On the Relativity of Lengths and Times

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A close logical analysis is given of Einstein's proof of the relativity of lengths and times. It turns out that in proving the relativity of lengths and times, some results concerning universal time and the true length of an object are exploited; or rather, for different inertial observers different definitions of length and synchronization of clocks are made, due to the deeply rooted influence of classical time and true length.

1. Introduction

Physics is a research science concerned first and foremost with understanding and describing nature, whose existence is independent of human consciousness; thus physics must be tested against reality. There are two kinds of realistic theories: nonlocal realistic theories and local realistic theories, with the latter formed by adding Einstein's locality limitation to the former. There is strong experimental evidence that local realistic theories are untenable (d'Espagnat 1979). This casts serious doubt on the Special Theory of Relativity (STR), on which Einstein locality is based. Although Einstein claimed that his theory is realistic, STR actually falls short of objectivity, as constantly stressed by Dingle (Dingle 1956, 1963, 1967).

Indeed, according to STR, there are no real entities in the universe at all, everything being relative, depending on the observer, since, as claimed by Miller (1981): "there were no such notions as the true time or the true length of an object; rather these were relative concepts: for example, the length of the rod was either l or r_{AB}, depending upon the rod's motion relative to an inertial observer". Even the so-called principle of the constancy of the velocity of light is relative in the same sense —as shown by Einstein in his 1905 paper (Einstein *et al.* 1923), for the same propagation of a ray of light relative to an observer A, observer A is able to consider the velocity of propagation to be equal to c, while observer B who is in uniform motion relative to A with velocity v along the ray of light is forced to regard this velocity as equal to $c+v$ or $c-v$, depending on the direction of v (the same or opposite to the direction of the propagation). The principle of relativity also applies to force, mass, density, *etc.* We are therefore so confused as not to know whether this principle should be referred to as the principle of the constancy of the velocity of light or as the principle of the relativity of the velocity of light.

Given that we are all observers, and can be at rest only in one coordinate system, if we are the observer B, we will have no operational way to know and believe what observer A knows, *i.e.*, never know and believe that the velocity of propagation of the ray of light relative to observer A is regarded by observer A as equal to c. How can we then know that there should be a so-called principle of the constancy of the velocity of light? Does such a principle, or even the whole of STR, have any physical significance to any observer?

In fact, since there is an infinite number of inertial observers, STR actually draws an infinite number of different conclusions due to different observers. Take, for example, the synchronization of two clocks. According to STR, different observers have different conclusions as to synchronization. As has been pointed out by this writer (Wen-Xiu Li 1994), if these observers are all considered correct, then there is immediately a contradiction that no one is actually able to find that "they are all right", since we are not really on Olympus—we are either at rest with respect to the two clocks, finding the others wrong, or in motion with a certain velocity relative to them, finding the rest wrong. If any one of them is considered to be wrong, the entire theory is then wrong. This unanswerable question is due to the lack of objectivity of the theory, which makes it unverifiable by experiments. In other words, STR can only be disproved by experiments, but not verified. The experiments that have been claimed as corroboration of this theory therefore in no sense represent what was claimed, and must be interpreted as inconsistent with STR.

The relativity of lengths and times is the most fundamental proposition of STR. Whether it is true is therefore crucial to this theory. Many authors have shown that the relativity of simultaneity suffers from serious contradictions (*e.g.*, see Mitsopoulos 1989, Xu and Xu 1993). It is the purpose of this paper to bring to light the essence of the relativity of lengths and times through a closely logical analysis of the proof given by Einstein. It turns out that, in his proof, Einstein exploited some results of classical time and the true length of an object. Specifically, he made different definitions of length and synchronization of clocks for different observers due to the deeply rooted influence of classical time and true length.

2. The relativity of times

Suppose there are two clocks, A and B, separated by a certain distance and at rest relative to each other. Einstein makes a new definition of synchronization for the two clocks in his 1905 paper on relativity theory in order to set up his new conception of time and make it essentially different from the classical one—the universal time. He writes:

> *Let a ray of light start at the 'A time' t_A from A towards B, let it at the 'B time' t_B be reflected at B in the direction of A, and arrive again at A at the 'A time' t'_A.*
>
> *In accordance with definition the two clocks synchronize if $t_B - t_A = t'_A - t_B$.*

We may further suppose that the two clocks can register the time values of the start and arrival of the light and automatically transmit these values to a computer to show whether the two clocks are synchronous by displaying whether these time values satisfy the above equation on the screen. Undoubtedly, if the computer shows us on the screen that these time values satisfy the above equation, we cannot but say that the two clocks synchronize. The display on the screen would not be changed by the motion of any observer relative to these clocks. Nor would the display on the screen be different when viewed from different observers in relative motion.

It is strange, however, that in the face of such an ironclad objective fact, Einstein should still be able to "prove" that the two clocks can no longer be looked upon as synchronous by observers in motion relative to them. Unquestionably, his "proof" must be nothing but a sophistry.

We now expose Einstein's sophistry. In the latter half of the second section of his paper quoted here, Einstein makes a fallacious argumentation of the relativity of times. He first imagines that there is a rigid rod with its axis "lying along the axis of x of the stationary system of co-ordinates and that a uniform motion of parallel translation with velocity v along the axis of x in the direction of increasing x is then imparted to the rod." Then he says:

> *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'.*
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> *"We imagine further that with each clock there is a moving observer, and that these observers apply to both clocks the criterion established in §1 for the synchronization of two clocks. Let a ray of light depart from A at the time ('Time' here denotes 'time of the stationary system' and also 'position of hands of the moving clock situated at the place under discussion') 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*
>
> $$t_B - t_A = \frac{r_{AB}}{c - v} \quad \text{and} \quad t'_A - t_B = \frac{r_{AB}}{c + v}$$
>
> *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.*

What a queer proof! The synchronization of the two clocks should all of a sudden become dependent on observers only by virtue of Einstein's saying "imagine further" twice. To explode the myth of the relativity of times let us analyze Einstein's first "imagine further". It is not difficult to see that this paragraph contains two propositions: (a) The necessary and sufficient condition for a moving clock to synchronize "with the clocks of the stationary system" is the correspondence of its indication "at any instant 'to the time of the stationary system' at the place where it happens to be"; (b) If two moving clocks are both synchronous with the clocks of the stationary system, these clocks are then synchronous. But Einstein does not make any proof of them. Let us not forget the fact that Einstein's argumentation refers to his new conception of time, not the classical and universal conception of time. In universal time, a particular point in time is said to be an instant, and clocks are referred to as synchronous if at any instant their indications are the same, and that these propositions are absolutely right and completely consistent with the classical definition of synchronization of clocks. But the conception of time is now essentially different. Under Einstein's new conception of time, it remains to be proven that these propositions are completely consistent with his new definition of synchronization. Without such a proof no one would be justified in saying so. The fact that Einstein draws from these propositions the conclusion of the relativity of times shows clearly that these propositions are altogether inconsistent with his new definition of synchronization of clocks. The mystery turns out to be that Einstein takes these propositions for granted to surreptitiously introduce another different definition of synchronization for the two clocks, that is

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

We eventually realize that the reason why different observers draw different conclusions about one and the same thing, such as the synchronization of two clocks, is that different observers have different definitions—an overt one for “observers moving with the moving rod” and a covert one for “observers in the stationary system”. The deception arises when Einstein uses these propositions to introduce another definition, as we are not aware that they are no longer valid under Einstein’s new conception of time.

3. Relativity of lengths

In order to shed light on how Einstein dupes us into taking his conclusion of the relativity of lengths for granted, let us first re-examine the classical length-determining theory. In the classical theory, the result of directly superposing a measuring-rod on a rod to be measured is defined as the length of the rod, and for one physical concept only one definition can be made.

The so-called “length contraction” is certainly a conclusion brought about by comparison. If, for example, if we say, “Low temperature contracts a rod,” we certainly mean something like this: “The length of the rod, measured according to the above definition after the temperature of the rod is reduced, is smaller than the length of the rod, measured according to the same definition before its temperature was reduced.” Obviously, it is meaningless to compare different lengths measured according to different definitions.

Having established the definition of length, we now see that the length of a body under various conditions is simply a problem that needs to be settled by means of theory. How does the classical theory resolve the problem of determining the length of a rod which is in motion relative to us in the direction parallel to its length with a velocity v?

To establish a theory we need, first of all, to establish axioms. Taking into consideration the fact that a rod which is at rest relative to the earth is simultaneously in various motions relative to other matter of the universe, it is reasonable to assume that the length of the rod is independent of its motion relative to any body. For the present, this assumption might be called the principle of the constancy of length. We now suppose that the rod AB of length l is placed along the x axis of the laboratory coordinate system and moved at velocity v in the direction of increasing x. Let there be two instruments at x_1 and x_2 to register the time t_1 of the end A of the rod passing through x_1 and the time t_2 of the end B passing through x_2, with x_1 and x_2 taken at random on the x axis. According to the universal notion of time and the principle of the constancy of length, at the instant of the arrival of the end A at x_1 the end B must be located at x'_1 so that $x_1x'_1 = AB = l$. Then, according to the definition of velocity, we have $x'_1x_2 = v(t_2 - t_1)$. From the explicitly geometrical relation it can be seen that $x_2 - x_1 = x_1x'_1 + x'_1x_2 = l + v(t_2 - t_1)$. We thus obtain

$$l = (x_2 - x_1) - v(t_2 - t_1), \tag{1}$$

which tells us that in this situation, although we cannot directly measure the length of the rod, we can work it out with the universal time values t_1 and t_2 and the directly measured distance $(x_2 - x_1)$. This is simply where the power of a correct theory lies.

In the special case when $x_1 = x_2$ and when $t_1 = t_2$, we have respectively

$$l = v(t_1 - t_2), \tag{2}$$

and

$$l = (x_2 - x_1) \tag{3}$$

Clearly, all these equations, (1), (2), and (3), are the outcomes of the classical length-determining theory with both the universal time and the principle of the constancy of length as premises. Therefore, if these premises are changed even a little, these equations will all no longer be valid.

We are now ready to see what Einstein’s relativity of lengths is. In the first half of §2 of the same paper as quoted in the last section Einstein imagines two operations for the length of a moving rod to be ascertained. The first is the one given above as the definition of length, and the second is simply the equation (3). And then Einstein comes to the conclusion of the relativity of lengths based on the “fact” that the length determined according to his imagined second operation on the basis of his two postulates is not equal to that measured according to his first operation.

It can be seen that Einstein takes for granted that equation (3) must hold without preconditions. In other words, Einstein takes equation (3) as valid, but at the same time regards its preconditions as wrong. No one knows why Einstein takes equation (3) as his second operation, out of the three equations—perhaps because equation (3) is more ambiguous than the others. It is not because that “current kinematics tacitly assumes that the lengths determined by these two operations are precisely equal,” but because the second operation directly follows from the principle of the constancy of length. Once we realize that the full equivalence of the two operations presupposes both universal time and the principle of the constancy of length, and that Einstein's "theory" has completely negated both, we realize that Einstein's two operations actually represent two different definitions of length. As has been pointed out in the foregoing statement, it is meaningless to compare different "lengths" resulting from different definitions. Since the second operation is not justified under Einstein's new conceptions of time and length, the conclusion of the relativity of lengths is completely fallacious.

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