nowhere was introduced polarization vector, but as the basis of examination assumed equation of motion and in this case in the second Maxwell equation are extracted all components of current densities explicitly.

In radio engineering exists the simple method of the idea of radio-technical elements with the aid of the equivalent diagrams. This method is very visual and gives the possibility to present in the form such diagrams elements both with that concentrated and with the distributed parameters. The use of this method will make it possible better to understand, why were committed such significant physical errors during the introduction of the concept of that depending on the frequency dielectric constant.

III. Physical Processes In The Parallel Resonant Circuit

In order to show that the single volume of conductor or plasma according to its electrodynamic characteristics is equivalent to parallel resonant circuit with the lumped parameters, let us examine parallel resonant circuit. The connection between the voltage U, applied to the outline, and the summed current I_Σ, which flows through this chain, takes the form

$$I_\Sigma = I_C + I_L = C\frac{dU}{dt} + \frac{1}{L}\int U\ dt,$$

where $I_C = C\frac{dU}{dt}$ - current, which flows through the capacity, and $I_L = \frac{1}{L}\int U\ dt$ - current, which flows through the inductance.

For the case of the harmonic stress $U = U_0 \sin\omega t$ we obtain

$$I_\Sigma = \left(\omega C - \frac{1}{\omega L}\right) U_0 \cos\omega t. \qquad (12)$$

In relationship (12) the value, which stands in the brackets, presents summary susceptance σ_Σ this medium of of and it consists it, in turn, of the the capacitive σ_C and by the inductive σ_L the conductivity

$$\sigma_\Sigma = \sigma_C + \sigma_L = \omega C - \frac{1}{\omega L}.$$

In this case relationship (12) can be rewritten as follows:

$$I_\Sigma = \omega C\left(1 - \frac{\omega_0^2}{\omega^2}\right) U_0 \cos\omega t,$$

where $\omega_0{}^2 = \frac{1}{LC}$ - the resonance frequency of parallel circuit.

And here, just as in the case of conductors, appears temptation, to name the value

$$C^*(\omega) = C\left(1 - \frac{\omega_0^2}{\omega^2}\right) = C - \frac{1}{\omega^2 L} \qquad (13)$$

by the depending on the frequency capacity. Conducting this symbol it is permissible from a mathematical point of view; however, inadmissible is awarding to it the proposed name, since. this parameter of no relation to the true capacity has and includes in itself simultaneously and capacity and the inductance of outline, which do not depend on frequency.

Is accurate another point of view. Relationship (12) can be rewritten and differently:

$$I_\Sigma = -\frac{\left(\frac{\omega^2}{\omega_0^2} - 1\right)}{\omega L} U_0 \cos\omega t,$$

and to consider that the chain in question not at all has capacities, and consists only of the inductance depending on the frequency

$$L^*(\omega) = \frac{L}{\left(\frac{\omega^2}{\omega_0^2} - 1\right)} = \frac{L}{\omega^2 LC - 1}. \qquad (14)$$

but, just as $C^*(\omega)$, the value of $L^*(\omega)$ cannot be called inductance, since this is the also composite parameter, which includes simultaneously capacity and inductance, which do not depend on frequency.

Using expressions (13) and (14), let us write down:

$$I_\Sigma = \omega C^*(\omega)\ U_0 \cos\omega t \qquad (15)$$

or

$$I_\Sigma = -\frac{1}{\omega L^*(\omega)} U_0 \cos\omega t \qquad (16)$$

The relationship (15) and (16) are equivalent, and separately mathematically completely is characterized the chain examined. But view neither

$C^*(\omega)$ nor $L^*(\omega)$ by capacity and inductance are from a physical point, although they have the same dimensionality. The physical sense of their names consists of the following:

$$C^*(\omega)=\frac{\sigma_X}{\omega},$$

i.e. $C^*(\omega)$ presents the relation of susceptance of this chain and frequency, and

$$L^*(\omega)=\frac{1}{\omega\sigma_X},$$

it is the reciprocal value of the work of summary susceptance and frequency.

Accumulated in the capacity and the inductance energy, is determined from the relationships

$$W_C=\frac{1}{2}CU_0^{\ 2} \quad (17)$$

$$W_L=\frac{1}{2}LI_0^{\ 2}. \quad (18)$$

How one should enter for enumerating the energy, which was accumulated in the outline, if at our disposal are $C^*(\omega)$ and $L^*(\omega)$? Certainly, to put these relationships in formulas (17) and (18) cannot for that reason, that these values can be both the positive and negative, and the energy, accumulated in the capacity and the inductance, is always positive. But if we for these purposes use ourselves the parameters indicated, then it is not difficult to show that the summary energy, accumulated in the outline, is determined by the expressions:

$$W_\Sigma=\frac{1}{2}\ \frac{d\sigma_X}{d\omega}\ U_0^{\ 2}, \quad (19)$$

or

$$W_\Sigma=\frac{1}{2}\ \frac{d\left[\omega C^*(\omega)\right]}{d\omega}\ U_0^{\ 2}, \quad (20)$$

or

$$W_\Sigma=\frac{1}{2}\ \frac{d\left(\dfrac{1}{\omega L^*(\omega)}\right)}{d\omega}\ U_0^{\ 2}. \quad (21)$$

If we paint equations (19) or (20) and (21), then we will obtain identical result, namely:

$$W_\Sigma=\frac{1}{2}CU_0^{\ 2}+\frac{1}{2}LI_0^{\ 2},$$

where U_0 - amplitude of stress on the capacity, and I_0 - amplitude of the current, which flows through the inductance.

If we compare the relationships, obtained for the parallel resonant circuit and for the conductors, then it is possible to see that they are identical, if we make $E_0 \to U_0$, $j_0 \to I_0$, $\varepsilon_0 \to C$ and $L_k \to L$. Thus, the single volume of conductor, with the uniform distribution of electrical pour on and current densities in it, it is equivalent to parallel resonant circuit with the lumped parameters indicated. In this case the capacity of this outline is numerically equal to the dielectric constant of vacuum, and inductance is equal to the specific kinetic inductance of charges.

Now let us visualize this situation. In the audience, where are located specialists, who know radio engineering and of mathematics, comes instructor and he begins to prove, that there are in nature of no capacities and inductances, and there is only depending on the frequency capacity and that just she presents parallel resonant circuit. Or, on the contrary, that parallel resonant circuit this is the depending on the frequency inductance. View of mathematics will agree from this point. However, radio engineering they will calculate lecturer by man with the very limited knowledge. Specifically, in this position proved to be now those scientists and the specialists, who introduced into physics the frequency dispersion of dielectric constant.

Thus, are obtained all necessary given, which characterize the process of the propagation of electromagnetic waves in the media examined, and it is also shown that in the quasi-static regime the electrodynamic processes in the conductors are similar to processes in the parallel resonant circuit with the lumped parameters. However, in contrast to the conventional procedure [5-7] with this examination nowhere was introduced polarization vector, but as the basis of examination assumed equation of motion and in this case in the second Maxwell equation are extracted all components of current densities explicitly.

IV. Physical And Methodological Errors In The Works Of Landau

Based on the example of work [2] let us examine a question about how similar problems, when the concept of polarization vector is introduced are solved for their solution. Paragraph 59 of this work, where this question is examined, it begins with the words: "We pass now to the study of the most important question about the rapidly changing electric fields, whose frequencies are unconfined by the condition of smallness in comparison with the frequencies, characteristic for establishing the electrical and magnetic polarization of substance" (end of the

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quotation). These words mean that that region of the frequencies, where, in connection with the presence of the inertia properties of charge carriers, the polarization of substance will not reach its static values, is examined. With the further consideration of a question is done the conclusion that "in any variable field, including with the presence of dispersion, the polarization vector of $\vec{P}=\vec{D}-\varepsilon_0\vec{E}$ (here and throughout all formulas cited they are written in the system SI) preserves its physical sense of the electric moment of the unit volume of substance" (end of the quotation). Let us give the still one quotation: "It proves to be possible to establish (unimportantly - metals or dielectrics) maximum form of the function $\varepsilon(\omega)$ with the high frequencies valid for any bodies. Specifically, the field frequency must be great in comparison with "the frequencies" of the motion of all (or, at least, majority) electrons in the atoms of this substance. With the observance of this condition it is possible with the calculation of the polarization of substance to consider electrons as free, disregarding their interaction with each other and with the atomic nuclei" (end of the quotation).

Further, as this is done and in this work, is written the equation of motion of free electron in the ac field

$$m\frac{d\vec{v}}{dt}=e\vec{E},$$

from where its displacement is located

$$\vec{r}=-\frac{e\vec{E}}{m\omega^2}.$$

Then is indicated that the polarization $\vec{P}$ is a dipole moment of unit volume and the obtained displacement is put into the polarization

$$\vec{P}=ne\vec{r}=-\frac{ne^2\vec{E}}{m\omega^2}.$$

In this case point charge is examined, and this operation indicates the introduction of electrical dipole moment for two point charges with the opposite signs, located at a distance

$$\vec{p}_e=-e\vec{r},$$

where the vector $\vec{r}$ is directed from the negative charge toward the positive charge. This step causes bewilderment, since the point electron is examined, and in order to speak about the electrical dipole moment, it is necessary to have in this medium for each electron another charge of opposite sign, referred from it to the distance $\vec{r}$. In this case is examined the gas of free electrons, in which there are no charges of opposite signs. Further follows the standard procedure, when introduced thus illegal polarization vector is introduced into the dielectric constant

$$\vec{D}=\varepsilon_0\vec{E}+\vec{P}=\varepsilon_0\vec{E}-\frac{ne^2\vec{E}}{m\omega^2}=\varepsilon_0\left(1-\frac{1}{\varepsilon_0 L_k\omega^2}\right)\vec{E},$$

and since plasma frequency is determined by the relationship

$$\omega_p^{\ 2}=\frac{1}{\varepsilon_0 L_k},$$

the vector of the induction immediately is written

$$\vec{D}=\varepsilon_0\left(1-\frac{\omega_p^{\ 2}}{\omega^2}\right)\vec{E}.$$

With this approach it turns out that constant of proportionality

$$\varepsilon(\omega)=\varepsilon_0\left(1-\frac{\omega_p^{\ 2}}{\omega^2}\right),$$

between the electric field and the electrical induction, illegally named dielectric constant, depends on frequency.

Precisely this approach led to the fact that all began to consider that the value, which stands in this relationship before the vector of electric field, is the dielectric constant depending on the frequency, and electrical induction also depends on frequency. And this it is discussed in all, without the exception, fundamental works on the electrodynamics of material media [2-6].

But, as it was shown above this parameter it is not dielectric constant, but presents summary susceptance of medium, divided into the frequency. Thus, traditional approach to the solution of this problem from a physical point of view is erroneous, although formally this approach is permitted from a mathematical point of view. However, it is not possible to take into account the initial conditions in calculating the integral in the ratios that determine the conduction current.

Further into §61 of work [2] is examined a question about the energy of electrical and magnetic field in the media, which possess by the so-called dispersion. In this case is done the conclusion that relationship for the energy of such pour on

$$W=\frac{1}{2}\left(\varepsilon E_0^{\ 2}+\mu H_0^{\ 2}\right), \tag{22}$$

that making precise thermodynamic sense in the usual media, with the presence of dispersion so interpreted be cannot. These words mean that the knowledge of real electrical and magnetic pour on on Wednesday with the dispersion insufficiently for determining the difference in the internal energy per unit of volume of substance in the presence pour on in their absence. After such statements is given the [ugadannaya] formula, which gives correct result for enumerating the specific energy of electrical and magnetic pour on when the dispersion ofis present,

$$W=\frac{1}{2}\frac{d\left(\omega\varepsilon(\omega)\right)}{d\omega}E_0^2+\frac{1}{2}\frac{d\left(\omega\mu(\omega)\right)}{d\omega}H_0^2 \quad . \qquad (23)$$

But if we compare the first part of the expression in the right side of relationship (23) with relationship (9), then it is evident that they coincide. This means that in relationship (23) this term presents the total energy, which includes not only potential energy of electrical pour on, but also kinetic energy of the moving charges. On what base is recorded last term in the relationship (23) not at all clearly.

Therefore conclusion about the impossibility of the interpretation of formula (22), as the internal energy of electrical and magnetic pour on in the media with the dispersion it is correct. However, this circumstance consists not in the fact that this interpretation in such media is generally impossible. It consists in the fact that for the definition of the value of specific energy as the thermodynamic parameter in this case is necessary to correctly calculate this energy, taking into account not only electric field, which accumulates potential energy, but also current of the conduction electrons, which accumulate the kinetic kinetic energy of charges (8). The conclusion, which now can be made, consists in the fact that, introducing into the custom some mathematical symbols, without understanding of their true physical sense, and, all the more, the awarding to these symbols of physical designations unusual to them, it is possible in the final analysis to lead to the significant errors, that also occurred in the work.

V. Conclusion

By all is well known this phenomenon as rainbow. To any specialist in the electrodynamics it is clear that the appearance of rainbow is connected with the dependence on the frequency of the phase speed of the electromagnetic waves, passing through the drops of rain. J. Heaviside R. Vull assumed that this dispersion was connected with the frequency dispersion (dependence on the frequency) of the dielectric constant of water. Since then this point of view is ruling. However, this approach is physical and methodological error, and this error is committed in the works of Landau. This error occurred because of the fact that during the record of current in the material media they were entangled integral and the derivative of the harmonic function, which take the identical form and are characterized by only signs.

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The Physical Aspect of Some Magic Rites. Spin Supercurrent

By Liudmila B. Boldyreva

Abstract- Some of so-called miracles accomplished by ancient and contemporary magicians (they are often called "psychics") are considered: (1) the selective action on remote objects (in particular, "contagious magic"); (2) the locating of hidden cavity structures (underground reservoirs of water, buried treasures, and the like), including dowsing; (3) the structuring of space around a psychic (the so-called magic rings or charmed rings, allegedly protecting against malicious influence); (4) the change in a person's own weight (in particular, levitation); (5) the ability to become invisible.

These miracles might be a result of processes taking place in the physical vacuum, the latter having the following properties: (1) it consists of quantum harmonic oscillators having the so-called zero-point energy; (2) a quantum entity creates in this vacuum a pair of oppositely charged virtual particles having spin (virtual photon), the virtual photon has precessing spin and consequently may be classified as a spin vortex, (3) spin vortices in this vacuum may interact by means of spin supercurrent whose value is determined by mutual orientation of spins of interacting spin vortices. The physical vacuum with the above-mentioned properties is called the vortex-type physical vacuum.

Keywords: contagious magic, magic circle, dowsing, levitation, invisibility, spin supercurrent, spin vortex, vortex-type physical vacuum.

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THEPHYSICALASPECTOFSOMEMAGICRITESSPINSUPERCURRENT

Strictly as per the compliance and regulations of:

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Keywords: contagious magic, magic circle, dowsing, levitation, invisibility, spin supercurrent, spin vortex, vortex-type physical vacuum.

I. Introduction

Researchers of magic rites can be divided into two groups: those who look upon these rites as caused by people’s ignorance (for example, the well-known anthropologist E. Tylor [1]), and those who think that the origin of the rites is the existence of some physical processes in nature. It is known that great mathematician and philosopher Pythagoras and his followers had strong views on magic rites [2]. As concerns the rituals aimed at search of underground water, buried ores, etc. (they were often performed with the use of a dowsing rod), Albert Einstein wrote in a letter to Dr. Herman Peisach [3]: "I know very well that many scientists consider dowsing as a type of ancient superstition. According to my conviction, this is, however, unjustified. The dowsing rod is a simple instrument which shows the reaction of the human nervous system to certain factors which are unknown to us at this time."

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The famous anthropologist James George Frazer was the first who addressed the properties of physical vacuum to explain some peculiarities of magic rites; in particular, the rites of the contagious magic based on people’s belief that things which once contacted with each other could continue interacting as well after they have been separated. Concerning the physical principles which could underlie the contagious magic, Frazer wrote: “things act on each other at a distance through a secret sympathy, the impulse being transmitted from one to the other by means of what we may conceive as a kind of invisible ether….” [4].

In this work, the properties of that “kind of invisible ether” are considered, and it suggests that the “invisible ether” may consist of quantum harmonic oscillators having the so-called zero-point energy. For the first time, the concept of physical vacuum, free from magnetic and electric fields (without regard to gravitational energy) but characterized by non-zero energy was developed in Germany by a group of physicists including Max Planck, Albert Einstein, and Otto Stern. In 1913, using the formula derived by Planck [5] for energy ε of atomic oscillator vibrating at frequency ν: $\varepsilon = h\nu/2 + h\nu/\left(\exp\left(h\nu/(kT)\right)-1\right)$, Albert Einstein and Otto Stern published a paper [6] in which they classified the energy $h\nu/2$ (h is the Planck constant) as “residual energy” that all atomic oscillators have at absolute zero. Later, “residual energy” was called “zero-point energy”, and the atomic oscillator became called “quantum harmonic oscillator” (in this paper the abbreviation QHO is used). It is shown in this work that energy $h\nu/2$ may be the energy of spin vortex; the spin vortex is an area of physical vacuum in which precession of spin takes place. Consequently, the physical vacuum that consists of QHOs, that is, consists of spin vortices may be called the vortex-type physical vacuum.

According to postulates of quantum mechanics, the quantum entity that is a singularity in electric or magnetic fields produces in the vortex-type physical vacuum a pair of oppositely charged virtual particles having spin (a so-called virtual photon) [7, 8]. The virtual photon has precessing spin and consequently may be classified as a spin vortex. Spin supercurrents may emerge between spin vortices [9-11].

The author shows that two factors determine the effectiveness of many magic rites and “miracles”: (1) the

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properties of the vortex-type physical vacuum and (2) the properties of spin supercurrent arising between spin vortices created by quantum entities that constitute magician's organism, on the one hand, and by quantum entities that constitute the object being influenced, on the other hand. From the second factor it follows that the ability of a magician to perform "miracles" is determined by efficiency of his/her influencing the characteristics of spins of spin vortices created in the vortex-type physical vacuum by quantum entities that constitute the magician's organism.

In this work, the following "miracles" performed by both ancient and contemporary magicians ("psychics") are considered:

1. the selective long-distance (some tens of kilometers) action on remote bodies (living and non-living);
2. the locating of hidden cavity structures (for example, underground reservoirs of water, underground caves, etc.), this is often performed with the use of a dowsing rod;
3. the structuring of space around the psychic: production of periodically repeating areas characterized by an increase in energy radiated by the psychic (the ancient people called these areas "magic rings" or "charmed rings", allegedly protecting the person against malicious influence);
4. the ability to change the psychic's weight (in particular, levitation);
5. the ability to become invisible.

Under the aim of the research, the work is divided into two parts: the theoretical and experimental.

II. The Theory

The properties of the vortex-type physical vacuum and properties of spin supercurrents are considered in this section. As the vortex-type physical vacuum consists of quantum harmonic oscillators (QHOs), the properties of the vacuum are determined by characteristics of QHO [12].

a) The Characteristics of QHO

1) The quantum entity that is a singularity in electric and/or magnetic fields may create a pair of oppositely charged virtual particles (a virtual photon) in the physical vacuum. The virtual photon has precessing spin and consequently may be classified as a spin vortex. The fact that the quantum entity may create a virtual photon having spin, while preserving the value of its own spin, suggests that spin of virtual photon must be "formed" in the physical vacuum, that is, it may consist of spins of QHOs [7].
2) The existence of electric polarization of physical vacuum suggests that QHO is an electric dipole (its electric dipole moment is denoted here as $\mathbf{d}_{QHO}$). Consequently, QHO has an electric component $\mathbf{E}_{QHO}$ and according to [13]:

$$\mathbf{E}_{QHO} \uparrow\downarrow \mathbf{d}_{QHO}. \qquad (1)$$

3) The existence of electric dipole moment means that the QHO has a mass m_{QHO} formed by two unlike charged particles.
4) The expression for energy of QHO, $\hbar\Omega_{QHO}/2$, may be interpreted as the energy of mass m_{QHO} performing the circular motion with frequency Ω_{QHO} and with angular momentum $J=h$ [14].
5) As spin of QHO is connected with its mass, the circular motion of mass with frequency Ω_{QHO} means the existence of precession motion of QHO spin with frequency Ω_{QHO}. Thus QHO may be considered as an area of physical vacuum with precessing spin, that is as a spin vortex.
6) The neighboring QHOs interact with each other. The following interactions between QHOs may take place: the gravitational one (QHO has a mass); the electric dipole-dipole one (QHO has an electric dipole moment); the one by means of spin supercurrent (QHO has a spin).

Such characteristics of QHO as the existence of precessing spin, electric component, mass are similar to the characteristics of spin vortices that constitute photon and pair of virtual particles (a virtual photon) created by a quantum entity [15]. Consequently, it may be supposed that this analogy is valid for other properties of these spin vortices [7, 8, 15] and the following conditions hold true for QHO as well:

$$\mathbf{E}_{QHO} \uparrow\uparrow \mathbf{S}_{QHO}, \qquad (2)$$

$$\mathbf{\Omega}_{QHO} \parallel \mathbf{u}, \qquad (3)$$

$$\sin\theta = u/c, \qquad (4)$$

where u is the speed of QHO, c is the speed of light, θ is the angle between $\mathbf{S}_{QHO}$ and $\mathbf{\Omega}_{QHO}$ (the deflection angle). The diagram of characteristics of QHO is given in fig. 1: $\mathbf{J}$ is the angular momentum, α is the precession angle relative to the reference line (ref. line).

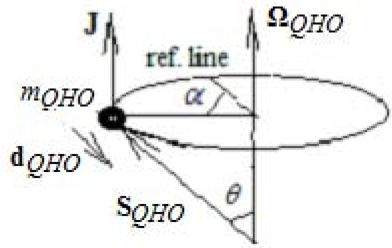

Fig. 1: The characteristics of QHO: $\mathbf{S}_{QHO}$ is spin; m_{QHO} is the mass; $\mathbf{d}_{QHO}$ is the electric dipole moment; Ω_{QHO} is the precession frequency; **J** is the angular momentum associated with m_{QHO}; θ is the deflection angle; α is the precession angle (phase); ref. line is the reference line.

b) The Properties of Spin Supercurrent

Spin supercurrent was discovered in experiments with superfluid ^{3}He-B. The spin supercurrent arises between regions with identically oriented and coherently precessing spins (in the case of superfluid ^{3}He-B such region consists of ^{3}He atoms [9-11]). Let us consider some characteristics of spin supercurrent.

1. The value of spin supercurrent is determined by characteristics of precession of spin of objects between which the supercurrent emerges: the precession angle (phase) α and the deflection angle θ (see figure 1). For example, the value of spin supercurrent j_z in the direction of orientation (axis z) of precession frequencies of spins of ^{3}He atoms in superfluid ^{3}He-B is determined as follows:

$$j_z = -g_1 \partial\alpha / \partial z - g_2 \partial\theta / \partial z\ , \qquad (5)$$

where g_1 and g_2 are coefficients depending on θ and the properties of the superfluid.

2. The spin supercurrent tends to equalize the respective characteristics of spins of interacting objects. As a result of equalizing, a change in the frequencies of precession of spins of the objects may take place. Let us prove it. Precession angles α_1 and α_2 of spins of these objects are related to the respective precession frequencies ω_1 and ω_2 (in the case of independence of frequencies of time *t,* that is before the action of spin supercurrent*)* as follows:

$$\alpha_1 = \omega_1 t + \alpha_{01}\ , \quad \alpha_2 = \omega_2 t + \alpha_{02}\ , \qquad (6)$$

where α_{01} and α_{02} are the values of precession angles at *t*=0. As a result of the action of spin supercurrent at an arbitrary moment *t*, the following holds: $|a_1 - a_2| > |a_1' - a_2'|$, where α_1' and α_2' are the values of precession angles of spins of interacting objects after the action of spin supercurrent. Using this inequality in (6) we obtain:

$$|\omega_1 - \omega_2| > |\omega_1' - \omega_2'|\ , \qquad (7)$$

where ω_1' and ω_2' are precession frequencies of spins of interacting objects after the action of spin supercurrent.

3. At a definite difference in precession phases of spins of interacting objects, a precession phase slippage (drop) by the value of $2\pi n$ takes place. As a result of phase slippage, the drop in value and change in sign of spin supercurrent may take place. Consequently, equation (5) holds in the absence of phase slippage. The possibility of phase slippage is negligible if difference $\Delta\omega = |\omega_1 - \omega_2|$ between precession frequencies of spins of the objects between which it arises satisfies the following:

$$\Delta\omega \to 0\ . \qquad (8)$$

4. The effectivity of action of spin supercurrent between objects having spin does not depend on the distance between the objects. For example, the action of spin supercurrent in superfluid ^{3}He-B throughout the volume of superfluid [9-11] does not vary. It may be explained by that the spin supercurrent is a dissipation-free process, i.e., it is not accompanied by the emergence of mass.
5. The spin supercurrent may emerge between spin vortices in the physical vacuum. One of the arguments in favor of this possibility is the existence of correlation of phases of spatially separated photons of the same frequency [16]. In the study by L. Boldyreva [17], it was shown that this correlation is accounted for by the emergence of spin supercurrents between spin vortices that constitute interacting photons.
6. Since spin supercurrent is a physical process responsible for quantum correlations and the latter are independent of using electromagnetic screens, then spin supercurrent is not shielded by electromagnetic screens.
7. As spin supercurrent is a physical process responsible for quantum correlations between separated photons, the speed of spin supercurrent must be greater than that of light. The experiments exist [18] in which it is shown that the speed of quantum correlations is 10^4 times greater than the speed of light. This does not contradict the second postulate of special relativity as this postulate holds true only for *inertial process* [19]; at the same time spin supercurrent is *an inertia-free process* (it is not accompanied by emergence of mass, see the above considered property 4, and consequently its speed may be greater than the speed of light.

c) The Properties of the Physical Vacuum Consisting of QHOs (the Vortex-Type Physical Vacuum)

In quantum field theory, the physical vacuum is defined not as an empty space but as consisting of QHOs characterized by zero-point energy. This physical vacuum may be called "the vortex-type physical vacuum". Based on the properties of QHO, let us determine the properties of the vortex-type physical vacuum as a continuum.

i. *The density of vortex-type physical vacuum*

As QHO has mass, the medium consisting of QHOs has a positive density ρ. Let us show that ρ is not constant. According to equations (3) and (4) (see also fig. 1), projection $\left(s_{QHO}\right)_u$ of spin $\mathbf{s}_{QHO}$ on the direction of velocity **u** of QHO (that is the velocity of vortex-type physical vacuum consisting of QHOs) depends on the deflection angle θ as:

$$\left(s_{QHO}\right)_u = s_{QHO}\sqrt{1-\sin^2\theta} \ . \qquad (9)$$

According to equations (4) and (9), the motion of QHO results in its contraction in the direction of motion, and the factor of contraction is equal to $\sqrt{1-u^2/c^2}$, that is, under the Lorentz transformation of length of bodies in the direction of their motion [19]. The change in the size of QHO, in turn, may result in a change of density ρ of vortex-type physical vacuum as consisting of QHOs.

According to equations (4) and (5), two factors can affect the deflection angle θ: the change in speed of QHO and spin supercurrent. Thus the density of vortex-type physical vacuum is a function, φ, of speed *u* and spin supercurrent *j*:

$$\rho = \varphi(u, j) \ . \qquad (10)$$

If the speed of spin supercurrent is greater than the speed of propagation of contraction in the vortex-type physical vacuum, the zones of jumps of density appear in this vacuum [14]. At the same time, a shock wave may arise in the vortex-type physical vacuum (similar to that which occurs when the speed of a moving object exceeds the speed of sound in a molecular medium).

ii. *The force arising in the vortex-type physical vacuum with oriented spins in a nonhomogeneous electric field*

According to conditions (1) and (2), in the area of vortex-type physical vacuum with oriented spins of QHOs the emergence of total nonzero electric dipole moment $\mathbf{d}_t$ of QHOs that constitute this area takes place

$$\mathbf{d}_t \uparrow\downarrow \mathbf{S}_t \ , \qquad (11)$$

where $\mathbf{S}_t$ is the total spin in the area of vortex-type physical vacuum with oriented spins of QHOs. In a nonhomogeneous electric field $\mathbf{E}$, the force $\mathbf{F}_d$ will act on these QHOs. This force is determined [13] as:

$$\mathbf{F}_d = \left(\mathbf{d}_t\nabla\right)\mathbf{E} \ , \qquad (12)$$

where ∇ is the nabla.

iii. *The vortex-wave-spin process in the vortex-type physical vacuum*

The first equation describing the vortex-wave-spin process

The photon may decay into a pair of oppositely charged particles in the electric field of heavy nuclei [20]. In this case, the total spin of emerging particles equals the photon spin, which suggests that the principle of conservation of angular momentum holds true in the vortex-type physical vacuum.

Due to conservation of angular momentum, the Einstein-de Haas effect takes place in this vacuum [21]; a change in the total spin **S** of a unit volume of vortex-type physical vacuum ($\partial\mathbf{S}/\partial t \neq 0$) results in the rotation of the vortex-type physical vacuum ($curl\mathbf{u} \neq 0$). That is the following holds true:

$$\partial\mathbf{S}/\partial t = -\left(1/k_1\right)\cdot curl\mathbf{u} \ , \qquad (13)$$

where *t* is time, $k_1 < 0$ is a proportionality factor.

The second equation describing the vortex-wave-spin process

According to equations (3) and (4), at the emergence of $\partial\mathbf{u}/\partial t$ in the vortex-type physical vacuum the following cases may take place:

1) at a change in the direction of velocity **u** the precession motion of **S** relative to a new direction of **u** arises;
2) at a change in only the value of *u*, the angle θ changes and consequently a precession motion of **S** emerges in the new area of vortex-type physical vacuum.

Thus at any change in velocity **u**, the precession motion of **S** emerges in the new area of vortex-type physical vacuum. As a result, the following equation may be taken to be true:

$$\partial\mathbf{u}/\partial t = k_2\, curl\mathbf{S} \ , \qquad (14)$$

where $k_2 < 0$ is a proportionality factor. If to introduce factor $y = \sqrt{k_2/k_1}$, then equations (13) and (14) may be rewritten as:

$$\partial\left(k_1 y\mathbf{S}\right)/\partial t = -y\ curl\mathbf{u} \ , \qquad (15)$$

$$\partial\mathbf{u}/\partial t = y\ curl\left(k_1 y\mathbf{S}\right) . \qquad (16)$$

The dimension of factor y is the same as that of speed. If in the vortex-type physical vacuum there is a mechanism that suppresses the vortex at a point of space and simultaneously transports the vortex energy to adjacent areas, then a vortex-wave-spin process (described by equations (15) and (16)) will propagate at speed y in the vortex-type physical vacuum. It should be noted that the speed of vortex-wave-spin process may change at its interaction with an inertial system due to interaction of spin vortices that arise in this process with the virtual photons (as with spin vortices) created by quantum entities that constitute the inertial system.

Note. According to condition (2) and conclusions of work [22] (the latter contains a proof that the vortex-type physical vacuum is a magnetic medium), the vortex-wave-spin process described by equations (15)-(16) is an electromagnetic process, *y* is the speed of light and the vortex-type physical vacuum is a luminiferous medium [23].

The condition of disappearance of vortex-wave-spin process

Equation (15) describing the vortex-wave-spin process contains $\partial \mathbf{S} / \partial t$. Consequently, this process could not spread in the area where the spin orientation cannot be changed, that is, where the following takes place:

$$\partial \mathbf{S} / \partial t = 0 , \tag{17}$$

and spins can be considered to be "frozen". The equality (17) means that in this area of physical vacuum the processes causing a definite orientation of spins (for example, spin supercurrent or rotation of vortex-type physical vacuum acting on spins due to the effect of Barnett [24]) suppress the vortex- wave-spin process.

The Properties of Cavity Structures

The processes that take place in the physical vacuum in the area of location of cavity structures were considered by Boldyreva in [25]. Like all quantum entities that are singularities in electric and/or magnetic fields, the quantum entities that constitute the substance of cavity structure create virtual photons, i.e., spin vortices in the vortex-type physical vacuum. According to equation (3), the orientation of precession frequency of spin of the spin vortex created by the quantum entity is determined by the direction of entity's velocity. Consequently, the orientations of precession frequencies of spin vortices created by the quantum entities (at least, electrons) of the substance are oriented along their orbital velocities. The mutual space arrangement of orbits of quantum entities that constitute the substance of the cavity structure depends on the form of the latter. Thus the mutual orientation of precession frequencies of spins of spin vortices created by these quantum entities cannot be arbitrary, in particular those precession frequencies may not be oriented along one line. An example of possible configuration of precession frequencies ($\boldsymbol{\omega}_1,\ldots,\ \boldsymbol{\omega}_p,\ldots,\ \boldsymbol{\omega}_q,\ldots,\ \boldsymbol{\omega}_r$) of spins of spin vortices created by quantum entities that constitute the substance of a cavity structure is shown in fig. 2 (the directions of frequencies $\boldsymbol{\omega}_1,\ldots,\ \boldsymbol{\omega}_p,\ldots,\ \boldsymbol{\omega}_q,\ldots,\ \boldsymbol{\omega}_r$ are tangential to a ring). In this configuration, according to the definition of spin supercurrent (see equation (5)), spin supercurrent $\mathbf{J}_{pq}$ between arbitrary spin vortices *p* and *q* will never be zero, that is:

$$\mathbf{J}_{pq} \neq 0 . \tag{18}$$

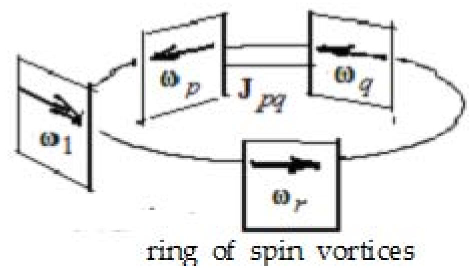

Fig. 2: A ring of spin vortices with respective precession frequencies $\boldsymbol{\omega}_1,\ldots,\ \boldsymbol{\omega}_p,\ldots,\ \boldsymbol{\omega}_q,\ldots,\ \boldsymbol{\omega}_r$; $\mathbf{J}_{pq}$ is spin supercurrent.

Thus the space inside the ring will constantly be "filled" with spin supercurrents. According to property 2 (section II.b), the action of the spin supercurrent results in changes in the characteristics of spins of interacting spin vortices, which in turn (according to equations (15)-(16)) results in the emergence of vortex-wave-spin process in the vortex-type physical vacuum. Thus the cavity structure will be filled with energy fluxes.

The validity of those theoretical conclusions is proved by experimental evidence. For example, in 1952, Czech researcher K. Drbal was granted a patent for maintaining razor blades and straight razors sharp without an auxiliary source of energy, the razors being placed in a pyramid [26].

III. Experimental Data

In this section, experimental data are compared with the above-considered properties of vortex-type physical vacuum and spin supercurrent.

a) Selectivity of Mental Influence on Remote Objects

Under the classification of James George Frazer, there exist two types of magic [4]: (1) homeopathic magic based on the principle of similars: "*similia similibus curantur*"; (2) contagious magic based on the belief in that "the things which have once been in contact with each other continue to act on each other at a distance after the physical contact has been severed", and it was believed that the distance between the things being interacted was of no importance. For example, a

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custom could be found among primitive peoples to thoroughly hide baby-teeth that had fallen out, or severed hair, nails, or pieces of food, so that whoever got possession of these could not work his or her ill will upon their former owner. In Australia, there was a custom to steal one's enemy's things (e.g., garment) in order to beat them soundly or roast them in fire thus harming the enemy. Doubtless that the cases of remote mental influence by contemporary psychics on various physical objects also must be classified as contagious magic since: first, for a successful psychic's influencing an object, the stage of "establishing the contact" is necessary; secondly, the efficiency of influence does not depend on the distance.

The main peculiarity of action of both ancient and contemporary magicians (psychics) on remote objects is selectivity of action; the control group of similar objects located near the object being influenced upon did not respond to the influence.

Preceding to the stage of influencing is a stage of "establishing the contact". The contact may be established by two methods. In the first method, the magician (psychic) contacts directly with the object of future influence or with things belonging to the object. In the second method, the psychic "tunes" his or her own organism in such a way that the effect of influencing the object chosen be maximum. This method is most often used in experiments. For example, in experiments conducted by V. Kartsev [27, 28], influencing mice by a psychic at a distance of 30 km was the most effective when the psychic played "harmonica" (a kind of button accordion). The famous psychic E. Dubitskiy described his method of tuning for cancer treatment (the treatment was conducted successfully by Skype from Moscow to New-York) [29] in such a way: the psychic mentally materializes "elementary" particles (electrons, protons, neutrons) and/or gamma-rays and directs the beam to a target, on which cancer cells have been placed mentally. In the experiments with microcalorimeter for changing the temperature of a piece of semiconductor inside the microcalorimeter, E. Dubitskiy mentally compressed the atoms and changed their speed [30]. Unique psychic A. Vdovin cured multiple sclerosis over the phone imaging that he is a snake squirming inside the body of the patient and eating the bacteria covering the nerves.

The necessity of establishing the contact is in accordance with property 3 of spin supercurrent: effective interaction of spin vortices by means of spin supercurrent takes place under condition (8), that is, under equality of precession frequencies of spins of interacting spin vortices. Thus the stage of establishing the contact is necessary for equalizing the precession frequencies of spins of spin vortices created by quantum entities that constitute the psychic's organism, on the one hand, and spins of spin vortices of quantum entities that constitute the object being influenced, on the other hand.

The mental influence on remote objects has the following characteristics:

– Independence of the distance

The variation of the distance between the psychic and the object influenced did not affect the result; for example, in experiments conducted by K. Korotkov [31], also by G. Gurtovoy and A. Parkhomov [32, 33] the distance varied in the range of 0.5 m to 2,000 km.

This characteristic is in accordance with property 4 of spin supercurrent (section II.b): the spin supercurrent is emerging between spin vortices independent of the distance between them. Note that the independence of the distance rules out the hypothesis of the thermal or acoustic nature of psychic's influence.

– Independence of the presence of electromagnetic screens

The screening of the object being influenced from electromagnetic radiation did not affect the result produced by the psychic, in some cases made it even more distinct [27-28, 31-32].

This characteristic of mental influence is in accordance with property 6 of spin supercurrent (section II.b): spin supercurrent is not shielded by electromagnetic screens.

– The ability to transmit information

The psychics showed an ability to transmit information to the objects. For example, while influencing a noise generator the psychic could, on the one hand, suppress at will the signal at the output of the generator, and, on the other hand, the psychic could also produce a train of pulses [27, 32]. While influencing concentrations of gas emitted by cucumber's slices (experiments were conducted by H. Kokubo, et al. [34]) the psychic could make the odor of cucumbers higher or suppress it.

This characteristic of mental influence is in accordance with property 1 (section II.b) of spin supercurrent: according to equation (5), by changing the characteristics of spins of spin vortices it is possible to change the sign of spin supercurrent emerging between these vortices.

Based on analogies between the action of psychic on remote objects and the properties of spin supercurrent (section II.b) the action of psychic may be represented by the scheme given in figure 3. The spin supercurrent emerges between the spin vortices created by quantum entities that constitute the psychic's organism, on the one hand, and spin vortices created by quantum entities that constitute remote objects, on the other hand.

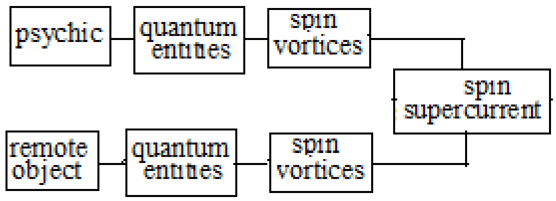

Fig. 3: The diagram of action of a psychic on devices by means of spin supercurrent

b) The Locating of a Hidden Cavity Structure. Dowsing

Analysis of experimental evidence on locating ground water, buried ores, etc. (sometimes performed with the use of a dowsing rod) makes it possible to specify the main features of locating [35, 36] and compare them with the properties of spin supercurrent. With this aim in view, let us represent spin supercurrent j_z emerging in a cavity structure as three summands:

$$j_z = (j_z)_1 + (j_z)_2 + (j_z)_3, \qquad (19)$$

where $(j_z)_1$ is spin supercurrent between spin vortices created by quantum entities of cavity wall substance, $(j_z)_2$ is spin supercurrent between spin vortices created by quantum entities of substance contained in the cavity, $(j_z)_3$ is spin supercurrent between spin vortices created by cavity wall substance, on the one hand, and spin vortices created by the substance contained in the cavity, on the other hand.

– The dependence of effectiveness of locating on the form of the cavity structure

The dependence of effectiveness of locating on the form of the cavity structure containing a substance under study (assume that the substance fills all the structure) may be explained using the properties of spin supercurrent $(j_z)_1$, see equation (19). As the mutual orientation of spins of spin vortices created by quantum entities that constitute the substance of cavity structure wall depends on the form of this structure (see section II.d), then from equation (5) it follows that the values of spin supercurrent $(j_z)_1$ depend on the form of cavity structure.

– The dependence of effectiveness of locating on the cavity wall substance and the substance contained in the cavity

The effectiveness of dowsing connected with the cavity wall substance and with the substance contained in the cavity is determined by values of spin supercurrents $(j_z)_1$ and $(j_z)_2$, see equation (19). It follows from equation (5) that the values of $(j_z)_1$ and $(j_z)_2$ are determined, through coefficients g_1 and g_2, by the properties of the substance where spin supercurrent emerges.

– The dependence of effectiveness of locating on the difference in the characteristics of the cavity wall substance and the substance contained in the cavity. In many cases the effectiveness is the highest when the substances are in different phase states: solid and liquid, solid and gas, etc.

It may be explained by the following: the less is the difference between respective characteristics of substances of cavity wall and substance contained in the cavity structure, the less the structure is one of the cavity type and, consequently, the less is the possibility of meeting the inequality (18). The latter results in decreasing the effectiveness of locating this cavity structure.

– The dependence of effectiveness of dowsing on the substance and form of the dowsing rod

The use of substance of rod or auxiliary object similar to that being searched for (for example, while searching a cavity containing oil it is useful to hold in hand a vial with oil [36]) may "tune" the dowser's organism to searching the substance. Then the following inequality will be justified: $|\omega_d - \omega_c| > |\omega_d' - \omega_c|$, where ω_c is the precession frequency of spins of spin vortices created by quantum entities that constitute the substance being searched for, ω_d is the precession frequency of spin of spin vortices created by quantum entities that constitute dowser's organism, ω_d' is the value of frequency ω_d while using the substance of rod or axillary object similar to that being searched for. Consequently, according to condition (8), the effectiveness of dowsing increases.

Note that according to equation (5) the action of spin supercurrent on spins is analogous to the action of a moment on these spins. It may explain why while locating with the use of a rod the latter *rotates* in the area of cavity structures.

c) The Structuring of Space by Psychics

In 2013, Japanese researcher H. Kokubo et al. conducted unique experiments on psychics' non-contact effect on bio-sensors. The cucumber slices were used as bio-sensors and concentrations of gas emitted by slices were measured [34]. The recurring zones of increased concentrations of gas emitted by slices were observed. The characteristics of the recurring zones (the number, form, and thickness of zones, the distances between them) were determined by the ability of psychic to create these zones. A schematic picture of observed recurring zones is shown in figure 4: the radius r of the external zone in these experiments is limited only by the size of setup (r~250*cm*), the thickness of a zone of maximum concentration is $\delta \sim 15cm$. The zones of maximum concentration are black.

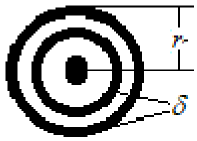

Fig. 4: Schematic picture of observed recurring zones created by a psychic: r is the radius of the external zone ($r \sim 250$cm), the radius in these experiments is limited only by the size of setup, δ is the thickness of zone of maximum concentration (~ 15cm).

The structuring of space by living and non-living objects was observed in many experiments. For example, in experiments with rotating magnets conducted by S. Godin and V. Roshchin (in 1990-1993) the emergence of recurring zones of elevated magnetic field strength (so-called walls) was observed [37-38]. In 1968-2000, V. Grebennikov studying bee combs discovered that empty beer combs were embanked by a system of invisible “shells” which seemed to be like a compression of air [39]. Jumps of the density of air are observed near the output of the nozzle of a jet engine (for example, de Laval nozzle) [40]. In all experiments, the emerging structures are not screened by electromagnetic screens.

This structuring of physical vacuum may be explained by the properties of spin supercurrent. Any person (and any non-living object as well) may interact with other objects by means of spin supercurrents. From this point of view, any person (and any non-living object as well) “radiates” spin supercurrents. According to property 6 (see section II.b), spin supercurrent is not screened by electromagnetic screens. According to property 7 of spin supercurrent (see section II.b), the speed of spin supercurrent is greater than the speed of light. If the speed of spin supercurrent is greater than the speed of propagation of contraction in the vortex-type physical vacuum, the zones of jumps of density and shock waves appear in the vortex-type physical vacuum [14]. As the characteristics of spin supercurrents “emitted” by a person are determined by the characteristics of spins of spin vortices created by quantum entities that constitute the person‘s organism, the person may influence the characteristics of those jumps of density by changing the state of their own organism.

d) The Changes in Weight. Levitation

According to memoirs of witnesses [41], Russian Orthodox saint Seraphim of Sarov (1759-1833) raised into the air from the ground during a fervent prayer, one of the witnesses being Russian emperor Alexander I. Shamans of Buryatia with 30 kg of metallic objects attached to them, after 24-hour fasting and dances including rotations, can hover for several seconds in the air at the height of 0.5 m. It is known [42] that a cocoon of ichneumon of the Ichneumonidae family, belonging to Bathyplectes anurus species (cocoon of parasitic fly or wasp), could jump upon exposing it to sunlight (the jumps were 30 mm long and 50 mm high, that is, exceeding the cocoon width by factor of 30); such jumps were performed even when the cocoon had been placed on a “cloud” of loose cotton wool [39].

Experimentally the changes in weight were also observed for non-living objects. One of the most striking examples of such experiments is a series of experiments conducted by J. Searl in 1940-1950 [43, 44]. In the experimental setup, there was a magnetic ring (stator) creating rotating nonlinear magnetic field. At the critical value of speed of rotation, the levitation of setup was observed. Similar experiments with rotating magnets were conducted by S. Godin and V. Roshchin in 1990-1993 [37, 38]: at the clockwise rotation of the rotor, a force arose directed oppositely to the gravitation vector (which is levitation), at the counter-clockwise rotation the arising force was directed along the gravitation vector. In 1977-1987, one of the pyramid researchers Joe Parr experimented with the pyramids rotating in an alternating magnetic field, and he observed the weight loss of pyramid [45, 46]. In experiments conducted by Japanese researcher H. Havasaka ($\sim$1989), a decrease in weight of right-hand rotating gyroscope with rotations around the vertical axis relative to the Earth was observed [47]; the magnitude of the decrease in weight did not depend on shielding the gyroscope from the external magnetic field (0.35 G). That is, the change in weight was not of magnetic nature.

The above experiments may be explained if to take into account the properties of the vortex-type physical vacuum (section II.c.ii). If spins of spin vortices created in the vortex-type physical vacuum by quantum entities that constitute an object are oriented uniformly, then, according to condition (11), this area of vortex-type physical vacuum will have a non-zero electric dipole moment. As the surface of the Earth has a negative charge, then force $\mathbf{F}_d$ determined by equation (12) will act on spin vortices in this area and consequently on the object that creates these spin vortices. At the orientation of spins downwards to the Earth, force $\mathbf{F}_d$ is directed from the Earth, that is, oppositely to the vector of gravitation; at reversed orientation, force $\mathbf{F}_d$ is directed towards the Earth, that is, along the vector of gravitation. Due to the Barnett effect [24], the orientation of spins of the spin vortices in the vortex-type physical vacuum may be caused by rotation of the object creating those spin vortices: at the right-hand rotation, levitation takes place.

e) Short-time Invisibility

Gospel of Luke [48] states that when Nazarites wanted to shove Christ off the mountain, where the town was situated, for his preaching in the synagogue, Christ became invisible and thus escaped.

It should be noted that "Invisibility Cloak" ("Mantle of Invisibility") and "Cap of Invisibility" are magical items found in folklore and fairy tales [49-50]. But these items remained not only as attributes of myths and legends: short-time invisibility is observed in contemporary experiments both with living and with non-living objects. For example, Grebennikov studying the behavior of the cocoon of an ichneumon of the Ichneumonidae family, belonging to Bathyplectes anurus species discovered that during the above-mentioned jumps of the cocoon, the invisibility of the cocoon took place for a short time [39]. Short-time invisibility was observed in experiments conducted by J. Searl [43-44] with magnets creating rotating nonlinear magnetic field, and in experiments conducted by S. Godin and V. Roshchin with rotating magnets [37, 38]. Note that in the experiments mentioned the short-time invisibility was observed simultaneously with levitation.

The above experiments may be explained if to take into account the properties of the vortex-type physical vacuum (section II.c.iii). If in the location of the object studied the spins of spin vortices created in the vortex-type physical vacuum by quantum entities that constitute this object are "frozen" (that is, equation (17) holds), then the vortex-wave-spin process will not spread in this location. As according to condition (2) and conclusions of work [22] the vortex-wave-spin process is also an electromagnetic process, then light will not spread in the location of the object mentioned. If "frozen" spins are oriented to the Earth or oppositely, then invisibility of object and changing in its weight may occur simultaneously.

IV. Discussion

The spin supercurrent may emerge not only between spin vortices that constitute different objects but also between spin vortices that constitute an object, on the one hand, and spin vortices that constitute the vortex-type physical vacuum, on the other hand. As follows from equation (7), as a result of the action of spin supercurrent the difference in values of respective characteristics of interacting spin vortices decreases. Consequently, it can be said that the area of vortex-type physical vacuum where the object is located "acquires" the properties of the object. After removing the object from the area of vortex-type physical vacuum, the characteristics of spins that constitute this vacuum in the area may not return to initial values. In this respect, one may say about "memory" of the spin system of vortex-type physical vacuum. It is possible that belief in that the soul of a deceased person remains for some days in the premises where the deceased lived is based on these properties of the physical vacuum. For example, the outstanding psychic L. A. Korabelnikova while identifying people by their belongings perceived the deceased as being alive for nine days after the person's death [27].

V. Conclusion

The following "miracles" accomplished by both ancient and contemporary magicians (at present they may be called "psychics"): the selective action on remote objects (for example, "contagious magic"); the locating of hidden cavity structures (in particular, dowsing); the structuring of space (the so-called "magic rings" or "charmed rings"); the changes in one's own weight (in particular, levitation); short-time invisibility, can be the results of the processes taking place in the physical vacuum having the following properties.

1. It consists of quantum harmonic oscillators (QHOs) characterized by zero-point energy.
2. The vortex-wave-spin process which is simultaneously an electromagnetic process may emerge.
3. The quantum entity creates a pair of oppositely charged virtual particles (virtual photon or spin vortex) in this vacuum.
4. Spin supercurrent may emerge between spin vortices in this vacuum. The spin supercurrent is determined by mutual orientation of spins of interacting spin vortices; it does not depend on the distance between the vortices, is not subject to electromagnetic screening, and its speed is greater than the speed of light (the latter does not contradict the second postulate of SR because the spin supercurrent is *an inertia-free process*). The effectivity of action of spin supercurrent is maximum if the difference between precession frequencies of spins of the spin vortices between which it arises is negligible.

Based on the properties of the vortex-type physical vacuum, the above-mentioned miracles accomplished by magicians may be explained in the following way.

1. The action of magicians on remote objects (in particular, "contagious magic") is due to spin supercurrents emerging between the spin vortices created by quantum entities that constitute magician's organism, on the one hand, and the spin vortices created by quantum entities that constitute the remote object, on the other hand.
2. Detection of hidden cavity structures, for example, underground water or buried treasures (in particular, dowsing) may be accomplished due to the action of spin supercurrent filling the cavity structure on the

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spin vortices created by quantum entities that constitute the magician's organism.

3. The structuring of space around a magician (the so-called "magic rings" or "charmed rings") may take place, because the speed of spin supercurrent emerging between the spin vortices created in the vortex-type physical vacuum by quantum entities that constitute the magician's organism, on the one hand, and spin vortices that constitute this vacuum, on the other hand, is greater than the speed of propagation of contraction in this vacuum. The contraction is caused by spin supercurrent.
4. The changes in the weight of a magician may take place as a result of spin polarization of vortex-type physical vacuum at the location of the magician: if spins are oriented downward to the Earth, the weight decreases (levitation), if oppositely to the Earth, the weight increases. The orientation may take place, for example, due to the Barnet effect at the rotation of the magician.
5. The short-time invisibility of magician may be accounted for by the impossibility of spreading the vortex-wave-spin process (the electromagnetic process) in the area of location of the magician due to the impossibility of changing the orientation ("freezing") of spins of the vortex-type physical vacuum in this area.

From the physical point of view, the ability of any person to accomplish a miracle is determined by his/her ability to control the characteristics of spins (orientation, precession frequency, etc.) of spin vortices created in the vortex-type physical vacuum by quantum entities that constitute the person's organism.

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Bending Dynamics of DNA

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Abstract- It is here pointed out that the local opening of base pairs induces the formation of kinks which facilitates the bending of double helix. The conformational properties of DNA can be mapped onto the Heisenberg spin system and denaturation occurs through quantum phase transition (QPT) induced by a quench when the temperature effect is incorporated through the quench time . The nonequilibrium effect in QPT introduced through the quench generate defects like kinks end antikinks, the density of which depends on the quench time and hence on temperature. It is here argued that when we transcribe this result in the rod –like-chain (RLC) model of DNA, these defects lead to bends. This suggests that we have dynamical generation of kinks leading to the formation of bends during local denaturation.

Keywords: *DNA, bends, kinks.*

GJSFR-A Classification: *FOR Code: 020302*

BENDINGDYNAMICSOFDNA

Strictly as per the compliance and regulations of:

Bending Dynamics of DNA

Subhamoy Singha Roy

Abstract- It is here pointed out that the local opening of base pairs induces the formation of kinks which facilitates the bending of double helix. The conformational properties of DNA can be mapped onto the Heisenberg spin system and denaturation occurs through quantum phase transition (QPT) induced by a quench when the temperature effect is incorporated through the quench time . The nonequilibrium effect in QPT introduced through the quench generate defects like kinks end antikinks, the density of which depends on the quench time and hence on temperature. It is here argued that when we transcribe this result in the rod –like-chain (RLC) model of DNA, these defects lead to bends. This suggests that we have dynamical generation of kinks leading to the formation of bends during local denaturation.

Keywords: DNA, bends, kinks.

I. Introduction

It is wellknown that DNA experiences bending due to thermal fluctuation . Also the bending occurs owing to the influence of special proteins or through an external force which deforms it to a circle. It is noted that the elastic properties of DNA can be best formulated when it is considered as an elastic object. The Worm-like-chain (WLC) model was introduced [1] which describes a chain by elastic continuous curve at thermal equilibrium with a single elastic constant, the persistent length P, characterizing the bending energy. The WLC can be solved analytically by mapping it onto a quantum mechanical problem. Indeed the partition function is a Euclidean path integral for a quantum dumbbell. Bouchiat and Mezard [2] generalized this model introducing twist rigidity and it appears that a DNA molecule can be depicted as a thin elastic rod . The rod-like-chain(RLC) model is characterized by the fact that the partition function can be mapped onto the path integral representing the charged particle in the field of a nonquantized magnetic monopole. Cloutier and Widom [3] have shown that the prediction of the WLC model is not consistent with the cyclization of short DNA fragments of around 100 base pairs. Crick and Klug [4] predicted earlier that strong bending of DNA is facilitated by kinks of the double helix. Vologodskii and Frank-Kamenetskii [5] have reviewed the situation of strong bending and pointed out that kinks in strongly bent DNA segments is not a property of short DNA fragments as it is equally possible in large DNA molecules. Indeed these authors have noted that kinks may represent opening of isolated base pairs which had been experimentally detected in linear DNA molecules. In this note we argue that kinks are produced dynamically when we have local denaturation of DNA which play a crucial role in bending of the double helix. Indeed the dynamical generation of kinks leading to the bending of the double helix is a specific property of local denaturation caused by thermal effect.

Recently we have pointed out that the conformational properties of a DNA molecule can be mapped onto a Heisenberg spin system [6]. In this framework denaturation transition can be formulated in terms of quantum phase transition induced by a quench where the temperature effect is incorporated in the quench time [6, 7]. In a DNA molecule two polynucleotide chains are twisted about the molecule axis with a specific helical sense. We can view this such that a spin with a specific helicity is inserted on this axis and two nearest neighbour spins having opposite helicities are located in the axis covering two adjacent coils. The system then represents a spin chain when two nearest neighbour spins have opposite orientations $+1/2$ and $-1/2$ with lattice spacing of the period of helix. Evidently this represents an antiferromagnetic spin chain. When the entanglement entropy of the system vanishes we have denaturation transition [6, 7].

II. Data And Method

The Hamiltonian of the one dimensional Heisenberg spin chain (XXX model), with nearest neighbor interaction is given by

$$H=\sum_i(\sigma_i^X\sigma_{i+1}^X+\sigma_i^Y\sigma_{i+1}^Y+\sigma_i^Z\sigma_{i+1}^Z)+\lambda\sum_i\sigma_i^2 \qquad (1)$$

$\sigma_i^{X(Y,Z)}$ is the Pauli matrix at the site i, which represents the spin vector through the relation $\vec{S}=(1/2)\vec{\sigma}$ and λ is the parameter representing the external magnetic field. In the context of DNA, λ represents torsion energy [6]. When the spin system undergoes quantum phase transition (QPT) the criticality corresponds to a two-limit behavior. At $\lambda=0\,(2)$ we have the antiferomagnetic (ferromagnetic) state. The region between $\lambda=0$ and $\lambda=2$ represents the critical region. The entanglement entropy is maximum at $\lambda=0$ and it decreases as λ increases when at $\lambda=2$ it vanishes.

It is now observed that the criticality of a finite temperature transition can be mapped onto a zero temperature QPT induced by a quench. Indeed as

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pointed out by Schutzhold [8] the nonequilibrium effect in zero temperature QPT shows a remarkable analogy between phase transition at finite and zero temperature. Vojta [9] has argued that quantum criticality can be approached in two different ways. It may be considered that at as $T \to 0$ the control parameter λ attains the critical value $\lambda = \lambda_c$. Also it may be argued that at $T = 0$, $\lambda \to \lambda_c$ [9]. In the vicinity of the critical point the spatial correlation as well as the temporal correlation of the order parameter fluctuations become long ranged. The crossover form the quantum to classical behaviour occurs when the correlation time exceeds $\beta = 1/k_B T$ in a quench induced QPT. This arises when we take into account the Kibble –Zurek (KZ) mechanism [10, 11] in QPT having time dependent control parameter which gives rise to nonequilibrium effect near criticality. This implies that zero temperature QPT induced by a quench can be mapped onto a classical finite temperature phase transition when temperature effect is incorporated in the quench time τ_q having the relation $T \sim 1/\tau_q$. In QPT induced by a quench in Heisenberg spin chain we can take

$$\lambda(t\langle 0) = 2 - 2t/\tau_q \qquad (2)$$

so that at $t = \tau_q$ we have $\lambda = 0$ and as t approaches zero starting from τ_q, λ increases so that at $t = 0$, $\lambda = 2$ when the entanglement entropy vanishes. In a recent paper [12] it has been shown that in the Heisenberg spin chain the λ dependence of the entanglement entropy S is given by

$$S(\lambda) = S(\lambda = 0) + \Delta S \qquad (3)$$

with

$$\Delta S = (1/6)\log_2(1 - \lambda/2) \qquad (4)$$

It may be mentioned here that in studying denaturation of DNA in terms of QPT induced bya quench the temperature dependence of λ is taken to be [6]

$$\lambda = \overline{A}T + \overline{B} \qquad (5)$$

where $\overline{A}$ and $\overline{B}$ are constants given by $\overline{A} = 0.0385$ and $\overline{B} = -11.47$

From eqns (4, 5, 6) we can now determine the entropy at a given temperature which gives a measures of the opening of base pairs at a given temperature [7]. A general property of QPT induced by a quench is that it generates defects in the form of kinks and antikinks and introduces a new lenhth scale known as the Kibble – Zurek (KZ) correlation length defined by the average distance between a kink and the nearest antikink [13, 14]. The density of defects ρ depends on the quench time τ_q through the relation $\rho \sim 1/\sqrt{\tau_q}$ so that the KZ correlation length ξ satisfies the relation $\xi \sim \sqrt{\tau_q}$ [13, 14]. Utilising the relationship between the quench time τ_q with temperature T through the relation $T \sim 1/\tau_q$ as mentioned above, we note that the KZ correlation length ξ depends on the temperature through the relation $1/\sqrt{k_B T}$.

III. Analysis And Discussion

Now we transcribe our above results derived from the situation where a double helix is mapped onto the Heisenberg spin chain into the elastic rod model. It is noted that local denaturation caused by QPT induced by a quench leads to the generation of defects like kinks and antikinks which correspond to the bends of the axis of the DNA molecule and represent dynamical bending of the elastic rod. The KZ correlation length corresponds to the bend length. These bends are dynamically produced and the associated bend length A is different from the structural persistent length P which is the geometrical property of the rod . As the formation of the defects is such that a kink is followed by an antikink, this would mean that every joint periodically bends oppositely to each other .From the relation that the KZ correlation length $\xi \sim \sqrt{\tau_q}$ and $\tau_q \sim 1/T$ we note that when we consider ξ as the bend length A, we can write the relation $A \sim 1/\sqrt{T}$. From this we write

$$(A^2/P) = k/K_B T \qquad (6)$$

Where k is the bend stiffness having dimension of $energy.length$. Here we have introduced the structural persistent length P in the L.H.S for dimensional reason as this corresponds to a fixed length scale for the system. Now observing that experimentally we have bend stiffness $k = 45nm(K_B T)$ and $P = 130nm$ [15] we have $A = 76.5nm$. This is to be compared with the experimental value $80nm$ [15].

From this we have the total persistence length given by

$$A_{tot} = (A^{-1} + P^{-1})^{-1} \qquad (7)$$

From eqn. (8) we have $A_{tot} = 48.3nm$ which is to be compared with the standard value $50nm$.

Thus we find that our results are consistent with experiments.

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It may be recalled here that Nelson [16] proposed that natural bends in DNA hinder the axial rotation of the transcribed DNA causing the propagation of torsional stress. The bends are taken to be random but their effects do not average to zero. In contrast the present analysis suggests that bends are produced dynamically during local denaturation associated with transcription. These bends follow a specific pattern having a more or less same distance between them determined by the KZ correlation length so that the bend length A satisfies the eqn (7) . According to Nelson's prescription the total effect of random natural bends makes DNA a random coil with total persistence length A_{tot} . However according to the present formulation the bends are produced dynamically which make DNA a systematic coil having a well defined bend length and total persistence length[17-18].

IV. Conclusion and Summary

In summary, we argue that local denaturation leads to the generation of defects like kinks and antikinks which correspond to bends in the elastic rod formulation of DNA. This dynamical formation of bends during transcription shut down spinning motion completely and generates significant torsional stress near the point of transcription.

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Electrodynamics of the Dielectrics

By F. F. Mende

Abstract- In the scientific literature is in sufficient detail opened the role of the kinetic inductance of charges in the conductors and the plasmo-like media, but it is not opened the role of this parameter in the electrodynamics of dielectrics. This parameter in the electrodynamics of dielectrics plays not less important role, than in the electrodynamics of conductors. In the article the electrodynamics of dielectrics taking into account the kinetic inductance of the charges, which form part of their atoms or molecules is examined. This most important question fell out from the field of the sight of scientists, and this article completes this deficiency.

Keywords: *dielectric, conductor, kinetic inductance of charges, dispersion of dielectric constant, plasmo-like medium.*

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ELECTRODYNAMICSOFTHEDIELECTRICS

Strictly as per the compliance and regulations of:

Electrodynamics of the Dielectrics

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Abstract- In the scientific literature is in sufficient detail opened the role of the kinetic inductance of charges in the conductors and the plasmo-like media, but it is not opened the role of this parameter in the electrodynamics of dielectrics. This parameter in the electrodynamics of dielectrics plays not less important role, than in the electrodynamics of conductors. In the article the electrodynamics of dielectrics taking into account the kinetic inductance of the charges, which form part of their atoms or molecules is examined. This most important question fell out from the field of the sight of scientists, and this article completes this deficiency.

Keywords: dielectric, conductor, kinetic inductance of charges, dispersion of dielectric constant, plasmo-like medium.

I. Introduction

In the scientific literature is in sufficient detail opened the role of the kinetic inductance of charges in the conductors and the plasmo-like media [1-4], but it is not opened the role of this parameter in the electrodynamics of dielectrics. However, this parameter in this case plays not less important role, than in the electrodynamics of the conductors [5-8]. This most important question fell out from the field of the sight of scientists and this article completes this deficiency.

II. Electrodynamics Of The Dielectrics

Let us examine the simplest case, when oscillating processes in atoms or molecules of dielectric obey the law of mechanical oscillator [5, 6]:

$$\left(\frac{\beta}{m}-\omega^2\right)\mathbf{r}_m=\frac{e}{m}\mathbf{E} \qquad (1)$$

Where $\mathbf{r}_m$ - deviation of charges from the position of equilibrium, β - coefficient of elasticity, which characterizes the elastic electrical binding forces of charges in the atoms and the molecules. Introducing the resonance frequency of the bound charges

$$\omega_0=\beta/m\,,$$

we obtain from (1)

$$\mathbf{r}_m=-\frac{e\,\mathbf{E}}{m(\omega^2-\omega_o^2)}. \qquad (2)$$

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Is evident that in relationship (2) as the parameter is present the natural vibration frequency, into which enters the mass of charge. This speaks, that the inertia properties of the being varied charges will influence oscillating processes in the atoms and the molecules.

Since the general current density on medium consists of the bias current and conduction current

$$\mathrm{rot}\,\mathbf{H}=\mathbf{j}_\Sigma=\varepsilon_0\frac{\partial\mathbf{E}}{\partial t}+ne\mathbf{v}.$$

That, finding the speed of charge carriers in the dielectric as the derivative of their displacement through the coordinate

$$\mathbf{v}=\frac{\partial\mathbf{r}_m}{\partial t}=-\frac{e}{m(\omega^2-\omega_o^2)}\frac{\partial\mathbf{E}}{\partial t}.$$

From relationship (2) we find

$$\mathrm{rot}\,\mathbf{H}=\mathbf{j}_\Sigma=\varepsilon_0\frac{\partial\mathbf{E}}{\partial t}-\frac{1}{L_{kd}(\omega^2-\omega_0{}^2)}\frac{\partial\mathbf{E}}{\partial t}. \qquad (3)$$

Let us note that the value

$$L_{kd}=m/\left(ne^2\right)$$

presents the kinetic inductance of the charges, entering the constitution of atom or molecules of dielectrics, when to consider charges free. Therefore (3) let us rewrite in the form:

$$\mathrm{rot}\,\mathbf{H}=\mathbf{j}_\Sigma=\varepsilon_0\left(1-\frac{1}{\varepsilon_0 L_{kd}(\omega^2-\omega_0{}^2)}\right)\frac{\partial\mathbf{E}}{\partial t}. \qquad (4)$$

Since the value

$$1/\left(\varepsilon_0 L_{kd}\right)=\omega_{pd}{}^2$$

presents the plasma frequency of charges in atoms and molecules of dielectric, if we consider these charges free, then relationship (9.4) takes the form:

$$\mathrm{rot}\,\mathbf{H}=\mathbf{j}_\Sigma=\varepsilon_0\left(1-\frac{\omega^2{}_{pd}}{(\omega^2-\omega_0{}^2)}\right)\frac{\partial\mathbf{E}}{\partial t}. \qquad (5)$$

It is possible to name the value

$$\varepsilon^*(\omega) = \varepsilon_0\left(1 - \frac{\omega^2{}_{pd}}{(\omega^2 - \omega_0{}^2)}\right) \qquad (6)$$

by the effective dielectric constant of dielectric and it depends on frequency. But this mathematical parameter is not the physical dielectric constant of dielectric, but has composite nature. It includes three those not depending on the frequency of the value: electrical constant, natural frequency of atoms or molecules and plasma frequency for the charge carriers, entering their composition, if we consider charges free[7].

Let us examine two limiting cases:

a) If $\omega << \omega_0$, then from (5) we obtain

$$\operatorname{rot}\mathbf{H} = \mathbf{j}_\Sigma = \varepsilon_0\left(1 + \frac{\omega_{pd}{}^2}{\omega_0{}^2}\right)\frac{\partial \mathbf{E}}{\partial t}. \qquad (7)$$

In this case the coefficient, confronting the derivative, does not depend on frequency, and it presents the static dielectric constant of dielectric. As we see, it depends on the natural frequency of oscillation of atoms or molecules and on plasma frequency. This result is intelligible. Frequency in this case proves to be such low that the charges manage to follow the field and their inertia properties do not influence electrodynamic processes. In this case the bracketed expression in the right side of relationship (7) presents the static dielectric constant of dielectric. As we see, it depends on the natural frequency of oscillation of atoms or molecules and on plasma frequency. Hence immediately we have a prescription for creating the dielectrics with the high dielectric constant. In order to reach this, should be in the assigned volume of space packed a maximum quantity of molecules with maximally soft connections between the charges inside molecule itself.

b) The case is exponential $\omega >> \omega_0$. In this case

$$\operatorname{rot}\mathbf{H} = \mathbf{j}_\Sigma = \varepsilon_0\left(1 - \frac{\omega_{pd}{}^2}{\omega^2}\right)\frac{\partial \mathbf{E}}{\partial t}$$

dielectric became conductor (plasma) since. The obtained relationship exactly coincides with the equation, which describes plasma.

One cannot fail to note the circumstance that in this case again nowhere was used this concept as polarization vector, but examination is carried out by the way of finding the real currents in the dielectrics on the basis of the equation of motion of charges in these media. In this case in this mathematical model as the initial electrical characteristics of medium are used the values, which do not depend on frequency.

From relationship (5) is evident that in the case of fulfilling the equality $\omega = \omega_0$, the amplitude of fluctuations is equal to infinity. This indicates the presence of resonance at this point. The infinite amplitude of fluctuations occurs because of the fact that they were not considered losses in the resonance system; in this case its quality was equal to infinity. In a certain approximation it is possible to consider that lower than the point indicated we deal concerning the dielectric, whose dielectric constant is equal to its static value. Higher than this point we deal already actually concerning the metal, whose density of current carriers is equal to the density of atoms or molecules in the dielectric.

Now it is possible to examine the question of why dielectric prism decomposes polychromatic light into monochromatic components or why rainbow is formed. For this the phase speed of electromagnetic waves on Wednesday must depend on frequency (frequency wave dispersion). Let us add to (5) the first Maxwell equation [8]:

$$\operatorname{rot}\mathbf{E} = -\mu_0\frac{\partial \mathbf{H}}{\partial t}; \quad \operatorname{rot}\mathbf{H} = \varepsilon_0\left(1 - \frac{\omega^2{}_{pd}}{(\omega^2 - \omega_0{}^2)}\right)\frac{\partial \mathbf{E}}{\partial t},$$

from where we immediately find the wave equation:

$$\nabla^2\mathbf{E} = \mu_0\varepsilon_0\left(1 - \frac{\omega_{pd}{}^2}{\omega^2 - \omega_0{}^2}\right)\frac{\partial^2\mathbf{E}}{\partial t^2}.$$

If one considers that

$$\mu_0\varepsilon_0 = 1/c^2,$$

Where c - the speed of light then is easy to see the presence in dielectrics of frequency dispersion. But the dependence of phase speed on the frequency is connected not with the dependence on it of physical dielectric constant. In the formation of this dispersion it will participate immediately three, which do not depend on the frequency, physical quantities: the self-resonant frequency of atoms themselves or molecules, the plasma frequency of charges, if we consider it their free, and the dielectric constant of vacuum.

Now let us show the weak places of the traditional approach, based on the use of a concept of polarization vector.

$$\mathbf{P} = -\frac{ne^2}{m} \cdot \frac{1}{(\omega^2 - \omega_0^2)} \mathbf{E}.$$

Its dependence on the frequency is connected with the presence of mass in the charges, entering the constitution of atom and molecules of dielectrics. The inertness of charges is not allowed for this vector, following the electric field, to reach that value, which it would have in the permanent fields. Since the electrical induction is determined by the relationship

$$\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{PE} = \varepsilon_0 \mathbf{E} - \frac{ne^2}{m} \cdot \frac{1}{(\omega^2 - \omega_0^2)} \mathbf{E}, \quad (8)$$

that introduced thus, it depends on frequency.

After introducing this induction into the second Maxwell equation, we will obtain:

$$\operatorname{rot} \mathbf{H} = \mathbf{j}_\Sigma = \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} + \frac{\partial \mathbf{P}}{\partial t}.$$

Or

$$\operatorname{rot} \mathbf{H} = \mathbf{j}_\Sigma = \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} - \frac{ne^2}{m} \frac{1}{(\omega^2 - \omega_0^2)} \frac{\partial \mathbf{E}}{\partial t}, \quad (9)$$

where $\mathbf{j}_\Sigma$ - the summed current, which flows through the model. In expression (9) the first member of right side presents bias current in the vacuum, and the second - current, connected with the presence of bound charges in atoms or molecules of dielectric. In this expression again appeared the specific kinetic inductance of the charges, which participate in the oscillating process

$$L_{kd} = m / ne^2,$$

the determining inductance of bound charges, and (9) takes the form:

$$\operatorname{rot} \mathbf{H} = \mathbf{j}_\Sigma = \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} - \frac{1}{L_{kd}} \frac{1}{(\omega^2 - \omega_0^2)} \frac{\partial \mathbf{E}}{\partial t}.$$

Obtained expression exactly coincides with relationship (3). Consequently, the eventual result of examination by both methods coincides, and there are no claims to the method from a mathematical point of view. But from a physical point of view, and especially in the part of the awarding to the parameter, introduced in accordance with relationship (8) of the designation of electrical induction, are large claims, which we discussed. These are the physical quantity of electrical induction, but the certain composite mathematical parameter. In the essence, physically substantiated is the introduction to electrical induction in the dielectrics only in the static electric fields.

Let us show that the equivalent the schematic of dielectric presents the sequential resonant circuit, whose inductance is the kinetic inductance L_{kd}, and capacity is equal to the static dielectric constant of dielectric minus the capacity of the equal dielectric constant of vacuum. In this case outline itself proves to be that shunted by the capacity, equal to the specific dielectric constant of vacuum. For the proof of this let us examine the sequential oscillatory circuit, when the inductance L and the capacity C are connected in series.

The connection between the current I_C, which flows through the capacity C, and the voltage U_C, applied to it, is determined by the relationships:

$$U_C = \frac{1}{C} \int I_C dt,$$

$$I_C = C \frac{dU_C}{dt}. \quad (10)$$

This connection will be written down for the inductance:

$$I_L = \frac{1}{L} \int U_L dt; \; U_L = L \frac{dI_L}{dt}.$$

If the current, which flows through the series circuit, changes according to the law $I = I_0 \sin \omega t$ then a voltage drop across inductance and capacity they are determined by the relationships

$$U_L = \omega L I_0 \cos \omega t; \; U_C = -\frac{1}{\omega C} I_0 \cos \omega t.$$

And total stress applied to the outline is equal

$$U_\Sigma = \left(\omega L - 1/(\omega C)\right) I_0 \cos \omega t.$$

In this relationship the value, which stands in the brackets, presents the reactance of sequential resonant circuit, which depends on frequency. The stresses, generated on the capacity and the inductance, are located in the reversed phase, and, depending on frequency, outline can have the inductive, the weather capacitive reactance. At the point of resonance the summary reactance of outline is equal to zero.

It is obvious that the connection between the total voltage applied to the outline and the current, which flows through the outline, will be determined by the relationship.

$$I = -\frac{1}{\omega\left(\omega L - 1/\left(\omega C\right)\right)}\frac{\partial U_{\Sigma}}{\partial t}. \qquad (11)$$

The resonance frequency of outline is determined by the relationship

$$\omega_0 = 1/\sqrt{LC},$$

therefore let us write down

$$I = \frac{C}{\left(1 - \omega^2/\omega_0^{\,2}\right)}\frac{\partial U_{\Sigma}}{\partial t}. \qquad (12)$$

Comparing this expression (12) with relationship (10) it is not difficult to see that the sequential resonant circuit, which consists of the inductance L and capacity C, it is possible to present to the capacity of in the form dependent on the frequency:

$$C(\omega) = C/\left(1 - \omega^2/\omega_0^{\,2}\right) \qquad (13)$$

The inductance is not lost with this idea, since it enters into the resonance frequency of the outline ω_0. Relationships (12) and (11) are equivalent. Consequently, value $C(\omega)$ is not the physical capacitance value of outline, being the certain composite mathematical parameter.

Relationship (11) can be rewritten and differently:

$$I = -\frac{1}{L\left(\omega^2 - \omega_0^{\,2}\right)}\frac{\partial U_{\Sigma}}{\partial t},$$

and to consider that

$$C(\omega) = -\frac{1}{L\left(\omega^2 - \omega_0^{\,2}\right)}. \qquad (14)$$

Is certain, the parameter of, introduced in accordance with relationships (13) and (14) no to capacity refers.

Let us examine relationship (12) for two limiting cases:

c) When $\omega << \omega_0$, *we have*

$$I = C\frac{\partial U_{\Sigma}}{\partial t}.$$

This result is intelligible, since at the low frequencies the reactance of the inductance, connected in series with the capacity, is considerably lower than the capacitive and it is possible not to consider it.

The equivalent the schematic of the dielectric, located between the planes of long line is shown in Figure 1.

d) When $\omega >> \omega_0$, *we have*

$$I = -\frac{1}{\omega^2 L}\frac{\partial U_{\Sigma}}{\partial t}. \qquad (15)$$

Taking into account that for the harmonic signal

$$\frac{\partial U_{\Sigma}}{\partial t} = -\omega^2 \int U_{\Sigma} dt,$$

we obtain from (15):

$$I_L = \frac{1}{L}\int U_{\Sigma} dt.$$

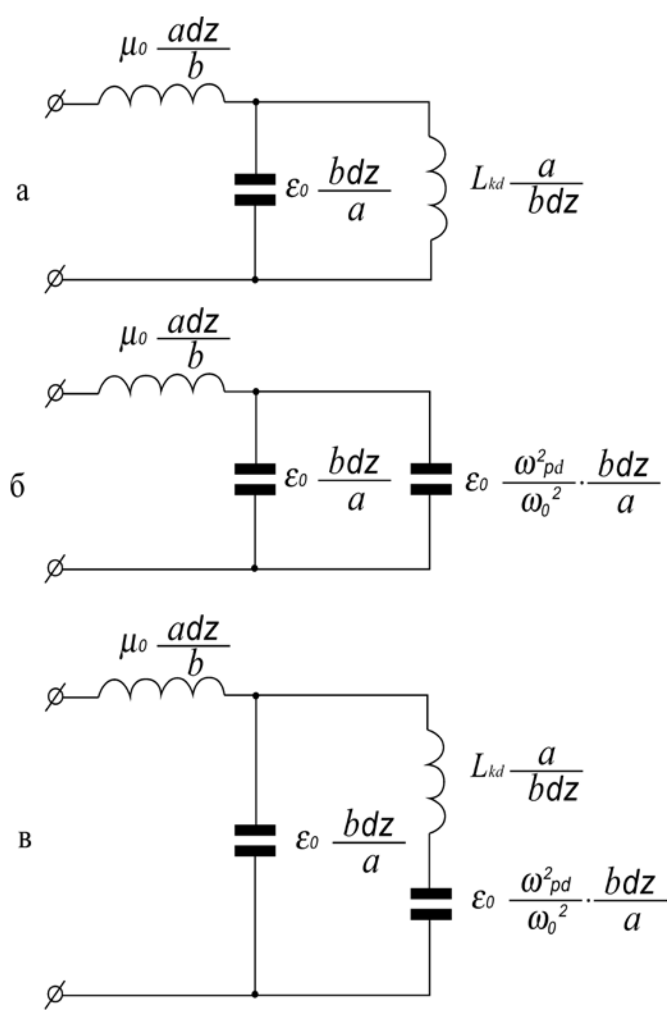

Figure 1: a - equivalent the schematic of the section of the line, filled with dielectric, for the by dielectric, for the case $\omega >> \omega_0$;

б - the equivalent the schematic of the section of line for the case of $\omega << \omega_0$;

в - the equivalent the schematic of the section of line for entire frequency band.

In this case the reactance of capacity is considerably less than in inductance and chain has inductive reactance.

The carried out analysis speaks, that is in practice very difficult to distinguish the behavior of resonant circuits of the inductance or of the capacity. For understanding of true design of circuits it is necessary to remove its amplitude and phase response in the range of frequencies. In the case of resonant circuit this dependence will have the typical resonance nature, when on both sides resonance the nature of reactance is different. However, this does not mean that real circuit elements: capacity or inductance depends on frequency.

In Figure 5аand 5бare shown two limiting cases. $\omega >> \omega_0$, when the properties of dielectric correspond to conductor; $\omega << \omega_0$, when - to dielectric with the static dielectric constant

$$\varepsilon = \varepsilon_0 \left(1 + \omega_{pd}^{\ 2} / \omega_0^{\ 2}\right).$$

Thus, the use of a term "dielectric constant of dielectrics" in the context of its dependence on the frequency is not completely correct. If the discussion deals with the dielectric constant of dielectrics, with which the accumulation of potential energy is connected, then correctly examine only static permeability, which is been the constant, which does not depend on the frequency. Specifically, it enters into all relationships, which characterize the electrodynamic characteristics of dielectrics.

Application of such new approaches most interestingly precisely for the dielectrics. Then each connected pair of charges is a separate unitary unit with its individual characteristics, and its interaction with the electromagnetic field (without taking into account the connections between the pairs) is strictly individual. Certainly, in the dielectrics not all dipoles have different characteristics, but there are different groups with similar characteristics, and each group of bound charges with the identical characteristics will resound at its frequency. Moreover the intensity of absorption and in the excited state and emission, at this frequency will depend on a relative quantity of pairs of this type. Therefore it is possible to introduce the appropriate partial coefficients. Furthermore, these processes will influence the anisotropy of the dielectric properties of molecules themselves, which have the specific electrical orientation in crystal lattice. By these circumstances is determined the variety of resonances and their intensities, which is observed in the dielectric media. With the electric coupling between the separate groups of emitters the lines of absorption or emission can be converted into the strips. Such individual approach to the types of the connected pairs of charges is absent from the available theories.

Let us emphasize the important circumstance, which did not receive thus far proper estimation. In all relationships for any material media (conductors and dielectrics) together with the dielectric and magnetic constant figures the kinetic inductance of the charges, which indicates not less important role of this parameter. This is for the first time noted in a number of the mentioned sources, including in the works [9, 10].

III. Conclusion

In the scientific literature is in sufficient detail opened the role of the kinetic inductance of charges in the conductors and the plasmo-like media, but it is not opened the role of this parameter in the electrodynamics of dielectrics. This parameter in the electrodynamics of dielectrics plays not less important role, than in the electrodynamics of conductors. In the article the electrodynamics of dielectrics taking into account the kinetic inductance of the charges, which form part of their atoms or molecules is examined. This most important question fell out from the field of the sight of scientists and this article completes this deficiency. Let us emphasize the important circumstance, which did not receive thus far proper estimation. In all relationships for any material media (conductors and dielectrics) together with the dielectric and magnetic constant figures the kinetic inductance of the charges, which indicates not less important role of this parameter.

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Path Integral Solutions of the PT-Symmetric and Non-Hermitian q-Deformed Eckart Plus Modified Hylleraas Potential

By Nalan Kandirmaz
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Abstract- In this study, the wave functions and the energy spectrum of the PT-Symmetric and non-Hermitian q-deformed Eckart plus modified Hylleraas potential are studied using Feyman's Path In-tegral method. The kernel and Green.s Function for PT-Symmetric and non-Hermitian q-deformed Eckart plus modified Hylleraas potential is analytically derived by transforming space-time. The results are discussed for the different parameters of the potential.

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PATHINTEGRALSOLUTIONSOFTHEPT-SYMMETRICANDNON-HERMITIANQ-DEFORMEDECKARTPLUSMODIFIEDHYLLERAASPOTENTIAL

Strictly as per the compliance and regulations of:

Path Integral Solutions of the PT-Symmetric and Non-Hermitian q-Deformed Eckart Plus Modified Hylleraas Potential

Nalan Kandirmaz

Abstract- In this study, the wave functions and the energy spectrum of the PT-Symmetric and non-Hermitian q-deformed Eckart plus modified Hylleraas potential are studied using Feyman's Path In-tegral method. The kernel and Green.s Function for PT-Symmetric and non-Hermitian q-deformed Eckart plus modified Hylleraas potential is analytically derived by transforming space-time. The results are discussed for the different parameters of the potential.

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I. Introduction

One of the important problems of quantum mechanics is to obtain the exact analytical solution of Schrodinger Equation for various potentials. In recent years, so many methods have been developed to solve the exact or quasi exactly for various complicated potentials, such as (SUSY), factorization, asymptotic iteration, path integral etc. These methods have been applied to a great variety of quantum mechanical interactions as analytical methods, variational methods, numerical approaches, Fourier analysis, semi-classical estimates, quantum field theory and Lie group theoretical approaches [1 - 8].

Feynman's Path Integral Method has wide application in many areas of theoretical physics [9 - 22]. It allows the transition to quantum mechanics from the Lagrangian formalism via quantization. Duru and Kleinert calculated Green's function for H-atom using a new time parameter and using the transform the Coulomb path integral into a harmonic oscillator path integral. The energy spectrum and the normalized s-state eigenfunctions for the Hulthen Potential and Woods Saxon potentials are obtained using Green's function [12 -14]. By using path integrals, coherent states are constructed for various potentials [17, 18, 20]. Feynman's Path integral Formalism is powerful and challenging method but it has difficulties for the many of the quantum mechanical systems. Path integration is an alternative method to obtain the exact analytical solution of Schrodinger Equation. The path integral formulation builds on the propagator, which is the probability amplitude for making a transition between the initial position x' at time $t' = 0$ and the final position x'' at time t. It is also called kernel which express the time evolution of the initial state. The kernel contains all dynamical information about a quantum mechanical system [1]. The quantum evolution operator that generates the propagator is defined as $\widehat{U}(t_b, t_a) = \exp[-i\widehat{H}(t_b, t_a)]$. Here H is Hamiltonian which determines the evolution over time. In the quantum theory the Hamiltonian includes the symmetries of the systems. If the symmetry is represented by an $\widehat{A}$ linear operator, the $\widehat{A}$ operator comutes to Hamiltonian: $[\widehat{A}, \widehat{H}] = 0$. Two important symmetry operators in quantum mechanics are Parity operator: P and Time operator T. When they act on the position and momentum operators they lead to momentum as $P: x \rightarrow -x, p \rightarrow -p$ and $T: x \rightarrow x, p \rightarrow p, i \rightarrow -i$ Due to the increased interest in PT-Symmetric quantum mechanics, the cases of real or complex eigenvalues for the Hermitian and non-Hermitian hamiltonians of various potentials have been studied [25 - 27].

The object of this paper is to evaluate energy spectrum and wave functions of the PT-Symmetric the and non-Hermitian q-deformed Eckart plus modified Hylleraas potential via Feynman's path integral method. The organization of this paper is as follows. In Sec. II Kernel and energy-dependent Green's function of The q-deformed Eckart plus modified Hylleraas potential derived using the Duru and Kleinert method. In Sec. III energy eigenvalues and the corresponding wave functions are derived using Green's function in Sec II. In Sec IV Woods-Saxon, Rosen Morse, were discussed reduced with different parameters than the q-deformed Eckart plus modified Hylleraas potential.

II. The Kernel

The PT-Symmetric and non-Hermitian q-deformed Eckart plus modified Hylleraas potential is

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$$V(x) = \frac{V_0}{b}\left(\frac{a - e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}}\right) - V_1\frac{e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}} + V_2\frac{e^{-2i\alpha x}}{(1 - qe^{-2i\alpha x})^2} . \quad (1)$$

It determines by taking $\alpha \longrightarrow i\alpha$ in the q - deformed Eckart plus modified Hylleraas potential [28]. The potential satisfies $V^*(-x) = V(x)$ which shows that we obtain PT-Symmetric q-deformed Eckart plus modified Hylleraas potential. The parameters V_0, V_1 and V_2 are the depths of the potential well, a, and b Hylleraas parameters and α is the inverse of the range of the potential in Eq. (1). The kernel of one dimension potential between the initial position x' at time $t' = 0$ and final position x'' at time t'' is given in Ref. [1] as

$$K(x_b, t_b; x_a, t_a) = \int \frac{DxDp}{2\pi} exp\{i \int dt[p\dot{x} - \frac{p^2}{2m} - V(x)]\} \quad (2)$$

Path integral express in terms of an integral over all paths in configuration space. Kernel is describes as

$$K(x_b, t_b; x_a, t_a) = \lim_{N\to\infty} \int \prod_{j=1}^{N} dx_j \prod_{j=1}^{N+1} \frac{dp_j}{2\pi\hbar} \sum_{j=1}^{N} \exp\frac{i}{\hbar}\left\{\sum_{j=1}^{N+1} p_j \Delta x_j\right. \quad (3)$$

$$\left. - \frac{V_0}{b}\left(\frac{a - e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}}\right) - V_1\frac{e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}} + V_2\frac{e^{-2i\alpha x}}{(1 - qe^{-2i\alpha x})^2}\right\} \quad (4)$$

The partial action is expressed by

$$S(x_j, x_{j-1}) = \sum_{j=1}^{N+1} p_j \Delta x_j - \left[\frac{p_j^2}{2m} + \frac{V_0}{b}\left(\frac{a - e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}}\right) - V_1\frac{e^{-2i\alpha x}}{1 - qe^{-2i\alpha x}} + V_2\frac{e^{-2i\alpha x}}{(1 - qe^{-2i\alpha x})^2}\right]\Bigg\} \quad (5)$$

where we shall $\hbar = m = 1$. To solution via Feynman Path integral method we introduce the new angular variable $\theta\epsilon(0, \pi)$ to transform the radial variable $x\epsilon(0, \infty)$

$$x = \frac{1}{2i\alpha}\ln(-\frac{1}{q}\cot^2\theta) \qquad p_x = i\alpha \sin\theta \cos p_\theta \quad (6)$$

The contribution to Jacobien of this transformation becomes

$$\frac{DxDp}{2\pi} = i\alpha \sin\theta_b \cos\theta_b \quad . \quad (7)$$

By defining $\Delta x_j = x_j - x_{j-1}$, $\varepsilon = t_j - t_{j-1}$, $t' = t_0 = t_a$, $t'' = t_N = t_b$, $(n+1)\varepsilon = T$ the Kernel in Eq.(3) can be written as

$$K(x_b, x_a; T) = i\alpha \sin\theta_b \cos\theta_b \int D\theta Dp_\theta \exp\left\{i\int_0^T dt \left[p_\theta\dot{\theta} + \alpha^2 \sin^2\theta \cos^2\theta \frac{p_\theta^2}{2m}\right.\right.$$

$$\left.\left.(-\frac{V_0 a}{b}\sin^2\theta + \frac{1}{q}(\frac{V_0}{b} + V_1)\cos^2\theta - \frac{V_2}{q}\sin^2\theta\cos^2\theta)\right]\right\} . \quad (8)$$

The coordinate transformation in Eq. (7) produces a factor $\alpha^2 \sin^2\theta \cos^2\theta$ that is kinetic energy term. We need a new time parameter s for eliminating the $\alpha^2 \sin^2\theta \cos^2\theta$ factor in the kinetic energy term [12 - 14] as

$$\frac{dt}{ds} = -\frac{1}{\alpha^2 \sin^2\theta \cos^2\theta} \quad or \quad t = -\frac{1}{\alpha^2}\int \frac{ds'}{\sin^2\theta \cos^2\theta} . \quad (9)$$

If Fourier transformation of $\delta-$ function

$$1=\int dS\frac{1}{\alpha^2\sin^2\theta_b\cos^2\theta_b}\delta(-T-\int ds\frac{1}{\alpha^2\sin^2\theta\cos^2\theta})$$
$$=\int dS\int\frac{dE}{2\pi}\frac{1}{\alpha^2\sin^2\theta_b\cos^2\theta_b}exp[-i(ET-\int ds\frac{E}{\alpha^2\sin^2\theta\cos^2\theta})] \quad (10)$$

is added to the kernel it becomes

$$K(x_b,x_a;T)=\frac{i}{i\alpha\sin\theta_b\cos\theta_b}\int_{-\infty}^{\infty}\frac{dE}{2\pi}e^{iET}\int_0^{\infty}dS\int D\theta Dp_\theta\; e^{i\left(\frac{V_2}{q\alpha^2}\right)S}$$
$$\times exp[i\int_0^S ds\;(p_\theta\dot{\theta}-\frac{p_\theta^2}{2}-\left[\frac{\frac{V_0}{qb\alpha^2}+\frac{V_1}{q\alpha^2}+\frac{E}{\alpha^2}}{\sin^2\theta}\right]-\frac{\frac{V_0a}{b\alpha^2}+\frac{E}{\alpha^2}}{\cos^2\theta})]. \quad (11)$$

It can be symmetrized according to points a and b the factor in front of the in Eq.(10) that get to from Jacobian as following

$$\frac{1}{\sin\theta_b\cos\theta_b}=\frac{2}{\sqrt{\sin 2\theta_a\sin 2\theta_b}}\exp\left(-\frac{1}{2}\ln\frac{\sin 2\theta_b}{\sin 2\theta_a}\right)$$
$$=\frac{2}{\sqrt{\sin 2\theta_a\sin 2\theta_b}}\exp\left(i\int_0^S dsi\frac{\cos 2\theta}{\sin 2\theta}\dot{\theta}\right)\quad . \quad (12)$$

Thus Eq. (10) takes

$$K(x'',x';E)=\int_0^{\infty}dSe^{i\left(\frac{V_2}{q\alpha^2}\right)S}\int_{-\infty}^{\infty}\frac{dE}{2\pi}e^{iET}\frac{i}{\alpha\sqrt{\sin 2\theta_a\cos 2\theta_b}}K\left(\theta_b,\theta_a;S\right) \quad (13)$$

Where

$$K\left(\theta_b,\theta_a;S\right)=\int D\theta Dp_\theta\exp\left\{i\int_0^S ds\left[p_\theta\dot{\theta}-\frac{p_\theta^2}{2}-\frac{1}{2}\left(\frac{\kappa\left(\kappa-1\right)}{\sin^2\theta}+\frac{\gamma\left(\gamma-1\right)}{\cos^2\theta}\right)-\frac{ip_\theta\cos 2\theta}{2\sin 2\theta}\right]\right\} \quad (14)$$

and K and γ are

$$\kappa=\frac{1}{2}\left[1+\sqrt{1+8\left(\frac{V_0}{qb\alpha^2}+\frac{V_1}{q\alpha^2}+\frac{E}{\alpha^2}\right)}\right]$$

$$\gamma=\frac{1}{2}\left[1+\sqrt{1+8\left(\frac{V_0a}{b\alpha^2}+\frac{E}{\alpha^2}\right)}\right]\quad . \quad (15)$$

If we take the time division of the momentum variables from $j=0$ to $j=n$ instead of from $j=0$ to $j=n+1$, we have the quantum mechanical contributions $+\frac{ip_\theta \cos 2\theta}{2\sin 2\theta}$ in Eq. (13).

In the same way if this factor is symmetrized as Eq.(13) which only sign, of imaginary term will be change. Therefore the contributions to be kernel becomes

$$\frac{\theta_j-\theta_{j-1}}{\epsilon} \longrightarrow \frac{\theta_j-\theta_{j-1}}{\epsilon} \pm \frac{i\cos\theta_j}{2\sin\theta_j}. \tag{16}$$

So the problem is reduced the path integral for Pöschl - Teller potential which is known exact solution [13; 15]. K $(\theta_b,\theta_a;S)$ can be obtained as

$$K(\theta_b,\theta_a;S)=\int D\theta Dp_\theta \exp\left\{i\int_0^S ds\left[p_\theta\dot{\theta}-\frac{p_\theta^2}{2}-\frac{1}{2}\left(\frac{\kappa(\kappa-1)}{\sin^2\theta}+\frac{\gamma(\gamma-1)}{\cos^2\theta}\right)\right]\right\}. \tag{17}$$

Writing the kernel as

$$K(\theta_b,\theta_a;S)=\sum_{n=0}^{\infty}\exp\left[-i\varepsilon_n S\right]\quad {}_n(\theta_a)\quad {}_n^*(\theta_b) \tag{18}$$

$$\varepsilon_n=\frac{1}{2}(\kappa+\gamma+2n)^2 \tag{19}$$

Where

$$\psi_n(\theta)=\sqrt{2(\kappa+\gamma+2n)}\sqrt{\frac{\Gamma(n+1)\Gamma(\kappa+\gamma+n)}{\Gamma\left(\gamma+n+\frac{1}{2}\right)\Gamma\left(\kappa+n+\frac{1}{2}\right)}}$$
$$\times(\cos\theta)^\gamma(\sin\theta)^\kappa P_n^{(\kappa-1/2,\gamma-1/2)}\left(1-2\sin^2\theta\right) \tag{20}$$

Eq.(12) can be expressed

$$K(x'',x';T)=\frac{iq}{\alpha\sqrt{\sin 2\theta_a\cos 2\theta_b}}\int_{-\infty}^{\infty}\frac{dE}{2\pi}e^{iET}\int_0^{\infty}dSe^{i\left(\frac{V_2}{q\alpha^2}\right)S}K(\theta_b,\theta_a;S). \tag{21}$$

With integrating over dS Greens function for Eq.(1) can be obtained as

$$G(x'',x';E)=\frac{8i\mu q}{\alpha\sqrt{\sin 2\theta_a\cos 2\theta_b}}\sum_{n=0}^{\infty}\int_{-\infty}^{\infty}\frac{dE}{2\pi}\frac{e^{iET}}{(\kappa+\gamma+2n)^2-\left(\frac{V_2}{q\alpha^2}\right)}\quad {}_n(\theta_a)\quad {}_n^*(\theta_b) \tag{22}$$

Therefore the kernel of a physical system is rewritten as

$$K(x'',x';E)=\sum_{n=0}^{\infty}e^{-iE_nT}\varphi_n(x_a)\varphi_n^*(x_b). \tag{23}$$

III. Energy Eigenvalues and Wave Functions

We calculated Green's function and Kernel for the PT Symmetric and Non-Hermitian q-deformed Eckart plus modified Hylleraas potential in Sec.(2). If we can integrate over dE, we can get energy eigenvalues as

$$E_n = \frac{V_0 a}{b} - \frac{\alpha^2}{8}\left\{\frac{\left[\frac{V_2}{q\alpha^2} - (2n+1)\right]^2 - \frac{2V_0 a}{\alpha^2 b} + \frac{2V_0}{\alpha^2 qb} + \frac{2V_1}{\alpha^2 q}}{\frac{V_2}{q\alpha^2} - (2n+1)}\right\}^2 \tag{24}$$

and normalized wave functions in terms of Jacobi polynoms are

$$\phi(r) = 2\sqrt{2}\sqrt{(\kappa_n + \gamma_n + 2n)}\sqrt{\frac{\Gamma(n+1)\Gamma(\kappa_n+\gamma_n+n)}{\Gamma\left(\gamma_n+n+\frac{1}{2}\right)\Gamma\left(\kappa_n+n+\frac{1}{2}\right)}}$$

9where we got

$$\kappa_n = \frac{1}{2} + \frac{1}{\frac{V_2}{q\alpha^2} - (2n+1)}\left\{\left[\frac{V_2}{q\alpha^2} - (2n+1)\right]^2 + \left(\frac{2V_0 a}{\alpha^2 b} + \frac{2V_0}{\alpha^2 qb} + \frac{2V_1}{\alpha^2 q}\right)\right\}$$

$$\gamma_n = \frac{1}{2} + \frac{1}{\frac{V_2}{q\alpha^2} - (2n+1)}\left\{\left[\frac{V_2}{q\alpha^2} - (2n+1)\right]^2 - \left(\frac{2V_0 a}{\alpha^2 b} + \frac{2V_0}{\alpha^2 qb} + \frac{2V_1}{\alpha^2 q}\right)\right\} \tag{25}$$

We can write the terms of Hypergeometric functions in Eq.(19)

$$P_n^{(\alpha,\beta')}(z) = \frac{\Gamma(n+\alpha+1)}{n!\Gamma(\alpha+1)}F\left(-n, n+\alpha+\beta'+1, \beta'+1, \frac{1+z}{2}\right) \tag{26}$$

and wave functions can be obtained

$$\phi(x) = \sqrt{(\kappa_n+\gamma_n+2n)}\sqrt{\frac{\Gamma(n+1)\Gamma(\kappa_n+\gamma_n+n)\Gamma(n+\kappa_n+1/2)}{\Gamma\left(\gamma_n+n+\frac{1}{2}\right)}}$$

$$\times\frac{\left(-iqe^{-2i\alpha x}\right)^{\gamma-1/2}}{\alpha\left(1-qe^{-2i\alpha x}\right)^{(\kappa_n+\gamma_n-2)}\left(1+qe^{-2i\alpha x}\right)^{1/2}}F\left(-n, \kappa_n+\gamma_n+n, \gamma_n+\frac{1}{2}, -\frac{qe^{-2i\alpha x}}{1-qe^{-2i\alpha x}}\right) \tag{27}$$

Therefore we evaluated energy spectrum and wave functions for the PT-Symmetric and Non-Hermitian q-deformed Eckart plus modified Hylleraas potential has real energy spectra.

IV. DISCUSSION

(i) Setting $V_0 = V_2 = 0,\ a = 0,\ b = 1$ and $q = -1$ the potential in Eq. (1) is reduced to PT-Symmetric and Non-Hermitian Woods-Saxon potential

$$V(x) = -\frac{V_1 e^{-2i\alpha x}}{1+e^{-2i\alpha x}} \tag{28}$$

Energy eigenvalues of (27) potential can be obtained as

$$E_n = -\frac{\alpha^2}{8}\left\{\frac{\left[\frac{2V_0}{\alpha^2} - (2n+1)^2\right]}{(2n+1)}\right\}^2. \tag{29}$$

and normalized wave functions can be written as

$$\phi(x) = \sqrt{(\kappa_n + \gamma_n + 2n)}\sqrt{\frac{\Gamma(n+1)\Gamma(\kappa_n+\gamma_n+n)\Gamma(n+\kappa_n+1/2)}{\Gamma\left(\gamma_n+n+\frac{1}{2}\right)}}$$

$$\times\frac{\left(ie^{-2i\alpha x}\right)^{\gamma-1/2}}{\alpha\left(1+e^{-2i\alpha x}\right)^{(\kappa_n+\gamma_n-2)}\left(1-e^{-2i\alpha x}\right)^{1/2}}F\left(-n,\kappa_n+\gamma_n+n,\gamma_n+\frac{1}{2},\frac{e^{-2i\alpha x}}{1+e^{-2i\alpha x}}\right) \tag{30}$$

(ii) Choosing $V_0 = V_2 = 0$, and $b = 1$, $a = -1$ and $q = 1$, the potential in Eq. (1) is reduced to PT-Symmetric and Non-Hermitian Rosen Morse potential

$$V(x) = -\frac{V_0(1+e^{-2i\alpha x})}{1-e^{-2i\alpha x}}\,. \tag{31}$$

So energy eigenvalues are

$$E_n = -\frac{\alpha^2}{8}\left\{\frac{4V_0-(2n+1)^2}{(2n+1)}\right\}^2 \tag{32}$$

and normalized wave function is

$$\phi(x) = \sqrt{(\kappa_n + \gamma_n + 2n)}\sqrt{\frac{\Gamma(n+1)\Gamma(\kappa_n+\gamma_n+n)\Gamma(n+\kappa_n+1/2)}{\Gamma\left(\gamma_n+n+\frac{1}{2}\right)}}$$

$$\times\frac{\left(-ie^{-2i\alpha x}\right)^{\gamma-1/2}}{\alpha\left(1-e^{-2i\alpha x}\right)^{(\kappa_n+\gamma_n-2)}\left(1+e^{-2i\alpha x}\right)^{1/2}}F\left(-n,\kappa_n+\gamma_n+n,\gamma_n+\frac{1}{2},-\frac{e^{-2i\alpha x}}{1-e^{-2i\alpha x}}\right)\,. \tag{33}$$

V. Conclusion

In this work, we have investigated the Schrodinger Equation with The q-deformed Eckart Plus Modified Hylleraas potential for n quantum states. We used space-time transformation to obtain energy eigenvalues and corresponding wave functions. We expressed normalized wave functions in terms of Jacobi polynomials and Hypergeometric functions. We obtained exactly the energy eigenvalues and the corresponding eigenfunctions. We have seen that the potential has real eigenvalues. The energy eigenvalues and the eigenfunctions can be computed making different choices for the $V_0, V_1, V_2,\ \alpha, q, b$ parameters of the potential. Choosing appropriate parameters for the potential, we indicated energy spectrum and wave functions n states for Woods Saxon, Rosen Morse potentials..

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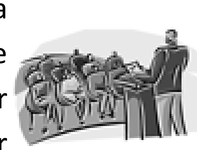

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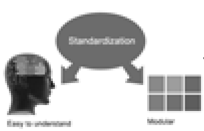

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The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSS” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

Auxiliary Memberships

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as “Institutional Fellow of Open Association of Research Society” (IFOARS).

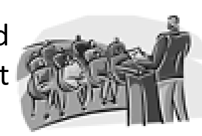
The “FARSC” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as “Institutional Board of Open Association of Research Society”-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.



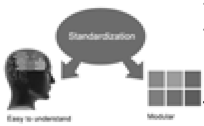
The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of “Open Association of Research Society, U.S.A (OARS)” so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone. "

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

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Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

  - Single section and succinct.
  - An outline of the job done is always written in past tense.
  - Concentrate on shortening results—limit background information to a verdict or two.
  - Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- o You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- o Give details of all of your remarks as much as possible, focusing on mechanisms.
- o Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- o One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- o Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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