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On the quantitative effects

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Abstract

The physical phenomena what modern physics describes seem all very peculiar, which results from the quantitative effects deviating from the absolute space-time theory. The absolute space-time theory, which describes the world with invariable space-time standards, is a fundamental space-time theory; while actual space-time standards can vary with environment, and thus, the actual measuring data are always to deviate from the absolute space-time theory and the quantitative effects occur. A light is the most exact tool measuring space-time in the modern physics, whose space-time standards have a variability and leads up to the quantitative effects such as relativistic and quantum effects. The relativistic equations of the quantitative effects and the analytic method of effect energy are proposed, they can be used to describe relativistic phenomena simply.

1. Introduction

In physical world, it is considered generally that a mathematical model in accord with experimental data reflects the truth of thing. Actually it must necessarily be so. The meaning of many things are becoming more and more clear along with the development of science, but the meaning of some things even are becoming more and more fuzzy, the time and space are just such.

The space, time and mass are the most foundational physical quantity in classical physics, where the three dimensional space is the stage, the one dimensional time is the process and the objects (the matter with mass) are the performers, they are interrelated as well as independent each other. Such a description accords with human sensation. The theory of relativity changed the space-time theory of classical physics, it believes that the space and time can vary with velocity or gravitational potential, and the space-time may be bent, which give us a feel that look at oneself in the distorting mirror. The concepts of space and time even are blurred by the statistical interpretation of the wave function, the uncertainty relation and so on in the quantum theory, where the physical quantities including space and time all are replaced by the unpredictable operators. The space even is described into a high dimensional world in the theories of supersymmetry and extra dimension etc[1][2]., in which there are invisible many dimensional spaces except the visible three dimensional spaces. Consequently, even some consider that the concept of space and time are the phantasms, say, they apply only to the macroscopic as having statistical essence as temperature[3]. But space and time exist everywhere, can we leave the space-time in reality?

Why are the space and time with universality becoming more and more elusive along with the development of physics? Some would say: the world is complicated originally, human understanding is always from the simple to the complicated. It is right only half of this word, in fact, humanity can turn a theory from the complicated into the simple on a new theoretical highness. I have pointed out[4] that the absolute and relativistic space-time theories are two different space-time theories in nature, and proposed the idea of the quantitative effects, which can simplify the understanding to the modern physics to some extent.

The absolute space-time theory, which describes the world with an invariable space-time standards, can be thought as the most foundational space-time theory. However, the actual standard tools of length and time, such as rulers, clocks and light, can vary with the environment due to temperature, velocity and gravitational potential. The physics is a experimental science, its theoretical data should accord with the experimental data. Thus, there are always certain differences between the physical quantitative relation and the absolute space-time theory. The effects caused by this differences are called *quantitative effects*, which are the insignificant in the condition of low velocity or the macroscopic, otherwise they would become obvious. Both of the relativistic and quantum effects are the quantitative effects, that is to say, they are the results that the actual quantitative relations deviate from the absolute space-time theory. Then, what the modern physics describes are the quantitative effects on the basis of classical physics. It is the quantitative effects that twist the physical description.

2. Two Different Space-Time Theories in Nature

The quantitative effects relate to space-time, let us state begin with the Newtonian space-time theory.

Newtonian space-time theory is called the absolute space-time theory. Newton said[5]:

> *"I do not define time, space, place and motion, as being well known to all. Only I must observe, that the vulgar conceive those quantities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which, it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common."*
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> *"Absolute, true, and mathematical time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration; relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time ; such as an hour, a day, a month, a year."*
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> *"Absolute space, in its own nature, without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces."*

For the above saying, there are absolute space-time as well as the relative space-time in the absolute space-time theory. Measuring is a course of comparison between measuring tool and measured body, and the absolute space and time can not be measured directly because they have nothing to do with matter and its motion. Therefore physical space-time are all the measurable relative space-time, and we know the absolute space-time through the relative space-time. Then, what is the most foundational characteristic of the absolute space-time theory? It is the invariability of space-time standards, which leads to the each independence of space and time, and both of them have nothing to do with material environment.

An intuition of individual person or organization is unreliable generally, and it is probable that the human total intuition is just the truth. The "as being well known to all" is like an axiom. The absolute space-time theory, which is an axiom in classical physics, can be regarded as the most foundational space-time theory. Owing to the invariability of space-time standards, everywhere we can establish a rigid three dimensional coordinate system and one dimension time axis, which are just a mathematical expression of a relative space-time in the absolute space-time theory. The mathematical expression of absolute space-time theory is the Galilean transformation where the intervals of space and time are the constant quantity, namely the invariability of space and time standards.

The general measuring-rods and clocks can vary with the temperature, which can not be believed that the space and time are changing because people may prove that these changes are only the changes of the measuring-rods and clocks themselves with more accurate space-time measuring tools. The scientists would take the changes of space-time standards as the changes of space-time itself if the most exact space-time measuring tool can change.

The light velocity is the known most quick velocity spreading information. Now the most accurate standards of length and time are defined by light. For example, a metre, the SI unit of length, being the length of the path travelled by light in vacuum during a time interval of $1/(299{,}792{,}458\times10^8)$ second[6], where the length of the path traveled by light in vacuum during a time interval of one second is always 299792458 meters whether it is fast or slow, the light speed become an invariable definitional speed. The modern physics is just established on the basis of such a space-time standard, which means what the modern physis describes are the quantitative effects with light as the measure of space-time. We can imagine there is a standing wave fixed on a moving body, its wave length would contract observed in the stationary system along with an increase of the velocity, and it is contracted into a point when the velocity of this body reach the light velocity. An observer in the stationary system, he would consider that the distance traveled by light in a unit time is decreased, or the time becomes slower in moving system than it in the stationary system if the light velocity is invariable.

Taking a change of the space-time standard as a change of space-time itself is a practicable mathematical model in the modern physics.

The description on the basis of absolute space-time theory is called *absolute description*; and the description on the basis of experimental data is called *quantitative description*.

The quantitative effects are caused by the difference between these two descriptions.

3. The Quantitative Effects of Relativity

The theory of relativity is a theory of the quantitative description and the relativistic effects are the quantitative effects. The theory of relativity, in fact, does not depart from the absolute space-time theory because it explains how the space-time standard changes with the help of the proper quantities, and according to the explanation that a rigid three dimensional coordinate system and one dimensional time axis are just a mathematical expression of a relative space-time in the absolute space-time theory, the proper quantities in the relativity are the quantities of absolute description.

The coordinate system and time axis in the relativity are nonrigid, and can vary with velocity or gravitational potential. The special theory of relativity shows that in a inertia frame of reference, the relationships between unit length dr or unit time dt and velocity v are as in Eqs. (1) and (2):

$$dt = \frac{dt_0}{\sqrt{1-v^2/c^2}}, \quad (1)$$

$$dr = \sqrt{1-v^2/c^2}\,dr_0, \quad (2)$$

Where dr_0 and dt_0 are the proper unit length and time, respectively. They do not vary with velocity and are used to measure the change of space-time standards on an objects in relative motion with any velocity. Thus, they are the unit length and time in the absolute description on this inertia frame of reference, and Eqs.(1) and (2) are the equations of quantitative effects in the special theory of relativity.

Similarly, the general theory of relativity states that the unit length dr or unit time dt can vary with gravitational potential. A simple expression can be obtained with the equivalent principle and conservation of energy: Let an object whose initial velocity is zero falls freely in an isolated gravitational field of a star. When it is a distance r away from the star, its velocity is v, and the gravitational potential is ϕ, which is zero when it is infinitely far away from the star. Then,

$$\frac{1}{2}mv^2 + m\phi = 0$$

i.e.,

$$\phi = -\frac{1}{2}v^2 \quad (3)$$

Substituting (3) into (1) and (2) gives

$$dt = \frac{dt_0}{\sqrt{1+2\phi/c^2}} = \frac{dt_0}{\sqrt{1-2GM/c^2r}} \quad (4)$$

$$dr = \sqrt{1+2\phi/c^2}\,dr_0 = \sqrt{1-2GM/c^2r}\,dr_0 \quad (5)$$

Eqs. (4) and (5) are identical with the results of the Schwarzschild solution in the general theory of relativity[7].

The dt_0 and dr_0 in (4) and (5) are the unit length and unit time on the reference frame that is far away from the gravitational field. They do not vary with the gravitational potential; that is, they are the unit length and unit time in the absolute description. Eqs. (4) and (5)are the equations of quantitative effects in the general theory of relativity.

The equations of quantitative effects can be used to explain relativistic phenomena simply. Two examples are given below.

The experiment on the delay of radar echo showed that the velocity of light becomes slower in a gravitational field, which can be solved simply using Eqs. (4) and (5): the relation between the velocities of the quantitative description (dr/dt) and the absolute description (dr_0/dt_0) is

$$dr/dt = \frac{\sqrt{1+2\phi/c^2}\,dr_0}{dt_0/\sqrt{1+2\phi/c^2}} = (1+2\phi/c^2)dr_0/dt_0 \quad (6)$$

Let the velocity of light without the gravitational field be c. Then, the velocity of light with unit of dr_0/dt_0 in the gravitational field is

$$c_0 = (1+2\phi/c^2)c = (1-\frac{2GM}{c^2r})c \quad (dr_0/dt_0) \quad (7)$$

Eq. (7) is identical to the result of the general theory of relativity[8].

Obviously, the conclusion that the velocity of light becomes slower in a gravitational field is an absolute description, which is the result of measuring the velocity of light over the whole gravitational field with an invariable space-time standard, say, the space-time standard on the earth. Quantitatively, the principle of the invariability of the velocity of light is still established in the gravitational field because where the standards of space-time can vary with gravitational potential. Using the quantitative space-time standard of one point to measure the velocity of light of this point, according to (6), if the quantitative unit dr/dt is substituted for the absolute unit dr_0/dt_0 in (7), then the velocity of light is always constant c. Therefore the invariability of light velocity is a quantitative effect, and there are certain complementarities between absolute and quantitative descriptions.

As for the gravitational red shift, it is because the space-time standards can vary with gravitational potential.

A. Einstein pointed out that the frequency of light corresponds to the time frequency of a clock[9]. According to (4), it is

$$v = \frac{v_0}{\sqrt{1-2GM/c^2 r}} \tag{8}$$

Equation (8) shows that the frequency of light can vary with the gravitational potential. If the vector radii of a light beam are r_1 and r_2 successively in a gravitational field, it can be shown that

$$\frac{v_1}{v_2} = \frac{\sqrt{1-2GM/c^2 r_2}}{\sqrt{1-2GM/c^2 r_1}} \tag{9}$$

Equation (9) is the formula of the gravitational red shift of spectral-line in the Schwarzschild geometry[8].

4. The Analytic Method of Effect Energy

According to the mass-energy relation $E = mc^2$, the relativistic mass-velocity equation $m = \frac{m_0}{\sqrt{1-v^2/c^2}}$ can be turn into energy-velocity equation:

$$E = \frac{E_0}{\sqrt{1-v^2/c^2}} \approx (1+\frac{v^2}{2c^2})E_0 \tag{10}$$

Substituting (3) into (10) gives

$$E = \frac{E_0}{\sqrt{1+2\phi/c^2}} \approx (1-\frac{\phi}{c^2})E_0 = \left(1+\frac{MG}{c^2 r}\right)E_0 \tag{11}$$

Eqs. (10) and (11) show that the energy of a relativistic body may be resolved into proper energy E_0 of proper motion and effect energy $\frac{v^2}{2c^2}E_0$ or $\frac{GM}{c^2 r}E_0$ of effect motion, where the proper energy is the energy in the absolute description; while the effect energy is a energy caused by quantitative effects. The effect motion is only a quantitative effect, which can not change the system of proper motion, and yet it can only change the system's direction of proper motion. Such a analytic method is called *analytic method of effect energy*, which is a recognized fashion to quantitative effect. Is this analytic method effective? Let us try to calculate the precession of a planet perihelion with it.

The system of proper motion of a planet is the ellipse, its effect energy does not change the form of this ellipse, and only makes whole ellipse rotated slowly, namely the precession.

Calculating along the orbit of a planet, the angular displacement between two adjacent perihelia is $2\pi + \alpha$, where the α is the precession angle. Here the energy of elliptic motion system is the proper energy, and the precession is caused by effect energy, which rolls ellipse as a whole. The precession energy is a extra kinetic energy of angular direction, and its direction is identical with the kinetic energy of angular direction of proper motion. Then the precession angle can be derived simple: to derive the ratio of angular direction kinetic energy between precession and proper motion, and thus, applying the analytic method of effect energy, the precession angle can be obtained in proportion when the planet accomplishes a period's elliptic motion.

For circular orbit, all of kinetic energy are the angular direction kinetic energy, whose value is half of potential energy because the gravitational acceleration $a = \frac{v^2}{r} = \frac{GM}{r^2}$, which leads to $\frac{1}{2}mv^2 = \frac{1}{2}m\frac{GM}{r}$. Therefore angular direction kinetic energy of a planet is $\frac{1}{3}E_0$ (E_0 is the sum of energy of proper motion). For elliptic orbit, part of kinetic energy is the radial direction kinetic energy, which has nothing to do with angular direction motion. When the planet lies to an aphelion, its kinetic energy is the least $\frac{GMm}{2(a+c)}$; when the planet lies to a perihelion, its kinetic energy is the largest $\frac{GMm}{2(a-c)}$, then the average kinetic energy of elliptic motion is: $\frac{1}{4}GMm\left(\frac{1}{a-c}+\frac{1}{a+c}\right) = \frac{GMm}{2a\left(1-e^2\right)}$, (e is the eccentricity); while the kinetic energy of circular motion with radius a is $\frac{GMm}{2a}$, which is $1-e^2$ times as much as the average kinetic energy of elliptic motion with long axis a. Therefore the angular direction kinetic energy of proper motion is approximately $\frac{1-e^2}{3}E_0$.

According to the the analytic method of effect energy, the angular direction kinetic energy of the planet precession is $\frac{-\phi}{c^2}E_0$, while that of proper motion is $\frac{1-e^2}{3}E_0$, the ratio of them is $\frac{-3\phi}{c^2\left(1-e^2\right)}$. Therefore when the planet accomplishes a period's elliptic motion (2π), the angle of precession is

$$\alpha = \frac{2\pi\times(-3\phi)}{c^2\left(1-e^2\right)} = \frac{6\pi GM}{ac^2(1-e^2)} \tag{12}$$

which is identical with the formula that is derived by the general theory of relativity[8], which shows that the analytic method of effect energy is effective.

5. Quantum Effect, a Quantitative Effect in Microscopic System

The quantum mechanics was established on the basis of a series of experiments. Therefore the quantum effect would is a quantitative effectIt. Let us make some analyses from different angles below.

Applying the analytic method of effect energy to uniform motion in a straight line, its effect motion can only be a transverse vibration or the spin whose direction is parallel to the moving direction because its proper motion system is a straight line. Is there such an effect motion? Macroscopically it seems not probable, but it is only too true microscopically because the microscopic particles all possess the wave-particle duality and intrinsic spin, which may be regarded as the manifestations of quantitative effects in microscopic system.

Moreover the Schrodinger equation is a semi-qualitative, semi-quantitative and non-relativistic theory, it can derive the quantization of some physical quantities, but the spin is placed into the theoretical framework as an additional degree of freedom; while Dirac equation, a relativistic equation of quantum mechanics, includes automatically the spin quantum number of particles[10], which indicates further that the quantization of intrinsic spin of a particle is a reflection of the quantitative effect of the special theory of relativity in the microscopic system

The invariability of light velocity is a most basic relativistic quantitative effect, which means that any photon model would have certain common nature, we assume that one period of a high-frequency light wave is a photon, and the electromagnetic amplitude of any photon is identical quantitatively. Attention please, low-frequency electromagnetic wave's one period is not one photon, which relates to the microscopic structure of a physicalvacuum, and it does not be made discussion in this paper.

I had pointed out that the light is a second sound in the superfluid of macroscopic physical vacuum, whose density is homogeneous and isotropic in quantitative description[4]. As is known to all, the average value ε of energy density of a wave is $\varepsilon = \frac{\rho A^2 \omega^2}{2}$, where the ρ is the density of a medium, the A is amplitude and the ω is circular frequency. In a vacuum, the ρ and A are the constant quantitatively, then the ε is only related to ω, $\varepsilon \propto \omega^2$. On the other hand, A single photon is the plane polarized wave, and the area of a photon is inversely proportional to its frequency, therefore the energy of a photon is $E \propto \omega \propto \nu$, thus, $E = h\nu$ (h is the Planck constant).

6. Conclusion

Physical space-time is measurable relative space-time. The theory of absolute space-time, which includes the relative space-time, describes the world with a invariable space-time standard，it can be regarded as a foundational space-time theory; while modern physics describe physical phenomona with light as the measure of space-time, whose standards are variable, and thus, what the modern physics describes deviate from the absolute space-time theory in quantity and the quantitative effects including the relativistic and quantum effects occur. The proper quantities in the relativity are the particular quantities of absolute description. There are certain complementarities between the absolute and quantitative descriptions.

In the final analysis, the quantitative effects rusult from the function of physical vacuum: the space-time standards can vary with the density of physical vacuum[4]. A. Einstein believed that God does not play dice. He is right in essence, but he does not know the existence of quantitative effects. What the quantitative experiments sustain are the viewpoints of N. Bohr because quantitative experiments include the results of quantitative effects. If we found a method of measuring space-time which is uninfluenced by physical vacuum, we should have a new space-time theory.

Objectively, the space is three dimensional, and the time is one dimensional. The relativistic and quantum effects result from the quantitative effects. As for so called high dimensional spaces are to take some independent physical parameters as the spaces, which are only mathematical models and not real spaces, just as the isospin space is not a real space and is a mathematical model describing the charge independence of nuclear force. For according with the facts, these higher dimensional theories stress that the spaces higher than three dimensions are the invisible due to the compactification or strong bend[2]. Moreover the duality relationships between the theories of ten dimensional superstring and eleven dimensional supergravity confuse the concept of dimension and show that these higher dimensions are not real dimensions of the space.

The physics does not depart from the mathematics, but a quantitative relationship is only a presentation. the mathematics can not replace the physics.

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