Special relativity arising from a misunderstanding of experimental results on the constant speed of light

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Abstract: All experiments show that the speed of light relative to its source measured in vacuum is constant. Einstein interpreted this fact such that any ray of light moves in the "stationary" system with a fixed velocity c, whether the ray is emitted by a stationary or by a moving body, and established special relativity accordingly. This paper reviews basic hypotheses and viewpoints of space-time relationship in special relativity; analyzes derivation processes and the mistakes in the Lorentz transformation and Einstein's original paper. The transformation between two coordinate systems moving uniformly relative to one another is established. It is shown that special relativity based upon the Lorentz transformation is not correct, and that the relative speed between two objects can be faster than the speed of light. © *2008 Physics Essays Publication*. [DOI: 10.4006/1.3006345]

Résumé: Toutes les expérimentations montrent que la vitesse de lumière relative à sa source mesurée dans le vacuum est constante. A propos de ce fait, Einstein expliquait que n'importe quel rayon de lumière se déplace dans le système "stationnaire" avec une vélocité fixe c, que le rayon soit émis par un corps stationnaire ou mobile, et il a donc établi la relativité restreinte. Cet article réexamine les hypothèses et les points de vue fondamentaux de la relation espace-temps dans la relativité restreinte; analyse les procéds de dérivation et les erreurs dans la transformation de Lorentz et l'article original d'Einstein. La transformation entre deux systèmes de coordonnées qui se déplacent uniformement relativement àun un autre est établie. Il est montré que la relativité restreinte basée sur la transformation de Lorentz n'est pas correcte, et que la vitesse relative entre deux objets peut être plus grande que celle de lumière.

I. INTRODUCTION

Special relativity was established by Einstein nearly a century ago[1] and today has become a compulsory course at many universities.[2] However, the rationality of its derivation process and its conclusions are still under suspicion.[3–28]

This paper briefly reviews the basic hypotheses and the main viewpoints of space-time in special relativity. The derivations and the mistakes involved in the Lorentz transformation and Einstein's original paper are analyzed. The transformation between two coordinate systems moving uniformly relative to one another will be revised. It will be shown that special relativity based upon the Lorentz transformation is not correct, and that the relative speed between two objects can be faster than the speed of light.

II. SUMMARY OF SPECIAL RELATIVITY

A. Basic hypotheses in special relativity

(Please see Ref. 2 for a summary of special relativity.)

(1) Principle of relativity: for describing any law of motion, all inertial coordinate systems moving uniformly relative to one another are equal.
(2) Principle of the constant speed of light: the speed of light measured in vacuum in all inertial coordinate systems moving uniformly relative to one another is the same.

B. Lorentz transformation

Two coordinate systems K and K' ($OXYZ$ and $O'X'Y'Z'$), with their respective axes parallel to one another, move uniformly relative to one another with a speed v of K' relative to K along the X-axis. The time count starts when O and O' coincide with each other, as shown in Fig. 1.

Let (x, y, z, t) be an event appearing in K at time t, the same event appears in K' as (x', y', z', t') at time t'. Time-
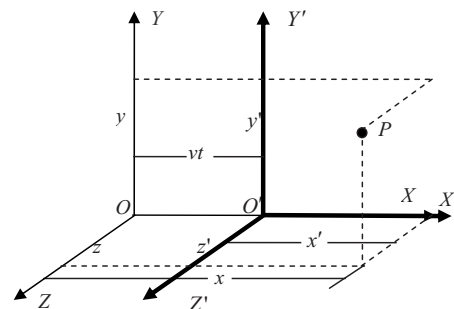

FIG. 1. Coordinate system 1.

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space coordinates (x, y, z, t) and (x', y', z', t') that describe the same event satisfy the Lorentz transformation

$$x' = \frac{x - vt}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}, \quad y' = y, \quad z' = z, \quad t' = \frac{t - \dfrac{vx}{c^2}}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}},$$

(1)

$$x = \frac{x' + vt'}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}, \quad y = y', \quad z = z', \quad t = \frac{t' + \dfrac{vx'}{c^2}}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}},$$

(2)

where c is the speed of light. The derivation of the Lorentz transformation is as follows.

For point O, $x = 0$ is observed in K all the time; but $x' = -vt'$ is observed in K' at time t', viz. $x' + vt' = 0$. Therefore it can be seen that x and $x' + vt'$ become zero at the same time for point O. Then, suppose that there is a direct ratio k between x and $x' + vt'$ all the time, i.e.,

$$x = k(x' + vt').$$

(3)

Alternatively, for point O',

$$x' = k'(x - vt).$$

(4)

The principle of relativity requires that K is equal to K'. The two equations above have to be of the same form, such that k is equal to k':

$$k = k'.$$

(5)

Thus,

$$x' = k(x - vt).$$

(6)

To establish the transformation, the constant k must be determined. According to the principle of the constant speed of light, if a light signal goes along OX when O and O' are at the same point ($t = t' = 0$), at any time t (t' in K'), the positions of this signal at these two coordinate systems are as follows, respectively,

$$x = ct, \quad x' = ct'.$$

(7)

Substituting Eq. (7) into the product of Eqs. (3) and (6), we have

$$k = \frac{c}{\sqrt{c^2 - v^2}} = \frac{1}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}.$$

(8)

Substituting Eq. (8) into Eqs. (3) and (4), we have

$$x' = \frac{x - vt}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}, \quad t' = \frac{t - \dfrac{vx}{c^2}}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}},$$

(9)

$$x = \frac{x' + vt'}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}, \quad t = \frac{t' + \dfrac{vx'}{c^2}}{\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}.$$

(10)

C. Key points of special relativity

Based on the Lorentz transformation, special relativity concluded that:

(1) Simultaneity effect: if two events appear at two points in a coordinate system at rest synchronously, the times that these two events appear in another coordinate system moving uniformly are not the same.
(2) Length contraction effect: in a coordinate system with a relative speed, the length of an object measured along the speed direction of the system is shorter than that measured in another coordinate system in which the object is at rest.
(3) Time dilation effect: for an event, the time measured in a coordinate system with relative speed to the place is longer than that measured in another coordinate system in which the place is at rest.

D. Dynamics of special relativity

(1) The mass of an object measured in a moving coordinate system is larger than that measured in the coordinate system in which the object is at rest.
(2) The energy of an object equals its mass multiplied by the square of the speed of light.

III. SOME MISTAKES IN SPECIAL RELATIVITY

A. Wrong comprehension of experimental results on the constant speed of light

Until now, all experiments show that the speed of light relative to its source measured in vacuum is constant. This can be explained as follows.

(1) For light signals in vacuum radiated from sources that are fixed in any inertial coordinate system, measured speeds of these light signals relative to their sources (or coordinate systems), respectively, are equal.
(2) For light signals in vacuum radiated from a definite source, light speeds relative to their source measured in coordinate systems moving uniformly relative to one another are equal.

The above fact described by Ref. 2, and Sec. II A of this paper, is changed to "the speed of light measured in vacuum in all inertial coordinate systems moving uniformly relative to one another is the same," named as "principle of the constant speed of light." It does not point out that the speed of light is relative to its source. In the derivation of the Lorentz transformation, the above fact is formulated such that for light in vacuum radiated from a definite source, light speeds relative to any coordinate system are equal. In Einstein's

TABLE I. Experimental result of light speed and the principle of the constant speed of light.

	True fact	Incomplete statement	Wrong explanation
Statement	The speed of light relative to its source measured in vacuum in all inertial coordinate systems moving uniformly relative to one another is constant.	The speed of light measured in vacuum in all inertial coordinate systems moving uniformly relative to one another is the same.	Any ray of light moves in the stationary system of coordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body.
Name	No	The principle of the constant speed of light from Ref. 2.	The principle of the constant speed of light by Einstein.
Mistakes	No	Not pointing out that the speed is light relative to its source.	Neglecting relative motions between coordinate systems.

words, any ray of light moves in the "stationary" system of coordinates with the determined velocity c, whether the ray is emitted by a stationary or by a moving body. This is also named "the principle of the constant speed of light." This is wrong, because it neglects relative motions between coordinate systems, as listed in Table I.

Equations (1)–(6) describe an object's motion in a fixed system, its motion in another moving system, and the possible transformation between these two systems. Here, k must be determined using Eq. (7). In Eq. (7), $x=ct$ describes a photon emitted from a source fixed at the origin of the fixed system. Equation (7), $x'=ct'$ describes another photon emitted from a source fixed at the origin of the moving system. There is a relative motion between these two sources. So, there is a relative motion between these two photons from two different sources. Equations (1)–(6) describe one object in two systems. On the other hand, Eqs. (7) $x=ct$, $x'=ct'$ describe two different objects (photons) moving in two systems independently. It is problematic to substitute Eq. (7) into Eq. (6). Actually, to obtain k, $x=ct$, $x'=ct'-vt'$ must be used instead of those in Eq. (7).

B. The coordinate in the direction of motion of the Lorentz transformation is 0=0

(Please see Ref. 20.) With reference to the equations in Sec. II B, in expression $x'=(x-vt)/\sqrt{1-(v/c)^2}$, because $x-vt\equiv0$, we have $x'\equiv0$. Similarly, in expression $x=(x'+vt')/\sqrt{1-(v/c)^2}$, $x'+vt'\equiv0$ results in $x\equiv0$.

Also in Sec. II B, there is a statement "For point O, $x=0$ is observed in K all the time; but $x'=-vt'$ observed in K' at time t', viz. $x'+vt'=0$. Therefore it can be seen that x and $x'+vt'$ become zero at the same time for point O. Then, suppose that there is a direct ratio k between x and $x'+vt'$ all the time, i.e., $x=k(x'+vt')$." Because $x'+vt'=0$ always holds, $x=0$ holds all the time.
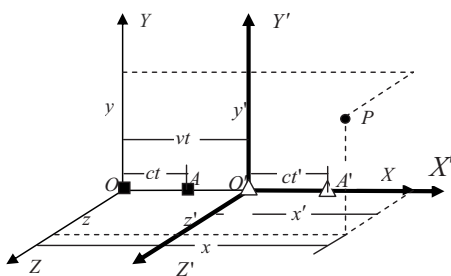
"Alternatively, for point O', $x'=k'(x-vt)$." Because $x+vt=0$ is valid all the time, $x'=0$ always holds. So, the coordinate in the direction of motion of the Lorentz transformation is $0=0$.

C. Wrong derivation of equations

1. Description of an event replacing description of another event

Equations (3)–(6) describe point O in two coordinate systems. Equation (7) describes the positions of two photons radiated from sources fixed in these two coordinate systems at their origins, respectively, not the positions of one photon. By substitution of Eq. (7) into Eqs. (3)–(6), the description of an event replaces the description of another event. A substitution mistake occurs.

Based on Eq. (7), in $OXYZ$ as shown in Fig. 2, a photon starts from point O at time $t=0$ and arrives at point A at time t; in $O'X'Y'Z'$, another photon starts from point O' at time $t'=0$ and arrives at point A' at time t'. It is obvious that these are two events of two different photons. It would be clearer if these two origins did not lie at the same point, with an original displacement S at time $t=0$, as shown in Fig. 3. Let us follow the derivation process of the Lorentz transformation.

Two coordinate systems K and K' ($OXYZ$ and $O'X'Y'Z'$), with their corresponding axes parallel to each other, respectively, move uniformly relative to the other, the speed of K' is v relative to K along the X-axis. The time count starts when O' is S from O in the $+X$ direction.

For point O, $x=0$ is observed in K all the time; but $x'=-vt'-S$ is observed in K' at time t', viz. $x'+vt'+S=0$. Thus it can be seen that x and $x'+vt'+S$ become zero at the same time for this point. Then, suppose that there is a direct ratio between x and $x'+vt'+S$ all the time, and let k be the proportional factor such that
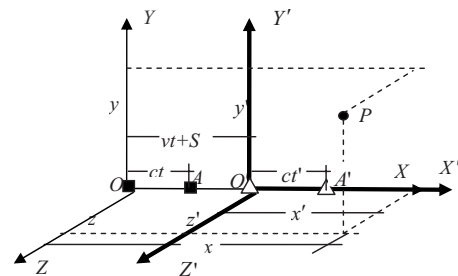

FIG. 2. Coordinate system 2.

FIG. 3. Coordinate system 3.

$$x = k(x' + vt' + S). \tag{11}$$

Similarly for point O', we have

$$x' = k'(x - vt - S). \tag{12}$$

From the principle of relativity, K is equal to K'. The two equations above must be of the same form. Therefore, k must be equal to k',

$$k = k'. \tag{13}$$

We further have

$$x' = k(x - vt - S). \tag{14}$$

To finish the transformation, the constant k must be given.

Absurdity 1. Based upon the principle of the constant speed of light, if a light signal goes along OX when O and O' at the same point $(t=t'=0)$, at any time t (t' in K'), the positions at these two coordinate systems are

$$x = ct, \quad x' = ct', \tag{15}$$

respectively. It is obvious that these are two events of two sources.

Substitution of Eq. (15) into the product of Eqs. (11) and (14) yields

$$xx' = k^2(x' + vt' + S)(x - vt - S),$$

$$c^2tt' = k^2(ct' + vt' + S)(ct - vt - S). \tag{16}$$

k is indeterministic.

Absurdity 2. From the principle of the constant speed of light, if a light signal goes along OX when O and O' coincide with each other $(t=t'=0)$, at any time t (t' in K'), the positions at these two coordinate systems are as follows, respectively,

$$x = ct, \quad x' = ct' - S. \tag{17}$$

It is obvious that these are two events of two sources.

Substitution of Eq. (17) into the product of Eqs. (11) and (14) gives

$$xx' = k^2(x' + vt' + S)(x - vt - S),$$

$$c^2t(t' - S) = k^2(ct' + vt' + S)(ct - vt - S). \tag{18}$$

k is also indeterministic.

2. Direct transformation is not equal to indirect transformation

Suppose there are three coordinate systems K, K', and K'' ($OXYZ$, $O'X'Y'Z'$, and $O''X''Y''Z''$), whose respective axes are parallel to one another, move uniformly relative to one another; speed of K' is v relative to K along the X-axis; speed of K'' is u relative to K' along the X-axis. The time count starts when O, O', and O'' are located at the same point.

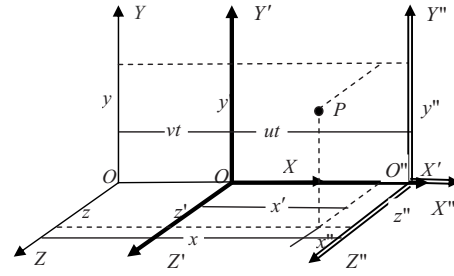The direct transformation from K to K'' is (Fig. 4)

FIG. 4. Coordinate system 4.

$$x'' = \frac{x - (v + u)t}{\sqrt{1 - \left(\dfrac{v+u}{c}\right)^2}}. \tag{19}$$

The indirect transformation from K to K'' via K' is

$$x'' = \frac{x' - ut'}{\sqrt{1 - \left(\dfrac{u}{c}\right)^2}} = \frac{x\left(1 + \dfrac{uv}{c^2}\right) - (u + v)t}{\sqrt{1 - \left(\dfrac{u}{c}\right)^2}\sqrt{1 - \left(\dfrac{v}{c}\right)^2}}. \tag{20}$$

It is obvious that Eq. (19) is not equivalent to Eq. (20).

D. The relative speed between two objects can neither reach nor exceed the light speed

The process of the above derivations does not make the assumption that the relative speed between two objects is smaller than the light speed, but the result is that the relative speed between two objects can neither reach nor exceed the light speed. The Lorentz transformation is self-contradictory. Now, astronomy observations find that many planets move apart faster than the light speed.

E. There is an antinomy between the length contraction effect and the principle of relativity

The length contraction effect indicates that if a sphere is fixed in a coordinate system, this sphere observed in another coordinate system moving uniformly relative to the system will become an ellipsoid. A direct extension to this claim is that if the relative speed equals the light speed, the sphere will become a circle, changing from three-dimensions to two-dimensions. Therefore, there is an antinomy between the length contraction effect and the principle of relativity.

IV. MISTAKES IN EINSTEIN'S "ON THE ELECTRODYNAMICS OF MOVING BODIES"

A. Excerpt from Einstein's paper

(Please refer to Ref. 1.) The following reflections are based on the principle of relativity and on the principle of the constancy of the velocity of light. These two principles we define as follows:

(1) The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to one or the other of two systems of coordinates in uniform translational motion.
(2) Any ray of light moves in the stationary system of co-

ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body. Hence

$$\text{velocity} = \frac{\text{light path}}{\text{time interval}}.$$

We imagine further that at the two ends A and B of the rod, clocks are placed, which synchronize with the clocks of the stationary system, that is to say that their indications correspond at any instant to the "time of the stationary system" at the places where they happen to be. These clocks are therefore "synchronous in the stationary system."

We imagine further that with each clock there is a moving observer, and that these observers apply to both clocks the criterion established for the synchronization of the two clocks. Let a ray of light depart from A at the time t_A, let it be reflected at B at the time t_B, and reach A again at the time t'_A.

Taking into consideration the principle of the constancy of the velocity of light we find that

$$t_B - t_A = \frac{r_{AB}}{c - v} \quad \text{and} \quad t'_A - t_B = \frac{r_{AB}}{c + v}, \tag{21}$$

where r_{AB} denotes the length of the moving rod—measured in the stationary system. Observers moving with the moving rod would thus find that the two clocks were not synchronous, while observers in the stationary system would declare the clocks to be synchronous.

Let us in stationary space take two systems of coordinates, i.e., two systems, each of three rigid material lines, perpendicular to one another, and issuing from a point. Let the axes of X of the two systems coincide, and their axes of Y and Z, respectively, be parallel. Let each system be provided with a rigid measuring-rod and a number of clocks, and let the two measuring-rods, and likewise all the clocks of the two systems, be, in all respects, alike.

Now to the origin of one of the two systems (k) let a constant velocity v be imparted in the direction of the increasing x of the other stationary system (K), and let this velocity be communicated to the axes of the coordinates, the relevant measuring-rod, and the clocks. At any time of the stationary system K there then will correspond a definite position of the axes of the moving system, and for reasons of symmetry we are entitled to assume that the motion of k may be such that the axes of the moving system are at the time t (this "t" always denotes a time of the stationary system) parallel to the axes of the stationary system.

We now imagine space to be measured from the stationary system K by means of the stationary measuring-rod, and also from the moving system k by means of the measuring-rod moving with it; and that we thus obtain the coordinates x, y, z, and ξ, η, ζ, respectively. Further, let the time t of the stationary system be determined for all points thereof at which there are clocks by means of light signals in the manner indicated before; similarly let the time τ of the moving system be determined for all points of the moving system at which there are clocks at rest relative to that system by applying the method, given before, of light signals between the points at which the latter clocks are located.

To any system of values x, y, z, t, which completely defines the place and time of an event in the stationary system, there belongs a system of values ξ, η, ζ, τ, determining that event relative to the system k, and our task is now to find the system of equations connecting these quantities. In the first place it is clear that the equations must be linear on account of the properties of homogeneity, which we attribute to space and time.

If we place $x' = x - vt$, it is clear that a point at rest in the system k must have a system of values x', y, z, independent of time. We first define τ as a function of x', y, z, and t. To do this we have to express in equations that τ is nothing else than the summary of the data of clocks at rest in system k, which have been synchronized according to the rule given before.

From the origin of system k let a ray be emitted at the time τ_0 along the X-axis to x', and at the time τ_1 be reflected thence to the origin of the coordinate, arriving there at the time τ_2; we then must have

$$\frac{1}{2}(\tau_0 + \tau_2) = \tau_1 \tag{22}$$

by inserting the arguments of the function τ and applying the principle of the constancy of the velocity of light in the stationary system:

$$\frac{1}{2}\left[\tau(0,0,0,t) + \tau\left(0,0,0,t + \frac{x'}{c-v} + \frac{x'}{c+v}\right) \right]$$
$$= \tau\left(x',0,0,t + \frac{x'}{c-v}\right). \tag{23}$$

Hence, if x' is chosen infinitesimally small,

$$\frac{1}{2}\left(\frac{1}{c-v} + \frac{1}{c+v} \right)\frac{\partial \tau}{\partial t} = \frac{\partial \tau}{\partial x'} + \frac{1}{c-v}\frac{\partial \tau}{\partial t}, \tag{24}$$

or

$$\frac{\partial \tau}{\partial x'} + \frac{v}{c^2 - v^2}\frac{\partial \tau}{\partial t} = 0. \tag{25}$$

With the help of this result we easily determine the quantities ξ, η, ζ, by expressing in equations that light (as required by the principle of the constancy of the velocity of light, in combination with the principle of relativity) is also propagated with velocity c when measured in the moving system.

We now have to prove that any ray of light, measured in the moving system, is propagated with the velocity c, if, as we have assumed, this is the case in the stationary system; for we have not as yet furnished the proof that the principle of the constancy of the velocity of light is compatible with the principle of relativity.

B. Mistakes

(1) Equation (21) is derived from the assumption that "Any ray of light moves in the stationary system of coordinates with the determined velocity c, whether it is emitted by a stationary or by a moving body." In fact, the light seen by us is emitted by the body observed by us,

no matter whether this body is moving or not, and the light speed is c relative to the body. So, Eq. (21) is just a hypothetical phenomenon that does not exist in the world. The fact is that observers moving with the moving rod and observers in the stationary system will find that the two clocks are synchronous. For further theories of moving objects observation, see Ref. 26.

(2) It is evident that if Eq. (21) is true [Eq. (21) is false in fact], then Eq. (22) will be false. However, the author continued to substitute Eq. (21) into Eq. (22). As a consequence, Eq. (23) is incorrect.

(3) There is a mistake from Eq. (23) to Eq. (24). From Eq. (23), there is

$$\frac{1}{2}\frac{\partial\tau}{\partial\left(t+\dfrac{x'}{c-v}+\dfrac{x'}{c+v}\right)}\left(\frac{\partial t}{\partial x'}+\frac{1}{c-v}+\frac{1}{c+v}\right)+\frac{1}{2}\frac{\partial\tau}{\partial t}\frac{\partial t}{\partial x'}$$
$$=\frac{\partial\tau}{\partial x'}+\frac{\partial\tau}{\partial\left(t+\dfrac{x'}{c-v}\right)}\left(\frac{\partial t}{\partial x'}+\frac{1}{c-v}\right). \tag{26}$$

Because $x'=x-vt$,

$$\frac{\partial\tau}{\partial\left(t+\dfrac{x'}{c-v}+\dfrac{x'}{c+v}\right)}\neq\frac{\partial\tau}{\partial t}\quad\text{and}\quad\frac{\partial\tau}{\partial\left(t+\dfrac{x'}{c-v}\right)}\neq\frac{\partial\tau}{\partial t},$$

then

$$\frac{1}{2}\left(\frac{1}{c-v}+\frac{1}{c+v}\right)\frac{\partial\tau}{\partial t}\neq\frac{\partial\tau}{\partial x'}+\frac{1}{c-v}\frac{\partial\tau}{\partial t}. \tag{27}$$

(4) For a definite ray, it is first defined that the ray moves with velocity c relative to the stationary system; then, it is also defined that the ray moves with velocity c relative to the moving system. This is an evident mistake.

(5) In Eqs. (21), (23), and (24), the velocity between bodies and photons $c+v$ exceeds the light velocity c. This conflicts with the main claim of special relativity.

(6) "If we place $x'=x-vt$, it is clear that a point at rest in the system k must have a system of values x', y, z, independent of time." Here, first, let $x'=x-vt$, then let x' be independent of t. This is a conflict.

(7) First assuming $x'=x-vt$, and then the result is $\xi=(x-vt)/\sqrt{1-(v/c)^2}$. $\xi=x'$. This is also a conflict.

Einstein's paper "On the electrodynamics of moving bodies" is full of mistakes and conflicts.

V. CORRECT TRANSFORMATION

A. Reestablishment of transformations

(Please refer to Ref. 26.) To finish the transformation, the constant k must be determined. Based upon the experimental result of the constant speed of light, if a light signal goes along OX when O and O' are at the same point ($t=t'=0$), at any time t (t' in K'), the positions at these two coordinate systems are as follows, respectively,

$$x=ct, \quad x'=ct'-vt'. \tag{28}$$

Substitution of Eq. (28) into the product of Eq. (3) and (6) yields

$$k=1. \tag{29}$$

Substitution of Eq. (29) into Eqs. (3) and (4) yields

$$x=x'+vt',$$

$$x'=x-vt,$$

$$t=t'. \tag{30}$$

This is the classic Galilean transformation. There is no light speed in it.

B. Equation (28) accords with experimental result of the constant speed of light

As shown in Fig. 2, if a photon emitted from a source fixed at O of the $OXYZ$ system moves from O at time $t=0$, arrives at A at time t, then its relative speed to O (or source) in $OXYZ$ is $\overline{OA}/t=x/t=ct/t=c$; and its relative speed to O' in $O'X'Y'Z'$ is $\overline{O'A}/t'=x'(A)/t'=(ct'-vt')/t'=c-v$; and the measured speed of this photon relative to its source in $O'X'Y'Z'$ is $\overline{OA}/t'=[x'(A)-x'(O)]/t'=[(ct'-vt')-(-vt')]/t'=c$. For a specific photon, its relative speeds to different systems are varied; its relative speeds to its source measured in different systems are the same.

C. Deductions

Special relativity based upon the Lorentz transformation is not correct. As the key components of special relativity, the simultaneity effect, length contraction effect, time dilation effect, mass increasing effect, and the question of rest energy are all groundless. The relative speed between two objects can exceed the light speed.

VI. CONCLUSIONS

(1) Special relativity is derived from a misunderstanding of experimental results involving the constant speed of light.

(2) Special relativity based upon the Lorentz transformation is not correct.

(3) Descriptions of a definite event in all inertial coordinate systems moving uniformly relative to one another are equal.

(4) The relative speed between two objects can exceed the light speed.

(5) Einstein's paper "On the electrodynamics of moving bodies" is full of mistakes and conflicts.

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