Observation theory of moving objects

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(Received 21 January 2010; accepted 12 December 2010; published online 11 January 2011)

Abstract: To observe moving objects, the speed of light is defined as the speed of photons relative to its source, and the propagation characteristics of light in pure space and a medium are introduced in this paper. New concepts called the moving space-time coordinate, the visual space-time coordinate, and the static space-time coordinate are proposed. This paper derives the relationship among the three in pure space and in a moving medium. It is concluded that the moving objects observation theory has solved the measurement problem of moving objects. Movement cannot cause changes in length, time, and mass. Moreover, there is not any light speed barrier. © *2011 Physics Essays Publication*. [DOI: 10.4006/1.3533336]

Résumé: Pour répondre à la question de l'observation d'objets en mouvement, on examine d'abord la vitesse de la lumière et la vitesse des photons par rapport à la source de lumière. On introduit la propriété de la lumière dans l'espace et les médias, présente la notion d'espace-temps du système de référence, l'espace-temps d'observation, et l'espace-temps de référence à l'arrêt. Le mouvement mécanique est calculé dans l'espace absolu et des médias mobiles, dans le temps de référence et l'espace. On explique la relation entre l'espace-temps du système de référence, l'espace-temps d'observation, et l'espace-temps de référence à l'arrêt. La théorie de l'observation d'objets en mouvement résout le problème des objets en mouvement, et explique que le mouvement mécanique ne change pas les longueurs, le temps ou la masse. D'ailleurs, il n'y a pas de barrière de lumière.

Key words: Special Relativity; Albert Einstein; The Speed of Light; Moving Object; Observation.

I. INTRODUCTION

In order to resolve the measurement problem of moving objects, Albert Einstein presented the theory of special relativity a century ago.[1] This theory as well as its author, Albert Einstein, is well known all over the world. Universities and colleges choose the special relativity as a required course.[2] But the rationality of the set-up process of the special relativity and the accuracy of its inferences have always been doubted and criticized.[3–23] Recently, Wang and Xu delivered the basic concepts and calculations of the observation theory of moving objects. The author improved this theory and suggested that a moving object observation theory may replace the theory of special relativity.[13] However, the theory in Ref. 13 is only for the observation of objects moving in pure empty space, and is of a mistake, and is not fitting for the observation of objects moving in a continuous medium.

This paper briefly introduces the basic assumptions of the observation theory of moving objects, the space-time in a moving coordinate system, the visual space-time in a static coordinate system, the space-time in a static coordinate system, the speed of light in pure empty space, and the speed of light in a continuous medium. It derives the relationship between the space-time in a moving coordinate system and the visual space-time in a static coordinate system, the relationship between the visual space-time in a static coordinate system and the space-time in a static coordinate system, the relationship between the space-time in a moving coordinate system and the space-time in a static coordinate system, for objects moving in pure empty space and in a continuous medium; it compares then this theory with the theory of special relativity.

II. BASIC ASSUMPTIONS

(1) For describing any law of motion, all inertial coordinate systems moving uniformly relative to one another are equal.
(2) Light travels in pure space at the speed of c with respect to its source or in a continuous medium at the speed of c' relative to the medium.

In pure space, the speed of light with respect to its source is of a definite limit. For a particular photon, if it does not interact with other matter, its speed relative to its source is a constant.

If the photon enters a continuous medium, while it meets matter, it will be absorbed by the matter, which then re-emits it as a photon or other particles, or keeps it. The moving direction of the re-emitted photon may be different from that of the original one, resulting in reflection, transmission, and diffusion. In this case, the speed of the re-emitted photon is the speed with respect to its new source-particles of the continuous medium. While propagating in a continuous medium, the photon is absorbed and re-emitted continuously. This of course needs time. Therefore, the speed of light in a continuous medium is lower than that in pure space. The higher the medium density is, the slower the speed of light in the me-

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dium and the shallower the penetration depth of the light into the medium. It is assumed here that the speed of light relative to the medium is a constant c'.

III. SOME TIME-SPACE CONCEPTS

Here, we use the space-time in the moving coordinate system, the visual space-time in the static coordinate system, the space-time in the static coordinate system.

(1) *Absolute time:* It is supposed that clocks tick at the same rate and are adjusted so that they start at the same moment (i.e., they are synchronized). Then, no matter in what reference systems and in what states of motion, and no matter where in the reference systems these clocks are positioned, these clocks still tick at the same rate and are synchronized.
(2) *Moving coordinate time: defined as the time of the clock moving with the moving coordinate system.* It is noted that the concept of time includes two meanings: "moment" (corresponding to the time coordinate at the location of the clock) and "time interval" (the interval between two time points).
(3) *Visual time:* The time image of a clock in moving coordinate system recorded by an observer in a static coordinate system.
(4) *Static coordinate time:* Defined as the time given by the clock in the static coordinate systems.
(5) *Absolute length:* Measured by some identically constructed rulers at any position in any coordinate system.
(6) *Moving coordinate length:* The length of an object measured by a ruler moving with the object.
(7) *Visual length:* The length an observer obtains in the static system, using a ruler to measure moving objects by making use of the light signal.
(8) *Static coordinate length:* The length of an object in the static coordinate system, measured via a ruler in static coordinate system.
(9) *Moving coordinate space-time:* Contains moving coordinate time and the moving coordinate length.
(10) *Visual space-time:* Comprises the visual time and the visual length. It is only a visual value, not a true one.
(11) *Static coordinate system space-time:* Contains the static coordinate time and the static coordinate length.

IV. THE TRANSFORMATION BETWEEN THE VISUAL SPACE–TIME AND THE SPACE-TIME IN THE MOVING COORDINATE SYSTEM

For convenience, place the moving coordinate system, the event and object in the static system in the positive direction of the x-axis, as shown in Fig. 1. The observer stands at O.

A. In pure space

In pure space, there are the static coordinate system K and the moving coordinate system K' ($OXYZ$ and $O'X'Y'Z'$), as shown in Fig. 1. Corresponding axes are parallel to each other and the moving one moves uniformly along a straight line. The speed of the moving coordinate system K' relative to the static coordinate system K is v in the direction of the x-axis. And the clocks start clicking at the moment when O coincides with O'.

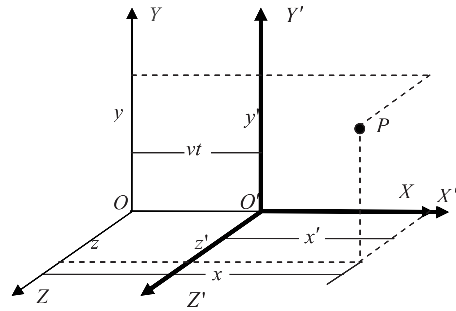

FIG. 1. Coordinate transformation in pure space.

If an event happens statically in the moving coordinate system K', the measurement values of the event in the static coordinate system K are given:

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

$$y_v = y',$$

$$z_v = z',$$

$$t_v = \frac{t' + x'/c}{1 - v/c}. \quad (1)$$

The point (x_v, y_v, z_v) is the visual coordinate and t_v is the visual time in the static coordinate system K. The point (x', y', z') is the actual coordinate and t' is the actual time in the coordinate system K'; v stands for the relative velocity of the two coordinate systems in the direction of x-axis; if the systems are getting closer, this value will be negative.

If an event takes place at time t' at point x', the person standing at origin O' sees the event at moment $t'+x'/c$ because the speed of light from the body is c. Because the moving object is moving along a straight line, the speed of light from the moving system to the static system is $c-v$, and thus $t_v=(t'+x'/c)/(1-v/c)$. The factor $1/(1-v/c)$ comes from the distance the light travels at speed of c in time $t'+x'/c$ in the moving system. The time t_v for the light going at the speed of $c-v$ in the static system is therefore $t_v(c-v)=c(t'+x'/c)$. Thus, $t_v=(t'+x'/c)/(1-v/c)$. The visual distance x_v is the transmission time of light $(t_v-t')\times$ the transmission speed of light $(c-v)$. Then, $x_v=x'+vt'$.

B. In a moving continuous medium

An object moves in a moving continuous medium, as shown in Fig. 2. The continuous medium moves at speed u relative to the static coordinate system K in the direction of the x-axis. The speed of the moving coordinate system K' relative to the static coordinate system K is v in the direction of the x-axis. The clocks start clicking at the moment O coincides with O'. And if the speed of light in the continuous medium is c', then

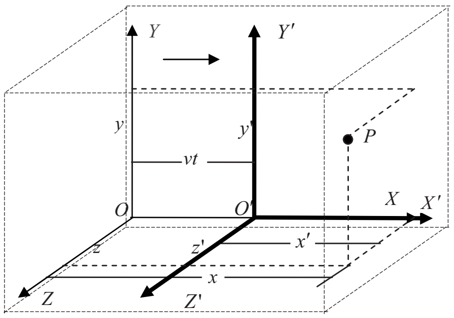

FIG. 2. Coordinate transformation in a moving medium.

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

$$y_v = y',$$

$$z_v = z',$$

$$t_v = \frac{t' + \dfrac{x'}{c' - u + v}}{1 - u/c'}. \tag{2}$$

V. THE VISUAL TIME INTERVAL AND VISUAL LENGTH IN THE VISUAL SPACE–TIME

A. In pure space

From Eq. (1), one may derive the relationship between the visual time interval and the actual time interval in the moving coordinate system, and that between the visual length and the actual length in the moving coordinate system in the moving direction as follows:

$$\Delta t_v = \frac{\Delta t'}{1 - v/c},$$

$$\Delta x_v = \Delta x', \tag{3}$$

in which $\Delta t'$ is the actual time interval in the moving coordinate system, Δt_v is the visual time interval in the static coordinate system, $\Delta x'$ is the actual length in the moving coordinate system, and Δx_v is the visual length in the static coordinate system.

If there is an event happening in the moving-away coordinate system, the observed time interval (the visual time interval of the evolution of the event) is longer than its actual time interval (the time interval in the moving coordinate system). For example, one observes that the moving-away watch has been clicking for 1 h, while the observer's watch in the static coordinate system indicates that 1 h and 10 min passed by. When observing an event in a moving-back coordinate system, the visual time interval of the observed evolution of the event is shorter than its actual time interval. For example, one observes that a moving-back watch has been clicking for 1 h, while the observer's watch in the static coordinate system shows it has been clicking for only 50 min.

B. In a moving continuous medium

$$\Delta t_v = \frac{\Delta t'}{1 - u/c'},$$

$$\Delta x_v = \Delta x'. \tag{4}$$

Equation (4) is not a function of the speed of the moving coordinate system. While the speed of the medium u is positive, if there is an event happening in the moving coordinate system, the observed time interval (the visual time interval of the evolution of the event) is longer than its actual time interval (the time interval in the moving coordinate system). For example, one observes that a moving watch has been clicking for 1 h, while the observer's watch in the static coordinate system indicates that an hour and ten minutes passed by. While the speed of the medium u is negative, if observing an event in the moving coordinate system, the visual time interval of the observed evolution of the event is shorter than its actual time interval. For example, one observes that a moving watch has been clicking for 1 h, while the observer's watch in the static coordinate system shows it has been clicking for only 50 min.

VI. THE TRANSFORMATION BETWEEN THE SPACE-TIME IN STATIC COORDINATE SYSTEM AND THE VISUAL SPACE-TIME

Because of the measurement effect caused by the limited propagation velocity of light and the movement of the object or the continuous medium, the measured results are not the objective reality itself. Only by eliminating the measurement effect can one find the objective reality itself.

A. In pure space

$$x = x_v,$$

$$y = y_v,$$

$$z = z_v,$$

$$t = t_v\left(1 - \frac{v}{c}\right) - \frac{x'}{c}. \tag{5}$$

$$\Delta t = \Delta t_v\left(1 - \frac{v}{c}\right),$$

$$\Delta x = \Delta x_v, \tag{6}$$

in which (x, y, z) is the real coordinate in the static system K, t is the real time in the static coordinate system K, Δt is the actual time interval in the static coordinate system, and Δx is the actual length in the static coordinate system.

If an observer in the static system records an event in a moving-away coordinate system via a clock in his hand and this event lasts 1 h and 10 min, the time of the event in the static coordinate system may be 1 h, shorter than that. If an

TABLE I. Comparisons between the special relativity and the observation theory of moving objects.

Item		Special relativity	Observation theory of moving objects
Basic assumptions	1	For describing any law of motion, all inertial coordinate systems moving uniformly relative to one another are equal.	
	2	The speed of light in the vacuum is constant, and it has nothing to do with the state of motion of its source. Not verified.	Light travels in pure space at the speed of c with respect to its source or in a continuous medium at the speed of c' with respect to the medium. Verified.
Space-time transformation equation		$x=\frac{x'+vt'}{\sqrt{1-(v/c)^2}},\ y=y',\ z=z',\ t=\frac{t'+vx'/c^2}{\sqrt{1-(v/c)^2}}$	$x=x'+vt',\ y=y',\ z=z',\ t=t'$
Length shortening		Always shortened	No
Simultaneity		At different time	At the same time
Time prolonging		Always prolonged	No
Mass increase		Always increased	No
Light barrier		Yes	No
Paradoxes or mistakes		Yes	No

observer in the static system records an event in the moving-back coordinate system by a clock in his hand and this event lasts 50 min, the time of the event lasting in the static coordinate system may be 1 h, longer than that.

B. In moving continuous medium

$$x = x_v,$$

$$y = y_v,$$

$$z = z_v,$$

$$t = t_v\left(1 - \frac{u}{c'}\right) - \frac{x'}{c' - u + v}. \quad (7)$$

$$\Delta t = \Delta t_v\left(1 - \frac{u}{c'}\right),$$

$$\Delta x = \Delta x_v. \quad (8)$$

If the speed of the medium u is positive and an observer in the static system records an event in the moving coordinate system by means of a clock in his hand and this event lasts 1 h and 10 min, the duration of the event in the static coordinate system may be 1 h, shorter than that. If the speed of the medium u is negative and an observer in the static system records an event in a moving coordinate system by way of a clock in his hand and this event lasts 50 min, the duration in the static coordinate system may be 1 h, longer than that.

VII. THE TRANSFORMATION BETWEEN THE SPACE-TIME IN STATIC COORDINATE SYSTEM AND THE SPACE-TIME IN MOVING COORDINATE SYSTEM

A. In pure space

Substituting Eq. (1) into Eq. (5) leads to

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

$$y = y',$$

$$z = z',$$

$$t = t'. \quad (9)$$

B. In a moving continuous medium

Substituting Eq. (2) into Eq. (7) leads to

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

$$y = y',$$

$$z = z',$$

$$t = t'. \quad (10)$$

Equation (9) is the same as Eq. (10). It is the classic Galileo transformation. So the true space-time in any coordinate system is not a function of the speed of light.

VIII. COMPARISONS BETWEEN THE SPECIAL RELATIVITY AND OBSERVATION THEORY OF MOVING OBJECTS

Table I shows the comparisons between special relativity and the observation theory of moving objects. It is clear that the observation theory of moving objects not only has the theoretical and practical foundation but also contains no fallacy.

It is seen that (i) movement cannot cause changes in length, time, and mass; and (ii) there is no light speed barrier. Similar conclusions were reached in papers of other scientists.[3]

IX. CONCLUSIONS

Observation theory of moving objects has solved the measurement problem of moving objects (especially high-speed objects). Moving cannot trigger the change of length, time and mass. There is no light speed barrier.

ACKNOWLEDGMENT

The author gratefully acknowledges Dr. Thomas Smid for polishing this paper's English.

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