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A Simple Refutation of Special Relativity

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Abstract

The Theory of Special Relativity [1][2] with its mathematical reprensentation, the Lorentz Transformation, is easily refuted by examining its results for the propagation of light.

The Test Case

Consider two light fronts travelling in opposite directions in an inertial frame $S(x,t)$. One light front is moving in the positive x-direction

$$x_+ = ct \tag{1}$$

and the other in the negative x-direction

$$x_- = -ct \tag{2}$$

where x_+ and x_- denote the x-coordinates of the two light fronts at time t in the system $S(x,t)$, and c denotes the speed of light.

Following special relativity, the space coordinate x' and the time t' in an inertial frame $S'(x',t')$, which is moving with velocity v relative to $S(x,t)$ in the positive x-direction, are given by the Lorentz transformation

$$x' = \gamma\,(x - vt) \tag{3}$$

$$t' = \gamma\left(t - \frac{xv}{c^2}\right) \tag{4}$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{5}$$

where x' is the space coordinate and t' is the time in the system $S'(x',t')$, which correspond to the space coordinate x and the time t in the system $S(x,t)$, respectively. γ is also known as Lorentz factor.

Substituting $x = x_+ = ct$ for the first light front we get

$$x'_+ = \gamma\left(x_+ - vt\right) = \gamma\left(ct - vt\right) = \gamma\left(1 - \frac{v}{c}\right)ct = \gamma\left(1 - \frac{v}{c}\right)x_+ \tag{6}$$

$$t' = \gamma\left(t - \frac{vx_+}{c^2}\right) = \gamma\left(t - \frac{vct}{c^2}\right) = \gamma\left(t - \frac{vt}{c}\right) = \gamma\left(1 - \frac{v}{c}\right)t \tag{7}$$

with the common factor

$$\gamma\left(1 - \frac{v}{c}\right) = \frac{1 - \frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{1 - \frac{v}{c}}{\sqrt{(1 + \frac{v}{c})(1 - \frac{v}{c})}} = \frac{\sqrt{1 - \frac{v}{c}}}{\sqrt{1 + \frac{v}{c}}} < 1 \tag{8}$$

From these equations special relativity tells us, that for a given time t the distance the light front travels is shorter than in the system $S(x,t)$, and time runs slower by the same factor, resulting in a constant speed of light $\Delta x/\Delta t = \Delta x'/\Delta t' = c$ in both systems.

Now substituting $x = x_- = -ct$ for the second light front we get

$$x'_- = \gamma\left(x_- - vt\right) = \gamma\left(-ct - vt\right) = -\gamma\left(1 + \frac{v}{c}\right)ct = \gamma\left(1 + \frac{v}{c}\right)x_- \tag{9}$$

$$t' = \gamma\left(t - \frac{vx_-}{c^2}\right) = \gamma\left(t + \frac{vct}{c^2}\right) = \gamma\left(t + \frac{vt}{c}\right) = \gamma\left(1 + \frac{v}{c}\right)t \tag{10}$$

with the common factor

$$\gamma\left(1 + \frac{v}{c}\right) = \frac{1 + \frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{1 + \frac{v}{c}}{\sqrt{(1 + \frac{v}{c})(1 - \frac{v}{c})}} = \frac{\sqrt{1 + \frac{v}{c}}}{\sqrt{1 - \frac{v}{c}}} > 1 \tag{11}$$

From these equations special relativity tells us now, that for a given time t the distance the light front travels is longer than in the system $S(x,t)$, and time runs faster by the same factor, resulting in a constant speed of light $\Delta x/\Delta t = \Delta x'/\Delta t' = -c$ in both systems.

This leads to a basic contradiction:
Time cannot run at different rates at the same time ($t' = 0$) and at the same place ($x' = 0$) in the same system ($S'(x',t')$).

Conclusion

It is shown that the Theory of Special Relativity, applied to the simple case of two light fronts moving in opposite directions, leads to a contradiction and is thus refuted.

References

[1] A. Einstein, *Zur Elektrodynamik bewegter Körper*. Annalen der Physik 322 (10), 891–921 (1905).

[2] A. Einstein, *RELATIVITY, The special and general theory*. Henry Holt and Company, New York, 1921.