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Expanding Uncertainty Principle to Certainty-Uncertainty Principles with Neutrosophy and Quad-stage Method

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Abstract. The most famous contribution of Heisenberg is uncertainty principle. But the original uncertainty principle is improper. Considering all the possible situations (including the case that people can create laws) and applying Neutrosophy and Quad-stage Method, this paper presents "certainty-uncertainty principles" with general form and variable dimension fractal form. According to the classification of Neutrosophy, "certainty-uncertainty principles" can be divided into three principles in different conditions: "certainty principle", namely a particle's position and momentum can be known simultaneously; "uncertainty principle", namely a particle's position and momentum cannot be known simultaneously; and neutral (fuzzy) "indeterminacy principle", namely whether or not a particle's position and momentum can be known simultaneously is undetermined. The special cases of "certainty-uncertainty principles" include the original uncertainty principle and Ozawa inequality. In addition, in accordance with the original uncertainty principle, discussing high-speed particle's speed and track with Newton mechanics is unreasonable; but according to "certainty-uncertainty principles", Newton mechanics can be used to discuss the problem of gravitational defection of a photon orbit around the Sun (it gives the same result of deflection angle as given by general relativity). Finally, for the reason that in physics the principles, laws and the like that are regardless of the principle (law) of conservation of energy may be invalid; therefore "certainty-uncertainty principles" should be restricted (or constrained) by principle (law) of conservation of energy, and thus it can satisfy the principle (law) of conservation of energy.

Keywords: Neutrosophy, quad-stage method, uncertainty principle, certainty-uncertainty principles, fractal, variable dimension fractal, Ozawa inequality, principle (law) of conservation of energy.

1 Introduction

In quantum mechanics, the uncertainty principle refers to the position and momentum of a particle cannot be determined simultaneously, the uncertainty of position (Δx) and uncertainty of momentum (Δp) obey the following inequality

$$\Delta x \Delta p \geq h / 4\pi \qquad (1)$$

where, h is the Planck constant.

As well-known, the most famous contribution of Heisenberg is uncertainty principle. But the original uncertainty principle is improper.

As a new branch of philosophy, Neutrosophy studies the origin, nature, and scope of neutralities, as well as their interactions with different ideational spectra. According to Neutrosophy that there is a 3D Neutrosophic Space, where each dimension of the space represents respectively the truth (T), the falsehood (F), and the indeterminacy (I) of the statement under consideration. More information about Neutrosophy may be found in references [1,2]. Quad-stage is introduced in reference [3], it is the expansion of Hegel's triad-stage (triad thesis, antithesis, synthesis of development). The four stages are "general theses", "general antitheses", "the most important and the most complicated universal relations", and "general syntheses". In quad-stage method, "general theses" may be considered as the notion or idea <A> in neutrosophy; "general antitheses" may be considered as the notion or idea <Anti-A> in neutrosophy; "the most important and the most complicated universal relations" may be considered as the notion or idea <Neut-A> in neutrosophy; and "general syntheses" are the final results. The different kinds of results in the above mentioned four stages can also be classified and induced with the viewpoints of neutrosophy. Thus, the theory and achievement of neutrosophy can be applied as many as possible, and the method of quad-stage will be more effective. The combination of Neutrosophy and quad-stage will be a powerful method to realize many innovations in areas of science, technology, literature and art. Therefore, this paper expands uncertainty principle with Neutrosophy and Quad-stage Method and presents certainty-uncertainty principles.

As expanding uncertainty principle with neutrosophy and quad-stage, the whole process can be divided into the following four stages.

The first stage (stage of “general theses”), for the beginning of development, the thesis (namely uncertainty principle) should be widely, deeply, carefully and repeatedly contacted, explored, analyzed, perfected and so on.

Regarding the advantages of uncertainty principle, that will not be repeated here, while we should stress the deficiencies of uncertainty principle.

For other perspectives on uncertainty principle, we will discuss in detail below, in order to avoid duplication.

The second stage, for the appearance of opposite (antithesis), the antithesis should be also widely, deeply, carefully and repeatedly contacted, explored, analyzed, perfected and so on.

There are many opposites (antitheses) to uncertainty principle. For example: certainty principle, law of conservation of energy, and so on, this paper discusses the problems related to law of conservation of energy in the last part.

The third stage is the one that the most important and the most complicated universal relations. The purpose of this provision stage is to establish the universal relations in the widest scope.

To link and combine uncertainty principle with Neutrosophy and law of conservation of energy, it can be expanded and developed effectively and successfully in the maximum area.

The fourth stage, to carry on the unification and synthesis regarding various opposites and the suitable pieces of information, factors, and so on; and reach one or more results to expand uncertainty principle, and these are the best or agreed with some conditions.

2 Heisenberg inequality, Ozawa inequality and their forms of equality in first stage and second stage

In first stage, we discuss the problems related to Heisenberg inequality firstly.

Heisenberg inequality (Eq.1) can be changed into the following form of equality

$$\Delta x \Delta p = kh/4\pi \qquad (2)$$

where, k is a real number and $k \geq 1$.

For other contents of the first stage (such as Heisenberg inequality cannot consider law of conservation of energy), we will discuss them below.

In second stage, we discuss the problems related to Ozawa inequality (the opposites of Heisenberg inequality) firstly.

Ozawa inequality [4] can be written as follows

$$\Delta Q \Delta P + \Delta Q \sigma(P) + \sigma(Q) \Delta P \geq h/4\pi \qquad (3)$$

It can be changed into the following form of equality

$$\Delta Q \Delta P + \Delta Q \sigma(P) + \sigma(Q) \Delta P = kh/4\pi \qquad (4)$$

where, k is a real number and $k \geq 1$.

For other contents of the second stage (such as Ozawa inequality cannot consider law of conservation of energy), we will also discuss them below.

3 "Certainty-uncertainty principles" with general form

Now we link the viewpoints of Neutrosophy and enter the fourth stage.

According to Neutrosophy, any proposition has three situations of truth, falsehood and indeterminacy respectively. Thus, the original uncertainty principle can be extended into the following "certainty-uncertainty principles" with general form

$$\Delta x \Delta p = Kh \qquad (5)$$

where, K is a real number and $K > 0$.

Eq.(5) can be divided into three principles:

The first one is the “uncertainty principle” ($K \geq K_1$): a particle’s position and momentum cannot be known simultaneously.

Obviously, if $K_1 = 1/4\pi$, then it is the original uncertainty principle.

The second one is the “certainty principle” ($K \leq K_2$): a particle’s position and momentum can be known simultaneously.

Referring to the experiments for establishing Ozawa inequality, the value of K_2 can be decided by related experiments.

The third one is the neutral (fuzzy) “indeterminacy principle" ($K_2 < K < K_1$): whether or not a particle’s position and momentum can be known simultaneously is undetermined.

Similarly, the original Ozawa inequality can be extended into the following Ozawa type’s "certainty-uncertainty principles" with general form

$$\Delta Q \Delta P + \Delta Q \sigma(P) + \sigma(Q) \Delta P = Kh \qquad (6)$$

where, K is a real number and $K > 0$.

Eq.(6) can be divided into three principles:

The first one is the “certainty principle” ($K \geq K_1$): a particle’s position and momentum can be known (namely can be measured with zero-error) simultaneously (here σ(P) or σ(Q) is equal to infinity).

Obviously, if $K_1 = 1/4\pi$, then it is the original Ozawa inequality (with equality form).

It should be noted that here the first one is not the uncertainty principle, but certainty principle.

The second one is the “uncertainty principle” ($K \le K_2$): a particle’s position and momentum cannot be known simultaneously.

The third one is the neutral (fuzzy) “indeterminacy principle" ($K_2 < K < K_1$): whether or not a particle’s position and momentum can be known simultaneously is undetermined.

4 "Certainty-uncertainty principles" with variable dimension fractal form

In order to process Eq. (5) and Eq.(6), as well as other equalities and inequalities that may arise in the future with unified manner, we will link variable dimension fractal to discuss the "certainty-uncertainty principles" with variable dimension fractal form.

The general form of variable dimension fractal is as follows

$$N = \frac{C}{r^D} \quad (7)$$

where, $D = f(r)$, instead of a constant.

For the sake of convenience, we only discuss the situation of $C = 1$, that is

$$N = \frac{1}{r^D} \quad (8)$$

Thus, Eq.(5) can be written as the following variable dimension fractal form

$$\Delta x \Delta p = \frac{1}{h^D} \quad (9)$$

Solving this equation, it gives

$$D = -\frac{\ln(Kh)}{\ln h} \quad (10)$$

Then, the values of D_1 and D_2 corresponding to K_1 and K_2 can be calculated by Eq.(10), for example

$$D_1 = -\frac{\ln(K_1 h)}{\ln h} \quad (11)$$

Similarly, Eq.(6) can be written as the following variable dimension fractal form

$$\Delta Q \Delta P = \frac{1}{h^D} \quad (12)$$

Solving this equation, it gives

$$D = -\frac{\ln(Kh - \Delta Q \sigma(P) - \sigma(Q)\Delta P)}{\ln h} \quad (13)$$

Then, the values of D_1 and D_2 corresponding to K_1 and K_2 can be calculated by Eq.(13), for example

$$D_1 = -\frac{\ln(K_1 h - \Delta Q \sigma(P) - \sigma(Q)\Delta P)}{\ln h} \quad (14)$$

5 Solving the problem of light speed with Newton mechanics

Now we link the problem related to Newton mechanics.

In accordance with the original uncertainty principle, discussing high-speed particle’s speed and track with Newton mechanics is unreasonable; but according to "certainty-uncertainty principles", Newton mechanics can be used to discuss the problem of gravitational defection of a photon orbit around the Sun (it presents the same result of deflection angle as given by general relativity). The solving method can be found in reference [4]; in which, for problem of gravitational defection of a photon orbit around the Sun, the improved formula of gravitation between Sun and photon is as follows:

$$F = -\frac{GMm}{r^2} - \frac{1.5GMmr_0^2}{r^4} \quad (15)$$

where : r_0 is the shortest distance between the light and the Sun, if the light and the Sun are tangent, it is equal to the radius of the Sun.

The funny thing is that, for this problem, the maximum gravitational force given by the improved formula is 2.5 times of that given by the original Newton’s law of gravity.

6 To be restricted (or constrained) by principle (law) of conservation of energy

In this part we will link principle (law) of conservation of energy to discuss further.

For the reason that in physics the principles, laws and the like that are regardless of the principle (law) of conservation of energy may be invalid; therefore "certainty-uncertainty principles" should be restricted (or constrained) by principle (law) of conservation of energy, and thus it can satisfy the principle (law) of conservation of energy.

The general form of the principle (law) of conservation of energy is as follows

$$E(t) = E(0) = const$$

Or

$$1 - \frac{E(t)}{E(0)} = 0$$

Thus, referring to reference [3] for applying least square method to establish "partial and temporary unified theory of natural science so far" including all the equations of natural science so far (in which, the theory of everything to express all of natural laws, described by Hawking that a single equation could be written on a T-shirt, is partially and temporarily realized in the form of "partial and temporary unified variational principle of natural science so far"), Eq.(5) (one kind of "certainty-uncertainty principles" with general form) can be restricted (or constrained) by principle (law) of conservation of energy as follows

$$(\Delta x \Delta p - Kh)^2 + w(1 - \frac{E(t}{E(0)}) = 0 \qquad (16)$$

where, K is a real number and $K > 0$, w is a suitable positive weighted number.

Similarly, Eq.(6) (one kind of Ozawa type's "certainty-uncertainty principles" with general form) can be restricted (or constrained) by principle (law) of conservation of energy as follows

$$(\Delta Q \Delta P + \Delta Q \sigma(P) + \sigma(Q)\Delta P - Kh)^2 + w(1 - \frac{E(t}{E(0)}) = 0 \qquad (17)$$

For Eq.(9) (the variable dimension fractal form of Eq.(5)), it can be restricted (or constrained) by principle (law) of conservation of energy as follows

$$(\Delta x \Delta p - \frac{1}{})^2 + w(1 - \frac{(t)}{E(0)}) = 0 \qquad (18)$$

For Eq.(12) (the variable dimension fractal form of Eq.(6)), it can be restricted (or constrained) by principle (law) of conservation of energy as follows

$$(\Delta Q \Delta P - \frac{1}{D})^2 + w(1 - \frac{(t)}{E(0)}) = 0 \qquad (19)$$

As the cases that "certainty-uncertainty principles" should be restricted (or constrained) by other principles (laws) and the like, similar method can be used.

Conclusion

The original uncertainty principle is improper. Considering all the possible situations (including the case that people can create laws), and applying Neutrosophy and Quad-stage Method, this paper presents "certainty-uncertainty principles" with general form and variable dimension fractal form. According to the classification of Neutrosophy, "certainty-uncertainty principles" can be divided into three principles in different conditions: "certainty principle", namely a particle's position and momentum can be known simultaneously; "uncertainty principle", namely a particle's position and momentum cannot be known simultaneously; and neutral (fuzzy) "indeterminacy principle", namely whether or not a particle's position and momentum can be known simultaneously is undetermined.

Referring to the "certainty-uncertainty principles" for a particle's position and momentum, the "certainty-uncertainty principles" for other physical quantities can also be presented with the similar method.

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