Comparative Studies of Laws of Conservation of Energy, Momentum and Angular Momentum —No.2 of Comparative Physics Series Papers

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Abstract: As No.2 of comparative physics series papers, this paper discusses the same and different points of law of conservation of energy, law of conservation of momentum, and law of conservation of angular momentum in the traditional viewpoints. The same points: they belong to the three fundamental conservation laws in modern physics; and they are all widely used in physics. The different points: the law of conservation of energy is derived by the time translation-invariant, the law of conservation of momentum is derived by the space translation-invariant, and the law of conservation of angular momentum is derived by the space rotation-invariant; and in the fields of natural sciences, the law of conservation of energy is the most important and the most widely used law, while the other two laws are not so important and far-reaching. With the comparative method, the above traditional viewpoints are re-discussed. According to the principle of uniqueness of truth, the law of conservation of energy should be considered as the unique truth, and establish the science of conservation of energy; accordingly, within the whole physics range, the law of conservation of momentum and the law of conservation of angular momentum are not forever right, namely these two laws are correct only in some conditions (for instance, we can give the examples that these two laws are not correct as considering the actions of the friction and the like), therefore these two laws cannot be taken as the fundamental conservation laws in the field of physics; furthermore, in the case of no external force, the law of conservation of momentum may not be correct, and in the case of no external moment, the law of conservation of angular momentum may be not correct too. Finally, the improvements of the laws of conservation of momentum and angular momentum are discussed.

Key words: Comparative physics, comparative study, law of conservation of energy, law of conservation of momentum, law of conservation of angular momentum, science of conservation of energy

Introduction

In reference [1], the concept of comparative physics is proposed. As No.2 of the series papers of comparative physics, this paper discusses the comparative studies of law of conservation of energy, law of conservation of momentum, and law of conservation of angular momentum; and reconsider the application scopes of these three laws of conservation, as well as the problems of the establishments of interdisciplinary science of conservation of energy, and the like.

1 In traditional viewpoints, the same points of three laws of conservation

The first same point: they belong to the three fundamental conservation laws in

modern physics.

However, this is the traditional viewpoint only. We will discuss the result that, for these three fundamental conservation laws, only one should be correct as fundamental conservation law.

The second same point: they are all widely used in physics.

Moreover, in many cases they are used simultaneously. For example, as determining the orbit of alpha particle scattering, law of conservation of energy and law of angular momentum are used simultaneously.

2 In traditional viewpoints, the different points of three laws of conservation

The first different point: the law of conservation of energy is derived by the time translation-invariant, the law of conservation of momentum is derived by the space translation-invariant, and the law of conservation of angular momentum is derived by the space rotation-invariant.

However, it is never questioned that whether or not these three invariances can be tenable at the same time.

The second different point: in the fields of natural sciences, the law of conservation of energy is the most important and the most widely used law, while the other two laws are not so important and far-reaching.

Law of conservation of energy has been the cornerstone of all natural sciences. It is widely used in physics, chemistry, biology and other fields.

However, for law of conservation of momentum and law of conservation of angular momentum, besides the field of physics, they almost cannot be used in other fields.

3 Rediscuss the above traditional viewpoints, the establishment of interdisciplinary science of conservation of energy with comparative method

One of the trends of science development is applying the least amount of laws and formulae to solve the problems as many as possible.

With the help of comparison we can find that, the importances of law of conservation of energy, law of conservation of momentum, and law of conservation of angular momentum are not the same, the law of conservation of energy is the most important one, and its important role is still not appeared in many fields.

Since the law of conservation of energy is so important, as dealing with the problems related to movement and energy, the law of conservation of energy can be considered as the unique truth to establish the interdisciplinary science of conservation of energy, and deal with all the related problems in the areas of physics, chemistry, and the like with the unified method.

More information about science of conservation of energy can be found in reference [4].

In reference [2, 3], for the example of a small ball rolls along the inclined plane, the improved law of gravity and improved Newton’s second law are derived with principle of conservation of energy.

The results suitable for this example with the constant dimension fractal form is as follows.

The improved Newton's second law reads

$$F = ma^{1.01458} \qquad (1)$$

The improved law of gravity reads

$$F = -\frac{GMm}{r^{1.99989}} \qquad (2)$$

The results suitable for this example with the variable dimension fractal form are as follows.

Supposing that the improved Newton's second law is as follows

$$F = ma^{1+\varepsilon} \quad , \quad \varepsilon = k_1 u \qquad (3)$$

and the improved law of gravity is as follows

$$F = -GMm / r^{2-\delta} , \quad \delta = k_2 u \qquad (4)$$

where: u is the horizon distance that the small ball rolls （$u = x + H$）.

After the values of k_1, k_2 are determined, the results of variable dimension fractal are as follows

$$\varepsilon = 8.85 \times 10^{-8} u$$

$$\delta = 2.71 \times 10^{-13} u$$

The results of variable dimension fractal are much better than that of constant dimension fractal.

In addition, in reference [5], the suggestion that deriving the related formulae and equations of general relativity with law of conservation of energy is presented.

For the reason that as dealing with problems associated with movement and energy, taking law of conservation of energy as the unique truth, then: in the whole context of physics, law of conservation of momentum and law of conservation of angular momentum are not always right. In other words, reconsidering the time translation-invariant, the space translation-invariant, and the space rotation-invariant, in some cases, these three invariances cannot be tenable at the same time. Why? Since in general, the law of conservation of momentum is only correct in the case that there is no external force; and the law of conservation of angular momentum is only correct in the case that there is no external moment.

What is more, in the case of no external force, the law of conservation of momentum may not be correct; and in the case of no external moment, the law of conservation of angular momentum may not be correct also. Why? Because in many cases, the law of conservation of momentum and the law of conservation of angular momentum can be derived by Newton's second law. However, Eq.(1) and Eq.(3) have shown that, in some cases, the original Newton's second law is not correct, and it should be replaced by the improved Newton's second law; therefore, for these cases, althought there is no external force or no external moment, the law of conservation of momentum and the law of conservation of angular momentum are no longer valid.

Accordingly, the law of conservation of momentum and the law of conservation of angular momentum cannot be considered as the fundamental conservation laws in physics.

Now we present the examples that the law of conservation of momentum and the law of conservation of angular momentum are not correct, while the law of conservation of energy is still correct.

The law of conservation of momentum is often used for processing the problem that two-ball collision on a plane; obviously, if the friction is considered, the law of conservation of momentum is no longer correct, but the law of conservation of energy is still correct.

Similarly, the law of conservation of angular momentum is often used for processing the problem that the motion of planets around the Sun; assuming the planets are moving in gas, instead of moving in vacuum, as considering the friction, the law of conservation of angular momentum is no longer correct, but the law of conservation of energy is still correct.

4 Improvements of the laws of conservation of momentum and angular momentum

To compare with Eq.(1) to Eq.(4), namely improved Newton's second law and improved law of gravity with two forms of constant dimension fractal and variable dimension fractal, and use them for reference, the similar ways can be used to improve the law of conservation of momentum and the law of conservation of angular momentum.

In references [2,3] we already pointed out that as the original law of conservation of momentum and law of conservation of angular momentum are not correct, they can be improved with the two forms of constant dimension fractal and variable dimension fractal.

Suppose that the original law of conservation of momentum reads

$$P_t = P_0 = Const$$

Then the improved law of conservation of momentum can be written as follows

$$P_t = P_0^{1+\delta}$$

where: δ is a constant or a variable.

After such treatment, not only the improved law of conservation of momentum is correct in the case of considering external force, but also correct in the case of considering friction and the like. That is, the application range of the improved law of conservation of momentum will be greatly extended. However, its application range is still less than the law of conservation of energy; and it is only available after tested by the law of conservation of energy, because the law of conservation of energy is the unique true. Therefore, the improved law of conservation of momentum still cannot be considered as the fundamental conservation law in physics.

Suppose that the original law of conservation of angular momentum reads

$$L_t = L_0 = Const$$

Then the improved law of conservation of angular momentum can be written as follows

$$L_t = L_0^{1+\varepsilon}$$

where: ε is a constant or a variable.

Similar to the case of improved law of conservation of momentum, after such treatment, not only the improved law of conservation of angular momentum is correct in the case of considering external moment, but also correct in the case of considering friction and the like. That is, the application range of the improved law of conservation of angular momentum will be greatly extended. However, its application range is still less than the law of conservation of energy; and it is only available after tested by the law of conservation of energy, because the law of conservation of energy is the unique true. Therefore, the improved law of conservation of angular momentum still cannot be considered as the fundamental conservation law in physics also.

5 Conclusions

In comparative physics, based on the comparative method, we can discuss the same and different points of law of conservation of energy, law of conservation of momentum, and law of conservation of angular momentum; then according to the principle of uniqueness of truth, the law of conservation of energy should be considered as the unique truth, and establish the science of conservation of energy. While the law of conservation of momentum and the law of conservation of angular momentum cannot be taken as the fundamental conservation laws in the field of physics. To compare with the improved Newton's second law and improved law of gravity with two forms of constant dimension fractal and variable dimension fractal, and use them for reference, the similar ways can be used to improve the law of conservation of momentum and the law of conservation of angular momentum. The improved law of conservation of momentum and the improved law of conservation of angular momentum are not only correct in the case of considering external force and external moment, but also correct in the case of considering friction and the like. That is, the application ranges of these two laws will be greatly extended. However, their application ranges are still less than the law of conservation of energy; and they are only available after tested by the law of conservation of energy, because the law of conservation of energy is the unique true. Therefore, the improved law of conservation of momentum and the improved law of conservation of angular momentum still cannot be considered as the fundamental conservation laws in physics.

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