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A New Perspective on Relativity Theory

By Toshiaki Ishikawa

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A New Perspective on Relativity Theory

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The analysis here began by considering the underlying evidence in the preceding article. First, by considering the starting point of the relativity theory, I discovered that differential equation is hidden in the relativity theory. Since the differential equation has already been obtained, not only the one-dimensional equation of motion but also the two-dimensional equations of motion of the planet and light quantum have already been derived. The results of this detailed analysis prove that "spatial distortion" does not exist, and that the general theory of relativity has no meaning at all in terms of physics. In the end, the entire relativity theory was elucidated for the first time in the world.

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I. Introduction

This essay is designed to explain in detail on the underlying evidence in the preceding article[1)]. Although the preceding article elucidated the overall picture of the relativity theory, there remain many gaps in the explanation of related matters and many questions regarding the development of the theory. The purpose of this essay is to resolve these points.

The work here began by improving the starting point of the relativity theory. It is well known that Dr Einstein started his relativity theory with two principles: the principle of relativity and the principle of the constancy of the velocity of light. First, I consider the first principle, the "principle of relativity." That is, the measured values obtained in each coordinate system are expressed by a "common function" that shows a certain relationship (Lorentz transformation). This principle of relativity is an epoch-making idea that is only allowed for inertial coordinate systems based on the particular theory of relativity (PTR). This is because if there is such a "common function" between the stationary system and the accelerated coordinate system, the acceleration of the accelerated coordinate system should be included in that function. However, since there is no room for the acceleration of the accelerating system to enter the stationary system, there is no "common function" between the stationary system and the accelerated coordinate system.

Next, I will take up the second starting point, the principle of the constancy of the velocity of light. Literally speaking, this means that the velocity of light always remains constant under any circumstances. However, in response to the fact that light rays are curved within the solar system (in a gravitational field), Dr Einstein proposed a "spatial distortion" while still adhering to the "principle of the constancy of the velocity of light." The development of this "spatial distortion" led to the later general

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theory of relativity (GTR). On the other hand, it is known that the velocity of light in a medium is inversely proportional to the refractive index of the medium. The phenomenon in which light rays passing through the atmospheric layer near the ground is curved is called "atmospheric difference," and it is a well-known fact that the velocity of light changes.

In any case, there are two points: the velocity of light is not constant regardless of whether it is in a medium or not, and the "principle of relativity" is valid in the PTR. These will be used as the basis for later theoretical development.

II. Hidden Differential Equation

a) Existence of Differential Equation

It is well known that the PTR was proposed by Dr Einstein in 1905. Dr Einstein proposed the existence of a "common function" when measured values obtained between inertial coordinate systems show a certain relationship (Lorentz transformation), and expressed this as the "principle of relativity." As the second principle that should play a role in determining the functional form of this "common function," he proposed the "principle of the constancy of the velocity of light," which states that the velocity of light is always kept at a constant value. This was the birth of the PTR. This theory attracted a lot of attention around the world because it resolved experimental facts that could not be explained by Newtonian mechanics. As a result, most people believed it blindly and no one questioned it. However, as pointed out in the previous chapter, the velocity of light changes, so the "principle of constancy of the velocity of light" is not appropriate as a starting point for a theoretical system. Therefore, a situation arose in which it was necessary to search for a new second principle of the relativity theory.

The second and most effective principle is "relativity in space (the receding velocity of the coordinate origin of each inertial system are equal)," which has the necessary and sufficient conditions for determining the functional form. Now, let us consider an inertial system that is moving in a straight line at a constant velocity with respect to a stationary system. The image of an inertial system starts with ships, trains, airplanes, etc., and ends with "light." The function F used in the "principle of relativity" is expressed as

$$F = F(t, x, y, z),$$

where time is t and the coordinates are x, y and z. Using this, the principle of relativity is expressed as

$$F(t_0, x_0, y_0, z_0) \equiv F(t_1, x_1, y_1, z_1),$$

where the value of a natural phenomenon measured in the stationary system K_0 system is indicated by the subscript "0," and the value measured in the inertial system K_1 system is indicated by the subscript "1." In fact, the "relativity in space" makes it meaningful to differentiate the equation of the principle of relativity with respect to the receding velocity v. In other words, if the receding velocity v is included in the function F, the equation of the principle of relativity becomes

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$$F(t_0, x_0, y_0, z_0, v) \equiv F(t_1, x_1, y_1, z_1, v). \quad ①$$

On the other hand, the receding velocity usually changes for some reason; if the inertial system is a ship, it is hit by a large wave, or if it is a train or airplane, it is hit by a gust of wind, and so on. Here, if the receding velocity changes slightly (dv), due to "relativity in space," Equation ① becomes

$$F(t_0, x_0, y_0, z_0, v + dv) \equiv F(t_1, x_1, y_1, z_1, v + dv). \quad ②$$

In this case, Equation ① gives a necessary condition and Equation ② gives a sufficient condition. As a result, if we subtract both sides of Equations ① and ② and divide by dv, we get an equation that partially differentiates both sides of Equation ① with respect to v (in this case, the differential operation is not an ordinary differential because the receding velocity has no effect on natural phenomena.). Therefore, as an essential property, the relativity theory has a hidden differential equation, and unless we seek it, the relativity theory can never be solved. And once again, the unnatural aspect of the "principle of the constancy of the velocity of light" becomes clear. In other words, if the inertial system becomes "light," Equation ② does not hold and a differential equation cannot be obtained.

b) *Necessity of Differential Equation*

Dr Einstein won the Nobel Prize in 1921 for his "Light quantum Hypothesis" (when light and electrons collide, the light shocks the electrons). At that time, he famously said, "the light has no weight, but it has impact." However, as a physical fact, the "Light quantum Hypothesis" means that light quanta have the "corpuscular character," which means that light quanta have mass.

The reason Dr Einstein went wrong was that he could not find hidden differential equation. Differential equation always has a constant of integration, and in this case, it is the universal velocity that the velocity is always kept constant. Dr Einstein's mistake was to intuitively replace the universal velocity with the velocity of light. In other words, from the essence of physics, he had to distinguish between the universal velocity and the velocity of light. Expressed as a formula, it is as follows; let the mass of the light quantum be δm, the momentum representing the impact force be p, and the universal velocity and the velocity of light be c and c_0, respectively, then

$$p = \frac{\delta m}{\sqrt{1 - \frac{c_0^2}{c^2}}} \cdot c_0. \quad ③$$

Therefore, when $\delta m > 0$, $c > c_0$. By the way, Einstein's mistake was to adopt $c = c_0$ ("principle of constancy of the velocity of light"). This is because the denominator of Equation ③ is always zero, so we had to set $\delta m = 0$.

III. Derivation of Differential Equation[2)]

This chapter is a Japanese-English translation of an excerpt from the reference literature[2)].

a) Introduction

Looking back at the history of academic fields, not just physics, the following can be said without exception: The level of understanding of the researcher who published the article and the researcher who read it cannot be the same. In some cases, the presenter's intention may be completely misunderstood and communicated to the reader, leading to new developments. As Dr Einstein said, it is important to "understand things in your own way" when it comes to learning. Therefore, it is a very natural idea to discuss alternative interpretations and expressions of the published articles.

Although the purpose of the article (hereafter referred to as Hattori's article) that caused the recent controversy is good, on the other hand, the purpose of the discourse article that refuted it is extremely regrettable. In other words, the attitude of not accepting anything other than Einstein's expressions is the same as what was once said in medieval Europe; "Do not research anything other than what is written in the Bible." After all, a rebuttal should take the form of an academic article, and I believe that the main point is to go into the content of Hattori's article and express objections.

Although it may not resolve the controversy, I will try to develop one aspect of the PTR. The conclusion is similar to Hattori's article and others, but the process leading up to it was designed to be understandable even to science students.

b) Basic Concept

In the relativity theory, we discuss what kind of relational expression holds between the measured values when the motion of a particle is measured separately in two coordinate systems. The two coordinate systems in the PTR can be expressed as follows; for convenience, one is called a stationary system K_0, and the other is an inertial system K_1 that is moving at a constant velocity v with respect to the K_0 system. For example, assume the K_0 system is a coordinate system fixed to the ground, and the K_1 system is a coordinate system fixed to a train that continues to run at a constant velocity. The motion of a ball hit by a baseball batter is measured separately from the ground and from the train, and the measured values are compared.

In the PTR, the "principle of the constancy of the velocity of light" plays an essential role and cannot be ignored, but there is no reason to consider it from the beginning. In other words, I think it is meaningful to discuss where the principle of the constancy of the velocity of light can be used to deepen our understanding of the PTR. In order to do this, in addition to the principle of relativity, the basic premise is the symmetry and relativity in space, and the uniformity of time and space.

c) Deployment

The PTR can be written as the "laws of physics are expressed in an invariant form in any inertial system." Therefore, we need a function to express it. In other words, if the time t, coordinates x, y and z are variables, it is generally set as

$$F = F(t, x, y, z). \quad ④$$

Using this, the particular principle of relativity is given by

$$F(t_0, x_0, y_0, z_0) \equiv F(t_1, x_1, y_1, z_1), \quad ⑤$$

but each variable has the following meanings; the value measured at a certain particle in the K_0 system is the subscript "0," and the value measured in the K_1 system is the subscript "1." By the way, Equation ⑤ shows a certain kind of symmetry because the coordinate axes can be chosen independently. This places a restriction on the form of Equation ④, and

$$F(t, x, y, z) = P(t) + Q(x) + Q(y) + Q(z). \quad ⑥$$

The reason is as follows; for example, when the y and z axes of the K_0 system are parallel to those of K_1 system, and the origin of the K_1 system is moving in the positive direction on the x axis of the K_0 system at a constant velocity v, since it is true $y_1 = y_0$ and $z_1 = z_0$, substituting into Equation ⑤ gives

$$F(t_0, x_0, y_0, z_0) \equiv F(t_1, x_1, y_0, z_0),$$

which does not explicitly include y_0 and z_0, as a result. Considering points with the same x coordinates in the K_0 system, the x coordinates will also be the same in the K_1 system. In other words, in this case, both t and x are not included in the conversion formula for y_0 or z_0. Furthermore, by considering the symmetry of the coordinate axes, it can be written as in Equation ⑥.

So, let us consider about the conversion of the K_0 system and the K_1 system (the time is set to zero when the origins of both overlap). In this case, from Equation ⑥ if it is used as

$$G = G(t, x) = P(t) + Q(x), \quad ⑦$$

the principle of relativity can be expressed instead of Equation ⑤ as

$$G(t_0, x_0) \equiv G(t_1, x_1). \quad ⑧$$

The conversion formula to be found is based on the x coordinate and the time t of a certain particle measured in each system, and can generally be written as

$$x_1 = f(t_0, x_0), \quad t_1 = g(t_0, x_0). \quad ⑨$$

However, we will introduce the following concept here; that is, the constant velocity motion of a particle seen in the K_0 system also appears to be the constant velocity motion in the K_1 system (uniformity of space and time). Therefore, the equation is written as

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$$k \cdot \{f(t_0 + \Delta t_0, x_0 + \Delta x_0) - f(t_0, x_0)\} \equiv$$
$$f(t_0 + k \cdot \Delta t_0, x_0 + k \cdot \Delta x_0) - f(t_0, x_0),$$

and the formula written as g instead of f holds true for any k. From now on, the functions f and g become linear expressions of t_0 and x_0 (proof omitted). However, when the origins $x_0 = 0$ and $x_1 = 0$ are from the initial condition, the times $t_0 = 0$ and $t_1 = 0$ become. Moreover, since $x_0 = v \cdot t_0$ is derived by the origin $x_1 = 0$ of the K₁ system when viewed from the K₀ system, it can be said that x_1 is proportional to $(x_0 - v \cdot t_0)$. Thus, Equation ⑨ is expressed as

$$\left.\begin{aligned} x_1 &= (x_0 - v \cdot t_0) \cdot A(v), \\ t_1 &= (t_0 - B(v) \cdot x_0) \cdot C(v), \end{aligned}\right\} \qquad ⑩$$

where the variables $A(v)$, $B(v)$ and $C(v)$ mean a function of v. Looking at the K₀ system from the K₁ system as a different point of view (relativity in space), we get

$$\left.\begin{aligned} x_0 &= (x_1 + v \cdot t_1) \cdot A(-v), \\ t_0 &= (t_1 - B(-v) \cdot x_1) \cdot C(-v). \end{aligned}\right\}$$

Therefore, since these must hold true, we immediately obtain

$$\left.\begin{aligned} C(v) &= A(v), \\ B(v) &= \frac{A(v) \cdot A(-v) - 1}{v \cdot A(v) \cdot A(-v)}. \end{aligned}\right\} \qquad ⑪$$

All we need to do now is find $A(v)$, but in order to investigate the properties of this function, we focus on the origin of the K₁ system and put it together by substituting a formula $x_0 = v \cdot t_0$ and Equation ⑪ into the second equation of Equation ⑩, we get

$$\frac{t_1}{t_0} = \frac{1}{A(-v)}. \qquad ⑫$$

This shows the relationship between the time in the K₀ and the K₁ systems. Similarly, when the direction of motion of the K₁ system is reversed, it is held as

$$\frac{t_1}{t_0} = \frac{1}{A(v)}.$$

However, it is natural to think that this type of time relationship does not depend on the direction of the motion of the K₁ system (spatial symmetry). Therefore, it can be summarized as

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$$A(v) = A(-v) = A > 0. \quad ⑬$$

At this time, the sign of A was determined based on Equation ⑫: In other words, it is commonly said that the future corresponds to the future, and both t_0 and t_1 have the same sign. Substituting this Equation ⑬ into Equations ⑪ and ⑩, we get

$$B = B(v) = \frac{A^2 - 1}{v \cdot A^2},$$

$$x_1 = (x_0 - v \cdot t_0) \cdot A, \quad t_1 = (t_0 - B \cdot x_0) \cdot A.$$

Now, in order to make it easier to handle mathematically, we will represent the variables $x_1 = x$ and $t_1 = t$, and the ordinary differential with respect to v with dashes $(')$, and $a = A' / A - (A^2 - 1) / v$ is defined. Now, if we consider the identity where the right-hand side of Equation ⑧ is rewritten by Equation ⑦, the left-hand side is expressed by quantities only for the K_0 system , so of course it has nothing to do with v . Of course, it also holds true for v , so if we differentiate both sides with respect to v , we get

$$\left(\frac{\partial t}{\partial v}\right) \cdot \left(\frac{\partial G}{\partial t}\right) + \left(\frac{\partial x}{\partial v}\right) \cdot \left(\frac{\partial G}{\partial x}\right) = 0,$$

and when we put it together, we get

$$\frac{\left(\dfrac{\partial G}{\partial t}\right)}{\left(\dfrac{\partial G}{\partial x}\right)} = \frac{A^2 \cdot t - a \cdot x}{-a \cdot t - A^2 B' \cdot x}.$$

The solution to this kind of differential equation is expressed as

$$G = h(A^2 \cdot t^2 - 2a \cdot tx - A^2 B' \cdot x^2),$$

where h is any one-dimensional function. However, since Equation ⑦ must be satisfied, it is true

$$a = 0 \quad \rightarrow \quad \frac{A'}{A} = \frac{(A^2 - 1)}{v},$$

and this solution can be easily obtained, and

$$\left| \frac{A^2 - 1}{v^2 \cdot A^2} \right| = \text{const.} = \frac{1}{c^2},$$

$$\therefore \left| \frac{A^2 - 1}{A^2} \right| = \left(\frac{v}{c}\right)^2 \equiv \beta^2, \quad ⑭$$

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where c is a constant of integration (the universal velocity) that has the dimension of velocity.

From this, we will divide into three cases. First, when $A^2 = 1$, it corresponds to $c \to \infty$, and

$$F(t, x, y, z) = t, \qquad ⑮$$

when $A^2 > 1$, A is expressed as $A = 1/\sqrt{1-\beta^2}$, and

$$F(t, x, y, z) = c^2 \cdot t^2 - (x^2 + y^2 + z^2),$$

and when $A^2 < 1$, A is expressed as $A = 1/\sqrt{1+\beta^2}$, and

$$F(t, x, y, z) = c^2 \cdot t^2 + x^2 + y^2 + z^2.$$

Without the principle of the constancy of the velocity of light, the discussion cannot proceed any further.

d) *Consideration*

From the results in the previous section, the first thing that can be said is that Equation ⑭ does not use the principle of the constancy of the velocity of light; in other words, it can be obtained by using the fundamental properties of space and time in addition to the principle of relativity. According to Equation ⑭, there is a possibility that there is a velocity v that is always observed as a constant value for any inertial system. Given that Hattori's article also asserts this point, it is clearly inappropriate to describe it as an "alternative axiom" to the "principle of the constancy of the velocity of light." The "principle of the constancy of the velocity of light" is necessary for the subsequent expansion of Equation ⑭. By the way, if the velocity of light in vacuum is c_0, then the "principle of the constancy of the velocity of light" can be formulated as

$$c = c_0.$$

This immediately eliminates the Galilean transformation of Equation ⑮.

e) *End Note*

I tried to develop one aspect of the PTR in the form of an article, using the very recent debate as an issue. Criticizing the style of debate seems to be imposing one's personal preferences, but emotional debates in various academic journals only leave an ugly impression. It seems that the manner in which debates are held expresses the specific characteristics of an academic journal and, by extension, that academic society. In order to prevent this from becoming an argument for the sake of argument, I wanted to help science university students deepen their understanding of the PTR through discussion with their teachers.

IV. Consideration of "Spatial Distortion"

a) *The Origin of "Spatial Distortion"*

Originally, the "spatial distortion" was proposed by Dr Einstein, but the fact that the "spatial distortion" does not exist can only be explained logically;

When the x -axes of the stationary and inertial systems overlap and the y -axes of both are parallel to each other, consider the x -coordinate of a point on the y -axis of the inertial system. At this time, if there is a gravity source on the x -axis, the space will be distorted, so there is a possibility that the x -coordinate of a point on the y -axis of the inertial system will vary depending on the value of the y -coordinate. René Descartes once founded the "analytical geometry," which is the study of geometry through algebraic calculations, representing the positions of points using coordinates. In other words, according to this, the distance from a point on the y -axis of the inertial system to the y -axis of the stationary system defines the x -coordinate of that point, so the x -coordinate is unrelated to the "spatial distortion." Therefore, as long as the coordinates of a point are expressed in Cartesian coordinates, the "spatial distortion" cannot be expressed. In short, the "spatial distortion" does not exist in principle.

On the other hand, there are materials that can determine the presence or absence of the "spatial distortion";

Now, in the pair of the stationary system (subscript "0") and the inertial system (subscript "1") treated above, the principle of relativity is expressed by Equation ⑤, but under the condition of $y_0 = y_1$ and $z_0 = z_1$, it is true

$$F(t_0, x_0, y_0, z_0) \equiv F(t_1, x_1, y_0, z_0). \qquad ⑯$$

In fact, this formula is the only material that can be used to determine the presence or absence of the "spatial distortion." In other words, there are two cases; [Skew]=[As a result, identity ⑯ explicitly includes y_0 and z_0], or [Flat]=[As a result, identity ⑯ does not include y_0 and z_0]. In other words, the fact that the coordinate x_1 depends on y_0 and z_0 , as in the apparent Equation ⑯, is [Skew], and is a case where the "spatial distortion" exists. Conversely, if the coordinate x_1 does not depend on y_0 or z_0 , there is no distortion, and there is no "spatial distortion." In the history of physics, there is no evidence that anyone has dealt with [Skew].

As is already clear, even if the "spatial distortion" exists, it will not logically appear in "coordinates." Therefore, in order to express the "spatial distortion," the length of the space along the distortion or a physical quantity that can replace it is required. Nevertheless, Dr Einstein did not try to find such physical quantities, and although he said that the "spatial distortion" cannot be expressed by a formula, but as a formula that took into account the "spatial distortion" he produced Equation (18) of the advance of the planetary perihelion (hereinafter, the formula numbers in parentheses correspond to the formula numbers in the reference literature[1)]).

b) A Study on "Spatial Distortion"

Here, as an example of analyzing the "spatial distortion", let's consider generalizing Equation ⑥;

$$F(t,x,y,z) = P(t) + Q(x) + Q(y) + Q(z) + R(tx) + R(ty) + R(tz)$$
$$+S(t^2x) + S(t^2y) + S(t^2z) + T(xy) + T(yz) + T(zx) + \cdots\cdots.$$

There are countless possible general functions. Therefore, we will limit ourselves to dealing with the cases from the first function P to the function R in this equation as a representative example that can be considered innumerably. Then, since the principle of relativity is given by the Equation ⑤, it is expressed as

$$P(t_0)+Q(x_0)+Q(y_0)+Q(z_0)+R(t_0\cdot x_0)+R(t_0\cdot y_0)+R(t_0\cdot z_0)\equiv$$
$$P(t_1)+Q(x_1)+Q(y_1)+Q(z_1)+R(t_1\cdot x_1)+R(t_1\cdot y_1)+R(t_1\cdot z_1).$$

Applying this formula to Equation ⑯, we get

$$P(t_0)+Q(x_0)+R(t_0\cdot x_0)+R(t_0\cdot y_0)+R(t_0\cdot z_0)\equiv$$
$$P(t_1)+Q(x_1)+R(t_1\cdot x_1)+R(t_1\cdot y_0)+R(t_1\cdot z_0).$$

This is the topic of [Skew] when I explained the previous Equation ⑯. Therefore, the only conditions where the "spatial distortion" does not exist are $R(tx)\equiv 0$, $R(ty)\equiv 0$ and $R(tz)\equiv 0$.

This result is utilized as an important basis for deriving hidden differential equations.

V. Content Rationale for the Preceding Article[1)]

a) Momentum of Particle and Light Quantum

From quantum mechanics, $E = h\nu$, and from the PTR,

$$E = m^*c^2. \;\rightarrow\; m^* = \frac{E}{c^2}, \tag{9}$$

For a Particle;

$$m^* = \frac{m}{\eta},\ \eta = \sqrt{1-\frac{v^2}{c^2}},\ v = c\cdot\sqrt{1-\eta^2},\quad \rightarrow\quad m^*v = \frac{E}{c}\cdot\sqrt{1-\eta^2},$$
$$\left(\frac{E}{c}\right)^2 - p^2 = m^2\cdot c^2,\quad \rightarrow\quad p = \sqrt{\left(\frac{E}{c}\right)^2 - m^2\cdot c^2} = \frac{E}{c}\cdot\sqrt{1-\eta^2} = m^*v.$$

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For a Light Quantum;

$$m^{*}=\frac{\delta m}{\delta\eta},\ \delta\eta=\sqrt{1-\frac{c_0^2}{c^2}},\ c_0=c\cdot\sqrt{1-\delta\eta^2},\quad\rightarrow\quad m^{*}c_0=\frac{E}{c}\cdot\sqrt{1-\delta\eta^2},$$

$$\left(\frac{E}{c}\right)^2-p^2=\delta m^2\cdot c^2,\quad\rightarrow\quad p=\sqrt{\left(\frac{E}{c}\right)^2-\delta m^2\cdot c^2}=\frac{E}{c}\cdot\sqrt{1-\delta\eta^2}=m^{*}c_0,$$

$$c_0=\lambda\cdot\nu=\frac{h\nu}{hk}=\frac{E}{hk},\quad\rightarrow\quad E=hk\cdot c_0,$$

$$\therefore\ p=m^{*}c_0=\frac{E}{c^2}\cdot c_0=\frac{hk\cdot c_0}{c^2}\cdot c_0=hk\cdot\frac{c_0^2}{c^2}=hk\cdot(1-\delta\eta^2).$$

b) Motion Equation of Light Quantum (one-dimensional)

$$\frac{d}{dt}\left\{\left(\frac{\delta m}{\delta\eta}\right)\cdot\dot{x}\right\}=-G\frac{M\cdot\delta m}{x^2},\quad\rightarrow\quad\frac{d}{dt}\left\{\left(\frac{\delta m}{\delta\eta}\right)\cdot c_0\right\}=-G\frac{M\cdot\delta m}{x^2},$$

$$\frac{d}{dt}\left(\frac{\delta m}{\delta\eta}\right)=-G\frac{M\cdot\delta m}{c\cdot x^2},\quad\rightarrow\quad x=\sqrt{-G\frac{M\cdot\delta m}{c}\Big/\frac{d}{dt}\left(\frac{\delta m}{\delta\eta}\right)},$$

$$\dot{x}=c_0=\frac{d}{dt}\left\{\sqrt{-G\frac{M\cdot\delta m}{c}\Big/\frac{d}{dt}\left(\frac{\delta m}{\delta\eta}\right)}\right\},\quad\rightarrow\quad t+T=\sqrt{-G\frac{M\cdot\delta m}{c^3}\Big/\frac{d}{dt}\left(\frac{\delta m}{\delta\eta}\right)},$$

$$\frac{d}{dt}\left(\frac{\delta m}{\delta\eta}\right)=\frac{GM\cdot\delta m}{c^3}\cdot\frac{d}{dt}\left\{\frac{1}{(t+T)}\right\},\tag{13}$$

$$\frac{d}{dt}\left(\frac{1}{\delta\eta}\right)=\frac{GM}{c^3}\cdot\frac{d}{dt}\left\{\frac{1}{(t+T)}\right\},\quad\rightarrow\quad\frac{\delta\eta_0'}{\delta\eta_0^2}=\frac{GM}{c^3T^2},\quad\rightarrow\quad\frac{\sqrt{\delta\eta_0'}}{\delta\eta_0}=\sqrt{\frac{GM}{c^3}}\cdot\frac{1}{T},$$

$$\left(\frac{1}{\delta\eta}-\frac{1}{\delta\eta_0}\right)=\frac{GM}{c^3}\cdot\left\{\frac{1}{(t+T)}-\frac{1}{T}\right\}=\frac{GM}{c^3}\cdot\frac{-t}{T(t+T)}=\sqrt{\frac{GM}{c^3}}\cdot\frac{\sqrt{\delta\eta_0'}}{\delta\eta_0}\cdot\frac{-t}{(t+T)},$$

$$\therefore\ \frac{\delta\eta_0}{\delta\eta}=1-\sqrt{\frac{GM\cdot\delta\eta_0'}{c^3}}\cdot\frac{t}{(t+T)},$$

c) Motion Equation of Particle (two-dimensional)

$$\left.\begin{aligned}\frac{d}{dt}\left\{\left(\frac{\dot{r}}{\eta}\right)\cdot\cos\theta-\left(\frac{r}{\eta}\right)\cdot\sin\theta\cdot\dot{\theta}\right\}&=-\frac{GM}{r^2}\cdot\cos\theta,\\ \frac{d}{dt}\left\{\left(\frac{\dot{r}}{\eta}\right)\cdot\sin\theta+\left(\frac{r}{\eta}\right)\cdot\cos\theta\cdot\dot{\theta}\right\}&=-\frac{GM}{r^2}\cdot\sin\theta,\end{aligned}\right\}\tag{15}$$

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$$\therefore \frac{d}{dt}\left(\frac{\dot r}{\eta}\right)\cdot\cos\theta-\left(\frac{\dot r}{\eta}\right)\cdot\sin\theta\cdot\dot\theta-\frac{d}{dt}\left(\frac{r}{\eta}\right)\cdot\sin\theta\cdot\dot\theta$$

$$-\left(\frac{r}{\eta}\right)\cdot\cos\theta\cdot\dot\theta^2-\left(\frac{r}{\eta}\right)\cdot\sin\theta\cdot\ddot\theta=-\frac{GM}{r^2}\cdot\cos\theta,$$

$$\therefore \frac{d}{dt}\left(\frac{\dot r}{\eta}\right)\cdot\sin\theta+\left(\frac{\dot r}{\eta}\right)\cdot\cos\theta\cdot\dot\theta+\frac{d}{dt}\left(\frac{r}{\eta}\right)\cdot\cos\theta\cdot\dot\theta$$

$$-\left(\frac{r}{\eta}\right)\cdot\sin\theta\cdot\dot\theta^2+\left(\frac{r}{\eta}\right)\cdot\cos\theta\cdot\ddot\theta=-\frac{GM}{r^2}\cdot\sin\theta,$$

$$\left(\frac{\dot r}{\eta}\right)\cdot\dot\theta+\frac{d}{dt}\left(\frac{r}{\eta}\right)\cdot\dot\theta+\left(\frac{r}{\eta}\right)\cdot\ddot\theta=0,$$

$$\left(\frac{\dot r}{\eta}+(\frac{\dot r}{\eta}-\frac{r\cdot\eta'}{\eta^2})\right)\cdot\dot\theta+\left(\frac{r}{\eta}\right)\cdot\ddot\theta=0,$$

$$\left(2\dot r-\frac{r\cdot\eta'}{\eta}\right)\cdot\frac{1}{r}+\frac{\ddot\theta}{\dot\theta}=0,$$

$$\frac{2\dot r}{r}-\frac{\eta'}{\eta}+\frac{\ddot\theta}{\dot\theta}=0,\quad\rightarrow\quad\eta=Kr^2\dot\theta,$$

$$\frac{d}{dt}\left(\frac{\dot r}{\eta}\right)-\frac{r\cdot\dot\theta^2}{\eta}=-\frac{GM}{r^2},$$

$$\frac{d}{dt}\left(\frac{\dot r}{\eta}\right)-\frac{\dot\theta}{Kr}=-\frac{GM}{r^2},$$

$$\frac{d}{dt}\left(\frac{\dot r}{\eta}\right)-\frac{\eta}{K^2r^3}=-\frac{GM}{r^2},$$

$$\because\frac{r\cdot\dot\theta^2}{\eta}=\frac{\dot\theta}{Kr}=\frac{\eta}{K^2r^3},$$

$$\left.\begin{aligned}&\dot r^2+r^2\dot\theta^2=v^2=c^2\cdot(1-\eta^2),\\&1-\eta^2=\frac{\dot r^2}{c^2}+\frac{r^2}{c^2}\cdot\left(\frac{\eta}{Kr^2}\right)^2=\frac{\dot r^2}{c^2}+\frac{\eta^2}{c^2K^2r^2},\end{aligned}\right\}\quad\rightarrow\quad\eta^2=\frac{\left(1-\frac{\dot r^2}{c^2}\right)}{\left(1+\frac{1}{c^2K^2r^2}\right)},$$

$$\left.\begin{aligned}&p=1-\frac{\dot r^2}{c^2},\quad\rightarrow\quad p'=-\frac{2\dot r\ddot r}{c^2},\\&q=1+\frac{1}{c^2K^2r^2},\quad\rightarrow\quad q'=-\frac{2\dot r}{c^2K^2r^3},\end{aligned}\right\}\quad\rightarrow\quad\eta=\sqrt{\frac{p}{q}}=\frac{\sqrt p}{\sqrt q},$$

$$\text{Left side}=\frac{d}{dt}\left(\frac{\dot r}{\eta}\right)-\frac{\eta}{K^2r^3}=\frac{d}{dt}\left(\frac{\dot r\cdot\sqrt q}{\sqrt p}\right)-\frac{\eta}{K^2r^3},$$

$$=\frac{\ddot r\cdot\sqrt q}{\sqrt p}+\frac{\dot r\cdot q'}{2\sqrt p\cdot\sqrt q}-\frac{\dot r\cdot\sqrt q\cdot p'}{2\sqrt{p^3}}-\frac{\eta}{K^2r^3},$$

$$=\frac{\ddot r\cdot\sqrt q}{\sqrt p}-\frac{\dot r^2}{c^2K^2r^3\cdot\sqrt{pq}}+\frac{\dot r^2\cdot\ddot r\sqrt q}{c^2\cdot\sqrt{p^3}}-\frac{\sqrt p}{K^2r^3\cdot\sqrt q},$$

$$=\frac{\ddot r\cdot\sqrt q}{\sqrt{p^3}}\cdot\left(p+\frac{\dot r^2}{c^2}\right)-\frac{1}{K^2r^3\cdot\sqrt{pq}}\cdot\left(\frac{\dot r^2}{c^2}+p\right),$$

$$= \frac{\ddot{r}\cdot\sqrt{q}}{\sqrt{p^3}} - \frac{1}{K^2r^3\cdot\sqrt{pq}} = \frac{\sqrt{q}}{\sqrt{p^3}}\cdot\left(\ddot{r} - \frac{\sqrt{p^3}}{K^2r^3\cdot\sqrt{pq}\cdot\sqrt{q}}\right),$$

$$= \frac{\sqrt{q}}{\sqrt{p^3}}\cdot\left(\ddot{r} - \frac{p}{K^2r^3\cdot q}\right) = \frac{\sqrt{q}}{\sqrt{p^3}}\cdot\left(\ddot{r} - \frac{\eta^2}{K^2r^3}\right) = \frac{\sqrt{q}}{\sqrt{p^3}}\cdot(\ddot{r} - r\cdot\dot{\theta}^2),$$

$$\therefore \ddot{r} - r\cdot\dot{\theta}^2 = -\frac{GM}{r^2}\cdot\frac{\sqrt{p^3}}{\sqrt{q}} = -\frac{GM}{r^2}\cdot\sqrt{\left(1-\frac{\dot{r}^2}{c^2}\right)^3\Big/\left(1+\frac{1}{c^2K^2r^2}\right)}, \tag{16}$$

d) Advance of Planetary Perihelion

Newtonian Mechanics;

$$r = \frac{\pm a(1-e^2)}{(1+e\cdot\cos\theta)}, \qquad R = \pm a(1-e), \quad ; \quad \text{Distance of Perihelion}(>0)$$

$$\frac{R(1+e)}{r} = 1 + e\cdot\cos\theta, \qquad Kr^2\dot{\theta} = 1,$$

$$-\frac{R(1+e)}{r^2}\cdot\dot{r} = -e\cdot\sin\theta\cdot\dot{\theta}, \quad\rightarrow\quad KR(1+e)\dot{r} = e\cdot\sin\theta,$$

$$KR(1+e)\ddot{r} = e\cdot\cos\theta\cdot\dot{\theta} = \left\{\frac{R(1+e)}{r} - 1\right\}\cdot\dot{\theta}, \quad\rightarrow\quad KR(1+e)\left(\ddot{r} - \frac{\dot{\theta}}{Kr}\right) = -\dot{\theta},$$

$$\ddot{r} - r\dot{\theta}^2 = -\frac{\dot{\theta}}{KR(1+e)} = -\frac{GM}{r^2}, \quad\rightarrow\quad \sqrt{R(1+e)GM} = r^2\dot{\theta} = \frac{1}{K},$$

$$\ddot{r} - r\dot{\theta}^2 = -\frac{GM}{r^2}\cdot\sqrt{\left(1-\frac{\dot{r}^2}{c^2}\right)^3\Big/\left(1+\frac{1}{c^2K^2r^2}\right)}, \tag{16}$$

$$\ddot{r} - r\dot{\theta}^2 \approx -\frac{GM}{r^2}\cdot\left(1-\frac{3\dot{r}^2}{2c^2}\right)\cdot\left(1-\frac{1}{2c^2K^2r^2}\right) \approx -\frac{GM}{r^2} + \frac{3GM}{2c^2}\cdot\frac{\dot{r}^2}{r^2} + \frac{GM}{2c^2K^2}\cdot\frac{1}{r^4},$$

$$\therefore \frac{-\dot{\theta}}{KR(1+e)} = \frac{3GM}{2c^2}\cdot < \frac{\dot{r}^2}{r^2} > + \frac{GM}{2c^2K^2}\cdot < \frac{1}{r^4} >,$$

$$= \frac{3GM}{2c^2K^2R^4(1+e)^4}\cdot < e^2\cdot\sin^2\theta\cdot(1+e\cdot\cos\theta)^2 >$$

$$+ \frac{GM}{2c^2K^2R^4(1+e)^4}\cdot < (1+e\cdot\cos\theta)^4 >,$$

$$= \frac{GM}{2c^2K^2R^4(1+e)^4}\cdot < 3e^2\cdot\sin^2\theta\cdot(1+e\cdot\cos\theta)^2 + (1+e\cdot\cos\theta)^4 >,$$

$$< 3e^2 \cdot \sin^2\theta \cdot (1+e\cdot\cos\theta)^2 + (1+e\cdot\cos\theta)^4 >$$

$$=< 3e^2 \cdot \sin^2\theta \cdot (1+e^2\cdot\cos^2\theta) + (1+6e^2\cdot\cos^2\theta + e^4\cdot\cos^4\theta) >,$$

$$=< 3e^2 \cdot (\tfrac{1}{2} + \tfrac{e^2}{4}\cdot\tfrac{1}{2}) + \{1+3e^2+\tfrac{e^4}{4}\cdot(1+\cos 2\theta)^2\} >,$$

$$= \tfrac{3}{2}e^2 + \tfrac{3}{8}e^4 + 1 + 3e^2 + \tfrac{e^4}{4}\cdot(1+\tfrac{1}{2}),$$

$$= 1 + \tfrac{9}{2}\cdot e^2 + \tfrac{3}{4}\cdot e^4,$$

$$\frac{-\dot{\theta}}{KR(1+e)} = \frac{GM\cdot(1+\frac{9}{2}\cdot e^2+\frac{3}{4}\cdot e^4)}{2c^2K^2\cdot R^4(1+e)^4},$$

$$\therefore -\dot{\theta} = \frac{GM\cdot(1+\frac{9}{2}\cdot e^2+\frac{3}{4}\cdot e^4)}{2c^2K\cdot R^3(1+e)^3} = \frac{(GM)^{3/2}\cdot(1+\frac{9}{2}\cdot e^2+\frac{3}{4}\cdot e^4)}{2c^2\cdot a^{5/2}\cdot(1-e^2)^{5/2}}, \qquad (17)$$

e) Calculation Example of Advance of Planetary Perihelion

Let ω be the angular velocity of the planetary perihelion movement, and let the direction of an orbital rotation be positive. In line with the GTR, the advance of the planetary perihelion for every rotation (where T is an orbital period) gives the following:

$$\omega = \left(\frac{2\pi}{T}\right)\cdot\frac{3GM}{c^2a\cdot\sqrt{1-e^2}}. \qquad (18)$$

On the other hand, in the PTR, the angular velocity gives

$$\omega = (-\dot{\theta}) = \frac{(GM)^{3/2}\cdot(1+\frac{9}{2}\cdot e^2+\frac{3}{4}\cdot e^4)}{2c^2\cdot a^{5/2}\cdot(1-e^2)^{5/2}}. \qquad (17)$$

Examples of calculation of ω are shown in Table 1 for the three inner planets.

Table 1: Calculated Values of ω (a 100-year total)

Planet	GTR	PTR
Mercury	$42''.0610406$	$9''.106565107$
Venus	$8''.624605961$	$1''.43795977$
Earth	$3''.838082181$	$0''.640840427$

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$\boxed{1}$ $c = 29.9792458 \times 10^{4+3} (\mathrm{m/s})$,

$\boxed{2}$ $GM_s = 1.32712440041 \times 10^{20} (\mathrm{m^3/s^2})$,

$\boxed{3}$ $1(\mathrm{AU}) = 1.49597870700 \times 10^{11} (\mathrm{m})$,

$\boxed{4}$ $1(\mathrm{rad/s}) = 6.509083065 \times 10^{14} (''/\mathrm{century})$,

$$= \left(\frac{180}{\pi} \times 3600 \right) \times (100 \times 365.24219 \times 24 \times 3600),$$

Table 2: Orbital Constants

	Mercury	Venus	Earth
$a(\mathrm{AU})$	0.3871	0.7233	1
$\boxed{5}$ $a(\mathrm{m})$	$5.790933575 \times 10^{10}$	$1.082041399 \times 10^{11}$	$1.49597870700 \times 10^{11}$
$\boxed{6}$ e	0.2056	0.0068	0.0167
$T(\mathrm{year})$	0.24085	0.61521	1.00004
$\boxed{7}$ $T(\mathrm{s})$	$7.600485438 \times 10^{6}$	$1.941413596 \times 10^{7}$	$3.155818749 \times 10^{7}$

f) Equation of Motion of Light Quantum (two-dimensional)

$$\left.\begin{aligned} \frac{d}{dt}\left(\frac{\dot{r} \cdot \cos\theta - r \cdot \sin\theta \cdot \dot{\theta}}{\delta\eta} \right) &= -\frac{GM}{r^2} \cdot \cos\theta, \\ \frac{d}{dt}\left(\frac{\dot{r} \cdot \sin\theta + r \cdot \cos\theta \cdot \dot{\theta}}{\delta\eta} \right) &= -\frac{GM}{r^2} \cdot \sin\theta, \end{aligned}\right\} \tag{15}$$

$$\frac{d}{dt}\left(\frac{\dot{r}}{\delta\eta} \right) \cdot \cos\theta - \frac{\dot{r}}{\delta\eta} \cdot \sin\theta \cdot \dot{\theta} - \frac{d}{dt}\left(\frac{r}{\delta\eta} \right) \cdot \sin\theta \cdot \dot{\theta}$$

$$-\frac{r}{\delta\eta} \cdot \cos\theta \cdot \dot{\theta}^2 - \frac{r}{\delta\eta} \cdot \sin\theta \cdot \ddot{\theta} = -\frac{GM}{r^2} \cdot \cos\theta,$$

$$\frac{d}{dt}\left(\frac{\dot{r}}{\delta\eta} \right) \cdot \sin\theta + \frac{\dot{r}}{\delta\eta} \cdot \cos\theta \cdot \dot{\theta} + \frac{d}{dt}\left(\frac{r}{\delta\eta} \right) \cdot \cos\theta \cdot \dot{\theta}$$

$$-\frac{r}{\delta\eta} \cdot \sin\theta \cdot \dot{\theta}^2 + \frac{r}{\delta\eta} \cdot \cos\theta \cdot \ddot{\theta} = -\frac{GM}{r^2} \cdot \sin\theta,$$

$$\frac{\dot r}{\delta\eta}\cdot\dot\theta+\frac{d}{dt}\left(\frac{r}{\delta\eta}\right)\cdot\dot\theta+\frac{r}{\delta\eta}\cdot\ddot\theta=0,$$

$$\left(\frac{\dot r}{\delta\eta}+\left(\frac{\dot r}{\delta\eta}-\frac{r\cdot\delta\eta'}{\delta\eta^2}\right)\right)\cdot\dot\theta+\frac{r}{\delta\eta}\cdot\ddot\theta=0,$$

$$\left(2\dot r-\frac{r\cdot\delta\eta'}{\delta\eta}\right)\cdot\frac{1}{r}+\frac{\ddot\theta}{\dot\theta}=0,$$

$$\therefore\frac{2\dot r}{r}-\frac{\delta\eta'}{\delta\eta}+\frac{\ddot\theta}{\dot\theta}=0,\quad\to\quad\delta\eta=Kr^2\dot\theta,$$

$$\frac{d}{dt}\left(\frac{\dot r}{\delta\eta}\right)-\frac{r}{\delta\eta}\cdot\dot\theta^2=-\frac{GM}{r^2},$$

$$\frac{d}{dt}\left(\frac{\dot r}{\delta\eta}\right)-\frac{\dot\theta}{Kr}=-\frac{GM}{r^2},$$

$$\frac{d}{dt}\left(\frac{\dot r}{\delta\eta}\right)-\frac{\delta\eta}{K^2r^3}=-\frac{GM}{r^2},$$

$$\because\frac{r}{\delta\eta}\cdot\dot\theta^2=\frac{\dot\theta}{Kr}=\frac{\delta\eta}{K^2r^3},$$

$$\left.\begin{aligned}&\dot r^2+r^2\dot\theta^2=c_0^2=c^2\cdot(1-\delta\eta^2),\\&1-\delta\eta^2=\frac{\dot r^2}{c^2}+\frac{r^2}{c^2}\cdot\left(\frac{\delta\eta}{Kr^2}\right)^2=\frac{\dot r^2}{c^2}+\frac{\delta\eta^2}{c^2K^2r^2},\end{aligned}\right\}\quad\to\quad\delta\eta^2=\frac{\left(1-\frac{\dot r^2}{c^2}\right)}{\left(1+\frac{1}{c^2K^2r^2}\right)},$$

$$\left.\begin{aligned}&p=1-\frac{\dot r^2}{c^2},\qquad p'=-\frac{2\dot r\ddot r}{c^2},\\&q=1+\frac{1}{c^2K^2r^2},\qquad q'=-\frac{2\dot r}{c^2K^2r^3},\end{aligned}\right\}\quad\to\quad\delta\eta=\sqrt{\frac{p}{q}}=\frac{\sqrt p}{\sqrt q},$$

Left side $=\dfrac{d}{dt}\left(\dfrac{\dot r}{\delta\eta}\right)-\dfrac{\delta\eta}{K^2r^3}=\dfrac{d}{dt}\left(\dfrac{\dot r\sqrt q}{\sqrt p}\right)-\dfrac{\delta\eta}{K^2r^3},$

$$=\left(\frac{\ddot r\sqrt q}{\sqrt p}+\frac{\dot r q'}{2\sqrt p\cdot\sqrt q}-\frac{\dot r\sqrt q}{2\sqrt{p^3}}\cdot p'\right)-\frac{\delta\eta}{K^2r^3},$$

$$=\frac{\ddot r\sqrt q}{\sqrt p}-\frac{\dot r^2}{c^2K^2r^3\cdot\sqrt{pq}}+\frac{\dot r^2\ddot r\sqrt q}{c^2\sqrt{p^3}}-\frac{\sqrt p}{K^2r^3\cdot\sqrt q},$$

$$=\frac{\ddot r\sqrt q}{\sqrt{p^3}}\cdot\left(p+\frac{\dot r^2}{c^2}\right)-\frac{1}{K^2r^3\cdot\sqrt{pq}}\cdot\left(\frac{\dot r^2}{c^2}+p\right),$$

$$=\frac{\ddot r\sqrt q}{\sqrt{p^3}}-\frac{1}{K^2r^3\cdot\sqrt{pq}}=\frac{\sqrt q}{\sqrt{p^3}}\cdot\left(\ddot r-\frac{\sqrt{p^3}}{K^2r^3\cdot\sqrt{pq}\cdot\sqrt q}\right),$$

$$=\frac{\sqrt q}{\sqrt{p^3}}\cdot\left(\ddot r-\frac{p}{K^2r^3q}\right)=\frac{\sqrt q}{\sqrt{p^3}}\cdot\left(\ddot r-\frac{\delta\eta^2}{K^2r^3}\right)=\frac{\sqrt q}{\sqrt{p^3}}\cdot(\ddot r-r\dot\theta^2),$$

$$\therefore\ddot r-r\dot\theta^2=-\frac{GM}{r^2}\cdot\left[\left[\frac{\sqrt{p^3}}{\sqrt q},\ \delta\eta^3\cdot q,\ \delta\eta\cdot p,\ \delta\eta^n\right]\right],\qquad(16),(19)$$

g) Consideration

Since Dr Einstein could not escape from the principle of the constancy of the velocity of light, he had no choice but to always make the mass of a light quantum zero. However, since light quantum exist within the solar system (in a gravitational field), it is abnormal in physics that the equation of motion for light quantum cannot be expressed. In reality, the equation of motion of Equation (19) holds true only for light quantum that have a near universal velocity.

On the other hand, planets have large masses, so it is puzzling that Dr Einstein did not discuss the equation of motion of planets. In other words, he did not solve the differential equation (15), which is an extension of Newtonian mechanics. For this reason, he was unable to obtain the subsequent equation of motion of the planet (16) and the exact solution to the advance of the planetary perihelion (17). Instead, Dr Einstein constructed a new GTR that incorporates "spatial distortion." In other words, they interpreted that the reason why advance of Mercury's perihelion exceeded the value predicted by Newtonian mechanics was that space was distorted by the Sun's strong gravity. As a result, he derived Equation (18) for the advance of the planetary perihelion according to the GTR.

The GTR does not explain the value of the advance of the planetary perihelion. The problem is that the GTR does not meet the necessary conditions. This is because the observed value of the advance of the planetary perihelion, minus the predicted value of Newtonian mechanics, is expressed as the product of the calculated value of Equation (18) and the planet's orbital eccentricity (reference to Table 1 in the preceding article[1)]). Dr Einstein never explained the situation involving orbital eccentricity.

In contrast, the PTR has proven that the necessary conditions are met for the most famous observation of the advance of the Mercury's perihelion in the history of physics. That is, Equation (17) is a correct equation, and Equation (18) is a meaningless equation. Therefore, it has been proven once again that the "spatial distortion" does not exist and that the GTR is meaningless in terms of physics.

VI. End Note

What is noteworthy is that physics has reached a qualitatively completely new stage. In other words, the universal velocity as a physical constant is expressed by one limit value (Equation (11) of the preceding article[1)]). In other words, there are physical constants that can never be obtained from experiments.

In the history of physics, the "Riemannian geometry" was adopted when the "spatial distortion" was discussed. In other words, this means abandoning the "Euclidean geometry" and is unacceptable in terms of physics.

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