International Journal of Theoretical and Mathematical Physics 2024, 14(1): 1-4
DOI: 10.5923/j.ijtmp.20241401.01

The New Analysis of Quantum Gravity by Adding Uncertainty to Gravitational Spacetime and Modifying Einstein's Full Field Equation and Introduction of 5 Physical Laws

Hyun Seuk Rhee

SJGT, Anyang, South Korea

Abstract This article shows the answer for the questions that raised for a long time of physics history. First, it shows how to make an interpretation for quantum gravity. The key concept of quantum mechanics is uncertainty principle, and particle-wave duality. This article explains what the key uncertainty of quantum gravity is, which is different from quantum electrodynamics one. In addition, this article explains that this uncertainty is real existence in gravitational field by showing that it obeys the law of particle, and the law of wave which are suggested by Rhee. Second, it explains the principle of universe expansion and it shows dependence of the expansion to R^2 which is observed recently by modifying the Einstein's full field equation, adding R^2dependent term to it. This article introduces the 3 laws of movement to gravitational world which are suggested by Rhee in the process of explaining the expansion.

Keywords Quantum gravity, Uncertainty, Universe expansion, Particle-wave duality, The law of existence, The law of movement

1. Introduction

The current quantum mechanics is the study about wave-particle duality. Wave in the current quantum mechanics is represented by wave function. Wave function represents the probability of the existence to reside at certain spacetime point. Particle in the current quantum mechanics is the existence itself which represented by the point at certain spacetime with 0 volume. The problem of current quantum mechanics occurs when this concept is introduced to gravity. Because of the definition of the above wave-particle duality, another kind of existence such as graviton must be introduced to satisfy the wave-particle duality, and this introduction leads to non-renormalization, as Feynman described.

Rhee, on the other hand, suggested the concept of wave-particle duality, which is different from the current quantum mechanics one. Rhee suggested 2 physical laws for wave-particle duality, one for wave (The Law of Wave: Every existence including fermion and boson etc., which has energy of its own must be physically continuous to each other), and the other for particle (The Law Of Particle: The whole integration over probability density of every existence must be integer multiples of $\hbar$).

The 2 laws (The Law of Wave and The Law of Particle) is going to be applied to gravity. For this application, there must be 2 modifications to the current gravitational theory. The one is about the energy conservation law. Energy conservation theory is already applied to current gravitation theory. However, "physically continuous" concept cannot be applied to energy stress tensor which is defined by General Relativity. Therefore, energy conservation law is going to be applied in the way different from the current gravitational theory, to make the energy stress tensor value non-zero value all over the whole spacetime in the universe which doesn't include the spacetime inside any black holes, so that "physically continuous" concept can be introduced to the whole universe(without black holes).

The other modification is about introducing new "wave function" concept to gravity. Rhee suggested new concept of wave function. According to him, the fermion wave function represents whether the "infinitesimal" fermion swaps their traveling path with their "identical" fermion or not. If they swap their path with each other, then the wave function value must be pure imaginary, and the value must be real number if they don't swap. This new concept of wave function is also going to be introduced. For this introduction, new complex number concept is going to be introduced to gravitation tensor. This complex number tensor is the type of the value

* Corresponding author:
erer8100@gmail.com (Hyun Seuk Rhee)
Received: Dec. 31, 2023; Accepted: Jan. 17, 2024; Published: Jan. 23, 2024
Published online at http://journal.sapub.org/ijtmp

the new wave function must have. This new wave function concept is going to introduce new kinds of uncertainty which universe gravitation must have.

(Einstein's summation convention is applied to every tensor products and differentiations)

2. Introduction of Complex Number Concept to Tensor

Assume There are 2 objects called A and B and 2 pictures 1 and 2. in picture 1 only A travels on the shortest path without B near A, and in picture 2 A travels on the shortest path with B near A:

1. If object A travels during the same time nearer to the object B in picture 2 compared with picture 1, then B is said to exerts attractive gravity.
2. If object A travels during the same time farther to the object B in picture 2 compared with picture 1, then B is said to exerts repulsive gravity.
3. If object A travels during the same time deviating from the shortest path to the object B in picture 2 compared with picture 1, then B is said to exerts imaginary gravity.

In each of 3 cases above, following 3 tensors must be multiplied to metric tensor g

1.

$$g_{ij}\, g^{jk} = \delta_i{}^k \# \tag{1}$$

(it will be called real unit tensor)

2.

$$g_{ij}\, g^{jk} = -\delta_i{}^k \# \tag{2}$$

3.

$$g_{ij}\, g^{jk} = i_i{}^k \# \tag{3}$$

where $i_i{}^k$ is called imaginary unit tensor

3. Unit Tenser

Unit tensor in this paper can be defined in the following way:

$$v_i{}^k = \alpha\delta_i{}^k + \beta i_i{}^k \# \tag{4}$$

$$\alpha^2 + \beta^2 = 1 \# \tag{5}$$

In the above equation, α, β is real scalar numbers

4. Application of Energy Conservation Law

Assumed that the following additional theorem must be applied to the entire universe:

1. Total energy inside entire universe must be zero.
2. Total potential energy inside entire universe doesn't change.
3. The additional effect to be introduced must be zero when curvature scalar R is almost zero.

To safisfy the above condition, The full field equation must be modified to the following form:

$$R_{\mu\nu} + Rg_{\mu\nu}(1 + cR) = T_{\mu\nu} \# \tag{6}$$

The above equation can be changed to the following form.

$$R_{\mu\nu} + Rg_{\mu\nu} = T_{\mu\nu} - cR^2 g_{\mu k} \# \tag{7}$$

($R_{\mu\nu}$: Ricci curvature tensor,
$g_{\mu\nu}$: Metric tensor
$T_{\mu\nu}$: stress-energy tensor
R: scalar curvature).

Therefore conservation of energy over the entire universe is to set the integration of the right handed part of the equation above over the entire universe to zero. The value of constant c must be decided based on this fact. This fact also means that the term on the righthand side of above equation which has the factor R^2 corresponds to negative energy to compensate the positive energy of matter represented by $T_{\mu\nu}$.

5. The Reason for the Gravitational Uncertainty - Introduction of the "Physically Continuous" Concept

According to Rhee, if two identical fermion exist and these 2 fermion meet each other (collision) while they are moving on the way of their shortest path, their path after the collision gets into the indistinguishable status between swapped and unswapped case because they are identical with each other. The swapped case can be represented by pure imaginary wave function and the unswapped case can be represented by real number. Therefore the indistinguishable status between swapped and unswapped case must be represented by complex number wave function.

In this paper, this explanation will be supplemented in detail by the following way:

1) Necessary terms and concepts

Before explanation, several new terms must be defined.

Identity: The identity of fermion which moves on certain path can be given by the following formula

$$E\psi dt = p\psi \mathrm{dx}$$

where E is energy whose value is the value of the reference frame where $dx = 0$, and p is the momentum whose value is the value of the reference frame where $dt = 0$, and E and p must satisfy the following equation:

$$mm^* = EE^* - pp^*$$

E, p can have complex number value, and imaginary number value of E and p means the non-shortest gravitational path.

ψ is wave function which can have complex number value. Imaginary part of ψ

means swapping(changing) its path, and real part of ψ means non-swapping its path. The magnitude of ψ has the value from 0 to 1 per each fermion.

Group Identity: Identity with wave function value 1.

Wave (Probability) Density: The amount of possible countinuous path that the existence ψ can move. It can be represented by the following way

$$\psi\psi^*$$

Identical: If 2 fermion whose identities are same as each other, when $d\tau$ and wave (probability) density of ψ of each identity is same as each other, then they are said to be identical to each other

Collision (Colliding): When 2 identical or non-identical fermion which were spacelike to each other become timelike to each other at certain spacetime, then they are said to collide to each other at the spacetime.

Normalization: Decide the value of wave density by the equation:

$$\int E_i\psi\psi^* dt - E_a dt = \int p_i\psi\psi^* dx - p_a dx = 1$$

Where $E_i\psi dt = p_i\psi dx$ is identity of infinitesimal fermion whereas $E_a dt$ and $p_a dx$ are group identity of energy-momenum conserved one fermion.

Indistinguishable and distinguishable status: If 2 fermion is identical and timelike to each other, then they are said to be in indistinguishable status. On the other hand, if they are not identical, or not timelike, then they are said to be in distinguishable status. Multiplication is applied to indistinguishable status and addition is applied to distinguishable status as Rhee suggested.

2) Explanation of Physically Continuous Concept

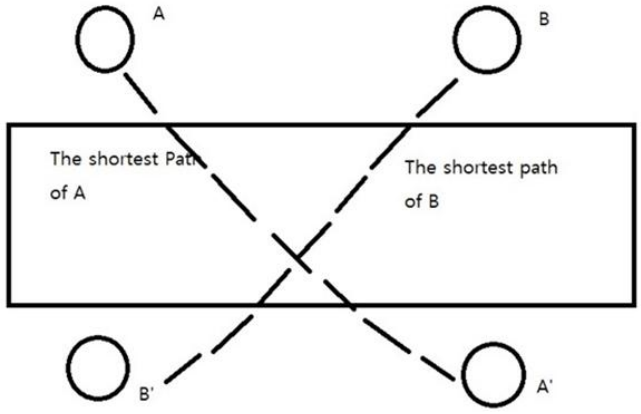

Figure 1. The picture of 2 infinitesimal identical fermions (A, B) which collide with each other inside black box

For example, the 2 identical fermions in the picture above are called A, B, and wave function of each A, B are ψ_A, ψ_B. They collide with each other in the black box. It means A, and B were spacelike before collision, but become timelike after collision. After collision, The part of A must be swapped with B and begins to travel on the path of B(fermion can be swapped with each other while collision). And part of A keep moving on the path of A. Part of A that moves on the path of B after collision is assigned to have the value of real number β, and part of A that moves on the path of A has the value of real number α, and it must satisfy equation $\alpha^2 + \beta^2 = 1$. A before collision and part of A that moves on the path B after collision are in indistinguishable status, A before collision and part of A that moves on the path of A after collision are in indistinguishable status as well. However, part of A that moves on the path B after collision and part of A that moves on the path of A are in distinguishabla status. Therefore, α is added to $i\beta$ (pure imaginary number i is multiplied because it is changing their path). And $\alpha + i\beta$ is multiplied to wave function ψ the wave function after collision becomes $\psi(\alpha + i\beta)$.

Physically continuous can be introduced by the following way: If there exists indistinguishable status between each of the 2 existences after collision, then the 2 existences is said to be physically continuous to each other.

3) Application to Gravitation

In the gravitation system, the above theory can be applied in the same way except that dt and dx is replaced by $g_{\mu\nu}$, E, p is replaced by $T_{\mu\nu}$ (energy tensor - assuming curvature scalar R is negligible).

Therefore, identity of gravitation spacetime field is:

$$T_{\mu\alpha}\psi_\beta^\alpha g^{\beta\nu}$$

In the above term, ψ_β^α is similar tensor as fermion wave function and is called gravitational wave function (tensor).

Therefore, the equation (6) must be modified further to the following form:

$$R_{\mu\nu} + Rg_{\mu k}(1 + cR\psi_\nu^k) = T'_{\mu k}\psi_\nu^k \# \quad (8)$$

(c is some constant) where $T_{\mu k}{}'\psi_\nu^k = T_{\mu\nu}$, $T_{\mu\nu}$ is stress energy tensor.

6. The Definition Application of 5 Physical Laws to Gravitation Field

To define gravitational existence, the following 2 laws (laws of existence) must be introduced.

1. The law of wave: A gravitational existence at one spacetime point which can be represented by gravitational wave function must be physically continuous to another gravitaional existence at infinitesimally close spacetime point.
2. The law of particle: The integration of normalized wave (probability) density of the gravitational existence over the corresponding entire universe must be integer.

To define the movement of the existence the following 3 laws (laws of movement) must also be introduced.

1. The Law of Energy Conservation.
2. The Law of Relativity - The same physical law must be applied to any reference frame.
3. The Law of Speed Limit - every physical element must not exceed speed c, and The Law of Momentum Conservation (These 2 laws are combined to 1 law).

Gravitational wave: The thing which can be represented by gravitational wave function and satisfies the law of wave and violates the law of particle. Every gravitational wave violates 2 of 3 laws of movement.

Gravitational particle: The thing which can be represented by gravitational wave function and satisfies the law of particle and violates the law of wave. Every particle satisfies all the 3 movement laws.

7. Gravitational Quantum Unit

To violate the law of wave means the spacetime which surrounds the gravitational particle must be closed so that there must be no exchange of energy between the inside and outside of the spacetime (physically discontinuous), and to violate the law of wave to satisfy the law of particle means the integration of wave (probabilistic) density over the entire universe is integer (1). Such a spacetime is called Gravitational Quantum Unit (GQU). There is such a spacetime which is closed, and that is called Black Hole in current physics. In addition, the entire universe we reside which consists of the spacetime without all the black holes must also be GQU. It means that Black Hole and our universe is physically equal. This is possible because there exists negative (repulsive) energy which is exerted by curvature of spacetime

$$cR^2\psi_v^k$$

* The Location of Event Horizen: it must be located at 3M radius of sphere which contains M Whole energy. Event Horizen is the plane of boundary between GQU.

8. Violation and Satisfaction of the Laws of Movement

1. The violation of the law of relativity: If

$$T_k^\alpha \psi_{;\beta}^{k\beta}$$

has non zero value, then corresponding gravitational wave function is said to violates the law. (satisfaction is the opposite of it)

($\psi_{;\beta}^{k\beta}$ is the differentiation of $\psi^{k\beta}$)

2. The violation of Energy conservation law the law of relativity: If

$$H_k^\alpha \psi_{;\beta}^{k\beta}$$

has non zero value, where

$$H^{\alpha\beta} = T^{\alpha\beta} - cR^2$$

then corresponding gravitational wave function is said to violates the law. (satisfaction is the opposite of it)

3. The violation of the law of speed limit: If

$$cR^2\psi_{;\beta}^{\alpha\beta}$$

has non zero value, then corresponding gravitational wave function is said to violates the law. (satisfaction is the opposite of it)

9. Picture

1. Lagrangian Picture: The picture in which the law of relativity is satisfied and the law of Energy conservation is violated by the particle.
2. Hamiltonian Picture: The picture in which the law of relativity is violated and the law of Energy conservation is satisfied by the particle. (The law of speed limit is violated in every picture)

10. Tolorance Rule

In Ideal situation, a GQU is closed spacetime, therefore the following normalization equation is satisfied:

$$\int H_k^\mu \psi_{\alpha\beta} \psi^{\alpha\beta *} g_{\mu\nu}\, dx - G.I. = 1$$

where G.I. means group identity.

In actual situation, however, There is a little bit of indirect energy exchange between GQU(Hawking radiation, for example), the GQU must always satisfy the following equation and inequality instead:

$$\int H_k^\mu \psi_{\alpha\beta} \psi^{\alpha\beta *} g_{\mu\nu}\, dx - G.I. + E_x = 1$$

$$\frac{1}{2} < \int H_k^\mu \psi_{\alpha\beta} \psi^{\alpha\beta *} g_{\mu\nu}\, dx - G.I < 1$$

$$0 < E_x < \frac{1}{2}$$

E_x is indirect energy exchange between GQU(Hawking radiation, for example).

11. Explanation of Space Expansion

If the law of speed limit is violated, then the entire universe is going to expand or shrink. In Lagrangian Picture, the total energy of gravitational matter inside our universe will decrease as time goes forward, and it cause the negative energy of spacetime curvature (represented by the term of factor R^2) to increase(magnitude decrease), and this phenomenon looks like space expansion to our eyes. In Hamiltonian Picture, The entire energy of our universe turns to negative from zero, it causes spacetime to expand.

REFERENCES

[1] Rhee, H. The New Interpretation of Quantum Mechanical Probability and Renormalization Using 4 Mathematical Laws and 5 Physical Laws. *International Journal of Complementary and Internal Medicine.* 2023, *4(1),* 156–166.

[2] Feynman, Richard P. (1995). *Feynman Lectures on Gravitation.* Reading, Massachusetts: Addison-Wesley. pp. xxxvi–xxxviii, 211–212.