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On The Homogeneity of Time

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Abstract

The twin paradox has been presented. The hypothesis that time is not homogeneous has been stated and in this way it has been explained why time slows down at speeds, comparable to light speed. Relativity of simultaneity has also been presented, and another argument is presented, that time is not homogeneous.

Introduction

The twin paradox is a thought experiment in special relativity of two twin brothers, one undertaking a long space journey with a very high-speed rocket at almost the speed of light, the other remaining on Earth. When the traveler finally returns to Earth, it is observed that he is younger than the twin who stayed put. It is well known from classical mechanics that time is homogeneous, i.e. all moments of time are synonymous. However the twin paradox is explained if we assume that time loses its homogeneity at speeds, comparable to light speed.

Time is inhomogeneous

Smarandache (1998) proposed that as a consequence of the Einstein-Podolsky-Rosen paradox, there is no speed limit in the universe (i.e., the speed of light is not a maximum at which information can be transmitted) and that arbitrary speeds of information or mass transfer can occur. The causality problem is a paradox involving time which occurs when a particle moves with speed faster than the speed of light. The causality problem results from that fact that when two causally-connected events A and B are connected with a speed faster than the speed of light for a stationary frame of reference, then event B happens before event A. Obviously, when a body travels with speed close to the light speed, time slows down, and when a body travels with hyper-light speed, the effect is ahead of the cause. As if time passes through a peculiar point, at speed equal to the speed of light. Photons travel in time with light speed. Time runs different for various particles, not only depending on their speed, but also probably depending on their mass. It is known from the relative theory that gravity slows down time. The photon is a massless particle, therefore there is no gravity field, which will interact with time, and thus it represents a boundary case.

When photons travel through media with refractive indexes, and move with speed close to light speed, time is not slowed down. Therefore, the twin paradox is not valid for photons. It is possible, when a body travels with speed close to light speed, time loses its homogeneity. The moments of time may move apart at speeds, comparable to light speed, and in such a way time loses its homogeneity and appears as if it moves more slowly. It is known that space is curve and its curvature depends on density. Space-time is also curved and its curvature also depends on density. Time has a pear-like form and it is also curved. The why homogeneous? Let's have a look on some of the properties of the Lagrange function. We say for material point that the Lagrange function does not depend on distance, because of homogeneity of space, and it does not depend on the radius vector, due to isotropic space. Due to homogeneity of time, the Lagrange function does not depend on it. Ensuing from the properties of space and time, we could write down for a material point:

$$L = L(v^2)$$

However, we know from the definition of speed that it depends on time, therefore the Lagrange's function obviously does not depend on time. An interesting property of Lagrange's function is that if we add to it a random function from co-ordinates and time, the equations of Lagrange remain unchanged.

$$\tilde{L}(q,\dot{q},t) = L(q,\dot{q},t) + \frac{d}{dt} f[q(t),t]$$

Let's find the effect of that function.

$$\tilde{S} = \int_{t_1}^{t_2} \tilde{L}(q,\dot{q},t)dt = \int_{t_1}^{t_2} L(q,\dot{q},t)dt + \int_{t_1}^{t_2} \frac{d}{dt} f(q,t)dt =$$
$$= S + f[q(t_2),t_2] - f[q(t_1),t_1]$$

The f function accounts for the fact that time is not homogeneous because t_1 and t_2 could take any value. Such a function disappears at varying and that accounts for the fact that action does not depend on whether time is homogeneous or not. Let's review the law of preservation of energy, which follows from homogeneity of time. We assume that time is not homogeneous, and the Lagrangiane depends on it $L = L(q,\dot{q},t)$. After differentiation of time, we obtain:

$$\frac{dL}{dt} = \sum_{i=1}^{s} \frac{\partial L}{\partial q_i}\dot{q}_i + \sum_{i=1}^{s} \frac{\partial L}{\partial \dot{q}_i}\ddot{q}_i + \sum_{i=1}^{s} \frac{\partial L}{\partial t_i}\dot{T}$$

Whereupon T is a more complex object, as the real time represents. We know that time also has a direction, which could not be described with one figure, which we measure. We also know that time has a pear-like form, therefore we assume that it is a more complex object. We substitute in the first term $\frac{\partial L}{\partial q_i}$ with $\frac{d}{dt}\frac{\partial L}{\partial \dot{q}_i}$ from the Lagrange equations and we place $\frac{d}{dt}$ in front of the brackets, thus receiving:

$$\frac{d}{dt}\left(\sum_{i=1}^{s} \frac{\partial L}{\partial \dot{q}_i}\dot{q}_i - L \right) + \sum_{i=1}^{s} \frac{\partial L}{\partial t_i}\dot{T} = 0$$

Let assume, that $\frac{dL}{dt} = \frac{\partial L}{\partial t}$ and we obtain

$$\frac{d}{dt}\left(\sum_{i=1}^{s}\frac{\partial L}{\partial \dot{q}_i}\dot{q}_i - L + L\dot{T}\right) = 0$$

In order for energy to be preserved, it should be $L\dot{T} = 0$, therefore $\dot{T} = 0$, i.e. T is in minimum or maximum. May be exactly in that minimum or maximum, time could be considered homogeneous. If we did not assume in the beginning that time is a more complex object, the law of preservation of light could not be executed. Therefore, time is a more complex object and it hardly could be homogeneous.

Equally, as we consider that a light ray travels from point A to point B then Time travels for both points so that it is greater than the velocity of light. Les us suppose a very long train travels with constant speed V in the direction of fig. 1.

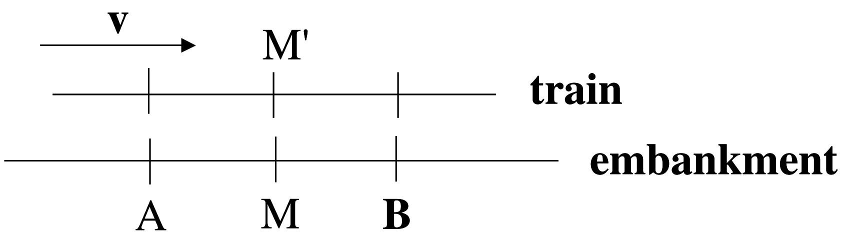

Fig. 1.

People who travel in this train will take it as a starting point. They consider all events with respect to the train. In that case every event on the railway will take place in a fixed spot of the train. The definition of simultaneity of the train could be given in the same way as regarding a railway embankment. Let two bolts of lightning, A and B appear. When we say lightning A and B are simultaneous according to the railway embankment we consider the following: light rays from point A and point B of lightning fall meet in the middle point M of the embankment AB segment. But the events A and B correspond to the fixed points A and B of the train. Consider M' as the middle point of the AB segment on the traveling train. In the exact moment of the lightning strike, (regarding the railway embankment) point M' coincides with M. [1] But it moves to the right as per fig. 1 at the speed of the train. If an observer sitting at point M' in the train was not in motion, the lightning rays A and B would reach him simultaneously. But in fact he travels towards the light ray from point A (relative to the railway embankment). Therefore the observer on the train will see the light ray from point B point later than the light ray from A. That is why the observers taking the train as a starting point have to conclude that the lightning at point B arrives later then the lightning from A. Therefore, events that are simultaneous regarding the railway embankment are not simultaneous regarding the train and vice versa. This is the well-known argument called the relativity of simultaneity [1]. The relativity of simultaneousness is also explained with homogeneity of time. We measure the time as homogeneous, without knowing whether it is a good approximation.

Reference:

[1] A. Einstein, Relativity The Special and the General Theory, Methuen &Co. Ltd. London.