Special Relativity and Length Contraction

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Abstract

The special theory of relativity, SR, is based on two so-called postulates/axioms:
1) The constancy of the speed of light
The special theory of relativity postulates that the speed of light in a vacuum is constant equal to c for all observers in uniform relative motion.
2) Principle of relativity
All systems, where observers move at constant speed, inertial systems, are equivalent and therefore the laws of physics must give the same result for all of them.
As a consequence of SR comes two concepts/physical phenomena:

- time dilation
- length contraction.

In this article we take a look at length contraction.

Keywords

Special Relativity, Reference System, Lorentz Transformations, Length Contraction

Analysis

Quote from the book [B1]: (Principle of relativity)
Q1: *"The laws of physics are identical in all inertial frames, or, equivalently, the outcome of any physical experiment is the same when performed with identical initial conditions relative to any inertial frame." (page 28)*

Q2: *"An ideal infinitesimal rigid body is one whose dimensions are unaffected by acceleration as such and whose length accordingly depends only on its instantaneous speed of light in accordance with (9.1)." (page 24)*

Here it says that if a body of length Δx in S' is in motion relative to S with speed v, it acquires the length $\Delta x'$ according to the formula

$$\Delta x' = \Delta x / \gamma,\ \gamma = 1/(1 - v^2/c^2)^{1/2},$$ γ is called Lotentz Factor.

Thought experiment:
We have two inertial reference systems S and S'. A body of length $\Delta \boldsymbol{x'} = \Delta \boldsymbol{x}$ located in S' starts from a point in S where it has velocity $\boldsymbol{v = 0}$ relative to S. Fig. 1.

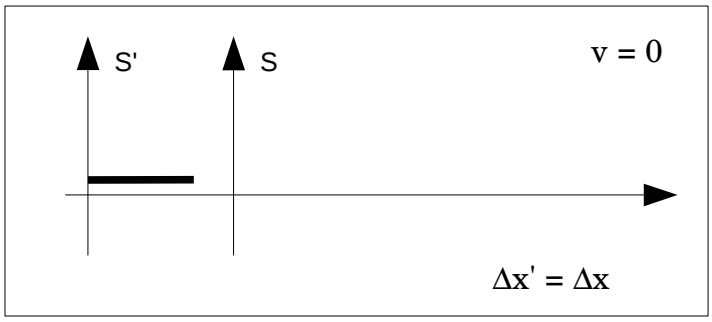

Fig. 1

S' **accelerates** and when S' passes S, it has acquired a constant velocity $\boldsymbol{v > 0}$.
From this moment applies to SR. Before this moment, see Q2, the length of the body is $\Delta \boldsymbol{x'} = \Delta \boldsymbol{x}$. Fig. 2.

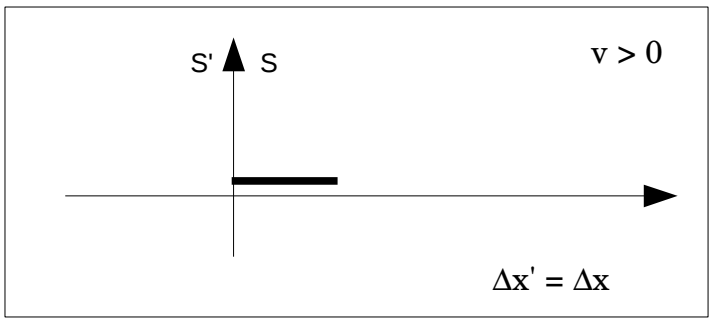

Fig. 2

Suddenly length of body becomes $\Delta \boldsymbol{x'} = \Delta \boldsymbol{x}/\gamma$. Fig. 3.

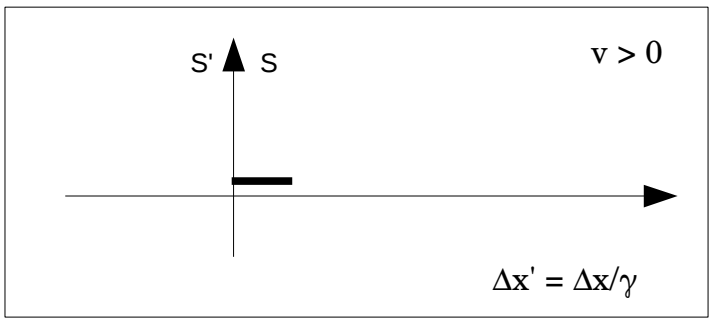

Fig. 3

The body in S' moves with constant speed $\boldsymbol{v > 0}$ a distance $\boldsymbol{d}$. During this time SR applies and the length of the body is $\Delta \boldsymbol{x'} = \Delta \boldsymbol{x}/\gamma$. Fig. 4.

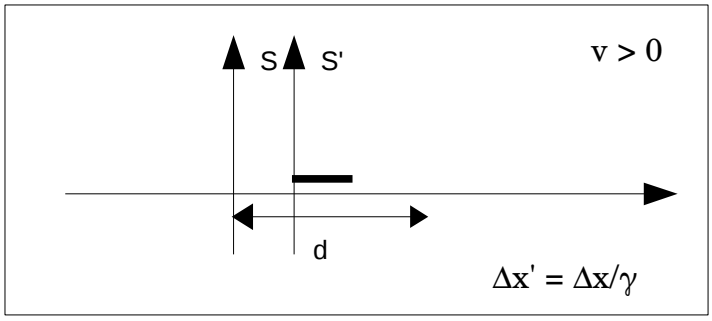

Fig. 4

After the body in S' has passed the distance $\boldsymbol{d}$, it begins to brake (negative acceleration) and return to speed $\boldsymbol{v = 0}$ relative to S. Then it again has length $\Delta\boldsymbol{x' = \Delta x}$. Fig. 5.

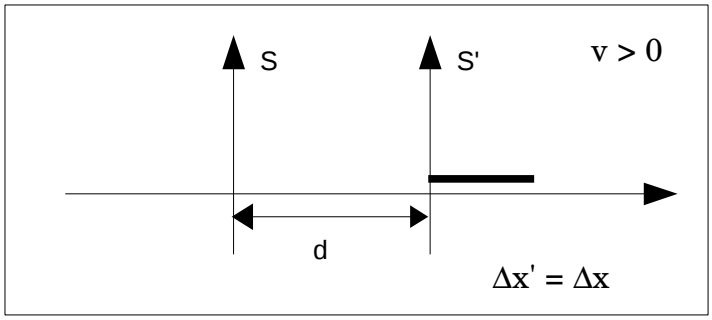

Fig. 5

There are two considerations here:

1) How does SR explain that the body in S' with length $\Delta\boldsymbol{x' = \Delta x}$ **suddenly** gains length $\Delta\boldsymbol{x' = \Delta x}/\gamma$ (at the instant when S' reaches S and acquires **constant velocity** $\boldsymbol{v}$)?
I want to see an explanation from those who claim that SR is right!

2) It is said that through SR, ***space and time*** have been linked to the new term ***spacetime***. But look at the formula for length contraction $\Delta\boldsymbol{x' = \Delta x}/\gamma$! It does not depend on either $\boldsymbol{t}$ or $\boldsymbol{t'}$! Isn't this strange?
I want to see an explanation from those who claim that SR is right!

This is as absurd as it gets! Therefore SR is nonsense.

References

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