Ralph Malcolm Rabbidge and relativity of simultaneity

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1 Introduction

The Special Theory of Relativity (SR) is based on its two postulates, and the relativity of simultaneity follows inevitably from these postulates.

Ralph Malcolm Rabbidge, who is posting in the usenet-group sci.physics.relativity under the pseudonym Henry Wilson, is however of another opinion. He has stated:

> " Einstein's RoS...and therefore his whole theory.... is based on an obvious fallacy.
>
> The amazing things is, NOBODY EXCEPT HENRY WILSON WAS CAPABLE OF NOTICING EINSTEIN'S FUNDAMENTAL ERROR FOR ONE HUNDRED AND SIX YEARS.
>
> AND THE WHOLE OF SR AND GR DEPENDS ON THE FALLACY."

2 Relativity of Simultaneity in SR

2.1 Einstein's original paper

Shown below is Paragraph 2 of Einstein's paper: **On the Electrodynamics of Moving Bodies**

§ 2. On the Relativity of Lengths and Times

The following reflexions are based on the principle of relativity and on the principle of the constancy of the velocity of light. These two principles we define as follows:—

1. The laws by which the states of physical systems undergo change are not affected, whether these changes of state be referred to the one or the other of two systems of co-ordinates in uniform translatory motion.
2. Any ray of light moves in the "stationary" system of co-ordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body. Hence

$$\text{velocity} = \frac{\text{light path}}{\text{time interval}}$$

where time interval is to be taken in the sense of the definition in § 1.

Let there be given a stationary rigid rod; and let its length be l as measured by a measuring-rod which is also stationary. We now imagine the axis of the rod 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. We now inquire as to the length of the moving rod, and imagine its length to be ascertained by the following two operations:—

(*a*) The observer moves together with the given measuring-rod and the rod to be measured, and measures the length of the rod directly by superposing the measuring-rod, in just the same way as if all three were at rest.

(*b*) By means of stationary clocks set up in the stationary system and synchronizing in accordance with § 1, the observer ascertains at what points of the stationary system the two ends of the rod to be measured are located at a definite time. The distance between these two points, measured by the measuring-rod already employed, which in this case is at rest, is also a length which may be designated "the length of the rod."

In accordance with the principle of relativity the length to be discovered by the operation (*a*)—we will call it "the length of the rod in the moving system"—must be equal to the length l of the stationary rod.

The length to be discovered by the operation (*b*) we will call "the length of the (moving) rod in the stationary system." This we shall determine on the basis of our two principles, and we shall find that it differs from l.

Current kinematics tacitly assumes that the lengths determined by these two operations are precisely equal, or in other words, that a moving rigid body at the epoch t may in geometrical respects be perfectly represented by *the same* body *at rest* in a definite position.

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."

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[4] $t_{\rm A}$, let it be reflected at B at the time $t_{\rm B}$, and reach A again at the time $t'_{\rm A}$. Taking into consideration the principle of the constancy of the velocity of light we find that

$$t_{\rm B} - t_{\rm A} = \frac{r_{\rm AB}}{c - v} \text{ and } t'_{\rm A} - t_{\rm B} = \frac{r_{\rm AB}}{c + v}$$

where $r_{\rm AB}$ 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.

So we see that we cannot attach any *absolute* signification to the concept of simultaneity, but that two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relatively to that system.

2.2 Elaboration of Einstein's proof

At the risk of offending the intelligent reader, I will repeat Einstein's proof that the relativity of simultaneity follows from the postulates of SR.

Two clocks, A and B, are placed at the ends of a rod. This rod is moving with the speed v in the 'stationary system'. The length of the rod is r_{AB} as measured in the stationary system. Einstein specifies that the indication of these clocks "correspond at any instant to the 'time of the stationary system' at the places where they happen to be".

Note that this means that the clocks on the rod can't be identical to the clocks in the stationary system; their intrinsic rate has to be slightly higher. This has no significance for the thought experiment, though. The clocks A and B are synchronous in the stationary system because they simultaneously show the same as observed in the stationary system.

The question is now, are they synchronous in the rest frame of the rod (moving system)?

To determine that, a light pulse is emitted from clock A, reflected off clock B, and received by A.

Let E_A be the event that light is emitted from A.
Let E_B be the event that light is reflected from B.
Let E'_A be the event that light is received by A.

We will place three stationary, synchronized clocks at strategic places in the stationary system.
Clock C_A is co-located with clock A at the event E_A.
Clock C_B is co-located with clock B at the event E_B.
Clock C'_A is co-located with clock A at the event E'_A.

Let clock C_A show t_A at the event E_A.

The light will be reflected off clock B when the co-located clock C_B shows $t_B = t_A + t_{AB}$, where t_{AB} is the transit time for the light to go from clock A to clock B, as measured in the stationary system.

Since the speed of light is c in the stationary system, we have:

$$ct_{AB} = r_{AB} + vt_{AB}$$
$$t_{AB} = \frac{r_{AB}}{c - v}$$

The light will be received by clock A when the co-located clock C'_A shows $t'_A = t_B + t_{BA}$ where t_{BA} is the transit time for the light to go from clock B to clock A, as measured in the stationary system.

Since the speed of light is c in the stationary system, we have:

$$ct_{BA} = r_{AB} - vt_{BA}$$
$$t_{BA} = \frac{r_{AB}}{c + v}$$

To be synchronous in the stationary system, clock A must show the same as clock C_A when they are co-located, and it will show the same as clock C'_A when they are co-located. Equivalently must clock B show the same as clock C_B when they are co-located.

So we can conclude that to be synchronous in the stationary system, the moving clocks A and B must be set thus:

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

In the rest frame of the rod, the clocks A and B are stationary, and since the speed of light is c in the rest frame of the rod, the criterion for stationary clocks to be synchronous is: $(t_B - t_A) = (t'_A - t_B)$.
But $(t_B - t_A) > (t'_A - t_B)$ so A and B are not synchronous in the rest frame of the rod.

Clock A and clock B do not simultaneously show the same as observed in their rest frame.

3 Ralph Malcolm Rabbidge's contribution to the subject

Ralph Malcolm Rabbidge's article

From where I quote:

> "His 1905 paper opens with a declaration of two postulates, the first of which more or less restates the Principle of Relativity and effectively removes the concept of absolutism provided by the elusive 'aether'. It is the second, P2, which is the main concern here. It states that light will always be found to move at exactly 'c' when measured by any observer, irrespective of the relative movement of its source. This is in direct conflict Newtonian physics and BaTh. But mere words do not constitute a sound physical law and neither the postulate nor any prediction of SR has been verified by a convincing experiment."

Note that Ralph Malcolm Rabbidge claims that SR is not experimentally confirmed.
I think the reader will know better.

And then the real gem:

> "Although SR appears mathematically consistent it does not stand up well to logical scrutiny. It is shown below that it does not represent physical reality and is wrong."

Ralph Malcolm Rabbidge knows that SR is a consistent theory.
Yet he claims that a logical scrutiny of Einstein's *thought experiment* will show that the predictions of SR will not be in accordance with the results of real experiments!

I will not offend the reader's intelligence by explaining why I find this hilarious.

4 Conclusion

Did Ralph Malcolm Rabbidge succeed in proving that 'relativity of simultaneity' violates the postulates of SR?

I will let the reader draw his own conclusion.