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Evidence for an Invalidity of the Principle of Relativity

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Abstract

The paper presents a thought experiment in which it has been proven that, on the basis of the observed trajectory of a light pulse in a moving space ship with a constant speed, it is in theory possible to determine the speed of the system. We conclude from this that Einstein's *principle of relativity* is not valid.

Keywords: Special Theory of Relativity, Principle of Relativity, Thought Experiment

1. Introduction

The special principle of relativity states, that if a system of coordinates K is chosen so that, in relation to it, physical laws hold in their simplest form, the *same* laws hold in relation to any other system of coordinates K' moving in uniform motion relatively to K [1]. This means also, that a perpendicular to the x axis light pulse should always move parallel to the y axis according to an observer in an inertial frame of reference. However, when two observers in two different inertial frames of reference measure the observed path length (d) of the same light pulse at the same time interval (Δt), each observer should note a different trajectory and path length. Since the principle requires the same relation $d = \Delta t \cdot c$ in both frames, in consequence a time dilation effect arise. All aspects of Einstein's special theory of relativity one may find, in numerous books, particularly in a recent published book of David N. Mervin [2].

In this paper a thought experiment is presented in which we show that a simple analysis of the path of a light pulse in an inertial frame of reference should indicate the motion of the frame with respect to the speed of light, despite the special principle of relativity.

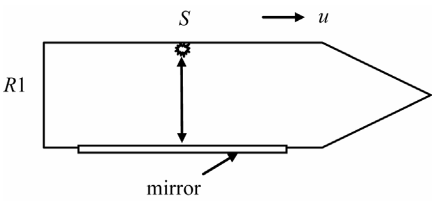
2. Thought Experiments

In "*Relativity, The special and General Theory*" Albert Einstein has shown that the vague word "space" should be replaced by "motion relative to a practically rigid body of reference" or more precisely - to a system of coordinates [1].

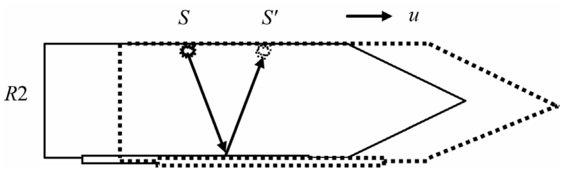
In a visualization of this idea [1] he describes a man who is standing at the window of a railway carriage and drops a stone on the embankment, without throwing it. Since the railway carriage is traveling uniformly then, if one is disregarding the resistance of the air, he sees the stone descend in a straight line, with respect to the system of coordinates of the railway-carriage. From the point of view of a pedestrian, who observes the event when standing at the embankment, the stone falls to earth in a parabolic curve with respect to the system of coordinates of the embankment. With the aid of this experiment, Einstein shows that one may not register an independently existing trajectory, but only a trajectory relative to a particular frame of reference.

This thought experiment has been commonly adopted in order to explain that time is really not running in the same manner for everybody [2-5]. In another thought experiment an observer in a spaceship directs a lightning flash from the ceiling to a mirror placed on the floor of the spaceship. After reflection from the mirror the light pulse returns to the ceiling. The observer in the spaceship sees that the light pulse is moving in both directions along the same straight path, down and up. However, according to an observer who is watching the event outside the spaceship, in a relative state of rest, the light pulse is moving along a trajectory in the form of a V letter, whose path is much longer than the simple path of down and up. Since the velocity of light is the same for both observers and the path longer, then, according to the observer in the relative state of rest, time is running much more slowly for the observer in the spaceship. This conclusion has been called *the time dilation effect* and is graphically presented in **Figures 1(a)** and **(b)**.

Let $R1$ be the frame of reference of the spaceship and $R2$ the frame of reference of the observer outside the ship. On this basis [4] a quantitative relation between time



(a)



(b)

Figure 1. (a) The light pulse is emitted from the source *S* and is reflected back along the same path, as observed in the frame of reference (*R*1) in the spaceship, which moves with a velocity *u* relative to the frame of reference (*R*2) in the relative state of rest. (b). It is assumed (Novikov, 1998; Sears *et al.*, 1982, Feynman *et al.*, 2005) that the path of the same light pulse is moving along a trajectory in the form of a V letter, as observed in *R*2. The positions of the light source at the time of departure and return of the pulse are given by *S* and *S′*, respectively. Since the speed of the light pulse is constant and the path is longer in *R*2 it is assumed that when the rate of a clock at rest in *R*1 is measured by an observer in *R*2, the rate measured in *R*2 is slower than the rate observed in *R*1.

intervals in the $R2$ and $R1$ coordinate systems has been derived

$$\Delta t = \frac{\Delta t'}{\sqrt{1-u^2/c^2}} \tag{1}$$

where $\Delta t'$ separates two events occurring at the same space point at a frame of reference $R1$, Δt is the time interval between these two events as observed in $R2$ and u is the velocity of the spaceship along the x axis relative to the outside observer. The Equation (1) has been also used to derive [4] a similar relation

$$l = \frac{l'}{\sqrt{1-u^2/c^2}} \tag{2}$$

between the lengths l and l' of a rod (which rests in $R1$) measured in $R1$ and $R2$, respectively, which gives an effect called *a contraction of length*.

In my opinion the thought experiment leading to relation (1) is not fully right. The error in the interpretation of this and similar thought experiments arises from the *principle of relativity* which assumes that the observer in the spaceship is not able to determine motion of the spaceship. In consequence he assumes that the light pulse must move down and up along the same path. However, when the light pulse has left the source, its motion cannot be influenced by the motion of the source *i.e.* by the motion of the system of coordinates of the spaceship because the mass of a photon "at rest" is equal to zero and therefore the light cannot move straight down like the stone in the Einstein's thought experiment. Thus it cannot by any means move down and up along the same path with respect to the system of coordinates of the spaceship (**Figure 1(a)**), only because it has been assumed so [3,4].

Consequently, the observer in the spaceship should notice that the light pulses are moving down and up

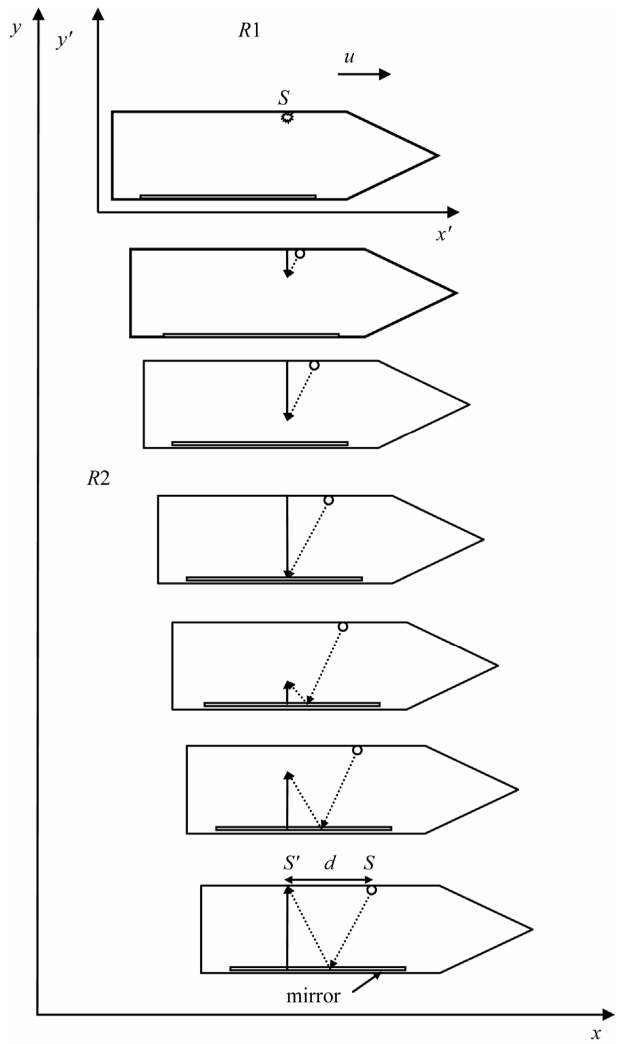


Figure 2. The light pulse in the frame of reference in the relatively state of rest *R*2, is emitted from source *S* and reflected back from the mirror along the same path of a straight line (solid line). In the frame of reference of the spaceship (*R*1) which moves with a velocity *u* relative to the frame of reference (*R*1), the observed trajectory of the path is in the form of a V letter and is marked by a dotted line. The positions of the light source at the times of departure and return of the pulse are given by *S* and *S′*, respectively and are totally different with those in Figure 1.

along a V-shaped trajectory with reference to the y'-axis of the (x', y') co-ordinates of the spaceship (dotted lines). Whereas the observer in the "relative" state of rest will observe the light impulse along the path of the parallel straight line (solid line, in **Figure 2**), with reference to the y-axis. Since, in reality the (x, y) co-ordinates are not in rest either, the latter observer should observe the path of the light pulse in the form of a different V shaped trajectory (depending on the speed), which for clarity reasons has been shown in the figure as the straight solid lines.

One should be able to confirm this statement by measuring the distance d between the positions of the light source S and return light impulse at the time of the round trip. Consequently by measuring the distance d (**Figure 2**) the observer in the spaceship should be able to determine the speed of the spaceship too.

The path of the light pulse as seen in the frame of reference $R1$ (**Figure 2**, dotted line) results from a superposition of the motion of the spaceship (frame of reference $R1$) and the motion of the light pulse. In other words the apparent longer distance in $R1$ is compensated by a proportionally smaller distance between the real path of the pulse and the frame of reference. Hence, any quantitative relations between time intervals in different coordinate systems derived on this basis [4] may be not considered as concerning real physical events.

For a better visualization of this experiment let us assume that the velocity of light does not amount to 299,792 km/s but only to 1 m/s and that the spaceship moves with a speed of 0.5 m/s in an ideal vacuum. To make it even clearer, let us imagine that the spaceship is 6 m high and 3 m long and that it does not possess the front and the back wall. In such case the beam of light, which has been sent from the ceiling, cannot reach the mirror but will reach the bottom somewhere at the end of the spaceship, or even may run out of it, because its motion and speed cannot be influenced by the motion of the spaceship. Otherwise either the velocity of the light should be larger than its maximal possible value or the spaceship should be in the state of an absolute rest. Both of them are unlikely.

The Special Theory of Relativity is well confirmed in many aspects of physics. On the other hand the presented thought experiment may also not be in any way questioned. Since the observer in the spaceship may determine the speed of his ship, the basic assumption of the theory is not fulfilled and needs reconsideration.

3. Conclusions

The presented thought experiment reveals that in any moving system with a constant speed along the X-axis, the path of a light pulse starting from the top of the system will not run parallel to the Y axis as is required by the principle of special theory of relativity.

4. References

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