Why speed of light is constant regardless the motion?

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ABSTRACT

In this paper, we explain why speed of light is constant for all observers by postulating that the moving frames travel to forward and backward with the same velocity with respect to observers at rest. The regress of moving frames to backward during its motion to forward refers to reversal of space and time of moving frames with respect to observers at rest. The conclusions drawn in this study refer to “Retrocausality" or "backward causation" of moving frames along reversed space and during reversed time with respect to a stationary frame of reference.

Keywords

Special relativity, Newtonian mechanics, speed of light, space, time

Introduction

In 1887, Michelson and Morley performed the well-known Michelson–Morley experiment to determine the speed of the earth relative to that of the luminiferous ether[1,2], which was considered the fundamental substratum of space and believed to be the medium of light propagation[3]. The idea of the experiment can be summarized as follows: “The motion of the earth in the ether at velocity v generates an ether wind with the same velocity; therefore, if we succeed in measuring the effect of the ether wind on light motion, it will serve as a strong evidence for the existence of the ether.” The null result of the Michelson–Morley experiment is considered strong evidence against the ether theory[4] and is unexpected according to Galilean physics. In 1892, Lorentz first explained this null result in an attempt to conserve the ether theory; he suggested that the length of a body/object in the direction of motion contracts by an amount equal to γ (the Lorentz factor) because of a postulated similarity between molecular cohesion forces and electrostatic forces[5]. The Lorentz transformations are a set of mathematical equations[6] used to correlate the space and time coordinates of a moving system to determine the space and time of another system when two observers (each in either system) are moving relative to each other. The Michelson–Morley experiment can be explained by these transformations; the length of an object along the direction of motion contracts (by a factor equal to γ)[7] while transforming to a moving frame. Consequently, the speed of light is identical in all frames, thus yielding the null result of the Michelson–Morley experiment.

Following this, in 1905, Einstein posited the non-existence of the absolute medium of ether and introduced the theory of “special relativity,” which is based on two postulates: first, the laws of electrodynamics and optics are valid for all frames of reference, and second, the speed of light is constant regardless of the motion of the light source[8]. Einstein deduced the Lorentz transformation from these two postulates. Consequently, he suggested that the length of moving bodies contracts along the direction of their motion and that the bodies undergo time dilation[9,10]; therefore, the result of the Michelson–Morley experiment is negative. Special relativity introduces a different system in which space and time are not absolute for all inertial frames[11]. Rather, they are relative to the frame of reference[12] unlike in the Newtonian world, where space and time are absolute for all inertial frames.

Constancy of speed of light has been one of the most confusing phenomenon in modern physics. Until now, the question of why speed of light is constant should look has not been given a clear answer. The present study shows that speed of light must be constant regardless the motion if we postulate that:

- The moving frames travel to forward and backward in space with the same velocity with respect to a stationary frame of reference.

By this postulate, the speed of light can not be affected by motion of bodies.

Results

Calculation of backward time of the moving frame with respect to observer at rest

Let us imagine a spaceship travel from Earth to Proxima Centauri, which is 4.25 light years away as measured by astronomers on Earth, the ship travels at v= 0.8c, and it get there in 3.19 years according to ship's clock, how we can calculate the elapsed backward time of the spaceship with respect to astronomers on Earth?

First, as the spaceship moves to forward and backward with the same velocity with respect to the stationary frame of reference (astronomers on Earth), the space interval that the spaceship travels from Earth to Proxima Centauri as measured by astronomers on Earth (x) equals the sum of the space interval that the spaceship travels as measured by passengers in spaceship (x') and the space that spaceship travels to backward (x_b) as measured by astronomers on Earth as the following equations show,

$$x = x' + x_b, \qquad (1)$$

$$v.t = vt' + v_b.t_b,$$

Where (t) is the elapsed time of the moving frame with respect to the stationary frame of reference, (t') is the elapsed time of the moving frame with respect to the moving observer and (t_b) is the backward time of the moving frame with respect to the stationary frame of reference. And as the velocity of the moving frame to backward (v_b) equals the relative velocity of the moving frame (to forward) (v),

$$v = v_b,$$

Thus

$$t = t' + t_b, \qquad (2)$$

Regarding to special relativity[13,14], duration of that journey according to astronomers on Earth (t) is dilated, it is given by multiplying Lorentz factor (γ) and the duration of that journey according to ship's clock (t') which represents the proper time as the following equations show:

$$dilated\ \ time = proper\ \ time + backward\ \ time,$$

$$\gamma t' = t' + t_b,$$

$$t_b = \gamma t' - t',$$

$$t_b = t'(\gamma - 1), \qquad (3)$$

$$backward\ \ time = proper\ \ time\,(\gamma - 1), \qquad (4)$$

The backward time (t_b) of frame S'(the spaceship) as measured in frame S (the earth) can be calculated using the Eq. (3) as the following:

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{(0.8c)^2}{c^2}}} = \frac{1}{\sqrt{1-0.8^2}} = \frac{5}{3},$$

$$t_b = 3.19 years\left(\frac{5}{3} - 1\right) = 3.19 \times \frac{2}{3} = 2.12\ years$$

The motion of spaceship's clock to backward with respect to observers at rest means that "Moving clocks are reversed with respect to a stationary clocks by value equals $\left[t'(\gamma - 1)\right]$ where (t') here refers to the proper time."

Calculation of backward space of the moving frame with respect to observer at rest

According to the previous section, the space interval between Earth and Proxima Centauri as measured by astronomers on Earth (x) is given by,

$$x = x' + x_b,$$

Regarding to special relativity[15], the space interval between Earth and Proxima Centauri as measured by passengers in spaceship (x') is contracted as the space is moving with respect to the spaceship, thus (x') is given by dividing the space interval between Earth and Proxima

Centauri as measured by astronomers on Earth (x) (which represents the proper length) on Lorentz factor (γ) as follows:

$$proper\ \ length = contracted\ \ length + backward\ \ length,$$

$$x = \frac{x}{\gamma} + x_b,$$

So, we find

$$x_b = x - \frac{x}{\gamma},$$

$$x_b = x\left(1 - \frac{1}{\gamma}\right), \qquad (5)$$

$$backward\ \ length = proper\ \ length\left(1 - \frac{1}{\gamma}\right), \qquad (6)$$

Thus The backward space (x_b) of frame S'(the spaceship) as measured in frame S (Earth) can be calculated using the Eq. (5) as:

$$x_b = 4.25\ \ light\ \ years\left(1 - \frac{3}{5}\right) = 4.25 \times \frac{2}{5} = 1.7\ light\ \ years$$

The motion of space of spaceship to backward with respect to observers at rest means that "Moving space is reversed with respect to a stationary space by value equals $\left[x\left(1 - \frac{1}{\gamma}\right)\right]$ where (x) here refers to the proper space or length".

Discussion

We show that the constancy of speed of light can be easily understood if we postulate that "the moving bodies are travel to forward and backward with the same velocity with respect to observers at rest," by this postulate, the speed of light can not be affected by motion of bodies. The motion of bodies to backward refers to reversal of space and time of moving bodies with respect to observers at rest. The reversed space and time of the moving frame with respect to a stationary frame of reference can be measured as follows:

$$t_b = proper\ \ time\,(\gamma - 1),$$

$$x_b = proper\ \ length\left(1 - \frac{1}{\gamma}\right). \qquad (7)$$

The reversal of space and time of moving body with respect to observers at rest must change the proper length and time of that moving body with respect to those observers (at rest), we find that the length of the moving body (e.g. train) with respect to observers at rest (e.g. observers at platform) become shorter than its length with respect to moving observers (e.g. train's passengers), this phenomenon doesn't occur because length of moving bodies is contracted along its motion but because regress of moving bodies to backward during its motion to forward. And we find there is a delay in moving clocks with respect to stationary clocks, where the second in a stationary frame of reference precedes the second in the moving frames, this phenomenon doesn't occurs because dilation of time of moving clocks with respect to stationary clocks but because reversal of time of moving clocks with respect to stationary clock. The reversal of space and time of moving bodies with respect to a stationary frame of reference return Newton ideas about space and time, according to Newton, space is absolute and all frames share the same time. If Newtonian moving space is reversed with respect to Newtonian stationary space, Newtonian moving space become shorter due to its regress to backward,

$$x_b = Newtonian\ \ space\left(1 - \frac{1}{\gamma}\right),$$

$$x = Newtonian\ \ space - x_b. \qquad (8)$$

and if Newtonian moving clock is reversed with respect to Newtonian stationary clocks, Newtonian moving clock become delayed due to motion of clock to forward and backward simultaneously.

$$t_b = Newtonian\ \ time\left(\gamma - 1\right),$$

$$t = Newtonian\ \ time + t_b. \qquad (9)$$

By reversal of space and time of moving frames with respect to a stationary frame of reference, we obtain six dimensions of space (i.e., three dimensions of the "Newtonian space" and three dimensions of the "reverse space"). The seventh dimension is the "reverse time." Hence, three dimensions of the "Newtonian space" and four dimensions of the "reverse space-time" are obtained.

Methods

The theoretical analysis of this study was performed in accordance with the constancy of the speed of light, regardless of the light source motion.

Data Availability

All data generated or analysed during this study are included in this published article.

Conclusions

The reversal of space and time of moving frames with respect to observers at rest refers to reversal of causality "Retrocausality" of events of the moving frame along reversed space or during reversed time where an effect occur before its cause. We conclude that future of the moving frame can affect the present of it when the time interval between future and present is less than or equal to the reversed time (t_b), in other words; from perspective of a stationary frame of reference, information about the future of the moving frame travels backward in time (t_b) and affect the present of the moving frame, in the same way, information about the present of the moving frame travels backward in time (t_b) and affect the past of the moving frame "backward causation".

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Conflict of Interest

There are no conflicts of interest to declare.

Author contributions

I was responsible for all the sections in this paper. I designed the study, discussed the results, derived the equations, and wrote the manuscript.