Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: A

Physics and Space Science

Radio-Technical Elements

Approach to Quantum Gravity

Highlights

Relativistic Quantum Wave

Derivation of Neel Temperature

Discovering Thoughts, Inventing Future

VOLUME 20 ISSUE 2 VERSION 1.0

Global Journal of Science Frontier Research: A
Physics & Space Science

Global Journal of Science Frontier Research: A
Physics & Space Science
Volume 20 Issue 2 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Contents of the Issue

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 20 Issue 2 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

A New Approach to Quantum Gravity

By Gang Lee

Abstract- In this paper, we introduce a different approach to the theory of gravitational field. This method can give the semiclassical graviton directly. We discuss the dynamics and quantization of graviton and obtain the field equation of graviton. Also we give proof to prove that the quantum field theory constructed in this paper is classically equivalent to the general theory of relativity. We obtain the Green's function of the graviton by the field equation, and the difficulty of Feynman integral divergence can be solved by this method.

GJSFR-A Classification: FOR Code: 020699

A New Approach to Quantum Gravity

Gang Lee

Abstract- In this paper, we introduce a different approach to the theory of gravitational field. This method can give the semiclassical graviton directly. We discuss the dynamics and quantization of graviton and obtain the field equation of graviton. Also we give proof to prove that the quantum field theory constructed in this paper is classically equivalent to the general theory of relativity. We obtain the Green's function of the graviton by the field equation, and the difficulty of Feynman integral divergence can be solved by this method.

I. Introduction

To solve the quantization in the gravitational field, we introduce a different approach to the theory of the gravitational field. This method can give the semiclassical graviton directly. We discuss the dynamics and quantization of graviton and obtain the field equation of graviton. The quantum field theory constructed in this paper is classically equivalent to the general theory of relativity. We obtain the Green's function of graviton; it can solve the difficulty of the Feynman integral divergence over large virtual momenta.

In section 2, there are some mathematical preparations. We give a brief description of noncommutative lattices. And then we introduce a very different approach to the theory of the noncommutative gravitational field. In section 3, we discuss the dynamics and quantization of the gravitons. In section 4, we compute the energy-momentum tensor of the gravitational field itself in two completely different ways: the method of the quantum field theory and the method of the general theory of relativity. In section 5, we obtain the Green's function of the graviton, the resulting Feynman rule can solve the difficulty of divergence of the Feynman integral over large virtual momenta.

II. Gravity on Noncommutative Lattices

The traditional arena of geometry is a set of points with some particular structure that, for want of a better name, we call space. In noncommutative geometry, under the influence of quantum physics, this general idea of replacing sets of points by classes of functions is taken further. In this way, we find that noncommutative lattices are the best tool to solve the contradiction between the general theory of relativity and the uncertainty principle. The most important result of this approach is to solve the difficulty of divergence of Feynman integral over large virtual momenta of the graviton.

Let's first introduce a simple model for future reference while referring to [1] and [2] for more details. Let $S^1 = \{0 \le \phi \le 2\pi, \mod 2\pi\}$, the detectors are U_1, U_2, U_3 as follows

$$U_1 = (-\frac{1}{3}\pi, \frac{2}{3}\pi),\ U_2 = (\frac{1}{3}\pi, \frac{4}{3}\pi),\ U_3 = (\pi, 2\pi) \tag{2.1}$$

The detectors can't distinguish any two points in their area. If two detectors, U_1 and U_2 say, are on, we will know that the particles are in the intersection $U_1 \cap U_2$, although we will be unable to distinguish any two points in this intersection. So we are forced to identify the points which cannot be distinguished and S^1 will be represented by a collection of six points $P = \{\alpha, \beta, \gamma, a, b, c\}$ which correspond to the following identifications

Author: e-mail: ganglee69@msn.com

$$
\begin{aligned}
\alpha &\rightarrow U_1 \cap U_3 = \{\frac{5}{3}\pi < \phi < 2\pi\} \\
\beta &\rightarrow U_1 \cap U_2 = \{\frac{1}{3}\pi < \phi < \frac{2}{3}\pi\} \\
\gamma &\rightarrow U_2 \cap U_3 = \{\pi < \phi < \frac{4}{3}\pi\} \\
a &\rightarrow U_1 \setminus \{(U_1 \cap U_2) \cup (U_1 \cap U_3)\} = \{0 \leq \phi \leq \frac{1}{3}\pi\} \\
b &\rightarrow U_2 \setminus \{(U_2 \cap U_1) \cup (U_2 \cap U_3)\} = \{\frac{2}{3}\pi \leq \phi \leq \pi\} \\
c &\rightarrow U_3 \setminus \{(U_3 \cap U_2) \cup (U_3 \cap U_1)\} = \{\frac{4}{3}\pi \leq \phi \leq \frac{5}{3}\pi\}
\end{aligned}
\tag{2.2}
$$

By these six points we get the noncommutative lattices $P_6(S^1)$. For the 1-dimensional real axis $\mathbb{R}$, the noncommutative lattices is $P_\infty(\mathbb{R})$. The unit of the noncommutative lattices is the $\vee$ poset. Please refer to section 3 of [2] for details of noncommutative lattices such as the $\vee$ poset and Hasse diagram.

The uncertainty principle is $\triangle r \triangle p \sim \hbar,\ \ \triangle t \triangle E \sim \hbar$; it gives an area with radius $(\triangle r, \triangle t)$. Due to the limitation of the uncertainty principle, the detector can only say in or out of this area. If in, the detector can't say at which point in this area. In mathematics, the detector can't distinguish different points in this area.

From the vierbein formalism of the gravitational field in the general theory of relativity[4], we know that the locally inertial coordinate system spans the cotangent space of the gravitational field, which means that the local inertial coordinate system is related to energy-momentum from the operator representation in quantum theory. Therefore, we assume that the limit of measurement for any spacetime point in the inertial coordinate system is limited by the uncertainty principle, so that in the inertial coordinate system we will be unable to distinguish different points in the area with the radius $(\triangle r, \triangle t)$. Considering the quantum fluctuation of spacetime in the Planck scale, let's try to take this radius equal to the Planck length l_P and the Planck time t_P: $(\triangle r, \triangle t) = (l_P, t_P)$.

Based on the above assumptions, let's first study the 1-dimensional case. Let x be the coordinate of the 1-dimensional spacetime, a and b are two points of the spacetime. Let spacetime be flat; then we can choose an inertial coordinate system, write it as $\xi(x)$. Similar to the method in quantum theory, we denote the operator of the inertial coordinate system of the 1-dimensional spacetime as $\hat{\xi}$. In the absence of the influence of the uncertainty principle, the operator $\hat{\xi}$ act on the spacetime point. At any point X, the value $\xi(X)$ is the eigenvalue of $\hat{\xi}$

$$
\begin{aligned}
\lambda(\hat{\xi})\big|_X &= \xi(x)\big|_{x=X} \\
&= \xi(X)
\end{aligned}
\tag{2.3}
$$

Let's take the uncertainty principle into the inertial coordinate system. The inertial coordinate system spans the cotangent space, then it relates to energy-momentum. After introducing the uncertainty principle, the measurement for any point in the inertial coordinate system $\xi(x)$ will be limited by the uncertainty principle. Then the value $\xi(a)$ can't correspond accurately to the point a; it corresponds to the entire line segment with length l_P. The analogy with the mathematical model discussed earlier, $\xi(a)$ is similar to the detectors U_1, U_2, U_3. Therefore, due to the effect of the uncertainty principle, the 1-dimensional space spanned by the inertial coordinate system becomes the noncommutative lattices.

The unit of the noncommutative lattices is the $\vee$ poset. Therefore the inertial coordinate system must be based on each $\vee$ poset. It means that the operator

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

$\hat{\xi}$ act on $\vee$ posets, the eigenvalue of $\hat{\xi}$ corresponds to $\vee$ posets. We can attach $\xi(a)$ and $\xi(b)$ to each arm of the $\vee$ poset, then on the $\vee$ poset, the eigenvalue of $\hat{\xi}$ is

$$\lambda(\hat{\xi})\big|_{\vee} = \xi(a) \text{ or } \xi(b) \tag{2.4}$$

This relation can be interpreted as: in the interval (a, b), two detectors $\xi(a)$ and $\xi(b)$ say, are on.

In this 1-dimensional spacetime limited by the uncertainty principle, given a point a, for another point b, if the distance between a and b less than l_P, we will be unable to distinguish these two points in the inertial coordinate system $\xi(x)$, or it could be interpreted that we will be unable to distinguish $\xi(a)$ and $\xi(b)$ if the distance between a and b less than l_P. Therefore the distance between a and b is equal to l_P if $\xi(a)$ and $\xi(b)$ are neighboring. Note that the Planck length l_P is the quantity in the laboratory coordinate x. Write l_P as l'_P in the inertial coordinate system $\xi(x)$. According to the scale transformation between different coordinate systems, we have

$$\frac{l'_P}{l_P} = \frac{d\xi(x)}{dx} \tag{2.5}$$

In the laboratory coordinate x, we have

$$b = a \pm l_P \tag{2.6}$$

Then in the inertial coordinate system $\xi(x)$, we have

$$\begin{aligned} \xi(b) &= \xi(a) \pm l'_P \\ &= \xi(a) \pm l_P \cdot \frac{d\xi(x)}{dx}\bigg|_{x=a} \end{aligned} \tag{2.7}$$

The operator $\hat{\xi}$ act on $\vee$ posets, by Eq.(2.4) and Eq.(2.7), at any point X, we can obtain the general expression of the eigenvalue of $\hat{\xi}$ as follows

$$\lambda(\hat{\xi}) = \xi(x)\big|_{x=X} \pm l_P \cdot \frac{d\xi(x)}{dx}\bigg|_{x=X} \tag{2.8}$$

where l_P is equal to 0 or l_P.

$\hat{\xi}$ is the operator of the inertial coordinate system, the eigenvalue $\xi(x)$ is the inertial coordinate system of spacetime without the uncertainty principle. Of course, there is no gravitational effect in the inertial coordinate system $\xi(x)$. After introducing the uncertainty principle, spacetime becomes noncommutative lattices, the operator $\hat{\xi}$ act on $\vee$ posets, then the eigenvalue should also be base on $\vee$ posets instead of points, thus from Eq.(2.8) we can see that the eigenvalue of $\hat{\xi}$ is no longer the former inertial coordinate system $\xi(x)$. It means that the former inertial coordinate system $\xi(x)$ which is not influenced by the uncertainty principle is no longer the inertial coordinate system of the noncommutative lattices and we know that there is no gravitational effect in $\xi(x)$, therefore the coordinate system $\xi(x)$ can only be interpreted as the inertial coordinate system at point X, that is, the locally inertial coordinate system $\xi_X(x)$.

Eq.(2.8) can be understood in this way: After introducing the uncertainty principle, space spanned by the inertial coordinate system becomes noncommutative lattices, spacetime as noncommutative lattices is flat. The operator $\hat{\xi}$ no longer acts on points of spacetime; it act on $\vee$ posets. The eigenvalue of $\hat{\xi}$, that is, the inertial coordinate system should also be interpreted as that it is based on $\vee$ posets, then the argument of the global inertial coordinate system of noncommutative lattices must be $\vee$ poset. Therefore the former inertial coordinate system $\xi(x)$ is no longer the global inertial coordinate system of the noncommutative lattices, it becomes the locally inertial coordinate system $\xi_X(x)$, so that the gravitational forces appear in the sense of the principle of equivalence. The space made up of $\vee$ posets is flat, the space made up of points like X can be interpreted as curved.

Now let's discuss the 4-dimensional case. After introducing the uncertainty principle, spacetime becomes noncommutative lattices. Let this noncommutative lattices be Minkowski space. In the 4-dimensional Cartesian rectangular coordinate system x^μ, the Minkowski metric is $\eta_{\mu\nu} = \text{diag}(+,+,+,-)$.

It is convenient to replace the Cartesian coordinate system x^μ with the spherical polar coordinate system $r^i = (r, \theta, \phi, t)$, defined as usual by

$$\begin{aligned} x^1 &= r\sin\theta\cos\phi \\ x^2 &= r\sin\theta\sin\phi \\ x^3 &= r\cos\theta \\ x^4 &= t \end{aligned} \tag{2.9}$$

where $r \in [0, +\infty),\ \theta \in [0, \pi],\ \phi \in [0, 2\pi),\ t \in (-\infty, +\infty)$.

In the spherical polar coordinate system r^i, the Minkowski metric is

$$\eta_{ij} = \begin{pmatrix} 1 & & & \\ & r^2 & & \\ & & r^2\sin^2\theta & \\ & & & -1 \end{pmatrix} \tag{2.10}$$

Denote $\hat{\xi}$ as the operator of the inertial coordinate system of Minkowski space. In the coordinate system r^i, the components of $\hat{\xi}$ are

$$\lambda(\hat{\xi}) = \Big(\lambda(\hat{\xi}^r), \lambda(\hat{\xi}^\theta), \lambda(\hat{\xi}^\phi), \lambda(\hat{\xi}^t)\Big) \tag{2.11}$$

After introducing the uncertainty principle, by Eq.(2.8), we can get the eigenvalue $\lambda(\hat{\xi})$ as follows

$$\begin{aligned} \lambda(\hat{\xi}^r) &= \xi^r + l_P \cdot \frac{\partial \xi^r}{\partial r} \\ \lambda(\hat{\xi}^\theta) &= \xi^\theta \\ \lambda(\hat{\xi}^\phi) &= \xi^\phi \\ \lambda(\hat{\xi}^t) &= \xi^t \pm t_P \cdot \frac{\partial \xi^t}{\partial t} \end{aligned} \tag{2.12}$$

where $(\xi^r, \xi^\theta, \xi^\phi, \xi^t)$ are the components of the locally inertial coordinate system at the origin of r^i.

Because we let the spacetime as noncommutative lattices be Minkowski space, we get the following equations

$$\begin{cases} \lambda(\hat{\xi^r}) = \xi^r + l_P \cdot \dfrac{\partial \xi^r}{\partial r} = r \\ \lambda(\hat{\xi^\theta}) = \xi^\theta = \theta \\ \lambda(\hat{\xi^\phi}) = \xi^\phi = \phi \\ \lambda(\hat{\xi^t}) = \xi^t \pm t_P \cdot \dfrac{\partial \xi^t}{\partial t} = t \end{cases} \tag{2.13}$$

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I 4 Year 2020

The solution is

$$\xi^i = \begin{cases} \xi^r = (r - l_P) + C_r \exp(-\dfrac{r}{l_P}) + C'_r \\ \xi^\theta = \theta + C'_\theta \\ \xi^\phi = \phi + C'_\phi \\ \xi^t = (t - t_P) + C_t \exp(-\dfrac{|t|}{t_P}) + C'_t \end{cases} \tag{2.14}$$

where C_r, C_t are the integral constants, $C'_r, C'_\theta, C'_\phi, C'_t$ are the arbitrary constants.

Because we always take the derivative of ξ^i, we can omit the constants $C'_r, C'_\theta, C'_\phi, C'_t$ for brevity. Then the solution (2.14) can be written as follows

$$\xi^i = \begin{cases} \xi^r = r + C_r \exp(-\dfrac{r}{l_P}) \\ \xi^\theta = \theta \\ \xi^\phi = \phi \\ \xi^t = t + C_t \exp(-\dfrac{|t|}{t_P}) \end{cases} \tag{2.15}$$

We will see in the next section that since the integral constants C_r, C_t as the variables of motion must satisfy the field equation, in this paper, the decomposition of spacetime in 3+1 dimensional does not break Lorentz invariance.

If $C = \dfrac{1}{2 \triangle x}$, the function $C \exp(-\dfrac{|x|}{\triangle x})$ be the Dirac δ-function while $\triangle x \to 0$. Because the Planck length and the Planck time (l_P, t_P) are very small quantities, the solution (2.15) approximate to the Dirac δ-function, therefore it can be explained as a particle. Eq.(2.15) means the locally inertial coordinate system at the origin of r^i, so that this particle can be interpreted as a semiclassical graviton at the origin of r^i.

This section can be understood in this way: The spacetime made up of physical points limited by the uncertainty principle is noncommutative lattices, it is the space of the gravitons, and it is flat. If we depend on traditional differential geometry to explain the spacetime limited by the uncertainty principle, the 4-dimensional space made up of mathematical points can be interpreted as curved, it is the space of gravitational effect because the gravitational forces appear in the sense of the principle of equivalence.

III. Dynamics and Quantization of Graviton

Let's discuss the dynamics of a graviton. The spherical polar coordinate system r^i is the local coordinate system of the graviton, denote τ as the parameter of the trajectory of the origin of r^i, then the moving graviton can be written as $\xi^i(\tau, r)$. On every point of the path τ, we set the coordinate r^i_τ, where the index τ in r^i_τ indicates that the origin of r^i is at the point τ. In the case of no doubt, we can omit the index τ. The variable of motion are the integral constants and the phase angles: $\big(C_r, \theta, \phi, C_t\big)$. On the path τ, they become the functions of τ: $\big(C_r, \theta, \phi, C_t\big) \to \big(C_r(\tau), \theta(\tau), \phi(\tau), C_t(\tau)\big)$.

If a graviton is excited at the point τ, the locally inertial coordinate system ξ^i can be written as follows

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

$$\xi^i(\tau, r) = \begin{cases} \xi^r = r + C_r(\tau)\exp(-\frac{r}{l_P}) \\ \xi^\theta = \theta(\tau) \\ \xi^\phi = \phi(\tau) \\ \xi^t = t + C_t(\tau)\exp(-\frac{|t|}{t_P}) \end{cases} \tag{3.1}$$

The natural action relate to the path of graviton as it propagates through spacetime, defined by[3]

$$\begin{aligned} S &= m \int ds \\ &= m \int d\tau \sqrt{-\eta_{ij}\frac{\partial \xi^i}{\partial \tau}\frac{\partial \xi^j}{\partial \tau}} \\ &\equiv m \int d\tau \sqrt{-\eta_{ij}\dot{\xi}^i\dot{\xi}^j} \end{aligned} \tag{3.2}$$

The Lagrangian can be written as follows

$$\begin{aligned} \mathscr{L} &= m \cdot \sqrt{-\eta_{ij}\dot{\xi}^i\dot{\xi}^j} \\ &= m \cdot \sqrt{-\dot{\xi}^i\dot{\xi}_i} \\ &\equiv m \cdot \sqrt{-\dot{\xi}^2} \end{aligned} \tag{3.3}$$

The Lagrange equation is

$$\partial_\tau \left(\frac{\partial \mathscr{L}}{\partial \dot{\xi}^i}\right) = \frac{\partial \mathscr{L}}{\partial \xi^i} \tag{3.4}$$

For this Lagrangian,

$$\frac{\partial \mathscr{L}}{\partial \xi^i} = 0 \tag{3.5}$$

Then the equation of motion can be written as follows

$$\partial_\tau \left(\frac{\partial \mathscr{L}}{\partial \dot{\xi}^i}\right) = \partial_\tau \left(m \cdot \frac{\dot{\xi}^i}{\sqrt{-\dot{\xi}^2}}\right) = 0 \tag{3.6}$$

The action is dimensionless. Although a graviton has the 4-dimensional extension structure in the coordinates r^i, τ is the trajectory of the origin of r^i, which is 1-dimensional in spacetime. In this sense, the graviton is similar to the vector particle. So the dimensional analysis of the action (3.2) shows that the factor m has the dimension of mass, which can be interpreted as the mass. It is very different from string theory. In string theory, the motion of a string related to the motion of each particle on the string and thus relate to the surface area of the "world-sheet" swept by the string, then the factor m has the dimension of the square of mass. Note that in the case of one graviton, we can use only one coordinate system coordinate system r^i, but in the case of more than one graviton or in quantum field theory, it is necessary to describe gravitons by

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

using two coordinate systems r^i and x^μ at the same time, so that the field of graviton has one more index than the field of vector particle, more like the field of tensor particle.

In the case of the graviton, we know that $m = 0$. The Lagrangian (3.3) is ill-defined for the massless particle, so that we should choose another action which is classical equal to the action (3.2) for the graviton.

Take the auxiliary variable $e(\tau)$ as an einbein on the path τ. The associated metric is $g_{\tau\tau} = e^2$, $g^{\tau\tau} = e^{-2}$. Then we can take an equivalent action as follows

$$\begin{aligned} S &= -\frac{1}{2}\int d\tau \sqrt{g_{\tau\tau}}\left(g^{\tau\tau}\dot{\xi}^i\dot{\xi}^j\eta_{ij} - m^2\right) \\ &= -\frac{1}{2}\int d\tau\, e\left(\frac{\dot{\xi}^2}{e^2} - m^2\right) \end{aligned} \tag{3.7}$$

Varying $e(\tau)$ in action (3.7)

$$\delta S = \frac{1}{2}\int d\tau\left(\frac{\dot{\xi}^2}{e^2} + m^2\right)\delta e \tag{3.8}$$

Setting $\delta S = 0$, we obtain the equation of motion for $e(\tau)$

$$\frac{\dot{\xi}^2}{e^2} + m^2 = 0 \tag{3.9}$$

By this equation of motion, we can obtain

$$e = \frac{\sqrt{-\dot{\xi}^2}}{m} \tag{3.10}$$

Varying ξ^i in the action (3.7)

$$\delta S = \frac{1}{2}\int d\tau\left(\frac{2\dot{\xi}^i}{e}\right)\partial_\tau\delta\xi^i \tag{3.11}$$

After partial integration, we obtain the equation of motion

$$\partial_\tau\left(e^{-1}\dot{\xi}^i\right) = 0 \tag{3.12}$$

Substituting Eq.(3.10) into Eq.(3.7), we obtain Eq.(3.2), Substituting Eq.(3.10) into Eq.(3.12), we obtain Eq.(3.6). Then we have proved that the action (3.7) is classical equal to the action (3.2).

The equation of motion (3.12) can be written as follows

$$\partial_\tau\dot{\xi}^i - e^{-1}\dot{e}\dot{\xi}^i = 0 \tag{3.13}$$

It is the equation of the geodetic line. Because the space of graviton is noncommutative lattices and we let the noncommutative lattices be Minkowski space, then this equation can be written as follows

$$\partial^\tau\partial_\tau\xi^i = 0 \tag{3.14}$$

It is a wave equation.

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

The parameter τ is the parameter of a free graviton's trajectory. For the quantum field theory, we can set the orthogonal coordinate system x^μ to indicate each excited graviton, so that the parameter τ should be replaced by the position x: $\tau \to x$, and the coordinate system becomes $r^i_\tau \to r^i_x$, where the index x in r^i_x indicates that the origin of r^i is at the point x. In case of no doubt, we can omit the index x. Then $\xi^i(x)$ can be written as follows

$$\xi^i(x,r) = \begin{cases} \xi^r = r + C_r(x)\exp(-\frac{r}{l_P}) \\ \xi^\theta = \theta(x) \\ \xi^\phi = \phi(x) \\ \xi^t = t + C_t(x)\exp(-\frac{|t|}{t_P}) \end{cases} \tag{3.15}$$

The free field equation is

$$\partial^\mu \partial_\mu \xi^i = 0 \tag{3.16}$$

The solution is

$$\xi^i(x,r) = \begin{cases} \xi^r = r + \langle x|C_r\rangle \exp(-\frac{r}{l_P}) \\ \xi^\theta = \langle x|\theta\rangle \\ \xi^\phi = \langle x|\phi\rangle \\ \xi^t = t + \langle x|C_t\rangle \exp(-\frac{|t|}{t_P}) \end{cases} \tag{3.17}$$

where

$$\begin{aligned} \langle x|C_r\rangle &= \int d^4k \left(C_r(k)\exp(ikx) + C_r^*(k)\exp(-ikx)\right) \\ \langle x|\theta\rangle &= \int d^4k \left(\theta(k)\exp(ikx) + \theta^*(k)\exp(-ikx)\right) \\ \langle x|\phi\rangle &= \int d^4k \left(\phi(k)\exp(ikx) + \phi^*(k)\exp(-ikx)\right) \\ \langle x|C_t\rangle &= \int d^4k \left(C_t(k)\exp(ikx) + C_t^*(k)\exp(-ikx)\right) \end{aligned} \tag{3.18}$$

The variables of motion should be quantized. The commutators are as follows

$$\begin{aligned} \left[C_r(k), C_r^*(k')\right] &= \delta(k-k') \\ \left[\theta(k), \theta^*(k')\right] &= \delta(k-k') \\ \left[\phi(k), \phi^*(k')\right] &= \delta(k-k') \\ \left[C_t(k), C_t^*(k')\right] &= \delta(k-k') \end{aligned} \tag{3.19}$$

All other commutators are equal to 0.

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

IV. Energy-Momentum of Gravitational Field Itself

In the function of $\xi^i(x,r)$, the variable of motion is x, not r, then the Lagrangian density of gravitational field is

$$\mathscr{L} = -\frac{\eta^{\mu\nu}}{2}\frac{\partial \xi^i(x,r)}{\partial x^\mu}\frac{\partial \xi^j(x,r)}{\partial x^\nu}\eta_{ij} \tag{4.1}$$

Note that in the case of graviton, the mass term vanishing.

The canonical momentum conjugate to ξ^i is

$$\Pi_i = -\frac{\partial \mathscr{L}}{\partial \dot{\xi}^i} = \dot{\xi}_i \tag{4.2}$$

The momentum is

$$P = \Pi_i \cdot \bigtriangledown \xi^i = \dot{\xi}_i \cdot \bigtriangledown \xi^i \tag{4.3}$$

The canonical Hamiltonian is given by

$$\mathscr{H} = \Pi_i \dot{\xi}^i - \mathscr{L} = \dot{\xi}_i \dot{\xi}^i - \mathscr{L} \tag{4.4}$$

The energy-momentum tensor is

$$\begin{aligned} T_{\mu\nu} &= \eta_{\mu\nu}\mathscr{L} - \frac{\partial \mathscr{L}}{\partial(\partial^\mu \xi^i)}\partial_\nu \xi^i \\ &= -\frac{\eta_{\mu\nu}}{2}\partial^\lambda \xi^i \partial_\lambda \xi^j \eta_{ij} + \partial_\mu \xi^i \partial_\nu \xi^j \eta_{ij} \end{aligned} \tag{4.5}$$

It is the energy-momentum tensor of the gravitational field itself in the quantum field theory.

The 4-dimensional momentum is

$$\begin{aligned} p_\nu = T_{4\nu} &= -\frac{\eta_{4\nu}}{2}\partial^\lambda \xi^i \partial_\lambda \xi_i + \dot{\xi}^i \partial_\nu \xi_i \\ &= (P, \mathscr{H}) \end{aligned} \tag{4.6}$$

Now we compute the energy-momentum tensor of the gravitational field itself in the general theory of relativity[4].

The metric is

$$g_{\mu\nu} = \frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x^\nu} \tag{4.7}$$

We write

$$g_{\mu\nu} = \eta_{\mu\nu} + h_{\mu\nu} \tag{4.8}$$

By Eq.(3.15) we can see that $h_{\mu\nu}$ vanishes at infinity.

The part of the Ricci tensor $R_{\mu\nu}$ linear in $h_{\mu\nu}$ is[5]

$$R^{(1)}_{\mu\nu} \equiv \frac{1}{2}\left(\frac{\partial^2 h^\lambda{}_\lambda}{\partial x^\mu \partial x^\nu} - \frac{\partial^2 h^\lambda{}_\mu}{\partial x^\nu \partial x^\lambda} - \frac{\partial^2 h^\lambda{}_\nu}{\partial x^\mu \partial x^\lambda} + \frac{\partial^2 h_{\mu\nu}}{\partial x^\lambda \partial x_\lambda}\right) \tag{4.9}$$

where we adopting the convenient convention that the indices on $h_{\mu\nu}$, $R^{(1)}_{\mu\nu}$ and $\partial/\partial x^\lambda$ are raised and lowered with η's, for example, $h^\lambda{}_\lambda \equiv \eta^{\lambda\kappa} h_{\lambda\kappa}$, $\partial/\partial x_\lambda \equiv \eta^{\lambda\kappa}\partial/\partial x^\kappa$, $R^{(1)} \equiv \eta^{\mu\nu} R^{(1)}_{\mu\nu}$, whereas indices on true tensors such as $g_{\mu\nu}$ are raised and lowered with g's as usual.

Then $R^{(1)}_{\mu\nu}$ can be written as follows

$$\begin{aligned}
R^{(1)}_{\mu\nu} \equiv &\frac{1}{2}\left(\frac{\partial^2 h^\lambda{}_\lambda}{\partial x^\mu \partial x^\nu} - \frac{\partial^2 h^\lambda{}_\mu}{\partial x^\nu \partial x^\lambda} - \frac{\partial^2 h^\lambda{}_\nu}{\partial x^\mu \partial x^\lambda} + \frac{\partial^2 h_{\mu\nu}}{\partial x^\lambda \partial x_\lambda}\right)\\
=&\frac{1}{2}\left(\frac{\partial^2\left(\frac{\partial \xi^i}{\partial x^\lambda}\frac{\partial \xi_i}{\partial x_\lambda}\right)}{\partial x^\mu \partial x^\nu} - \frac{\partial^2\left(\frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x_\lambda}\right)}{\partial x^\nu \partial x^\lambda} - \frac{\partial^2\left(\frac{\partial \xi^i}{\partial x^\nu}\frac{\partial \xi_i}{\partial x_\lambda}\right)}{\partial x^\mu \partial x^\lambda} + \frac{\partial^2\left(\frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x^\nu}\right)}{\partial x^\lambda \partial x_\lambda}\right)\\
=&\frac{1}{2}\left(\frac{\partial^3 \xi^i}{\partial x^\mu \partial x^\nu \partial x^\lambda}\frac{\partial \xi_i}{\partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x_\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x^\lambda} + \frac{\partial \xi^i}{\partial x^\lambda}\frac{\partial^3 \xi_i}{\partial x^\mu \partial x^\nu \partial x_\lambda}\right)\\
&-\frac{1}{2}\left(\frac{\partial^3 \xi^i}{\partial x^\mu \partial x^\nu \partial x^\lambda}\frac{\partial \xi_i}{\partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\nu}\frac{\partial^2 \xi_i}{\partial x^\lambda \partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda} + \frac{\partial \xi^i}{\partial x^\mu}\frac{\partial^3 \xi_i}{\partial x^\nu \partial x^\lambda \partial x_\lambda}\right)\\
&-\frac{1}{2}\left(\frac{\partial^3 \xi^i}{\partial x^\mu \partial x^\nu \partial x^\lambda}\frac{\partial \xi_i}{\partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\nu}\frac{\partial^2 \xi_i}{\partial x^\lambda \partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x_\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x^\lambda} + \frac{\partial \xi^i}{\partial x^\nu}\frac{\partial^3 \xi_i}{\partial x^\mu \partial x^\lambda \partial x_\lambda}\right)\\
&+\frac{1}{2}\left(\frac{\partial^3 \xi^i}{\partial x^\mu \partial x^\lambda \partial x_\lambda}\frac{\partial \xi_i}{\partial x^\nu} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda} + \frac{\partial^2 \xi^i}{\partial x^\mu \partial x_\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x^\lambda} + \frac{\partial \xi^i}{\partial x^\mu}\frac{\partial^3 \xi_i}{\partial x^\nu \partial x^\lambda \partial x_\lambda}\right)
\end{aligned} \tag{4.10}$$

According to the free field equation (3.16), some of the terms vanishing, and most of the terms cancel, leaving us with

$$R^{(1)}_{\mu\nu} = \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda} \tag{4.11}$$

From the mass-shell constraint $p_\mu p^\mu = 0$, we have

$$\begin{aligned}
p_\mu p^\mu &= PP - \mathscr{H}\mathscr{H}\\
&= \left(\dot{\xi}_i \cdot \triangledown \xi^i\right)\cdot\left(\dot{\xi}_i \cdot \triangledown \xi^i\right) - \left(\dot{\xi}_i\dot{\xi}^i - \mathscr{L}\right)\cdot\left(\dot{\xi}_i\dot{\xi}^i - \mathscr{L}\right)\\
&= 0
\end{aligned} \tag{4.12}$$

Then we can get the mass-shell condition

$$\partial^\lambda \xi^i \partial_\lambda \xi_i = 0 \tag{4.13}$$

By the mass-shell condition (4.13) we have

$$\int d\xi^i d\xi_i = C \tag{4.14}$$

where C is the integral constant.

By Eq.(4.14) we can obtain

$$\frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x^\nu} = \int \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda}\, d\xi^i d\xi_i$$
$$= C \cdot \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda} \tag{4.15}$$

Then Eq.(4.11) can be written as

$$R^{(1)}_{\mu\nu} = \frac{\partial^2 \xi^i}{\partial x^\mu \partial x^\lambda}\frac{\partial^2 \xi_i}{\partial x^\nu \partial x_\lambda}$$
$$= \frac{1}{C} \cdot \frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x^\nu} \tag{4.16}$$

and

$$R^{(1)} = \eta_{\mu\nu} R^{(1)}_{\mu\nu} = \frac{1}{C} \cdot \frac{\partial \xi^i}{\partial x^\kappa}\frac{\partial \xi_i}{\partial x_\kappa} \tag{4.17}$$

For empty space, Ricci tensor is vanishing $R_{\mu\nu} = 0$. Then in the general theory of relativity, the energy-momentum tensor of gravitational field itself can be written as follows[5]

$$t_{\mu\nu} = \frac{1}{8\pi G}\left(\frac{1}{2}\eta_{\mu\nu} R^{(1)} - R^{(1)}_{\mu\nu}\right)$$
$$= \frac{1}{8\pi G \cdot C}\left(\frac{1}{2}\eta_{\mu\nu}\frac{\partial \xi^i}{\partial x^\kappa}\frac{\partial \xi_i}{\partial x_\kappa} - \frac{\partial \xi^i}{\partial x^\mu}\frac{\partial \xi_i}{\partial x^\nu}\right) \tag{4.18}$$

Finally, we obtain, up to a constant factor, the energy-momentum tensor (4.18) is equal to the energy-momentum tensor (4.5). It is a strong evidence to prove that the quantum field theory constructed in this paper is classically equivalent to the general theory of relativity.

V. The Green's Function of Gravitational Field

According to the above discussion, the fields $C_i(x) = \big(C_r(x), \theta(x), \phi(x), C_t(x)\big)$ can be interpreted as the equivalent field of the gravitational field. Recall Eq.(2.15), the space of the gravitational effect is described by the coordinate system r^i, then the metric and the connection of the space of gravitational effect are the derivatives concerning the variable r rather than x, so that the metric and the connection contains no derivatives of the fields $C_i(x)$. Therefore the gravitational interaction can be regarded as the perturbation from the fields $C_i(x)$.

In the preceding discussion, when we discuss the dynamics and quantization of graviton, we use the orthogonal coordinate system x^μ and the spherical polar coordinate system r^i at the same time. The coordinate system x^μ conjugate to the energy-momentum of the graviton, so that x^μ describe the dynamics of graviton itself. But it is not clear how r^i affects gravitons, to make this clear, we try to use the same coordinate system. Let's set the orthogonal coordinate system X^μ and let it be the same as x^μ, then transform the spherical polar coordinate system r^i to the orthogonal coordinate system X^μ: $r^i \to X^\mu$. To distinguish variables in X^μ and x^μ, we use a capital letter "X" and lowercase letter "x". By Eq.(2.15), we can see that graviton has the ductility in the coordinate system r^i (or X^μ). Therefore a graviton is not a point particle; it is a wave packet approximate to the Dirac δ-function. It is a important property because the ductility of graviton enables us to solve the difficulty of the Feynman integral divergence by the Fourier transform.

Let's discuss the Feynman rules. The purpose is to obtain the Green's function. In the present case, we should obtain the Green's function of the fields $C_i(x)$ in the orthogonal coordinate system x^μ.

In the coordinate system r_x^i, the components of the Planck length and the Planck time at the point x are $\big(l_P, \theta(x), \phi(x), t_P\big)$. In the orthogonal coordinate system x^μ, it can be written as $L_P^\mu(x) = \big(L_P^1(x), L_P^2(x), L_P^3(x), L_P^4(x)\big)$.

where

$$\begin{aligned} L_P^1(x) &= l_P|\sin\theta(x)\cos\phi(x)| \\ L_P^2(x) &= l_P|\sin\theta(x)\sin\phi(x)| \\ L_P^3(x) &= l_P|\cos\theta(x)| \\ L_P^4(x) &= t_P \end{aligned} \tag{5.1}$$

In the orthogonal coordinate system x^μ, the integral constants $C_r(x), C_t(x)$ can be written as $C^\mu(x) = \big(C^1(x), C^2(x), C^3(x), C^4(x)\big)$.

where

$$\begin{aligned} C^1(x) &= C_r(x)\sin\theta(x)\cos\phi(x) \\ C^2(x) &= C_r(x)\sin\theta(x)\sin\phi(x) \\ C^3(x) &= C_r(x)\cos\theta(x) \\ C^4(x) &= C_t(x) \end{aligned} \tag{5.2}$$

Then in the orthogonal coordinate system x^μ and X^μ, the graviton can be written as

$$\xi^\mu(x, X) = X^\mu + C^\mu(x)\exp\Big(-\frac{|X^\mu|}{L_P^\mu(x)}\Big) \tag{5.3}$$

Let $j^\mu(x)$ be the source flow in the orthogonal coordinate system x^μ. We can get the field equation in the orthogonal coordinate system x^μ by Eq.(3.16)

$$\Box^2\, \xi^\mu(x, X) = j^\mu(x) \tag{5.4}$$

The D'Alembertian operator acts on the variable x.

Denote $\dfrac{|X^\mu|}{L_P^\mu(x)}$ as $\overline{L}(X)$ for short. The function $e^{-\overline{L}(X)}$ can be interpreted as a function of the variable X because $L_P^\mu(x)$ is just the component-wise manner of the Planck length (l_P, t_P) in the orthogonal coordinate system x^μ. Later we will show that there is no problem with this approach.

Then the field equation (5.4) can be written as

$$e^{-\overline{L}(X)}\Box^2\, C^\mu(x) = j^\mu(x) \tag{5.5}$$

In the scattering theory, Eq.(5.5) can be written as

$$e^{-\overline{L}(X)}\Box^2\, G^\mu(x) = \delta^4(x) \tag{5.6}$$

where $G^\mu(x)$ is the Green's function of the field $C^\mu(x)$

$$C^\mu(x) = C^{(0)}(x) + \int d^4X'\, G^\mu(x - x')j^\mu(x') \tag{5.7}$$

where $C^{(0)}(x)$ satisfying the homogenous equation.
Let $G^{\mu}(x)$ be

$$G^{\mu}(x) = \frac{1}{(2\pi)^4} \int d^4k \, \tilde{G}^{\mu}(k) e^{-ikx}$$
$$\tilde{G}^{\mu}(k) = \int d^4x \, G^{\mu}(x) e^{ikx} \tag{5.8}$$

It is the transformation between coordinate space and momentum space

$$|x\rangle = \frac{1}{(2\pi)^4} \int d^4k \, e^{-ikx} \, |k\rangle$$
$$|k\rangle = \int d^4x \, e^{ikx} \, |x\rangle \tag{5.9}$$

Eq.(5.6) can be rewritten as

$$\Box^2 \, G^{\mu}(x) = \delta^4(x) e^{\overline{L}(X)} \tag{5.10}$$

Denote

$$F = F_1 \cdot F_2$$
$$F_1(x) = \delta^4(x), \quad F_2(X) = e^{\overline{L}(X)} \tag{5.11}$$

Then Eq.(5.10) can be rewritten as

$$\Box^2 \, G^{\mu}(x) = F \tag{5.12}$$

The Fourier transform of F is

$$\tilde{F} = \int d^4x \, F_1 \cdot e^{ikx} \cdot \int d^4X \, F_2 \cdot e^{iKX}$$
$$= \delta\Big(K - \frac{i}{L_P^{\mu}(x)}\Big) \tag{5.13}$$

By the Fourier transform, Eq.(5.12) can be written as follows

$$\Box^2 \frac{1}{(2\pi)^4} \int d^4k \, \tilde{G}^{\mu}(k) e^{-ikx} = \frac{1}{(2\pi)^4} \int d^4k \, \tilde{F} \cdot e^{-ikx} \tag{5.14}$$

Since X^{μ} and x^{μ} are the same coordinate system, the solution of Eq.(5.14) is

$$\tilde{G}^{\mu}(k) = -\frac{1}{k^2} \cdot \delta\Big(k - \frac{i}{L^{\mu} \quad x}\Big) \tag{5.15}$$

Then

$$G^{\mu}(x) = -\frac{1}{(2\pi)^4}\int d^4k\,\frac{1}{k^2}\cdot\delta\Big(k - \frac{i}{L_P^{\mu}(x)}\Big)\cdot e^{-ikx} \tag{5.16}$$

Retransform the orthogonal coordinate system X^{μ} back to the spherical polar coordinate system r^i, the Green's function in momentum space can be written as

$$\tilde{G}^i(k) = \begin{cases} \tilde{G}^r(k) = -\dfrac{1}{(k^r)^2}\cdot\delta\Big(k^r - \dfrac{i}{l_P}\Big) \\ \tilde{G}^{\theta}(k) = -\dfrac{1}{(k^{\theta})^2} \\ \tilde{G}^{\phi}(k) = -\dfrac{1}{(k^{\phi})^2} \\ \tilde{G}^t(k) = -\dfrac{1}{\omega^2}\cdot\delta\Big(\omega - \dfrac{i}{t_P}\Big) \end{cases} \tag{5.17}$$

where $k^r, k^{\theta}, k^{\phi}, \omega$ are the expressions of the energy-momentum in the spherical polar coordinate system r^i.

To make the physical image intuitive and clear, we use the orthogonal coordinate system x^{μ} and X^{μ}. We can also use the spherical polar coordinate system r^i and R^i, where the coordinate system R^i is the same as r^i. Replace x^{μ} with R^i, replace X^{μ} with r^i. Then the graviton can be written as follows

$$\xi^i(R,r) = \begin{cases} \xi^r = r + C_r(R)\exp(-\dfrac{r}{l_P}) \\ \xi^{\theta} = \theta(R) \\ \xi^{\phi} = \phi(R) \\ \xi^t = t + C_t(R)\exp(-\dfrac{|t|}{t_P}) \end{cases} \tag{5.18}$$

For the source flow $j^{\mu}(R)$, the field equation is

$$\Box^2\,\xi^{\mu}(R,r) = j^{\mu}(R) \tag{5.19}$$

The D'Alembertian operator acts on the variable R.

The scattering equation is

$$\begin{cases} \exp(-\dfrac{r}{l_P})\Box^2\,G^r(R) = \delta^r(R) \\ \Box^2\,G^{\theta}(R) = \delta^{\theta}(R) \\ \Box^2\,G^{\phi}(R) = \delta^{\phi}(R) \\ \exp(-\dfrac{|t|}{t_P})\Box^2\,G^t(R) = \delta^t(R) \end{cases} \tag{5.20}$$

By the Fourier transform we can also obtain the Green's function (5.17). It shows that there is no problem in treating $e^{-\overline{L}(X)}$ as a function of X.

Compare the Green's function (5.17) with the usual Feynman propagator, we can see that the generalized functions $\delta\left(k^r - \frac{i}{l_P}\right)$ and $\delta\left(\omega - \frac{i}{t_P}\right)$ give the regularization to the integral over k^r and ω of the usual Feynman propagator.

The Green's function (5.17) is the generalized function, it must be interpreted in the sense of integral. The bounds of integral over k^r is $[0, +\infty)$, the bounds of integral over ω is $(-\infty, +\infty)$, but the integral paths deviate from the real axis into the complex plane and the integral paths pass through singularities $k^r = \frac{i}{l_P}$ and $\omega = \frac{i}{t_P}$, respectively. According to the properties of the Dirac δ-function, we just need to give singularities on the integral paths without calculating specific integrals when calculating the Feynman diagrams, so that the difficulty of divergence of Feynman integral over large virtual momenta of graviton has been solved.

The bounds of integral over k^θ is $[0, \pi]$, the bounds of integral over k^ϕ is $[0, 2\pi)$. The Feynman diagram's integral over k^θ and k^ϕ is limited.

Note that the variables k^r and ω always appear in the form of squares in Feynman rule, therefore the introduction of the imaginary number i in the generalized function $\delta\left(k^r - \frac{i}{l_P}\right)$ and $\delta\left(\omega - \frac{i}{t_P}\right)$ will change sign.

VI. Conclusion

Since the introduction of the uncertainty principle, space spanned by the inertial coordinate system becomes noncommutative lattices, then the inertial coordinate system of the noncommutative lattices becomes the locally inertial coordinate system on the point of spacetime, therefore the gravitational forces appear in the sense of the principle of equivalence. The space made up of physical points limited by the uncertainty principle is the noncommutative lattices, it is the space of graviton and it is flat. If we depend on traditional differential geometry to explain the spacetime limited by the uncertainty principle, the 4-dimensional space made up of mathematical points can be interpreted as curved, it is the space of the gravitational effect. The gravitational field can be interpreted as coming from energy-momentum limited by the uncertainty principle. By introducing gravitational interactions in this way, we can get a wave packet approximate to the Dirac δ-function; it can be explained as a semi-classical graviton. From compute the energy-momentum tensor of gravitational field itself, it is proved that the quantum field theory constructed in this paper is classically equivalent to the general theory of relativity. Because the graviton is a wave packet approximate to the Dirac δ-function, the propagator of graviton can solve the divergence difficulty caused by the integration over the large virtual momentum of the graviton in the Feynman rule. So we think we have a new approach to quantum gravity, it can be calculated and verified.

References Références Referencias

1. A. Connes, Noncommutative Geometry, Academic Press, 1994.
2. G. Landi, An Introduction to Noncommutative Spaces and Their Geometries, Lecture Notes in Physics. New Series M, Monographs No. 51, Springer-Verlag, Heidelberg, 1997.
3. E. Kiritsis, Introduction to Superstring Theory, CERN-TH/97-218, hep-th/9709062P. 10.
4. Weinberg, I. Gravitation and Cosmology: Principle and Applicatons of General Theory of Relativity (Wiley, New York, 1972) P.365.
5. Weinberg, I. Gravitation and Cosmology: Principle and Applicatons of General Theory of Relativity (Wiley, New York, 1972) P.165.

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 20 Issue 2 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Derivation of Neel Temperature and Pressure Expressions for High Temperature Superconductors

By Rasha Abd Elhai Mohammad Taha, Mashael Habab Al buqomi, Einas Mohamed Ahmed Mohamed, Nagwa Idriss Ali Ahmed, Musa Ibrahim Babiker Hussein, Mohamed Idriss Ahmed & Mubarak Dirar Abd-Alla

Majmaah University

Abstract- Using plasma equations beside Maxwell statistical distribution law a useful expression of the Neel temperature similar to that obtained for high temperature superconductors was derived. This expression was found by obtaining a new expression of energy from the plasma equation. The same procedures were used to find an expression of the pressure and isotope mass in terms of the critical temperature for high temperature superconductors. These expressions resembles the conventional ones.

Keywords: neel temperature, high temperature superconductors, plasma.

GJSFR-A Classification: FOR Code: 020404

DERIVATIONOFNEELTEMPERATUREANDPRESSUREEXPRESSIONSFORHIGHTEMPERATURESUPERCONDUCTORS

Strictly as per the compliance and regulations of:

Derivation of Neel Temperature and Pressure Expressions for High Temperature Superconductors

Rasha Abd Elhai Mohammad Taha [α], Mashael Habab Al buqomi [σ], Einas Mohamed Ahmed Mohamed [ρ], Nagwa Idriss Ali Ahmed [Ѡ], Musa Ibrahim Babiker Hussein [¥], Mohamed Idriss Ahmed [§] & Mubarak Dirar Abd-Alla [χ]

Abstract- **Using plasma equations beside Maxwell statistical distribution law a useful expression of the Neel temperature similar to that obtained for high temperature superconductors was derived. This expression was found by obtaining a new expression of energy from the plasma equation. The same procedures were used to find an expression of the pressure and isotope mass in terms of the critical temperature for high temperature superconductors. These expressions resembles the conventional ones.**

Keywords: neel temperature, high temperature superconductors, plasma.

I. Introduction

Superconductor (Sc) is one of the most important physical phenomena that attracts attention of physicists. It was found experimentally that beyond a certain critical value of temperature the resistance of the material vanishes [1]. The Sc acts also as a perfect dismagnetic material which expells the external magnetic field be applied when it exceeds a certain critical value [2]. This phenomenon is well explained by the so called Bardeen Shiffer and Cooper (BSC). Recently the so called high temperature superconductors (HTS), which show sc properties at critical temperatures above 130 k were discovered by the researchers [3,4]. These HTS show some very interesting properties [5,6]. For example the critical temperature is highly dependent on the doping process [5,6]. The material can be converted from an insulator to a sc when the concentration of the free carriers changed. The material can also be converted from anti ferromagnetic material to sc above the so called Neel temperature [7]. When some elements are replaced by their isotopes the critical temperature changes also comprising the so called isotope effect [8]. The so called pressure effect shows also that applying external pressure changes also the critical temperature. Different attempts were made to describe HTS phenomena but unfortunately the approaches used are complex and incomplete and unsatisfactory [9]. However recently new promising approaches were tackled by different authors. One of them was proposed by Ghada, et al, where she used Newtonian mechanics to prove that the Sc state is destroyed by the external magnetic field when it exceeds certain critical value for both types 1 and 2 Sc. Despite the success of this model but unfortunately it is based on classical laws that cannot describe other Sc phenomena on the atomic and subatomic scales. Thus this model cannot be promoted further to describe all Sc phenomena [10]. Another seminal paper done by Rasha, et al was published, finding the ordinary expression of the energy gap using tight binding approximation. This expression, however sayes nothing about the other effects, like the pressure and isotope effects [11]. Recently Einas, et al, also used plasma equations to modify Schrodinger equation to explain pressure effect. This model explains why some times the pressure increases critical temperature and why it sometimes decreases the critical temperature. This model however does not give the conventional well known pressure and isotope mass relationships with the critical temperature [12].

In this work one needed to find T_c for high superconducting materials in general and superconducting cuprates with the aid of quantum mechanical treatment in which electrons are considered as harmonic oscillators beside using plasma equations. This work tries to explain the isotope effect and pressure effect. These are done in sections 2&3 respectively. Sections 4&4&5 are devoted for the discussion and conclusion respectively.

Author α: Department of physics, College of Science, Majmaah University, Majmaah 11952, KSA.
Author σ ρ: Department of physics, University College (Turba) Taif University, KSA.
Author ρ Ѡ: Department of physics & Mathematics, Hantoub, Faculty of Education, Algezira University Wad Madaniin-Hanttoub,Sudan.
Author Ѡ: Department of physics, Faculty of Science & Art (Dariyah), Qassim Uveristy, Al-Mulida, KSA.
Author ¥: Department of phscis and Mathamatical, Faculty of Education Albutana University, Rufaa, Sudan. e-mail: garaof@yahoo.com
Author ¥ §: Physics Department, Faculty of Science & Art. Albaha University, Buljurashi, KSA.
Author § χ: Department of physics, Faculty of Science, Sudan University of Science and Technology, Khartoum, Sudan.

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020
17

II. Determination the Neel Temperature T_N

To find Neel temperature considers a particle of particles density n_o moving in resistive a medium of density n_r. The resistive force F_r in this case depends on the densities n_o and n_r as well

i.e

$$F_r = \gamma_o n_r v$$

Hence one can write the plasma equation under the effect of the internal field E_i and pressure P in the form

$$nm\frac{dv}{dt} = neE_i - \nabla P - \gamma_o n_r v \qquad (1)$$

If the system oscillates as a harmonic oscillator, thus ج

$$F = -nkx = nm\frac{dv}{dt} = neE_i - \gamma k_B T \nabla n - \gamma_o n_r v$$

Using the perturbation solution

$$v = v_o + v_1 e^{i\omega t}$$

$$n = n_o + \tilde{n}_1 e^{i\omega t}$$

$$x = x_o e^{i\omega t} \qquad (2)$$

$$E_i = E_{oi} e^{i\omega t}$$

One gets

$$-n_o k x_o = n_o e E_{oi} - \gamma k_B T \nabla \tilde{n}_1 - \gamma_o n_r v_o$$

Thus the frequency

$$m\omega_o^2 = k = \frac{\gamma k_B T \nabla \tilde{n}_1}{n_o x_o} + \frac{\gamma_o n_r v_o}{n_o x_o} - \frac{eE_{oi}}{x_o} \qquad (3)$$

$$\omega_o = \sqrt{\frac{1}{mx_o}}\sqrt{\frac{\gamma k_B T \nabla \tilde{n}_1}{n_o} + \frac{\gamma_o n_r v_o}{n_o} - eE_{oi}}$$

This can be satisfied if ω_o is imaginary, where

$$\omega_o = \omega + i\omega_i$$

The real part ω vanishes, when

$$\frac{\gamma k_B T \nabla \tilde{n}_1}{n_o} + \frac{\gamma_o n_r v_o}{n_o} - eE_{oi} < 0$$

$$T < \frac{n_o}{\gamma k_B \nabla \tilde{n}_1}[eE_{oi} - \frac{\gamma_o n_r v_o}{n_o}]$$

Thus Neel temperature is given by

$$T_N = \frac{n_o}{\gamma k_B \nabla \tilde{n}_1}[eE_{oi} - \frac{\gamma_o n_r v_o}{n_o}] \qquad (4)$$

According to Maxwell distribution n is given by

$$n_r = Ae^{-\beta E} \qquad (5)$$

The electrostatic potential V due to the hole doping which increases positive ions shows the effect of holes on the negative charges in the resistive medium.

$$V = +\frac{ne^2}{4\pi\varepsilon_o r} = -\frac{ne^2}{4\pi\varepsilon_o r} = -V_o$$

where n stands for the hole concentration. The energy E can thus be written as a sum of V blues the rest of energies E_o, i.e

$$E = E_o + V = E_o - V_o$$

Thus

$$n_r = Ae^{-\beta E_o} e^{-\beta V} = A_o e^{+\beta V_o} = A_o e^{C_2 n}$$

The Neel temperature in equation (4) can thus given by

$$T_N = c_4[c_3 - c_1 e^{+c_2 n}] \qquad (6)$$

Where c_1, c_2, c_3 and c_4 are constants.

III. Isotope Effect and Pressure Coefficient of T_C

The relation between the pressure and absolute temperature is

$$pv = Nk_B T$$

$$p = \frac{Nk_B T}{v} = n_e k_B T \qquad (7)$$

Where $\mathbf{n_e}$ the density of electron (the number of electron in unit volume). The equation of motion of the electrons can be found by treating the medium as a fluid by using Euler equation to get

$$\rho[\frac{\partial v}{\partial t} + v\frac{\partial v}{\partial x}] = -\frac{\partial p}{\partial x} - n\gamma v + Bev \qquad (8)$$

The density mass of fluid ρ equals the density of electrons n_e multiplied by mass of one electron m is given by expression

$$\rho = m_e n_e$$

The resistive force $n\gamma v$ is assumed to be dependent on the total number of electrons and protons in the medium, n, beside the parameter, γ , since

$$\nu = \nu(x,t)\ ;\ d\nu = \frac{\partial \nu}{\partial x}dx + \frac{\partial \nu}{\partial t}dt$$

It follows that

$$\frac{d\nu}{dt} = \frac{\partial \nu}{\partial x}\frac{dx}{dt} + \frac{\partial \nu}{\partial t} = \nu\frac{\partial \nu}{\partial x} + \frac{\partial \nu}{\partial t}$$

$$\rho\frac{d\nu}{dt} = -\frac{\partial p}{\partial x} - n\gamma\nu + Be\nu$$

$$\rho\frac{d\nu}{dx}\frac{dx}{dt} = \rho\nu\frac{d\nu}{dx} = -\frac{\partial p}{\partial x} - n\gamma\nu + Be\nu \qquad (9)$$

If the pressure is a function of x only it follows that

$$p = p(x)\ ;\ \frac{dp}{dx} = \frac{\partial p}{\partial x} \qquad (10)$$

Hence the equation (9) becomes

$$m_e n_e \nu\frac{d\nu}{dx} = -\frac{dp}{dx} - n\gamma\nu + Be\nu \qquad (11)$$

Integrating the equation (11) assuming by B, ν , γ, n to be constants one gets

$$m_e n_e \int \nu d\nu = \int Be\nu dx - \int dp - \int n\gamma\nu dx$$

$$\frac{1}{2}m_e\nu^2 = \frac{1}{n_e}[Be\nu x - p - n\gamma\nu x] \qquad (12)$$

The right hand side of this equation represents the kinetic energy of the electron hence

$$E = \frac{1}{2}m_e\nu^2 = \frac{1}{n_e}[Be\nu x - p - n\gamma\nu x] \qquad (13)$$

According to Maxwell distribution the number of electrons is given by

$$N_o = C_o e^{-\beta E} \qquad (14)$$

Thus using (13) one gets

$$N_o = C_o \exp[-\frac{\beta}{n_e}[Be\nu - p - n\gamma\nu x]] \qquad (15)$$

where n the total density number of electrons and protons in the sample which is equal to the density of ions multiplied by the total number of electrons and protons $(n_e + n_p)$ in each ion. Hence

$$n = n_i \times (n_e + n_p) = n_i n_e + n_i n_p = n_i n_e + n_i \frac{M}{m_p} \qquad (16)$$

Where the mass of electrons is neglected compared to the mass of protons. Hence M=mass of the ions $=n_p M_p$, where M_p is the proton mass.

In view of equation (4) by replacing n by N, Ee by Bev, gamma by 1 and neglecting nr, one gets

$$T_c = \frac{B_a e\nu_o N_o}{k_B \nabla n} \qquad (17)$$

Using equation (15) and (16) one get

$$T_c = \frac{B_a e\nu_o C_0}{k_B \nabla n_o}\exp[-\frac{\beta}{n_e}[Be\nu - p - \gamma\nu x\left(n_i n_e + \frac{n_i M}{m_p}\right)]] \qquad (18)$$

Taking the logarithm of both side

$$\ln T_c = \ln[\frac{B_a e\nu_o C_0}{k_B \nabla n_o}] - \frac{\beta}{n_e}[Be\nu - p - \gamma\nu x\left(n_i n_e + \frac{n_i M}{m_p}\right)]$$

Hence by differentiating this equation, one can obtain the isotope effect and coefficient of pressure, respectively.

$$\frac{\partial \ln T_c}{\partial M} = \frac{\nu x n_i \gamma\beta}{n_e m_p} = -\alpha \qquad (19)$$

$$\frac{\partial \ln T_c}{\partial p} = \frac{\beta}{n_e} = \gamma \qquad (20)$$

IV. Discussion

Plasma equation (1) together with the fact that the pressure dependent on the temperature for gases in addition to assuming the real part of frequency to vanish, beside Maxwell equation were used to find a useful expression of the Neel temperature. The relation between the absence of the frequency, thus the energy, according to Plank hypothesis, is too vanishes by treating the plasma particles as vibrating strings. The absence of real energy and the dominance of imaginary energy means that the collision is very effective and the thermal energy is very large as pointed out by Dirar et al[10]. This high thermal energy causes random motion of magnetic dipoles due to thermal agitation. This leads to dis appearance of ferro and anti ferro magnetism. Thus it is quite natural to obtain Neel temperature according to this hypothesis in equations (4) and (6) respectively. The emperical expressions of the HTC for pressure and isotope effects were found using gas law in equation (7) and plasma equation (8) to find first a useful expressions for kinetic and total energy in equations (12) & (13) respectively. This leads to a useful expression of the critical temperature in equation (17). Using these relations a theoretical relationship between isotope mass and critical temperature is typical to the conventional emperical one was found in equation (19). A useful expression of the pressure related to the critical temperature is also found in equation (20).This expression is similar to the emperical conventional one.

V. Conclusion

Using plasma equation together with Maxwell equation beside gas laws a useful expression of the Neel temperature, Pressure, isotropic mass for H TS was derived. These relations fortunately conforms with the emperical conventional relations.

References Références Referencias

1. Gerald Burns (1985), Solid State Physics, Academic Press, London.
2. Khogali (2002), Azza Publication, Khartoum.
3. J. Robert Schrieffer, James S. Brooks (2007), Hand Book of High Temperature Superconductivity, Springer New York.
4. Puri R. K (2004), Solid State Physics and Electronics, S. Chad & Company Ram Nagar, New Delhi.
5. S. Alexandrov (2003), Theory of Superconductivity, IOP Series Cond. Mat., T. Spicer (ed).
6. K.K.A. Muller (2005), Essential heterogeneities in hole - doped cuprate superconductors, in structure and binding, vol 114, Springer, Berlin Heidelberg, New York.
7. C. Yasuda, S. Todo, K. Hukushima, F. Alet, M. Keller, M. Troyer, and. Takayama (2005),Phys. Rev. Lett., 94, 217201.
8. J. J. Zasadzinski, The Physics of Superconductors (2003), Springer, Berlin Heidelberg, New York.
9. V. Chubukov, D. Pines, and J. Schmalian (2002), The Physics of Conventional and Unconventional Superconductors, Springer, New York.
10. T. Maier, M. Jarrell, T. Pruschke and M. Hettler (2005), Rev.Rev.Mod.Rev.Mod.Phys, 77,77,1027.
11. N. Bulut (2002), Adv. Phys. 51, 1587.
12. Ghada E. S. Elammen, Amna E. Musa, Hassaballa M. A.,, Elharam A. E., Mubarak Dirar, Sawsan Ahmed Elhouri (2019), Global Journal of Engineering Science and Researchs, [Elammen, 6(3): March 2019.
13. Rasha Abd Elhai Taha, Mahmoud H. M. Hillio, R. A. Elgani Mubarak Dirar Abd-Alla (2013), Natural Science, V. 5, N.8.
14. Einas M. A. M, Nagua I. A. A, Musa I. H, Rasha A. E. M. T, Mohamed Idriss A, Mubarak Dirar (2020), Natural Science, 2020, V1(N1).

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 20 Issue 2 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Surfing on Top of a Gravitational Wave

By Stanislav Konstantinov
Herzen State Pedagogical University

Abstract- The article proposes, within the framework of the new cosmological model, which includes superfluid dark energy and dark matter, to revise the Einstein's "vacuum field equation" and, based on new astronomical observations, to refine the type and speed of gravitational waves. I note the need for further improve the LIGO and Virgo detectors for detecting longitudinal of gravitational waves. The article considers the Wakefield effect implemented in the AWAKE project for particle acceleration in the Large Hadron Collider as a mechanism for the possible acceleration of primary protons and spacecraft to superluminal speeds at the top of longitudinal gravitational waves in space. I suggest using the SMOLA plasma space engine to provide spacecraft energy in stationary and pulsed modes.

Keywords: *warp drive, gravitational wave, wakefield, surfing, proton, gamma radiation.*

GJSFR-A Classification: *FOR Code: 020105*

SURFINGONTOPOFAGRAVITATIONALWAVE

Surfing on Top of a Gravitational Wave

Stanislav Konstantinov

Abstract- The article proposes, within the framework of the new cosmological model, which includes superfluid dark energy and dark matter, to revise the Einstein's "vacuum field equation" and, based on new astronomical observations, to refine the type and speed of gravitational waves. I note the need for further improve the LIGO and Virgo detectors for detecting longitudinal of gravitational waves. The article considers the Wakefield effect implemented in the AWAKE project for particle acceleration in the Large Hadron Collider as a mechanism for the possible acceleration of primary protons and spacecraft to superluminal speeds at the top of longitudinal gravitational waves in space. I suggest using the SMOLA plasma space engine to provide spacecraft energy in stationary and pulsed modes.

Keywords: warp drive, gravitational wave, wakefield, surfing, proton, gamma radiation.

I. Introduction

The warp drive is perhaps the Holy Grail of space exploration. With a propulsion system capable of moving at a speed exceeding the speed of light, man can reach the far corners of our galaxy and even go beyond it. According to professor of aerospace engineering Jason Cassibry (Jason Cassibry), scientists are getting closer to hacking the physics of the warp engine to make it work just like in Star Trek. Cassibry teaches at the University of Alabama, Huntsville, where he advises undergraduate student Joseph Agnew, author of a recently published study on this fantastic type of engine (Figure 1).

Figure 1: Graduate student Joseph Agnew

In 1994, the Mexican physicist Miguel Alcubierre suggested that an object could deform spacetime in front of itself [1]. The Alcubierra drive, which remains theoretical, creates a "wave bubble" around the object. This bubble deforms space-time, creating a region of contracting in front of it and expanding the space behind it, placing the spaceship and everything else - in a new position faster than the light moves. It is important to note that the object inside the bubble never moves than the speed of light. Problems arise in the process of creating this deformation bubble. Initially, estimates showed that the curvature of Alcubierre would require all the energy available in the universe to create such a bubble. However, as Agnew pointed out in his presentation and work, this estimate has since decreased due to the inclusion of exotic matter in the model, which does not yet exist [2]. Theoretical progress is one thing, and the physical creation of such an engine is another, and, as Cassibrey said in an interview with Motherboard, scientists still have a long way to go before they reach this ultimate goal. I think shorten this path by including dark matter as an exotic matter Agana, capable of creating a "wave bubble" around the spacecraft.

Author: Department of Physical Electronics, Herzen State Pedagogical University, Saint Petersburg RSC"Energy", Russia.
e-mail: konstantinov.s.i@yandex.com

II. Propagation of Gravitational Waves in the Elastic Medium of Superfluid Dark Energy and Dark Matter

According to observations using the Hubble Space Telescope space telescope in 1998, established the accelerated expansion of galaxies in the visible part of the Universe. Cosmological antigravity in the standard ΛCDM (Λ- Cold Dark Matter) model is described Einstein by linear force depending on the distance:

$$Fe = (c^2 / 3) \cdot \Lambda \cdot R, \qquad (1)$$

Where Λ is Einstein's cosmological constant, and R is the distance [3].

However, Nobel Prize winner Brian P. Schmidt in his Nobel Lecture on 8 December 2011 "The Path to Measuring an Accelerating Universe", was forced to admit: "The discovery of the accelerated expansion of the universe caused a huge amount of theoretical research. Unfortunately, the apparent progress in our understanding of this problem has not yet happened - the cosmological acceleration remains as mysterious as in 1998"[4]. In this paper, based on the development of the theory of superfluid media are invited to expand the scope the standard ΛCDM and give a physical explanation of the cosmological acceleration, based on the structural features and the elastic properties of the space environment. If the deformation arising in the elastic spring or the elastic intergalactic medium (dark energy) would is proportional to the force applied to the body of **F** = k · r (Guka's law), space-time will represent straight lines that go from the observer to infinity [5]. Obeying this law describes the repulsive forces between the structural elements forming dark energy. Phase state quantum vacuum characterizing dark energy, are considered in the model as analogous the superconducting α-phase ^{3}He-B while assuming that dark matter can be considered as an analog of the spontaneously ferromagnetic β phase ^{3}He-B, formed in strong gravitational and electromagnetic fields of galaxies and black holes and at the same time acquired gravitational properties. Consider the antigravity mechanism inherent in dark energy. Similarly to the interaction of vortices in superfluid ^{3}He-B, vortices in the environment of dark energy should also interact. In ^{3}He-B, the magnetization of vortex cores takes place along the axis of the vortex; that is, there is a spin polarization of the superfluid liquid. Thus, the space environment in the turbulent region can be characterized by the state of all-round stretching [5]. In the framework of the hydrodynamic model, the effect of a superfluid fluid on the vortex core can be mathematically described by the introduction of pressure **Pn** at the boundary of the vortex. The sign of pressure depends on the nature of the internal stresses in the medium. If these the internal stresses in the dark energy have the character of all-round stretching, then the pressure will be negative. That is, all the dynamic characteristics will have a sign opposite to that which they would have had for the usual ideal incompressible fluid with the same kinematic properties. This behavior of the system is similar to the presence of a negative mass. Strength **Fe** is antigravity repulsive force acting in a space environment (dark energy):

$$Fe = - \int_{S'} Pn \, ds, \qquad (2)$$

Where,

n is external normal to the surface S';

ds is infinitesimal element of the surface.

In a superfluid ^{3} He-B medium during rotation, quantum vortex filaments are formed in which the angular momentum of paired atoms ^{3}He is nħ; ħ is the Planck constant, n = 1, 2 [6]. Today, astrophysicists discovered in 12 billion light-years from Earth in the constellation Aquarius of a previously unknown megastructure. She is a complex interweaving of "channels" or "threads" of hydrogen gas that extend between galaxies. Scientists believe that this is part of the structure, previously called the "space network", which, according to calculations, should connect all galaxies and black holes in the Universe. A detailed map of elusive structures in one of the regions of the early Universe was compiled during observations using the MUSE tool at the Very Large Telescope of the European Southern Observatory (ESO) for the light emitted by hydrogen in the massive proto-cluster SSA22, located at a distance of about 12 billion light-years from Earth in direction of the constellation Aquarius (Figure 2).

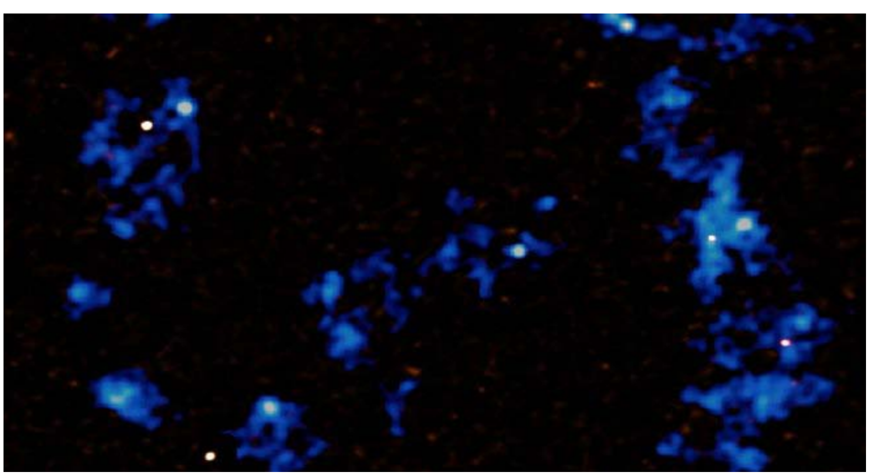

Figure 2: Space network. White dots are actively forming galaxies

The results showed that the gas forms long filaments in the intergalactic space, which exactly corresponds to the simulation performed on this site and forecasts of galaxy formation models. The intergalactic filaments of the space network extend over more than three million light-years and provide "fuel" for the formation of new stars and the growth of supermassive black holes in the parent protocluster. A map of the giant "web" compiled basis on of observations, and the findings of scientists were published in the journal Science on June 6, 2019 [7]. In my opinion, this discovery confirms that in a superfluid medium of dark energy filling the intergalactic space, quantum vortex filaments are formed from paired hydrogen atoms, similar to paired He atoms in a ^{3}He-B superfluid medium (Figure 2).

ESA XMM-Newton X-ray Observatory discovered three massive filaments of hot gas in a cluster of galaxies. So exposed part of the cosmic skeleton that permeates the entire universe. Galaxies gather to form groups and even large agglomerates called clusters. These clusters are the most massive space structures held by gravity. Clusters contain a large amount of hot gas and even more invisible dark matter. On a universal scale, galaxies and clusters of galaxies are connected into a giant network, at the nodes of which are the most massive clusters. XMM-Newton's new study discovered several filaments of galaxies, gas, and dark matter that flow to one of the most massive clusters of galaxies in the universe. This is the first discovery to confirm theoretical calculations. "It was an unexpected and long-awaited discovery!" Says Dominic Eckert of the University of Geneva, Switzerland, author of a report in the journal Nature. Figure 3 shows the image of the four galactic clusters that make up Abell 2744. Four very massive clusters of galaxies are visible where there is a higher concentration of galaxies (white and purple regions). Two clusters in the lower-left corner of the image are in the early stages of the merge process. Two other clusters can be seen in the central part of the image just above the center.

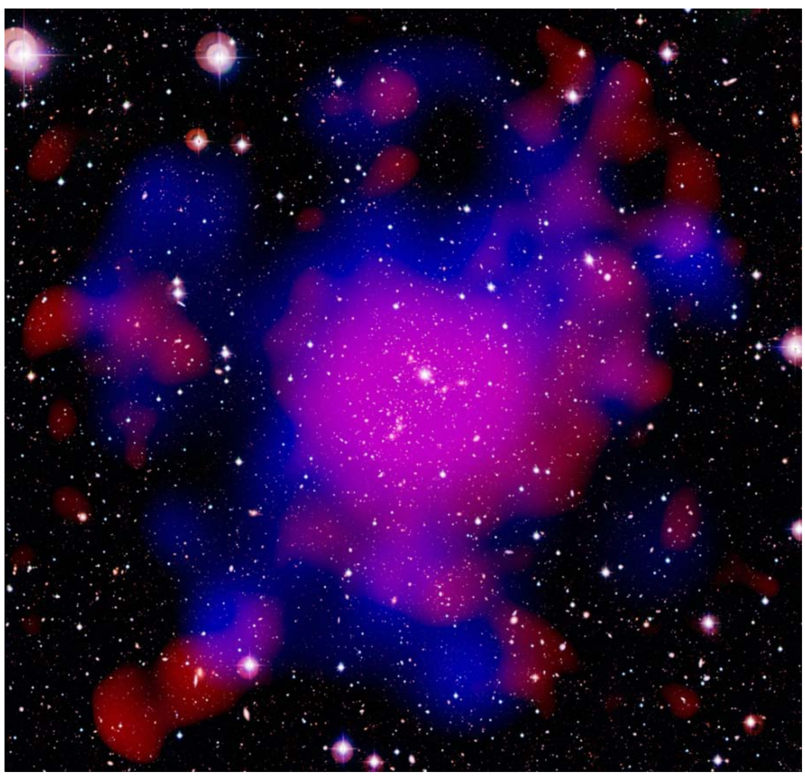

Figure 3: Components of the cluster of galaxies Abell 2744. White color - galaxies, red color - hot gas and blue color - dark matter

In early 2020, scientists managed to register small clumps of dark matter - only 1/10 000 and even 1/100 000 of the mass of the Milky Way. And for dark matter, these are indeed very shallow meanings. Detection is made possible by gravitational lensing of light. If there is even a small cluster of dark matter in the galaxy lying in the foreground, or on the line of observation, the observed picture is distorted. Based on these distortions, we can conclude about the size of the clots. As you know, massive objects can refract rays of light. Not much, but at distances of millions of light-years, deviations will be noticeable. This characteristic gives rise to the effect of gravitational lensing, thanks to which we can see the light from distant stars that are behind galaxies or other massive objects (Fig. 4).

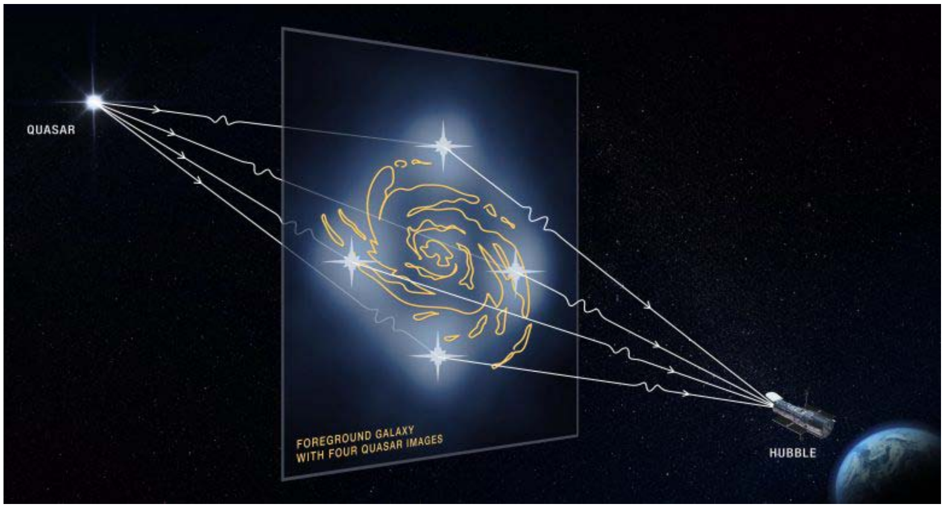

Figure 4: The effect of gravitational lensing

The Hubble observation yields new insights into the nature of dark matter. “We made a very compelling observational test for the cold dark matter model, and it passes with flying colors,” said Tommaso Treu of the University of California, Los Angeles (UCLA), a member of the observing team [8]. Since gravitational fields are not possible to screen by material bodies, the propagation path of the gravitational waves will differ from electromagnetic waves.

It can be assumed that the structure of the Universe is much more complicated than previously imagined in cosmology. This assumption is based on the latest discoveries of astrophysicists who discovered that in the universe, the location of galaxies changes synchronously, like a flock of birds in flight. For example, a study published in the Astrophysical Journal in October 2019 showed that hundreds of galaxies rotate in sync with other galaxies that were tens of millions of light-years away. “The discovery is completely new and unexpected,” said June Heo Lee, an astronomer at the Korea Institute of Astronomy and Space Sciences. “The observed coherence must have some connection with large-scale structures because it is impossible for galaxies separated by six megaparsecs (approximately 20 million light-years) to interact directly with each other,” Lee said. Scientists suggest that synchronized galaxies can be embedded along with the same large-scale structure, which rotates very slowly counterclockwise. This fundamental dynamics can cause some consistency between the rotation of the studied galaxies and the movements of their neighbors.

For the dark energy and dark matter, the generalized vector Lame wave equation is valid. This equation is equivalent to two simpler wave equations, which describe elastic waves of two types: longitudinal waves that propagate with phase velocity *Vp* and transverse waves with phase velocity *Vs*. It can be gravitational, electromagnetic, and torsion waves. The speed of propagation of longitudinal waves is higher than the transverse. Gravitational waves can be attributed to the longitudinal waves since according to the calculations of Laplace, their speed should exceed the transverse electromagnetic waves at least 7000000 times. Otherwise, the retarded gravity of the Sun to cease to be strictly central and the planetary system fall apart very quickly due to cyclic torque [9]. In the work "Elastic Model of Physical Vacuum" Professor V. A. Dubrovsky in 1985 presented an estimate of the speed of gravitational waves based on the fact that the ratio of the interaction forces according to the Coulomb law for transverse electromagnetic waves and longitudinal gravitational waves is determined by the ratio of the corresponding elastic modules, which is equivalent to the ratio of their square of velocities. It follows that the speed of gravitational waves exceeds the speed of electromagnetic waves by 10^9 times [10]. In 1994, when July 16, 1994, the great nucleus of the comet Shoemaker-Levy collided with the Jupiter gas sphere, radial oscillations gave rise to the surface gravity waves, instantly resulted in fluctuations in several geodetic satellite command-measuring complex of Russia. Typically, geodetic satellites have an orbit inside a tube with a diameter of about 1 km. And their orbit control is carried out with very great accuracy - the error in the coordinate is up to a 1meter, and the error in speed is up to 1 cm /sec. During the collision period, the diameter of the tube path increased by 5–8 times. Unfortunately, the author does not have similar information from the USA from NASA. Speed gravitational waves, formed by the collision of a comet with Jupiter, significantly exceeded the velocity of electromagnetic waves (light spreads from Jupiter to Earth is 43.2 min). A more recent example is the registration of gravitational waves generated from the merger of neutron stars on August 17, 2017. So, on the morning of August 17, 2017, at 15:41 Moscow time, two Advanced LIGO gravitational detectors in the USA and Advanced Virgo detector in Italy recorded a gravitational wave surge GW170817. Thanks to data from three detectors, it was possible to localize by triangulation the location of the source in the sky (with an area of about 35 square degrees), which turned out to be in the southern sky. After 2 seconds, telescopes Fermi and INTEGRAL detected a short burst of gamma radiation in the same region of the sky. A message about this discovery was promptly sent to observatories located in the southern hemisphere of the Earth. In this case, astrophysicists have suggested that this is a fusion of neutron stars. Since this process, according to modern ideas, basically generates short gamma-ray bursts and superlight neutrinos. Incidentally, superluminal neutrinos were also observed during supernova explosions, when neutrinos first arrive, and then an optical flash is visible after a few hours [11]. Telescopes around the world were waiting for the night and got into work after a few hours. The astronomers at the Las Campanas Observatory in Chile were the first to record a Kilonova flare using the Henrietta Swope optical 1-meter telescope. Almost simultaneously with it, a flash in the infrared was seen by the VISTA telescope. At the moment of merging of two neutron stars into one compact object (a neutron star or a black hole), a "fireball" is formed from gamma radiation, followed by a Kilonova flash, visible in all wavelengths, including the optical, due to the ejection of part of the substance into space (Fig 5). Then, astronomers at another Chilean observatory - Las Chambres - activated their network of 20 robotic telescopes around the world and tracked a 20-fold decrease in the optical brightness of a Kilonova flash for five days, which allowed us to construct a light curve. Estimates of the distance to the object, obtained both from gravitational wave data and from other observations, gave consistent results: GW170817 is at the same distance from Earth as the galaxy NGC 4993, that is, 130 million light-years away.

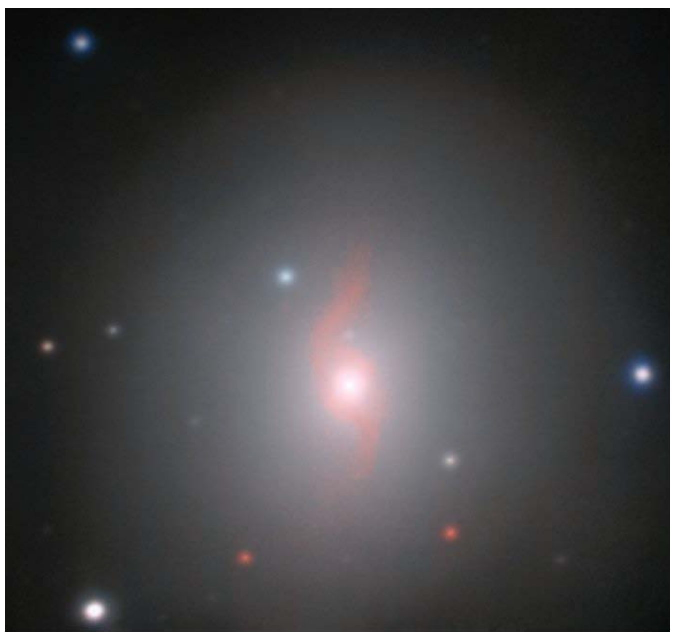

Figure 5: Galaxy NGC 4993, VLT image (ESO, Chile). A faint light source at the top of the center of the galaxy is a Kilonova, an explosion when two neutron stars merge. Red shows gas emission with an unexpected spiral structure. (Photo by ESO / J.D. Lyman, A.J. Levan, N. R. Tanvir)

The discovery of 2017 was the second case, after the explosion on Jupiter during the impact of the nucleus of comet Shoemaker-Levy, when an astronomical event was observed both on light and gravitational waves, ushering in a new era of “multi-medium astronomy”. The information received gave scientists invaluable evidence that gravitational waves can propagate at a speed different from the speed of light. Professor of Osaka University of Japan L. Baiotti, in his article published in September 2019 states: “While the GW170817 event was very fortunate because of its proximity to us, it can be expected that future observations will not all have such a high signal-to-noise ratio, but the increasing sensitivity of advanced GW detectors over the next years will surely lead to a large number of detections of merging BNS systems” [12]. Here, it should be noted that experiments to study longitudinal gravitational waves in plasma-like media both in laboratory conditions and in outer space are carried out using methods and recording equipment designed to receive transverse electromagnetic waves. Visible space Universe contains more than 90% of the substance in a plasma state in which various types of longitudinal waves arise. Especially strong generation of longitudinal waves of great intensity is manifested during the collapse of stars or their explosive evolution, for example, the formation of new and supernova stars, when powerful ejections and plasma flows are formed.

During these processes, charge separation occurs, leading to the generation of longitudinal waves. The same applies to the Sun, especially during activity cycles. In-ground and airborne detectors, waves are usually recorded as transverse electromagnetic waves, even when their longitudinal nature is known. It is believed that longitudinal waves are transformed into transverse at various inhomogeneities of the plasma, its boundaries, or due to various interactions with other waves. On the way from Jupiter to the Earth, longitudinal gravitational waves underwent fewer transformations than on the way 130 million light-years from the galaxy NGC 4993 and maintained a high superluminal speed when they met the Earth. For a reliable interpretation of gravitational waves in GW detectors, specific methods for recording longitudinal gravitational waves should be developed this primarily relates to antennas.

Consider the famous "Einstein Field Equation" which governs the behavior of general relativity. The left-hand side describes the curvature of space-time, while the right-hand side describes the distribution of matters [3]:

$$R\mu\nu - \frac{1}{2} g\mu\nu = \frac{8\pi G}{c^4} T\mu\nu \quad (3)$$

Where $R\mu\nu$ is the Ricci tensor; $g\mu\nu$ is the event space metric tensor; $T\mu\nu$ is the energy-momentum tensor of matter.

Einstein is talking about gravitational waves propagating in the free space, which means there is no matter, not even electromagnetic field, consequently the right hand side should be zero. So the equation is simplified to $R\mu\nu - \frac{1}{2} g\mu\nu R = 0$, which is equivalent to a more concise form $R\mu\nu = 0$, which is also known as "Vacuum Einstein Field Equation". Both EFE and VEFE are nonlinear partial differential equations, while in the weak field setting, they can be approximated with linear equations. The linear EFE is similar to other wave equations like Maxwell's Equations, so Einstein predicted the existence of transverse gravitational wave and predicted that the speed of the gravitational waves is equal to speed of light. However, there is no free space in galaxies, there is dark matter there, which is five times more than baryonic matter and the right side of equation (3) cannot be equated to zero. Therefore, Einstein's predictions regarding the type and the speed of gravitational waves in the new cosmology need to be clarified. In 2019, thanks to the Event Horizon telescope, an M87 image was obtained - the world's first photograph of a black hole (Figure 6).

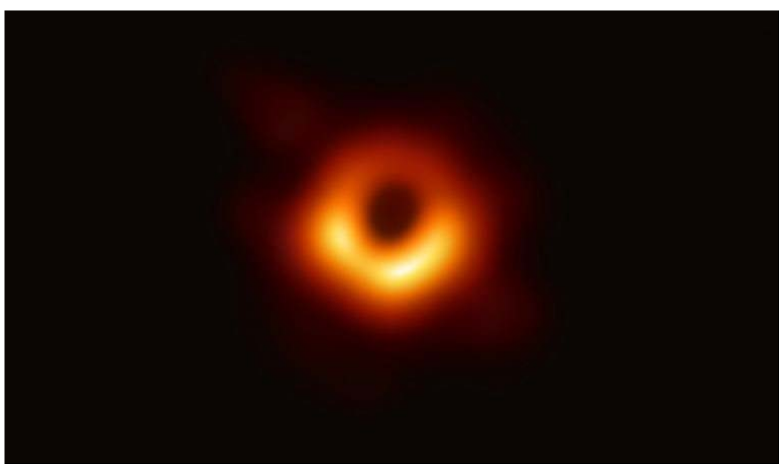

Figure 6: The famous photo of a black hole in the galaxy M87

This hole is located in the center of the eponymous galaxy, also known as NGC 4486, it is about 6.5 billion times more massive than the Sun and emits streams of red-hot "semi-digested" stellar matter into space. The super-giant elliptical galaxy is about 53 million light-years distant from Earth, and its length is about 240,000 light-years - that is, it is slightly larger than the Milky Way.

The substance erupts from a black hole at speed significantly higher than the speed of light. Although the erupted substance takes the form of an elongated ray, it does not look like a uniform stream - it is rather lumpy, inhomogeneous clumps of hot material flying on the crest of a longitudinal gravitational wave (Figure 7). The results of the latest study are presented in a paper published in the Astrophysical Journal [13].

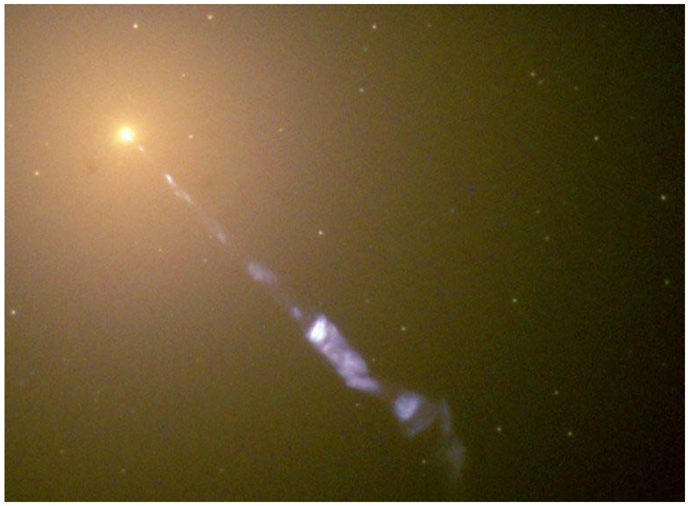

Figure 7: The flow of matter discharged from a black hole NGC 4486 at speed 6.3 times the speed of light

The model of the quantum vacuum as an analog of superfluid ^{3}He-B clearly shows how microscopic processes studied only by quantum mechanics manifest themselves in macroscopic processes. The initial information from classical hydrodynamics on the motion of spherical bodies in a fluid (Stokes work), which has been the primary source of progress in the study of low-frequency anomalies [14], allows you to theoretically calculate the additional energy extracted from dark matter to create gravitational waves. It is a complex force **F** (ω), exerted by the fluid on the sphere of radius R, which performs periodic oscillations with a frequency ω. Within the low Reynolds numbers, we have:

$$F(\omega)= 6\pi\eta R\,(1+\frac{R}{\delta(\omega)})V(\omega) + 3\pi R^2\sqrt{\frac{2\eta\rho}{\omega}}\,(1+\frac{2}{9}\frac{R}{\delta(\omega)})i\omega V(\omega), \quad (4)$$

$$\delta(\omega) = (2\eta/\rho\omega)^{1/2}$$

Where ρ - fluid density, η - the viscosity, V - velocity amplitude sphere, δ (ω) - the so-called viscous penetration depth, which increases with an increase in viscosity and a decrease of the oscillation frequency.

The real part of the expression (4) is a known Stokes force derived from the movement of fluid in the sphere. Imaginary component (coefficient of iωV) is naturally identified with the effective mass of the cluster added:

$$\mathrm{Meff}\,(\omega R) = \frac{2\pi\rho R^3}{3}\,[1+\frac{9}{2}\,\frac{\delta(\omega)}{R}] \quad (5)$$

Origin added (attached) mass Meff (ωR), depending on the frequency ω and the radius R of the sphere of the cluster associated with the excitation of the field around a moving cluster of hydrodynamic velocity υ_i (r) and the appearance in connection with this additional kinetic energy [14]. It's in the laboratory, and in space, the reason for the increase in the inertial mass of Mercury is the perturbation of the space environment caused by the nonequilibrium state of Mercury, whose orbit is subject to strong perturbations due to proximity to the Sun, when the vector of velocity is constantly changing, forming vortices in the medium. The pressure in the region of the vortex formed behind the planet will become lower, which, in turn, will cause an increase in drag and, as a result, an additional field of inertia. The relationship between friction resistance and pressure resistance depends on the Reynolds number (Re). The more Re, the greater the compaction of the medium is created in front of the planet, and the more rarefied medium will be behind it [15]. This creates longitudinal gravitational waves in the space environment. If a spaceship moves in the wake of such a super-light gravitational wave, then it will move in space with super-light speed.

III. Wakefield -The Mechanism of Spacecraft Acceleration by "Surfing" on Top of a Longitudinal Gravitational Wave

As in AWAKE accelerators, where particles are accelerated when “surfing” at the top of a plasma wave (or Wakefield field), a spaceship can accelerate at the top of gravitational waves in the quantum vacuum (dark matter) which contains similar zones of positive densifications and discharges in the galactic and intergalactic environment. The team behind the Advanced Proton Driven Plasma Wakefield Acceleration Experiment (AWAKE) at CERN in Geneva has been working five years after CERN approved the project in 2013. In an interview with the project manager AWAKE Edda Gshwendtner “This is fantastic: the new method of particle acceleration works” explains the essence of the experiment. “In the classical scheme, the electron beam in the collider accelerates under the influence of the electromagnetic field. In our experiment, a beam of protons flies in the plasma. It creates a wave and

Global Journal of Science Frontier Research (A) Volume XX Issue II Version I Year 2020

thereby ensures the acceleration of the electron beam that follows. The beam of electrons with the energy of 19 MeV flew in the plasma ten meters and increased energy to 2 GeV, that is, more than 100 times. This means that the average acceleration rate was 200 MeV / m." [16]. The experiment was carried out by the AWAKE collaboration and scientists from the Budker Institute of Nuclear Physics, Siberian Branch of the RAS. Traditional accelerators use what are known as radio-frequency (RF) cavities to kick the particle beams to higher energies. In Wakefield accelerators, the particles get accelerated by "surfing" on top of the plasma wave (or Wakefield) that contains zones of positive and negative charges. Allen Caldwell, spokesperson of the AWAKE said, "Wakefield accelerators have two different beams: the beam of particles that is the target for the acceleration is known as a witness beam, while the beam that generates the Wakefield itself is known as the drive beam. AWAKE is the first experiment to use protons for the drive beam, and CERN provides the perfect opportunity to try the concept. Drive beams of protons penetrate deeper into the plasma than drive beams of electrons and lasers. Therefore, Wakefield accelerators relying on protons for their drive beams can accelerate their witness beams for a greater distance, consequently allowing them to attain higher energies." Like an accelerator AWAKE, the spaceship can get accelerated by "surfing" on top of the longitudinal wave, caused by an explosion similar to the explosion comet Shoemaker-Levy collided with Jupiter (Figure 8).

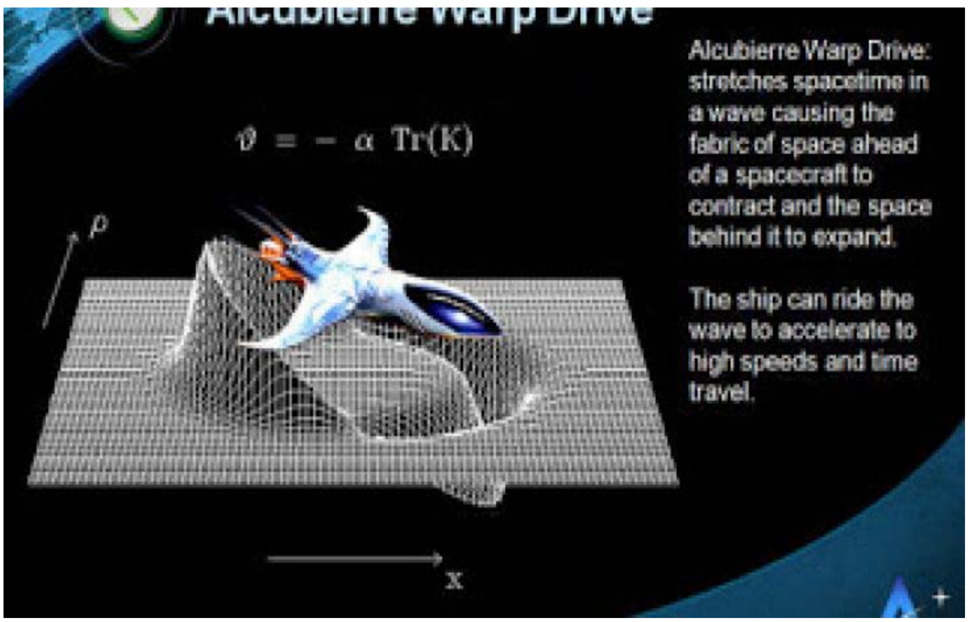

Figure 8: Spaceship on top of a gravitational wave

Like in the AWAKE accelerator, in space primary protons generated by supernova fusion could accelerate by "surfing" at the top of a longitudinal gravitational wave and upon reaching the Fermi and INTEGRAL space telescope detectors cause a short burst of gamma radiation in them. There is a process, leading to the birth of gamma-rays generated by the interaction of protons accelerate to ultra-high energies with matter:

$$p + X \rightarrow \pi^0 + Y \rightarrow \gamma + \gamma + Y \qquad (6)$$

Therefore, the categorical approval of astrophysicists that the speed of gravitational waves is equal to the speed of light, because that only 2 seconds elapsed between registering a gravitational burst GW170817 that is, 130 million light-years away and the gamma-ray burst, should be verified again. A new burst of gravitational waves, recorded on January 18, 2020, is explained by a collision of neutron stars that occurred at a distance of 520 million light-years, was not accompanied by the detection of a gamma-ray burst. This may indicate that at such a great distance the primary protons and gamma rays do not reach the Earth.

IV. Plasma Engine for Spacecraft based on the SMOLA Installation

To accelerate the spacecraft by "surfing" on top of a longitudinal gravitational wave, it must be equipped with a SMOLA plasma engine. The SMOLA installation (Spiral Magnetic Open Trap) is a new technology for creating a space fusion engine. In stationary mode, it works like a thermonuclear reactor, providing spacecraft with energy, and in the pulsed mode it accelerates the spacecraft for surfing on the crest of gravitational waves. Scientists at the G. Budker Institute of Nuclear Physics, RAS have tested the installation SMOLA (Spiral Magnetic Open Trap), with which you can keep the thermonuclear plasma in linear magnetic systems

(Figure 9). On the one hand, the new installation should help to make one more step towards controlled thermonuclear fusion (TNF), and on the other hand, it will enable the spacecraft to accelerate to record speeds. Open traps, which are dealt with in the Institute of Nuclear Physics, are free from the shortcomings the closed plasma traps (tokamaks). The thermonuclear energy of the future is unlikely to be generated on the basis of a tokamak. First of all, it costs too much (the estimate of the ITER Tokamak exceeded 15 billion euro), and construction time is constantly delayed. And secondly, in tokamak it is possible to ignite the only plasma, consisting of a tritium and deuterium mixture. But tritium is itself radioactive, and the reaction process creates neutron radiation. So such a thermonuclear station will cause nearly the same environmental problems as the nuclear power plant today.

$$ {}_1^2H + {}_1^3H \rightarrow {}_2^4He + {}_0^1n + 17.6 \text{ MeV} \qquad (7) $$

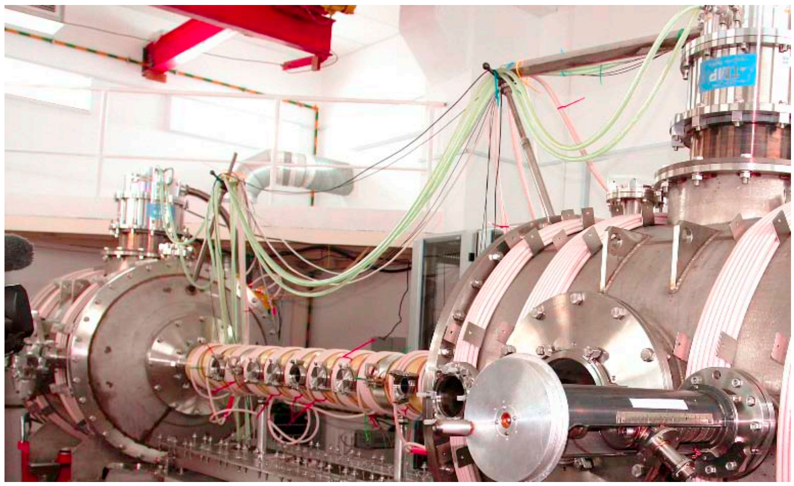

Figure 9: The installation of SMOLA

Open traps are way simpler and cheaper and can generate a clean, neutron-free thermonuclear reaction. But the trouble is that they are open, which means that the plasma may possibly leak out of them. The installation SMOLA is meant to solve this issue. “The idea was to create a magnetic field in the form of a screw. Imagine a meat grinder that is turning minced meat. In our case that minced meat is the plasma” - senior researcher of the Institute, Anton Sudnikov explained. “Plasma particles tend to fly out of the meat grinder through the grill, but if we turn the handle in the opposite direction, the mincemeat will move backward - the opposite impulses compensate each other, and the plasma remains in place, that is, in trap” [17]. Deputy Director of the Institute Alexander Ivanov gave additional comments: “According to theoretical estimates, the longitudinal plasma losses will decrease by 20-100 times. This will make it possible to raise the plasma temperature a lot. It is planned that two SMOLA units will become parts of a new gas-dynamic multi-mirror trap, which is designed in the Institute. It is expected to attain plasma parameters, which are not inferior to the best tokamaks. This can be a real breakthrough. Besides, if we start turning the handle of the meat grinder in the opposite direction, then the plasma particles will not be decelerated, but, on the contrary, will fly out with acceleration”. Alexander Ivanov told that the scientists achieved a temperature of plasma of 100,000 degrees and reached a sufficient density. These parameters are enough for the creation of the rocket engine. The Institute director, Pavel Logachev said: “If the experiments planned on it are successful we expect to get new technologies for thermonuclear fusion, on the one hand, and a promising plasma engine for spacecraft, on the other hand” [18].

V. Conclusion

In the framework of the new cosmological model, which includes superfluid dark energy and dark matter, it is proposed to revise Einstein's “vacuum field equation” and, based on new astronomical observations, to clarify the type and speed of gravitational waves. For this, further improvement of the gravitational wave detectors is necessary by developing new specific methods for detecting longitudinal gravitational waves.

In the article, I cited astrophysical observations confirming the existence of superluminal speeds, and proposed a real mechanism for accelerating primary protons and spacecraft by "surfing" at the top of a longitudinal gravitational wave.

References Références Referencias

1. Alcubierre, Miguel. “The warp drive: hyper-fast travel within general relativity”. *Classical and Quantum Gravity, 11 (5): L73–L77* (1994). Ar Xiv: gr-qc/0009013. Bibcode: (1994) CQGra.11L.73A. doi: 10.1088/0264-9381/11/5/001.

2. Joseph Francis; Xavier Agnew. "An Examination of Warp Theory and Technology to Determine the State of the Art and Feasibility" Conference: AIAA Propulsion and Energy (August 2019).
3. Einstein, *The Meaning of Relativity: Four Lectures Delivered at Princeton University*, (Princeton Univ. Press, Princeton, 2004).
4. Schmidt B. P. "The Path to Measuring an Accelerating Universe", *Physics – Uspekhi, Vol.56, No.10, pages 1078—1089, DOI: https://doi.org/10.3367/UFNr.0183.201310f.1078* (2013).
5. Konstantinov S. I. *Dark Matter is an Extreme State of Dark Energy (Fifth Interaction)- GJSFR-A* , Volume 19 Issue 9 Version 1.0, pp 1-10 (2019).
6. Lounasmaa O. V. and Thuneberg E. "Vortices in rotating superfluid ^{3}He" Proceedings of the National Academy of Sciences of the United States of America (PNAC) 96(14) (6 Jul. 1999).
7. Nadia Drake. "Giant 'thread' of radio emissions found linking galaxy clusters" *SCIENCE*, JUNE 6, (2019).
8. Tommaso Treu. "Hubble detects smallest known dark matter clumps". *By ESA/Hubble Information Centre, Home Astronomy & Space* JANUARY 9, (2020).
9. Laplace P. S. "Statement of the system of the world" *L .: Science*, (1982).
10. Dubrovskii V. A., "An elastic model of physical vacuum," Dokl. Akad. Nauk SSSR, 282(1), 83 (1985).
11. Tsao Chang. "Neutrinos as Superluminal Particles". *Journal of Modern Physics, 4, p.6* (2013).
12. L. Baiotti. Gravitational waves from neutron star mergers and their relation to the nuclear equation of state. arXiv: 1907.08534v3 [astro-ph.HE] 26 Sep (2019).
13. Bradford Snios, Paul E. J. Nulsen, Ralph P. Kraft, C. C. Cheung, Eileen T. Meyer, William R. Forman, Christine Jones, Stephen S. Murray. "Detection of Superluminal Motion in the X-Ray Jet of M87" arXiv: 1905.04330 [astro-ph.HE] (2019) DOI: 10.3847/1538-4357/ab2119.
14. Shikin V. "Low – frequency anomalies the effective mass of charged clusters in liquid helium" *Low - Temperature Physics, 39 (10):837* (October 2013) DOI: 10.1063/1.4825362.
15. Konstantinov S. I. "Calculation Method the Value of the Gravitational Constant for the Non-Equilibrium System of Mercury-Sun". *International Journal of Advanced Research in Physical Science, Volume 5, Issue 6, pp 1-5* (2019).
16. Edda Gshwendtner, "This is fantastic: the new method of particle acceleration works". *Naked Science, September, 9*, (2018).
17. Svyatoslav Ivanov "Siberian physicists conducted the first successful experiments on the creation of a thermonuclear engine". *RIA "Novosti",* December 27, (2018).
18. Physicists Developing Plasma Engine for "Super Fast" Space Travel (Nations compete for cutting-edge interstellar travel). *NEWS WARS*, February 11, (2019).

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 20 Issue 2 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Dirac Generalized Relativistic Quantum Wave Function Which Gives Right Electrons Number in Each Energy Level by Controlling Quantized Atomic Radius

By Mubarak Dirar Abd-Alla Yagoub & Mohammed Idriss

Abstract- Using generalized special relativistic energy-momentum relation the linear energy-momentum Dirac relation was obtained. This equation was used to find Dirac generalized relativistic quantum equation. This equation was used to find the probability and the number of particles for each atomic energy level. The wave function found using this equation can give an expression for the number of electrons in each energy levels if the atomic radius is quantized and satisfy a certain relation.

Keywords: generalized special relativity, dirac equation, atomic energy levels, number of electrons in the energy level, atomic radius.

GJSFR-A Classification: *FOR Code: 020699*

Dirac Generalized Relativistic Quantum Wave Function Which Gives Right Electrons Number in Each Energy Level by Controlling Quantized Atomic Radius

Mubarak Dirar Abd-Alla Yagoub [α] & Mohammed Idriss [σ]

Abstract- **Using generalized special relativistic energy-momentum relation the linear energy-momentum Dirac relation was obtained. This equation was used to find Dirac generalized relativistic quantum equation. This equation was used to find the probability and the number of particles for each atomic energy level. The wave function found using this equation can give an expression for the number of electrons in each energy levels if the atomic radius is quantized and satisfy a certain relation.**

Keywords: generalized special relativity, dirac equation, atomic energy levels, number of electrons in the energy level, atomic radius.

I. Introduction

Quantum mechanics, as formulated by Bohr, Heisenberg, Schrödinger, Pauli, Dirac, and many others, is based on wave particle dual nature of the atomic world. Schrödinger equation is based in addition on the Newtonian energy-momentum relation [1, 2].

According to quantum mechanics, particles do not have definite values of position and momentum at the same moment. The square of the absolute value of the wave function correspond to regions where the particle is more likely to be found if a location measurement is done [3,4].

The Schrödinger equation is the key equation of Quantum mechanics. The first step in the development of a logically consistent theory of non relativistic Quantum mechanics is to drive a wave equation which can describe the particle, wave like behavior of a quantum particle. This equation can describe successfully the behavior of atoms including Hydrogen atom [5, 6].

Hydrogen atom consists of a positively charged proton and a negatively charged electron, moving in orbit under the action of centrifugal force and the influence of their mutual attraction [6,7]. The fast electrons can be described by relativistic Klein- Gordon or Dirac equation [8]. Despite the successes of quantum laws, they suffer from some setbacks, for example the wave function cannot give the correct number of electrons in each energy level [9,10]. It cannot also explain quantum gravity [11, 12].

Fatma Osman, Mubarak Dirar and other studies Quantum Equation for Generalized Special Relativistic Linear Hamiltonian, to solve some of these problems. They use generalized special relativistic energy – momentum relation a useful linear equation was obtained. They found that the coefficients and matrixes resembles that of Dirac relativistic quantum equation Anew quantum linear relativistic equation sensitive to the potential and the effects of fields was also obtained. This equation reduces to that of Dirac in the absence of fields [13].

The solution of this equation predicts the propagation of travelling wave inside fields without attenuation. Thus it can describe the electromagnetic wave propagation inside fields. It also predicts the existence of biophotons as stationary waves that spreads themselves, instantaneously through the surrounding media. It also shows that particles behave as harmonic oscillator inside atoms with rest mass energy equal to the zero point energy. These results agree with observations [14].

Ebtisam A. Mohamed and other studied Derivation of Statistical Physical Laws from Quantum Mechanics. Their work mainly aims to derive Maxwell – Boltzmann distribution, Fermi – Dirac and Bose – Einstein distribution laws by using the quantum wave function in the energy and momentum space beside the relation between the number of particles and chemical potential in addition to some thermodynamic relations concerning probability. The ordinary quantum mechanical wave function for free particle was differentiated with respect to energy and momentum. The derivation of statistical laws from quantum wave function shows the general nature of quantum laws [15]. These successes motivate to try to use GSR Dirac equation to solve the problem of the number of electrons in the energy states. This is done in section (2). Sections (3) and sections (4) are devoted for discussion and conclusion.

*Author α σ: Department of physics, Faculty of Science, Sudan University of Science and Technology, Khartoum, Sudan.
e-mail: garaof@yahoo.com*

a) Time Independent Potential Dependent Special Relativistic Dirac Equation

The full Dirac potential (GSR) equation takes the from

$$-\hbar^2 \frac{\partial^2 \psi}{\partial t^2} = c\hbar^2 \alpha.\nabla \left(\frac{\partial \psi}{\partial t}\right) - c\frac{\hbar}{i} V \alpha.\vec{\nabla}\psi + i\hbar\, \beta m_o c^2 \left(\frac{\partial \psi}{\partial t}\right) + \beta m_o c^2 V \psi \quad (1)$$

To find time independent Dirac equation, substitute

$$\psi(r,t) = f(t)u(r) = e^{-i\omega t} u(r) \quad (2)$$

To get

$$\hbar^2\omega^2 = \frac{-i\omega\hbar^2 c\alpha}{u}\nabla u + \frac{ic\hbar v}{u}\alpha.\nabla u + \hbar\omega\beta m_o c^2 + \beta m_o c^2 v$$

From time dependent potential the above equation can be rewrite as

$$ic\hbar\, v\alpha\nabla u - i\hbar\omega(\hbar c)\alpha\nabla u = (\hbar^2\omega^2 - \beta m_o \hbar\omega c^2 - \beta m_o c^2 v)u$$

For simplify let

$$E = \hbar\omega \quad (3)$$

$$ic\hbar\, v\alpha\nabla u - ic\hbar E\alpha\nabla u = (E^2 - \beta E m_o c^2 - \beta m_o c^2 v)u = b_o u - \beta m_o c^2 v\, u \quad (4)$$

$$b_o = E^2 - \beta E m_o c^2 \quad (5)$$

For hydrogen atoms and hydrogen like atoms the potential is spherical up systemic, in the form

$$V = \frac{-c_0}{r} \quad (6)$$

Let

$$c_0 = \frac{qq_0}{4\pi\varepsilon} \quad (7)$$

Where q & $q_0 \equiv$ charge of particles and r $\equiv$ distance between the centers of particles.

A direct substitution of equation (6) in (4) yields

$$ic\hbar\alpha[v\nabla u - E\nabla u] = b_o u + \frac{\beta m_o c^2 c_0}{r} u \quad (8)$$

Try now a solution

$$c_1 e^{-c_2 r} \quad (9)$$

$$ic\hbar\alpha\left[\frac{c_0}{r}c_2 + c_2 E\right]u = b_o u + \frac{\beta m_o c^2 c_0}{r} u \quad (10)$$

Equating free terms and that having the power (r^{-1}), one gets

$$ic\hbar\alpha c_0 c_2 = \beta m_o c^2 c_0 = -i^2 \beta m_o c^2 c_0$$

$$c_2 = -\frac{i\beta}{\alpha}\frac{m_o c}{\hbar} \quad (11)$$

$$ic\alpha\,\hbar c_2 E = b_o = (E^2 - \beta E m_o c^2) = i^2(\beta m_o c^2 - E)E$$

$$c_2 = -i\frac{(E - \beta m_o c^2)}{c\hbar\alpha} \quad (12)$$

Comparing (11) with (12) yields

$$E - \beta E m_o c^2 = \beta m_o c^2$$

$$E = 2\beta m_o c^2 \quad (13)$$

Let

$$c_3 = c\hbar\alpha c_0,\ c_4 = c\hbar\alpha c_0 E,\ c_5 = \beta m_o c^2 c_0 \quad (14)$$

Sub in (8) to get

$$-i\frac{c_3}{r}\nabla u - ic_4\nabla u = b_o u + \frac{c_5}{r}u \tag{15}$$

Multiply by (r) and use the fact that

$$\nabla u = \frac{du}{dr} \tag{16}$$

One gets

$$-ic_3\frac{du}{dr} - ic_4 r\frac{du}{dr} = (b_o r + c_5)u$$

$$-i(c_3 + c_4 r)\frac{du}{dr} = (b_o r + c_5)u \tag{17}$$

Let

$$y = c_3 + c_4 r\ , \quad dy = c_4 r\ , \quad dr = \left(\frac{1}{c_4}\right)dy \tag{18}$$

Thus

$$-iy(c_4)\frac{du}{dy} = \left[\frac{b_o}{c_4}(y - c_3) + c_5\right]u$$

$$= \left[\frac{b_o}{c_4}y - \frac{b_o c_3}{c_4} + c_5\right]u$$

$$[b_1 y - b_2 + c_5]u = [b_1 y + b_3]u$$

$$b_1 = \frac{b_0}{c_4}\ , \qquad b_2 = \frac{b_o c_3}{c_4}\ , \qquad b_3 = c_5 - b_2 \ = c_5 - \frac{b_o c_3}{c_4} \tag{19}$$

$$-ic_4\frac{du}{dy} = \left[b_1 + \frac{b_3}{y}\right]u\ , \qquad \frac{du}{u} = \frac{-1}{ic_4}\left[b_1 + \frac{b_3}{y}\right]dy = i\left[b_4 + \frac{b_5}{y}\right]dy \tag{20}$$

$$b_4 = \frac{b_1}{c_4}\ , \quad b_5 = \frac{b_3}{c_4} \tag{21}$$

$$\int\frac{du}{u} = i\int b_4 dy + ib_5\int\frac{dy}{y} + b_6$$

$$\ln u = ib_4 y + ib_5 \ln y + b_6 \tag{22}$$

$$\ln u - \ln y^{ib_5} = ib_4 y + b_6 \tag{23}$$

$$\ln\left(\frac{u}{y^{ib_5}}\right) = ib_4 y + b_6$$

$$\frac{u}{y^{ib_5}} = e^{ib_4 y}e^{b_6} \tag{24}$$

$$u = b_7 e^{y^{ib_5}} e^{ib_4 y} \tag{25}$$

$$where b_7 = e^{b_6} \tag{26}$$

Thus where in view b_7 of (18) yields

$$u = b_7(c_3 + c_4 r)^{ib_5} e^{ib_4(c_3 + c_4 r)} \tag{27}$$

In view of equations (21),(19) and (4)
Let $b_5 = 0$
Thus

$$b_3 = 0, \quad b_2 = c_5\ , \quad c_5 = \frac{b_o c_3}{c_4}, \quad b_0 = \frac{c_4 c_5}{c_3} \quad = \frac{E}{c_0}\beta m_o c^2 c_0$$

From (5)

$$E^2 - \beta m_o c^2 E = \beta E m_o c^2$$

$$E^2 = 2\beta m_o c^2 E$$

$$E = 2\beta m_o c^2 \quad (28)$$

Thus

$$u = b_7(c_3 + c_4 r)e^{ib_4(c_3+c_4 r)} \quad (29)$$

The probability of finding the particle at position

$$|u|^2 = {b_7}^2(c_3 + c_4 r)^2 \quad (30)$$

But experimentally it was found that the number of electrons in the energy level n is a nature number n_0

Thus

$$|u|^2 = {b_7}^2(c_3 + c_4 r)^2 = n_0 \quad (31)$$

$$n_0 = 2,8,18,32,50,72,98$$

Thus

$$r = \frac{{n_0}^{\frac{1}{2}}}{b_7 c_4} - \frac{c_3}{c_4} \quad (32)$$

II. Discussion

The GSR Dirac obtained by Fatma (Quantum Equation for Generalized Special Relativistic Linear Hamiltonian) has been exhibited in equation (1). The time independent part has been found in equation (4), by assuming the time dependent part to be time oscillating.

For hydrogen like atoms the potential is given by equation (6). The GSR Dirac equation for hydrogen atom is given by (8). Rearranging for simplification is found by defining new variably in equation (19). The solution of this equation is a complex wave function given by equation (25) and (27). In its general form this solution is purely complex. To make the wave function (r) dependent the energy should be proportional to the rest mass energy as shown by equation (28). This is quite natural as well as the stable atom corresponds to minimum non existed atomic state [see equation (29)]. The probability or the square of the wave function can be made to be equal to the number of atoms in each level [see equation (31)] by adjusting the atomic radius(r) to be dependent on the number of electrons in a certain energy level. This expression [see equation (32)] shows that (r) increases and quantized. This conforms to observation.

III. Conclusion

The GSR Dirac equation can successfully explain the mystery of the electrons quantum number if the atomic radius is quantized and satisfies a certain relation. It shows also that the stable atom corresponds to the minimum relativistic Einstein energy.

References Références Referencias

1. Michele Maggiore (2005), A Modern Introduction to Quantum Field Theory, Oxford University Press.
2. David Tong (2007), Quantum Field Theory, Department of Applied Mathematics and Theoretical Physics, Centre for Mathematical Sciences, Wilberforce Road, Cambridge, UK.
3. David_J._Griffiths (2005), Introduction to Quantum Mechanics, Reed College.
4. B.H. Bransden and C. J. Joachain (2000), Quantum mechanics. Second edition, Essec CM 202 England. ISBN 0582-35691.
5. Phillips A. C (2003) Introduction to Quantum Mechanics, New York, ISBN 0-470-85323-9 (Hardback), 0-470-85324-7 (Paperback).
6. Andrew Igla (2017), Quantum Mechanics Schrodinger Schrodinger's Equation Transmission and Reflection at barrier the tunnel effect Compton Effect and university physics, ISBN: soft cover 798-1-5245-9260-8 e Book 978-1-5245-9259-2.
7. Raymond A. Serway and John W. Jewett (2014), Physics for Scientists and Engineers with Modern Physics, Compositor: Lachina Publishing Services 2014, 2010, 2008 by Raymond A. Serway, Library of Congress Control Number: 2012947242, ISBN-13: 978-1-133-95405-7, ISBN-10: 1-133-95405-7.
8. Greiner, W. (2000) Relativistic Quantum Mechanics, Springer, Berlin, 3rd edition.
9. Hilo, M.H.M., et al. (2011), Using of the generalized special relativity (GSR) in estimating the neutrino masses to explain the conversion of electron neutrinos. NS, 3, 334-338. doi: 10.4236/ns.2011. 32020.
10. P. Dirac (1928), The quantum theory of the electron. In Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, The Royal Society.
11. David McMahon (2008), Quantum Field Theory Demystified, McGraw-Hill Companies.

12. Hobson, E fstathion and Lasen by (2006), General relativity An Introduction for physicists, ISBN -13 978-0521-82951-9 published in New York.
13. Fatma Osman, Mubarak Dirar, Ahmed Alhassen, Musa Ibrahim and Sawsan Ahmed, (2019), Quantum Equation for Generalized Special Relativistic Linear Hamiltonian, IJRERD, ISSN: 2455-8761.
14. Fatma Osman, Mubarak Dirar, Ahmed Alhassen, Musa Ibrahim and Sawsan Ahmed, (2019), Time Independent Generalized Special Relativity Quantum.
15. Mubarak Dirar Abd Allah, Ebtisam Abd-Alla Mohamed, Ibrahim Adam Ibrahim Hammad, Ibrahim Alfaki (2017), Derivation of Statistical Physical Laws From Quantum Mechanics, American Journal of Innovative Research and Applied Sciences. ISSN 2429-5396, www.american-jiras.com

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 20 Issue 2 Version 1.0 Year 2020
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Induction and Parametric Properties of Radio-Technical Elements and Chains and Property of Charges and their Flows

By F. F. Mende

Abstract- In the theory of electrical chains is customary to assume that the capacities and inductances are the reactive elements, which cannot accumulate energy. However, this point of view is not accurate, since under specific conditions both the capacity and inductance can accumulate energy. In addition to this, it occurs that the capacity and inductance can play the role of effective resistance, which depends on time. At present wave equations for the long lines require the knowledge second derivative voltages and currents, which are extended in such lines. However, there are such cases, when such derivatives cannot be determined. This is the case, when dc power supply is connected to the line, or when this voltage changes according to the linear law. Answer to a question, as one should enter in this case, give in the proposed article. The properties of long lines are characterized by such parameters as linear capacity and inductance, which do not consider the kinetic properties of charges.

Keywords: self-induction, reactive elements, field inductance, kinetic inductance, long line, wave equations.

GJSFR-A Classification: FOR Code: 029999

INDUCTIONANDPARAMETRICPROPERTIESOFRADIO-TECHNICALELEMENTSANDCHAINSANDPROPERTYOFCHARGESANDTHEIRFLOWS

Induction and Parametric Properties of Radio-Technical Elements and Chains and Property of Charges and their Flows

F. F. Mende

Abstract- In the theory of electrical chains is customary to assume that the capacities and inductances are the reactive elements, which cannot accumulate energy. However, this point of view is not accurate, since under specific conditions both the capacity and inductance can accumulate energy. In addition to this, it occurs that the capacity and inductance can play the role of effective resistance, which depends on time. At present wave equations for the long lines require the knowledge second derivative voltages and currents, which are extended in such lines. However, there are such cases, when such derivatives cannot be determined. This is the case, when dc power supply is connected to the line, or when this voltage changes according to the linear law. Answer to a question, as one should enter in this case, give in the proposed article. The properties of long lines are characterized by such parameters as linear capacity and inductance, which do not consider the kinetic properties of charges. This connected with the fact that linear field inductance in the long lines considerably exceeds linear kinetic inductance. This condition cannot be observed when as the conductors of line it serves electronic or ionic flux. This special feature of such lines in the existing publications also is not examined. In the article the new law, which determines the dependence of the specific resistance of electron beam on a potential difference between the electrodes and the distances between them, is obtained. It follows from this law that the specific resistance of electronic flux depends on the distance between the electrodes, between which moves electronic flux. This opens the new technical possibility of designing of the analog converters, which connect displacement with the specific resistance of beam. It is shown that the stepped voltage-current characteristic of the superconductive thin narrow superconductive channels, which are been in an intermediate state, is connected with the presence to resistance in electron beams.

Keywords: *self-induction, reactive elements, field inductance, kinetic inductance, long line, wave equations.*

I. Introduction

In the theory of electrical chains is customary to assume that the capacities and inductances are the reactive elements, which cannot accumulate energy. However, this point of view is not accurate, since under specific conditions both the capacity and inductance can accumulate energy. In addition to this, it occurs that the capacity and inductance can play the role of effective resistance, which depends on time. Such properties of these elements before the appearance of publications [1-4] were not known. At present wave equations for the long lines require the knowledge second derivative voltages and currents, which are extended in such lines. However, there are such cases, when such derivatives cannot be determined. This is the case, when dc power supply is connected to the line, or when this voltage changes according to the linear law. Answer to a question, as one should enter in this case, give in the proposed article. The properties of long lines are characterized by such parameters as linear capacity and inductance, which do not consider the kinetic properties of charges. This connected with the fact that linear field inductance in the long lines considerably exceeds linear kinetic inductance. This condition cannot be observed when as the conductors of line it serves electronic or ionic flux. This special feature of such lines in the existing publications also is not examined. In the article the new law, which determines the dependence of the specific resistance of electron beam on a potential difference between the electrodes and the distances between them, is obtained. It follows from this law that the specific resistance of electron beam depends on the distance between the electrodes and a potential difference between them, which opens the new technical capability of regulating this resistance by the way of changing the distance between the electrodes. This opens the new technical possibility of designing of the analog converters, which connect displacement with the specific resistance of beam.

Author: *e-mail: fedormende@gmail.com*

a) Electrical and current self-induction

To the laws of self-induction should be carried those laws, which describe the reaction of such elements of radio-technical chains as capacity, inductance and resistance with the galvanic connection to them of the sources of current or voltage. To such elements let us carry capacities, inductances, effective resistance and long lines.

By self-induction of reactive elements we will understand the reaction of such elements as capacity and inductance with the constant or changing parameters to the connection to them of the sources of voltage or current. Subsequently we will use these concepts: as current generator and the voltage generator. By ideal voltage generator we will understand such source, which ensures on any load the lumped voltage, internal resistance in this generator equal to zero. By ideal current generator we will understand such source, which ensures in any load the assigned current, internal resistance in this generator equally to infinity. The ideal current generators and voltage in nature there does not exist, since both the current generators and the voltage generators have their internal resistance, which limits their possibilities.

If the capacity is charged to a potential difference U, then the charge Q, accumulated in it, is determined by the relationship

$$Q_{C,U} = CU.$$

When the discussion deals with a change in the charge, determined by relationship, then this value can change with the method of changing the potential difference with a constant capacity, either with a change in capacity itself with a constant potential difference, or and that and other parameter simultaneously.

If the value of a voltage drop across capacity or capacity itself depends on time, then the strength of current, which flows in the chain, which includes the voltage source and capacity, is determined by the relationship:

$$I(t) = \frac{dQ_{C,U}}{dt} = C\frac{\partial U}{\partial t} + U\frac{\partial C}{\partial t}.$$

This expression determines the law of electrical self-induction. Thus, current in the circuit, which contains capacitor, can be obtained by two methods, changing voltage across capacitor with its constant capacity either changing capacity itself with constant voltage across capacitor, or to produce change in both parameters simultaneously.

When the capacity C_0 is constant, we obtain expression for the current, which flows in the chain:

$$I(U) = C_0\frac{\partial U}{\partial t} \quad (1.1)$$

when changes capacity, and at it is supported the constant voltage U_0, we have:

$$I(C) = U_0\frac{\partial C}{\partial t}. \quad (1.2)$$

This case to relate to the parametric capacitive self-induction, since the current strength it is connected with a change in the capacitance value.

Let us examine the consequences, which escape from relationship (1.1).

If we to the capacity connect the direct-current generator I_0, then voltage on it will change according to the law:

$$U(t) = \frac{I_0 t}{C_0}. \quad (1.3)$$

Using to this relationship Ohm's law

$$U = IR,$$

We obtain the value of the effective resistance of the chain in question

$$R(t) = \frac{t}{C_0}.$$

Thus, the capacity, connected to the current source, plays the role of the effective resistance, which linearly depends on the time. It should be noted that obtained result is completely obvious; however, such properties of capacity, which customary to assume by reactive element they were for the first time noted in the work [1].

From a physical point of view this property of capacity is connected with the fact that, charging capacity, current source to expend energy. Capacity itself in this case performs the role of storage battery.

Charging capacity, current source expends the power

$$P(t) = \frac{I_0^2 t}{C_0} \quad (1.4)$$

The energy, accumulated by capacity in the time t, we will obtain, after integrating relationship (1.4) with respect to the time:

$$W_C(t) = \frac{I_0^2 t^2}{2C_0}.$$

Substituting here the value of current from relationship (1.3), we obtain the dependence of the value of the accumulated in the capacity energy from the instantaneous value of voltage on it:

$$W_C(U) = \frac{1}{2}C_0 U^2.$$

Now we will support at the capacity constant voltage U_0, and change capacity itself, then

$$I(C) = U_0\frac{\partial C}{\partial t}.$$

Using to this relationship Ohm's law

$$R_C = \left(\frac{\partial C}{\partial t}\right)^{-1}$$

Plays the role of the effective resistance R_C. The derivative, entering this expression can have different signs. This result is intelligible. Since with a change in the capacity change the energy accumulated in it, capacity, it can extract energy in the current source, or return energy into the external circuit. The power, expended by current source, or output into the external circuit, is determined by the relationship:

$$P(C)=\frac{\partial C}{\partial t}U_0^{\ 2}.$$

Let us examine one additional process, which earlier the laws of induction did not include, however, it falls under for our extended determination of this concept. From relationship (1.2) it is evident that if the charge, accumulated in the capacity, remains constant, then voltage on it can be changed by changing the capacity. In this case the relationship will be carried out:

$$Q_0=C_0U_0=CU=const,$$

where C and U - instantaneous values, and C_0 and U_0 - initial values of these parameters. The voltage on the capacity and the energy, accumulated in it, will be in this case determined by the relationships:

$$U=\frac{C_0U_0}{C}, \qquad (1.5)$$

$$W_c(C)=\frac{1}{2}\frac{(C_0U_0)^2}{C}.$$

It is natural that this process of self-induction can be connected only with a change in capacity itself, and therefore it falls under for the determination of parametric self-induction.

Let us examine the processes, proceeding in the inductance. If the current strength through the inductance or inductance itself depend on time, then the value of voltage on it is determined by the relationship:

$$U(t)=L\frac{\partial I}{\partial t}+I\frac{\partial L}{\partial t}.$$

Let us examine the case, when the inductance L_0 is constant

$$U(I)=L_0\frac{\partial I}{\partial t}. \qquad (1.6)$$

After integrating expression (1.6) on the time, we will obtain:

$$I(t)=\frac{Ut}{L_0}. \qquad (1.7)$$

Using to this relationship Ohm's law, we obtain, that the inductance, connected to the dc power supply, presents for it the effective resistance

$$R(t)=\frac{L_0}{t}.$$

The power, expended in this case by source, is determined by the relationship:

$$P(t)=\frac{U^2t}{L_0}. \qquad (1.8)$$

After integrating relationship (1.8) on the time, we will obtain the energy, accumulated in the inductance

$$W_L(t)=\frac{1}{2}\frac{U^2t^2}{L_0}. \qquad (1.9)$$

After substituting into expression (1.9) the value of voltage from relationship (1.7), we obtain the value of the energy, accumulated in the inductance:

$$W_L(I)=\frac{1}{2}L_0I^2.$$

Now let us examine the case, when the current I_0, which flows through the inductance, is constant, and inductance itself can change. In this case we obtain

$$U=I_0\frac{\partial L}{\partial t}. \qquad (1.10)$$

Consequently, the value

$$R(t)=\frac{dL}{dt}$$

as in the case the electric flux, effective resistance can be (depending on the sign of derivative) both positive and negative. This means that the inductance can how derive energy from without, so also return it into the external circuits.

If inductance is shortened outed, and made from the material, which does not have effective resistance, for example from the superconductor, then

$$L_0I_0=const,$$

where L_0 and I_0 - initial values of these parameters, which are located at the moment of the short circuit of inductance with the presence in it of current.

This regime we will call the regime of the frozen flow. In this case the relationship is fulfilled:

$$I_0=\frac{I_1L_1}{L_0},$$

where I_1 and L_1 - the instantaneous values of the corresponding parameters.

In flow regime examined of current induction remains constant, however, in connection with the fact that current in the inductance it can change with its change, this process falls under for the determination of parametric self-induction. The energy, accumulated in the inductance, in this case will be determined by the relationship of

$$W_L(L)=\frac{1}{2}\frac{(L_0I_0)^2}{L}.$$

where L - the instantaneous value of inductance.

b) Propagation of signals in the long lines

The processes of the propagation of voltages and currents in the long lines it is described with the aid of the wave equations

$$\frac{\partial^2 U}{\partial z^2}=\frac{1}{v^2}\ \frac{\partial^2 U}{\partial t^2}$$

$$\frac{\partial^2 I}{\partial z^2}=\frac{1}{v^2}\ \frac{\partial^2 I}{\partial t^2},$$

which are obtained from the telegraphic equations

$$\frac{\partial U}{\partial z}=-L\ \frac{\partial I}{\partial t}$$

$$\frac{\partial I}{\partial z}=-C\ \frac{\partial U}{\partial t},$$

But as to enter, if to the line is connected dc power supply or source of voltage, which is changed according to the linear law, when the second derivatives of voltages and currents do be absent? In existing publication before the appearance of works [1-4] answers to this question it was not.

The processes, examined in two previous paragraphs, concern chains with the lumped parameters, when the distribution of potential differences and currents in the elements examined can be considered uniform.

We will use the results, obtained in the previous paragraph, for examining the processes, proceeding in the long lines, in which the capacity and inductance are the distributed parameters [1]. Let us assume that the linear capacity and the inductance of line compose C_0 and L_0. If we to the line connect the dc voltage U , thus will begin to charge the capacity of long line and the front of this voltage will be extended along the line some by the speed v. The moving coordinate of this front will be determined by the relationship $z=vt$. In this case the total quantity of the charged capacity and the value of the summary inductance, along which it flows current, calculated from the beginning lines to the location of the front of voltage, will change according to the law:

$$C(t)=zC_0=vt\ C_0,$$

$$L(t)=zL_0=vt\ L_0.$$

The source of voltage U will in this case charge the being increased capacity of line, for which from the source to the charged line in accordance with relationship (1.2) must leak the current:

$$I=U\frac{\partial C(t)}{\partial t}=UvC_0. \qquad (2.1)$$

This current there will be the leak through the conductors of line, that possess inductance. But, since the inductance of line in connection with the motion of the front of voltage, also increases, in accordance with relationship (1.10), on it will be observed a voltage drop:

$$U_1=I\frac{\partial L(t)}{\partial t}=IvL_0=v^2UC_0L_0.$$

But a voltage drop across the conductors of line in the absolute value is equal to the voltage, applied to its entrance; therefore in the last expression should be placed $U=U_1$. We immediately find taking this into account that the rate of the motion of the front of voltage with the assigned linear parameters and when, on, the incoming line of constant voltage of is present, must compose

$$v=\frac{1}{\sqrt{L_0C_0}}. \qquad (2.2)$$

This expression corresponds to the signal velocity in line itself. Consequently, if we to the infinitely long line connect the voltage source, then in it will occur the expansion of electric field on and the currents, which fill line with energy, and the speed of the front of constant voltage and current will be equal to the velocity of propagation of electromagnetic vibrations in this line. This wave we will call [elektrotokovoy]. It is interesting to note that the obtained result does not depend on the form of the function U, i.e., to the line can be connected both the dc power supply and the source, whose voltage changes according to any law. In all these cases the value of the local value of voltage on incoming line will be extended along it with the speed, which follows from relationship (2.2). This result could be, until now, obtained only by the method of solution of wave equations. This process occurs in such a way that the wave front, being extended with the speed v, leaves after itself the line, charged to a potential difference U, which corresponds to the filling of line with electrostatic electric field energy. However, in the section of line from the voltage source also to the wave front flows the current I, which corresponds to the filling of line in this section with energy, which is connected with the motion of the charges along the conductors of line, which possess inductance.

The current strength in the line can be obtained, after substituting the values of the velocity of propagation of the wave front, determined by relationship (2.2), into relationship (2.1). After making this substitution, we will obtain

$$I=U\sqrt{\frac{C_0}{L_0}},$$

where $Z=\sqrt{\frac{L_0}{C_0}}$ - line characteristic.

The regularities indicated apply to all forms of transmission lines.

If we to the line with the length z_0 connect the effective resistance, equal to line characteristic, then the voltage of the power source will appear on it with the time delay $\Delta t = \frac{z_0}{v}$. This resistance will be coordinated with the line and entire energy, transferred by the line, will be in it absorbed. This connected with the fact that the current, which flows in the line is equal to the current, which flows through the resistance, when voltage on it is equal to voltage on incoming line.

Thus, the processes of the propagation of a potential difference along the conductors of long line and current in it are connected and mutually supplementing each other, and to exist without each other they do not can. This process can be called elektrocurent spontaneous parametric self-induction. This name flow expansion they connected with the fact that occur spontaneously.

For different types of lines the linear parameters depend on their sizes. For an example let us examine the coaxial line, whose linear capacity and inductance are expressed by the relationships:

$$C_0 = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D}{d}\right)} \qquad L_0 = \frac{\mu_0}{2\pi}\ln\left(\frac{D}{d}\right)$$

where D and d - inside diameter of the cylindrical part of the coaxial and the outer diameter of central core, and ε_0 and μ_0 - dielectric and magnetic constant of vacuum.

Exist coaxial lines with the variable section both the cylindrical part and the internal conductor. The sections of such coaxials are used as the soglasuyushchikh devices between the coaxials with different diameters of cylindrical part and central core. Propagation of signals in such prekhodnikakh has its specific character (Fig. 1).

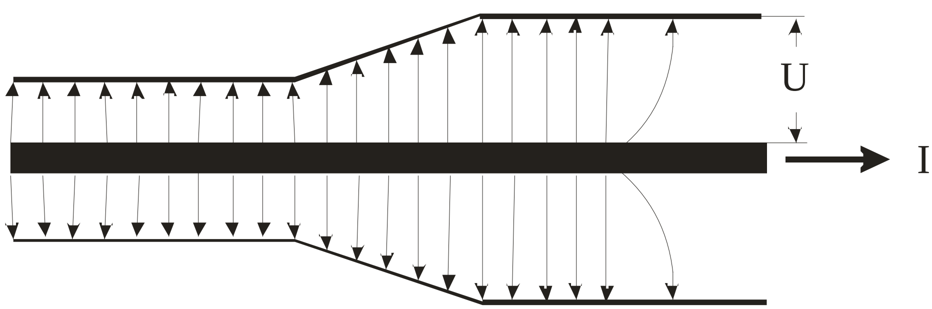

Fig. 1: Propagation of signal along the coaxial line with the variable section.

A change in the dimensions of coaxial leads to the fact that the linear parameters begin to depend on coordinate. Begins to depend on coordinate and the wave drag

$$Z = \sqrt{\frac{L}{C}} = \ln\left(\frac{D}{d}\right)\sqrt{\frac{\mu_0}{\varepsilon_0}},$$

At the same time velocity of propagation, both in the limits of the sections of coaxials and in the transition section it remains constant

$$v = \sqrt{\frac{1}{CL}} = \sqrt{\frac{1}{\varepsilon_0\mu_0}}$$

Penetrating this adapter, signal changes its parameters.

Since wave drag gives the relation between the voltage and the current in the line

$$Z = \frac{U}{I}$$

that changes the relationship between the voltage and the current in the initial and final section of coaxial. Consequently, such adapter is the current transformer and voltage. And this transformation occurs both with the propagation on the line of alternating voltage so and the constant. Thus this device is the configurative voltage transformer and currents. It is in the literature accepted to call such devices impedance transformers, but it is more correct them to call the voltage transformers and currents.

c) Properties of static charges and their flows

The capacity of the vacuum capacitor, which consists of the flat parallel plates, is determined by the relationship:

$$C = \frac{\varepsilon_0 S}{d},$$

where ε_0, S and d - dielectric constant of vacuum, the area of plates and the distance between them respectively. Substituting in this relationship equality (1.5), we obtain

$$W_c = \frac{1}{2}\frac{d\left(C_0U_0\right)^2}{\varepsilon_0 S}, \tag{3.1}$$

is evident that with the constant charge, stored up in the capacitor, an increase in the distance between the plates leads to an increase in its energy. This is connected with the fact that in order to increase the distance between the plates, it is necessary to spend the work, which will pass into the energy of its electric field on. As this occurs, evidently from Fig. 2.

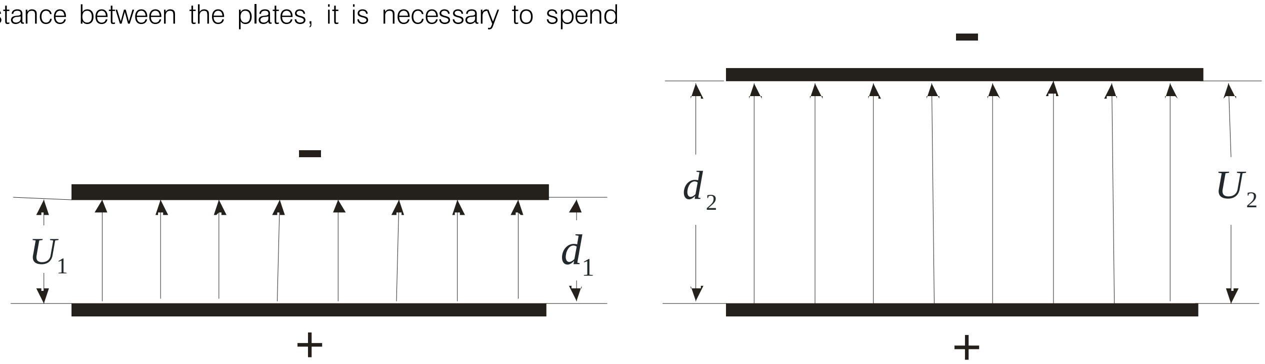

Fig. 2: The electric fields of parallel-plate capacitor with the different distance between its plates

Taking into account that the work of capacity and voltage is equal to charge, accumulated in the capacitor, relationship (1.9) can be rewritten

$$W_c = \frac{1}{2}\frac{d(Q_0)^2}{\varepsilon_0 S} = \frac{1}{2}\varepsilon_0 E^2 Sd \qquad (3.2)$$

where E - tension of electric field in the line.

From relationship (3.2) follows

$$E = \frac{Q_0}{\varepsilon_0 S}.$$

This means that in the parallel-plate capacitor the field strength does not depend on the distance between the plates, but it is determined by the surface density of charge on them. Let us note that with this examination we do not consider edge effects that correctly when the distance between the plates much less than their length and width. Consequently, voltage across capacitor is determined by the distance between the plates

$$U(d) = \frac{Q_0 d}{\varepsilon_0 S}$$

From the carried out analysis escapes the interesting property of the electrons, which compose the charge Q_0 . A total quantity of electrons is equal

$$N = \frac{Q_0}{e},$$

where e is a charge of one electron. Thus, energy of one electron, which is located on the plate of capacitor, is equal

$$W_e = \frac{de}{\varepsilon_0 S}.$$

This energy depends on the distance between the plates, but since no limitations on they are superimposed, this energy can be as as desired to large.

In the case examined the electric fields of each separate electron are located in the tube, located between the planes of capacitor. The cross-sectional area of this tube is equal and its height it is respectively equal: $\frac{S}{N}$ and d. When an increase in the size occurs d, volume of this tube increase, and, therefore, it grows and energy pour on. In this case the mechanical energy, spent on the displacement of the plate of capacitor, passes into the energy of electric field on electron. Analogous situation will be observed, also, in the coaxial capacitor. Difference will be only the fact that the fields of electron will occupy not tube with the constant section, but annular disk.

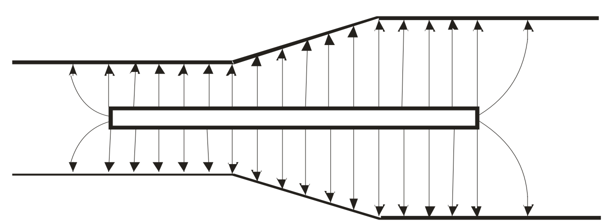

Fig. 3: Coaxial capacitor with the variable section

Let us load coaxial capacitor with the variable section, as shown in Fig. 3. If we move the charged rod from left to right, then the volume of electric field on it will be grow, and for this will have to expend energy. But if rod will be moved in the reverse direction, then volume pour on it will decrease, and rod will carry out external work. If we as the rod take the section of the moving electron beam, then picture not change. During the motion from left to right, kinetic energy of beam will pass into the energy of electric field on, and beam will slow down and vice versa.

The introduced linear parameters, can be named field, since the discussion deals with that energy, which is stored up in the electrical and magnetic fields. However, the circumstance is not considered with this approach that besides field inductance there is still a kinetic inductance, which is obliged to kinetic energy of the moving charges.

If charges can move without the losses, then equation of motion takes the form:

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

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

Using an expression for the current density

$$\vec{j} = ne\vec{v},$$

We obtain the current density of the conductivity

$$\vec{j}_L = \frac{ne^2}{m}\int \vec{E}\,dt = \frac{1}{L_k}\int \vec{E}\,dt,$$

where

$$L_k = \frac{m}{ne^2}$$

Kinetic inductance of charges.

Maxwell's equations for this case take the form:

$$rot\ \vec{E} = -\mu_0 \frac{\partial \vec{H}}{\partial t},$$
$$rot\ \vec{H} = \varepsilon_0 \frac{\partial \vec{E}}{\partial t} + \frac{1}{L_k}\int \vec{E}\,dt, \qquad (3.3)$$

where ε_0 and μ_0 - dielectric and magnetic constant of vacuum.

System of equations (3.3) completely describes all properties of the conductors, in which be absent the ohmic losses. From relationship (3.3) we obtain

$$rot\ rot\ \vec{H} + \mu_0\varepsilon_0 \frac{\partial^2 \vec{H}}{\partial t^2} + \frac{\mu_0}{L_k}\vec{H} = 0. \qquad (3.4)$$

For the case pour on, time-independent, equation (3.4) passes into the equation of London

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

where $\frac{L_k}{\mu_0} = \lambda_L^2$. In this relationship of λ_L there is London depth of penetration.

Thus, it is possible to conclude that the equations of London being a special case of equation (3.4), and do not consider bias currents. 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 electric field 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

$$\vec{j}_L = \frac{1}{L_k}\int \vec{E}\,dt. \qquad (3.5)$$

In the real transmission lines kinetic inductance is not calculated on the basis of that reason, that their speed is small in view of the very high density of current carriers in the conductors and therefore field inductance always is considerably greater than kinetic. Let us show this based on simple example.

Let us examine processes in the line, which consists of two superconductive planes (Fig. 4).

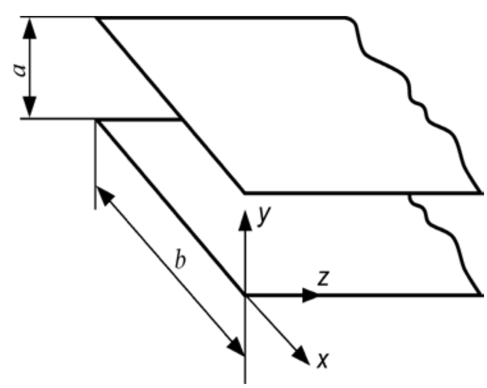

Fig. 4: The two-wire circuit, which consists of two ideally conducting planes

The magnetic field on the internal surfaces of this line, equal to specific current, is determined from the relationship:

$$H = nev\lambda = j\lambda,$$

where n, e, v - density, charge and the velocity of the superconductive electrons, and $\lambda = \sqrt{\frac{L_k}{\mu}}$ - depth of penetration of magnetic field into the superconductor.

If we substitute the value of depth of penetration into the relationship for the magnetic field, then we will obtain:

$$H = v\sqrt{\frac{nm}{\mu}}.$$

Thus, specific kinetic the kinetic energy of charges in the skin-layer

$$W_H = \frac{1}{2}\mu H^2 = \frac{nmv^2}{2} = \frac{1}{2}L_k j^2$$

is equal to specific the energy of magnetic pour on. But magnetic field exists not only on its surface, also, in the skin-layer. If we designate the length of the line, depicted in Fig. 4, as l, that the volume of skin-layer in the superconductive planes of line will comprise $2lb\lambda$. Energy of magnetic pour on in this volume we determine from the relationship:

$$W_{H,\lambda} = nmv^2 lb\lambda.$$

However, energy of magnetic pour on, accumulated between the planes of line, it will comprise:

$$W_{H,a} = \frac{nmv^2 lba}{2} = \frac{1}{2}lba\mu_0 H.$$

If one considers that the depth of penetration of magnetic field in the superconductors composes several hundred angstroms, then with the macroscopic dimensions of line it is possible to consider that the total energy of magnetic pour on in it they determine by relationship.

Is obvious that the effective mass of electron in comparison with the mass of free electron grows in this case into $\frac{a}{2\lambda}$ times. Thus, becomes clear nature of such parameters as inductance and the effective mass of electron, which in this case depend, in essence, not from the mass of free electrons, but from the configuration of conductors, on which the electrons move.

The kinetic flow of charges we will consider such flow, whose kinetic inductance is more than field. Let us examine this question in the concrete example.

For the evacuated coaxial line linear inductance is determined by the relationship

$$L_0 = \frac{\mu_0}{2\pi}\ln\left(\frac{D}{d}\right).$$

With the current I, which flows along the internal conductor, energy accumulated in the linear inductance will compose

$$W_L = \frac{1}{2}L_0 I^2 = \frac{\mu_0}{4\pi}\ln\left(\frac{D}{d}\right)I^2$$

With the uniform distribution of current density over the section of internal conductor linear kinetic energy of charges will comprise

$$W_k = \frac{\pi d^2 nmv^2}{8}$$

where n, m, v - electron density, their mass and speed respectively.

If one considers that $I = \frac{nev\pi d^2}{4}$, then it is possible to write down

$$W_L = \frac{1}{2}L_0 I^2 = \frac{\mu_0}{4\pi}\ln\left(\frac{D}{d}\right)\frac{n^2e^2v^2\pi^2 d^4}{16}$$

From these relationships we obtain, that for the fulfillment of conditions

$$W_k \geq W_L$$

Fulfilling of the inequality is required

$$\frac{m}{ne^2} \geq \frac{\mu_0}{8}\ln\left(\frac{D}{d}\right)d^2.$$

From this relationship we obtain

$$n \leq \frac{8m}{d^2 e^2 \mu_0}$$

Electronic flux we will consider kinetic when the linear field inductance of less than the linear kinetic inductance, which is carried out with the observance of the given condition.

Let us estimate, what electron density in the flow corresponds to the case examined.

Let us examine the concrete example $d = 1\,мм$, $\ln\left(\frac{D}{d}\right) = 2$, then we obtain

$$n \leq \frac{8m}{e^2\mu_0 \ln\left(\frac{D}{d}\right)d^2} \approx 10^{-20}\frac{1}{м^3}$$

Such densities are characteristic to electron beams, and they are considerably lower than electron density in the conductors. Therefore electron beams should be carried to the kinetic flows, while electronic current in the conductors they relate to the potential flows.

Therefore for calculating the energy, transferred by electromagnetic fields they use Poynting's vector, and for calculating the energy, transferred by electron beams is used kinetic energy of separate charges. This all the more correctly, when the discussion deals with the calculation of the energy, transferred by ion beams, since. the mass of ions many times exceeds the mass of electrons.

Thus, the reckoning of the flows of charges to one or the other form depends not only on density and diameter of beam itself, but also on the diameter of that conducting tube, in which it is extended. It is obvious that in the case of potential beam, its front cannot be extended at a velocity, which exceeds the speed of light. It would seem that there are no such limitations for the purely kinetic beams.

d) Electronic flux as the effective resistance

Electronic flux can be represented as the effective resistance, which absorbs energy. If electron is accelerated for the action of electric field and it moves between two electrodes with a potential difference U, it acquires energy eU , which is equal to its kinetic energy

$$eU = \frac{mv^2}{2}$$

With braking of electron with the impact about the target this energy is converted in the heat-. Consequently, the chain, in which occurs this process, is the effective resistance, which has specific resistance and specific conductivity.

The specific conductivity of metal is determined by the relationship

$$\sigma = \frac{ne^2\tau}{m} = \frac{\tau}{L_k}$$

The electron transit time between two electrodes, the distance between which is equal d , and a potential difference between them is equal U, it is determined from the relationship

$$\tau = d\sqrt{\frac{2m}{eU}},$$

This is a relaxation time for the electrons in the electron beam; therefore the conductivity of beam will be determined by the relationship

$$\sigma = \frac{d}{L_k}\sqrt{\frac{2m}{eU}}.$$

Since specific resistance ρ early

$$\rho = \frac{1}{\sigma},$$

We obtain

$$\rho = \frac{L_k}{d}\sqrt{\frac{eU}{2m}} = \frac{1}{dn}\sqrt{\frac{mU}{2}} \qquad (3.5)$$

In the article the new law, which determines the dependence of the specific resistance of electron beam on a potential difference between the electrodes and the distances between them, is obtained. Interesting circumstance is the fact that the specific resistance of beam does not depend on electron charge, but it depends only on its mass. The obtained dependence opens the new technical capabilities of the resistance control of beam by the way of changing the distance between the electrodes. This opens the new technical possibility of designing of the analog converters, which connect displacement with the specific resistance of beam.

their resistance. Control of lamp resistance is accomplished with the aid of control grid, which regulates electron density.

From relationship (3.5) it follows that the specific resistance of beam depends that the mass of charge carriers. This circumstance it is possible to use for purposes spectroscopies. For this into the camera with the rarefied gas should be placed two electrodes, to which should be connected the dc power supply. To one of the electrodes should be given the radio-frequency voltage for the ionization of gas. Measuring the flow resistance of the charges between the electrodes, and controlling current in the circuit of the voltage source it is possible to measure the mass of atoms or molecules of gas.

II. Conclusion

In the theory of electrical chains is customary to assume that the capacities and inductances are the reactive elements, which cannot accumulate energy. However, this point of view is not accurate, since under specific conditions both the capacity and inductance can accumulate energy. In addition to this, it occurs that the capacity and inductance can play the role of effective resistance, which depends on time. Such properties of these elements before the appearance of publications [1-4] were not known. At present wave equations for the long lines require the knowledge second derivative voltages and currents, which are extended in such lines. However, there are such cases, when such derivatives cannot be determined. This is the case, when dc power supply is connected to the line, or when this voltage changes according to the linear law. Answer to a question, as one should enter in this case, daN in the proposed article. The properties of long lines are characterized by such parameters as linear capacity and inductance, which do not consider the kinetic properties of charges. This connected with the fact that linear field inductance in the long lines considerably exceeds linear kinetic inductance. This condition can not be observed when as the conductors of line it serves electronic or ionic flux. In the article carried out the study also of this problem are given the conditions for the separation of the flows of charges into the field flows and kinetic.

In the article the new law, which determines the dependence of the specific resistance of electron beam on a potential difference between the electrodes and the distances between them, is obtained. It follows from this law that the specific resistance of electron beam depends on the distance between the electrodes and a potential difference between them, which opens the new technical capability of regulating this resistance by the way of changing the distance between the electrodes. This opens the new technical possibility of designing of the analog converters, which connect displacement with way of changing the distance between the electrodes. This opens the new technical possibility of designing of the analog converters, which connect displacement with the specific resistance of beam. It is shown that the stepped voltage-current characteristic of the superconductive thin narrow superconductive channels, which are been in an intermediate state, is connected with the presence to resistance in electron beams.

References Références Referencias

1. Ф. Ф. Менде. Непротиворечивая электродинамика. Харьков, НТМТ, 2008.
2. Ф. Ф. Менде. Великие заблуждения и ошибки физиков XIX-XX столетий. Революция в современной физике. Харьков, НТМТ, 2010.
3. Ф. Ф. Менде. Новая электродинамика. Революция в современной физике. Харьков, НТМТ, 2012.
4. Ф. Ф. Менде. Новые подходы в современной классической электродинамике. Часть I, Инженерная физика, №1, 2013, с. 35-49.

Global Journals Guidelines Handbook 2020

www.GlobalJournals.org

Memberships

FELLOWS/ASSOCIATES OF SCIENCE FRONTIER RESEARCH COUNCIL

FSFRC/ASFRC MEMBERSHIPS

Introduction

FSFRC/ASFRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSFRC/ASFRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSFRC

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefit

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FSFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FSFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSFRC or William Walldroff, M.S., FSFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FSFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows and associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career Credibility Exclusive Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ASFRC

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

> The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A ASFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The “ASFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ASFRC or William Walldroff, M.S., ASFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Associate members of ASFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All associates get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Associates receive discounts on the future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Associates get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to almost all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

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

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

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

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

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:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o 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.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	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

Index

save our planet

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896