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Time/Space and Inertial System Reconsidered Based on the Adaptive Dynamical View

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Abstract

We have succeeded in 2-slit interference simulation by assuming that a travelling particle interacts with its environment, getting information on the environmental condition according to the adaptive dynamics by Ohya, thus proposed the possibility that the entanglement comes from the interaction with the environment (Ando *et al.*, 2023). This concept means that there should be no isolated or inertial system other than our unique universe space. Taking this message into account and assuming that the signal velocity is constant against our unique universe space, we reconsidered the inertial system and relativity theory by Galilei and Einstein and found several misunderstandings and errors. Time delay and Lorentz shrinkage were derived similarly to the prediction by special relativity theory, but Lorentz transformation and 4-dimensional time/space view were not. They must have implicitly and unconsciously assumed that any signals transfer information without giving any influences to any systems different from our adaptive dynamical view. We propose that their relativity theories should be reinterpreted in view of adaptive dynamics.

Keywords

Relativity Theory, Inertial System, Adaptive Dynamics, Interconnection

1. Introduction

In 1905, Einstein published his special relativity theory [1] [2]. It has been widely accepted that signal (light) velocity is constant in any inertial systems and that according to the 4-dimensional view of time/space, Lorentz transformation, Lorentz shrinkage, and time delay in a moving inertial system [3] should be observed when compared to those in another inertial system moving with different constant velocity. However, the experimental confirmation of the light velocity being constant has been difficult and the adequateness of 4-dimensional view of time/space has not been proven. The relativity theory is built on the basis of Galilei's inertial system [4] that without force working, an object keeps moving straight with constant velocity; this is an inertial system and there can be many such systems in our universe. But we do not understand well whether there are such independent inertial systems in our universe. Moreover, the general relativity theory proposed that mass [5] produces the distortion in time/space, which in turn makes us doubt the existence of any isolated or inertial systems in our universe.

In information transduction of biology, biosystems behave non-Kolmogorovian or quantum-like due to the interaction networks [6]: Any members in the system are not isolated, but rather are in the entangled state influenced by the interaction of each other with more than two interactions at a time on at least one member. Ohya [7] proposed the adaptive dynamics as the analysis approach: It proposes that environment is important and essential for every existence and every event, which gives rise to the observation dependence, because observation itself changes the environment. Then, it claims that environmental conditions should be explicitly taken into account when considering any physical processes, including quantum mechanics. In other words, everything is interconnected and any signals (interactions) should influence the environment. This is typically true in biological systems and is also useful in the study of physical systems, especially to explain the observation dependence in quantum mechanics [8] [9].

In our previous report [9], we succeeded in the simulation to reproduce 2-slit interference by assuming that a particle is influenced by the interaction with universe and its environment. It does not necessarily prove that the principle of quantum mechanics is the same as that of adaptive dynamics, but it suggests the possibility. If the stochastic behavior of a particle in quantum mechanics is really due to the entanglement by the interaction with everything in its environment, then there should be no inertial system other than the universe space: Because any system is always watching the outside universe with any kinds of interacting particles (such as photons and gravitons), and vice versa [8] [9]. This in turn suggests the disagreement with the special relativity theory proposed by Einstein: Instead, everything or everyone is interconnected, never inertial.

Based on the above consideration, here we studied the situation that our universe space is a unique reference frame and signal velocity is constant against the universe space. Then, we found that most of the predictions by special relativity theory can be derived, including the time delay, Lorentz shrinkage, and mass/energy equality, but Lorentz transformation or velocity transformation is not the same as the results of special relativity theory. And by our assumptions, the apparently contradictory annoyances in the special relativity theory of respective time delays of two moving systems and the simultaneity discrepancy seem to be avoided.

There have been many controversies on time/space view since Galilei's inertial system [4] and Newton's absolute time/space [10]. Einstein's relativity theories [1] [2] [5] finally seemed to settle it down. But now, as introduced above, we think it should be revisited and reinterpreted according to adaptive dynamics. The present-day astronomy considers comoving frame and cosmic time [11] as unique space and time of our universe, similar to our proposal in this study, but they are not based on the adaptive dynamics and rather based on the relativity theories admitting many inertial systems in our universe. So far, it seems that there has been no proposal on unique space and time discarding the Galilei's inertial systems; our proposal seems to be the first.

2. Assumptions

1) Our universe space is the unique reference frame with isotropic time and space.

2) Our system is composed of particles with interacting particles as well. Velocity of the signal born by such interacting particles is finite and constant in the unique reference frame: Irradiated from a moving source, the velocity additivity of the signal may be probable, but it soon resumes its own velocity in space by renormalization by the interacting particles full in space.

Here, we study how time and space in a moving system can be described from the viewpoint of the unique reference frame, universe space. Preposition is that any moving systems are not inertial, thus Einstein's Gedanken experiments, *i.e.* there are two independent observers at the same time in the moving inertial box and on the outside static unique reference frame looking at a light irradiated in the box showing the same constant velocity c against both respective systems, cannot be applicable. We can just compare the situation of how time and space are felt when the light is irradiated in a static box staying in the reference frame with the situation how it is seen by the observer staying in the outside reference frame when it is irradiated in a moving box (not inertial).

3. Reproduction of Results Predicted by the Special Relativity Theory

3.1. Time Delay

Consider a light pulse clock, as shown in **Figure 1**. When one observes the light from the reference frame, the light path in a moving box with constant velocity V shall be longer than the path in the reference frame. Therefore, with the same constant light velocity c in the reference frame, the time t' measured by the clock in the moving box should be longer than t measured by the light pulse clock in a reference frame. Thus, we obtain by defining $\beta = V/c$,

$$t' = \frac{t}{\sqrt{1-\beta^2}} \tag{1}$$

3.2. Lorentz Shrinkage

The outside observer in the reference frame compares the same event taking place in the moving box with that in his reference frame. He should observe that the time of the event in the moving box should flow slower following the above rule 3.1: Otherwise, both systems could have been discriminated, and Galilei, Einstein and others would have noticed that something is different. Since they seemed to have detected both events taking place under the same physical rules, they rather interpreted that both systems are inertial, leading to the proposal of Lorentz transformation; they just thought that the coming-in signals provide information without giving any environmental influences to the system. On the contrary, we think that the signals come in via any interacting particles through the interaction network conveying information and accompanying environmental influences into the system as well.

A light reflects and comes back in a box of certain length L in the reference frame within a time of t. When the light reflects and comes back in the same box but moving with velocity V in the same direction of the light radiation (**Figure 2**), the time $t'(=t_1'+t_2')$ spent by the radiation (t_1') and its reflection (t_2') should be counted longer as predicted above 3.1 if one observes it from the reference frame.

We propose that the light velocity should be the same, c, in the space of the moving box as that in the outside reference frame. This is the different point from the assumption of relativity theory, where the light velocity in the moving box is assumed to be the same velocity c against the moving box itself; relativity theory assumes the moving box is also inertial, but we think our universe alone is the reference frame.

Then, the apparent length L' of the moving box observed from outside reference frame can be derived as follows: Since $(c-V)t_1'=L'$ and $(c+V)t_2'=L'$, then $t_1'+t_2'=\dfrac{2L'}{c\left(1-\beta^2\right)}$. Therefore, $\dfrac{2L}{c}=t=\sqrt{1-\beta^2}\,t'=\dfrac{2L'}{c\sqrt{1-\beta^2}}$, giving $L'=\sqrt{1-\beta^2}\,L$.

Length in a moving box is apparently measured shorter when observed from the static reference frame.

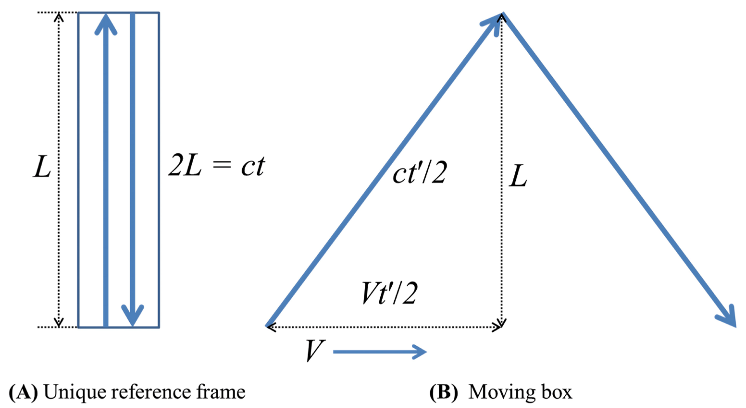

Figure 1. Light pulse clock. (A) A clock with the light path length L in a reference frame. (B) The clock in a moving box with velocity V observed from outside reference frame. Light velocity c and time t for reference frame or t' for a moving box.

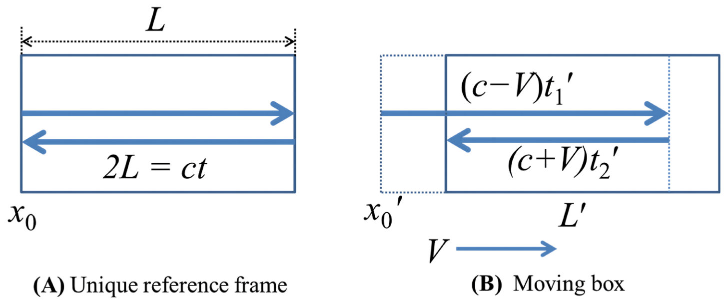

Figure 2. A light reflection in a box. (A) In a box with length L, a light is irradiated at x_0 and is reflected to come back to the starting point. t is the time and c is the light velocity. (B) A light reflection occurs in a moving box with velocity V. The light is irradiated at x_0' and the time t' ($=t_1'+t_2'$) is spent by the radiation (t_1') and its reflection (t_2') in the box of length L'.

3.3. Mass/Energy Equality

First, the velocity transformation rule is calculated. We consider one-dimensional case (Figure 2). The relationship between the velocity of a particle v_x measured in the unique reference frame and the apparent velocity v_x' experienced in a moving box calculated from outside reference frame is considered. Let the travelling distance ΔL during Δt be for the reference frame and $\Delta L'$ and $\Delta t'$ for the moving box. The coordinates of the particle in the reference frame x and that in the moving box measured by the observer in outside reference frame x' should be as follows:

$$x' = x_0' + Vt' + \frac{\Delta L'}{\Delta t'} t',\ x = x_0 + \frac{\Delta L}{\Delta t} t, \tag{2}$$

and

$$v_x' = \frac{\mathrm{d}x'}{\mathrm{d}t'} = V + \frac{\Delta L'}{\Delta t'} = V + \frac{1}{\gamma}\frac{\Delta L}{\Delta t}\frac{\mathrm{d}t}{\mathrm{d}t'}. \tag{3}$$

here, x_0 and x_0' are the starting coordinates of the particles and can be the same, 0; and $\gamma = 1\big/\sqrt{1-\beta^2}$.

Let's consider the relationships between t, t', x and x'. We consider the situation of one-way light travelling in the reference frame and transform the variables for the reference frame (travelling distance Δl, time t) into those for the moving box system ($\Delta l'$, t') using the results of the above 3.1 and 3.2.

$$ct = \Delta l = \frac{\Delta l}{\gamma} + \left(1 - \frac{1}{\gamma}\right)\Delta l = \Delta l' + (\gamma - 1)\Delta l' = (c - V)t' + (\gamma - 1)\Delta l', \tag{4}$$

and

$$\Delta l' = x' - Vt'. \tag{5}$$

Therefore, $t = (1-\gamma\beta)t' + (\gamma-1)x'/c$.

By differentiating both sides with $\mathrm{d}t'$, we obtain $\mathrm{d}t/\mathrm{d}t' = 1 - \gamma\beta + (\gamma-1)\beta_x'$, where $\beta_x' = v_x'/c$.

By the way, since $\Delta l' = \Delta l/\gamma = x/\gamma$, we obtain $x = \gamma\Delta l' = \gamma(x' - \beta ct')$.

By substituting the above relation $\mathrm{d}t/\mathrm{d}t'$ into the above Equation (3), we obtain:

$$\beta'_x = \frac{\left(\frac{1}{\gamma} - \beta\right)\beta_x + \beta}{1 + \left(\frac{1}{\gamma} - 1\right)\beta_x}, \tag{6}$$

where $\beta_x = v_x/c$.

This form is different from the result obtained in special relativity theory.

Second, let's think of a model of two-particle collision of same mass m with the same velocity but in opposite directions in the reference frame (Figure 3(A)). We calculate the case of collision in the moving system with the same velocity of one of the particles, where the particle looks to stay static, by watching from the outside reference frame under the boundary condition of the conserved momentum, $m(v)v = M(V)V$ (Figure 3(B)). We here admit a working hypothesis concerning to the mass and assume that $m(v) + m_0 = M(V)$, where $m(v)$ is the velocity-dependent mass and m_0 is the static mass. Then, we can derive the following:

$$\frac{m(v)}{m_0} = \frac{\beta}{\beta'_x - \beta} = \gamma + \gamma^2(1+\beta)\beta, \tag{7}$$

where $\beta_x = V/c = \beta$ as can be understood from Figure 3.

When one calculates $1/\gamma'^2_x = 1 - \beta'^2_x$, we can finally obtain:

$$\frac{m(v)}{m_0} = \gamma'_x. \tag{8}$$

This may lead to the formulation corresponding to the energy description with velocity-dependent mass in the special relativity theory:

$$E = m(v)c^2 = m_0\gamma'_x c^2. \tag{9}$$

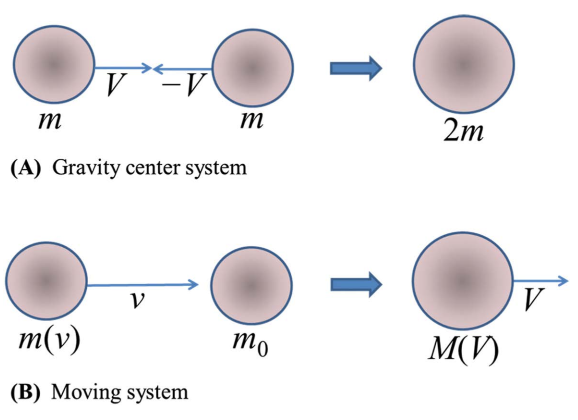

Figure 3. Collision and fusion of two equal particles. (A) Seen from the gravity center system, two particles with mass m move with the velocity V in the opposite directions. After fusion the particle stays static with mass $2m$. (B) Seen from the moving system with velocity V, a particle with m_0 stays static and the other particle with mass $m(v)$ moves with velocity v. After fusion the particle moves with velocity V with mass $M(V)$ depending on the velocity.

3.4. Some Other Predictions of the Special Relativity Theory Are Supposed to Be Derived from Our Viewpoint Similarly to the Above Items

We should note that the big difference from the special relativity theory is the following: We think that our universe space alone is the unique reference frame, while Einstein considered many moving systems with relative constant velocity can be the inertial systems. As a result, we consider that even an observer staying in a moving box should watch the same phenomenon as the observer in the outside reference frame, since the moving system is no more inertial.

4. A Naïve Doubt: The General and Special Relativity Theories Seem Contradictory

General relativity theory [5] claims that every existence influences others through time/space distortion via gravity. This situation seems similar to that according to adaptive dynamics [7] [9].

On the other hand, the Gedanken experiment for the special relativity theory [1] [2] considers two inertial systems relatively moving with constant velocity. It claims that a light irradiated in the moving box can independently reach both observers in the static and moving systems with the same light velocity c against the respective systems. "Is it possible?" is the question.

According to the general relativity theory, each system should influence the other system, resulting in the dependence of light behavior on the environment one another. This means that any existences in our universe are inter-dependent and never inertial. On the contrary, when the two systems are both inertial, there should be no way for the information transfer between the two and thus each system cannot see any event occurring in the other system.

In short, the two theories seem contradictory, we think. And we believe that the adaptive dynamics [8] [9], which assumes the interconnection of everything in our universe, can explain most of the predictions by the general relativity theory or rather describe the same view.

In addition, based on the above consideration of the contradiction, it is natural to have many reports on the Lorentz invariance violated [12] [13].

5. Discussion

As described in the introduction, Einstein considered many moving systems with constant velocity can be the inertial systems according to Galilei's view [4]. Therefore, he thought that an observer in a moving box sees the simultaneous arrivals of light at both ends of the box located at the same distance from the center where light is irradiated. Then, he had to consider the Lorentz transformation to explain the apparent discrepancy seen by the outside static observer.

As pointed out in the previous section, special and general relativity theories by Einstein seem contradictory to each other. Furthermore, we proposed the possibility that everything in the universe, including quantum mechanical world, is interconnected according to the adaptive dynamical view [8] [9], as written in the introduction section, which is also contradictory to the classical Galilei's view of inertial systems and rather is describing the same to the distorted time/space view derived from the general relativity theory.

Then, we considered our universe space alone as the unique reference frame. According to the assumptions in this study, we derived several time/space properties similar to those obtained from special relativity theory. We showed some differences between them. By our new time/space properties, such as Michelson-Morley experiment [14], long life span of moving μ meson, and velocity limit of light can be explained. On the other hand, such as Minkowski 4-dimensional time/space [15] and black holes are denied or cannot be predictable. We can just speculate that our universe is filled with interacting particles of constant velocity [9], which may interfere with the behavior of other particles or may assemble into other kinds of particles. They may finally produce black holes or dark matter.

The confirmation experiments to show the adequateness of our new view are necessary; if we can check the interference of two lights travelling around our earth in both directions toward and reverse to the earth's rotation direction, or if we can measure the initial light velocity irradiated from a moving system to obtain the quantitative estimation of the interaction of light with interacting particles, it may be possible.

Our view apparently seems to correspond to the old ether model, which was considered the light mediator. Instead of such wave model, we consider particle models for signaling and interaction.

It would be challenging to examine further whether our model can explain other observations predicted by the special and general relativity theories of Einstein. We expect that our model may turn out to correspond to the concept of recent comoving frame and cosmic time [11] in astrophysics.

For the confirmation or investigation toward the next progress in time/space view, it is inevitable to identify and to characterize such interacting particles; we do not understand well the origins and properties of gravity and light, *i.e.* graviton and photon, yet, including whether they have constant velocities or not. Depending on their clarified properties, it can be possible that our proposal is also an approximation of the real world, since it is based on the adaptive dynamical view; everything, including such interacting particles, is interconnected to each other by watching its environment and influenced by its environment.

6. It Is Time to Doubt: There Is No Inertial System Other than Our Universe Space, Unique Reference Frame

As described in the introduction, Galilei [4], Einstein [1] [2] and others believed that there can be many inertial systems moving with relative constant velocities: Because they observed that many physics laws, such as Newtonian dynamics and Maxwell electromagnetic equations, are equally applicable in those systems; they did observe no difference. But now we believe that it is time to doubt them, especially did they perform experiments precisely enough?

In classical physics, information transfer by signal (light) was taken to give no or negligible influence on any systems. But is it true? After Einstein's relativity theories, light (signal) is shown to interact with any mass as observed in gravity lens and in reverse, light influences any mass as observed in light forceps. Thus, it is natural to think that information transfer by any signals should accompany with the environmental influence as proposed by adaptive dynamical view.

Adaptive dynamical view that everything is under interaction network with environment has been shown to be applicable to the quantum-like interference behavior in biological and macroscopic world [6] [8]. When this view was applied to the typical interference phenomenon of quantum mechanics in microscopic world, the similar interfering effect could be simulated [9]; the successful reproduction does not prove that the view is the principle of quantum mechanics but does not disprove the possibility. Then, it is possible that the view can be applied to any systems in this universe. Based on this consideration, we assumed that both macroscopic moving systems should be interconnected, not inertial at all. Therefore, any signals between them, including relative movement itself, should bring about certain environmental influence (change) on one another through the interaction network.

Furthermore, as we discussed above, Einstein's general relativity theory [5] tells the distortion of time/space by any mass. Therefore, we can expect any influence from the moving mass of the moving system over the other system, which we think cannot be inertial.

At present, we do not know so well about the properties of interacting particles such as gravitons and photons. Their influences on the other systems may be so minute that we humans may have observed apparently no difference in physics laws between such moving systems with relative constant velocity. If this were the case, now we should become careful to doubt that such moving systems cannot be inertial at all. We should reconsider the time/space well now. We may think that Einstein's special relativity theory could be an approximation by neglecting signal influences, but there should be no distorted time/space as predicted by general relativity theory.

Galilei [4] may have proposed that a moving system is inertial as long as no force works on it because he observed that it kept its straight orbit with constant velocity in his era. This system is an inertial system and there can be many such systems. He proposed that if there is gravity working between two systems, their orbits are circuits around each other. Then, Einstein [1] [2] assumed two inertial systems with relative constant velocity in his special relativity theory. But it should have meant that there should be no interaction between them, no gravity or no information transfer. (This is also applicable to Galilei's transformation, where signal velocity was assumed infinite.) This consideration leads us to think that any inertial systems are rather isolated completely without any interaction with each other and also with their environment, contrary to our adaptive dynamical view.

7. Conclusion

In conclusion, we propose that we should consider a unique reference frame according to the adaptive dynamical view instead of independent inertial systems as proposed by Galilei and Einstein and further pursue the investigations in science toward a much deeper understanding of time/space. It is essential and inevitable to detect and characterize such interacting particles as gravitons and photons.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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