Galilean and Einsteinian Observers

Stephen J. Crothers

Tasmania, Australia
thenarmis@yahoo.com
15 March, 2017

ABSTRACT

Physicists since Einstein have assumed that the Galilean system of clock-synchronised stationary observers is consistent with the Special Theory of Relativity. More specifically, they have always assumed that the Galilean system of clock-synchronised stationary observers, that obeys the Galilean transformation equations, is consistent with the non-Galilean Lorentz transformation equations. Einstein's assumption is however, demonstrably false.

1 Introduction

When Einstein spoke of 'length contraction' and 'time dilation' he asserted that these effects are observed from the 'stationary system'. Any general system of observers has any number of observers. Einstein's effects are observed by all observers in his 'stationary system'. He invoked systems of clock-synchronised stationary observers and subjected them to non-Galilean relations: the Lorentz Transformation. But systems of clock-synchronised stationary observers are Galilean. Einstein's assumption that they are compatible with the non-Galilean relations of his Special Theory of Relativity is false.

2 Galilean observers

Figure 1 depicts two systems of observers and their coordinates. K reads time t, k reads time $\tau = t$.

For any $x > 0$ in system K the position of every stationary observer on the x-axis can be specified by $x_\sigma = \sigma x$, $0 \leq \sigma$. The locations of some such observers are tabulated:

σ	x_σ
0	$x_0 = 0$
1/2	$x_{1/2} = x/2$
1	$x_1 = x$
2	$x_2 = 2x$
π	$x_\pi = \pi x$

A similar arrangement can be made for the system k. Now put a rigid rod of length l_0 in the system k and attach a clock to its end, as shown in figure 2. All the observers' clocks in K and k read the same time: $t = \tau$: they are all synchronised. Every observer x_σ of K finds the rod to have length l_0 at any time t. Every observer in k finds the same.

Imagine now that the system k has a speed v in the positive direction of x, as in figure 3. After a time $t > 0$, the rod has

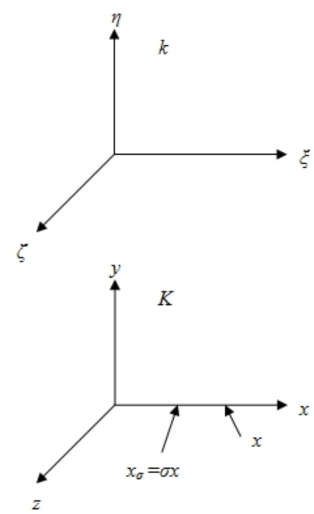

Fig. 1: Two systems of clock-synchronised stationary observers that are at rest. For any given arbitrary $x > 0$, the locations of all observers in the system K can be specified by $x_\sigma = \sigma x, 0 \leq \sigma$.

advanced the distance $d = vt$. Then,

$$x = d + l_0 = vt + l_0,$$

hence,

$$l_0 = x - vt.$$

This is the Galilean Transformation of the x values. All the observers x_σ find, from their vantage points, that the length of the rod is always l_0 at any time $t \geq 0$. All observers in the moving system k also find no change in the length of the rod and that all their clocks read the same as all in K.

3 Einstein's observers

Einstein however, by means of the Lorentz Transformation, asserted that all the clock-synchronised stationary observers

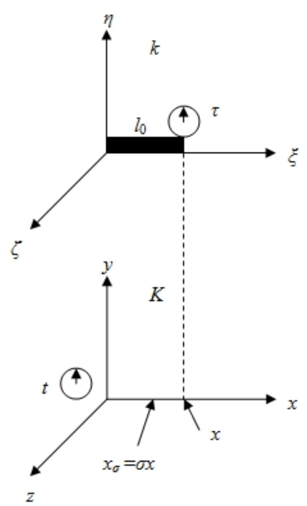

Fig. 2: Two systems of clock-synchronised stationary observers that are at rest. The system k contains a rigid rod of length $\xi = l_0$. All observers agree as to its length at any time.

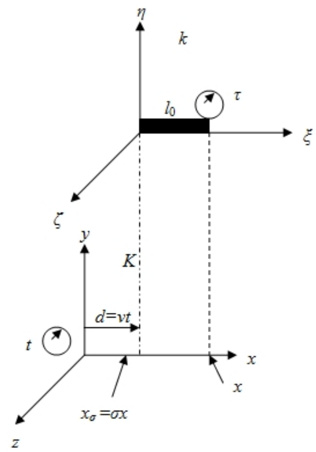

Fig. 3: After a time $t > 0$ the system k has advanced a distance $d = vt$. The clocks of all the observers x_σ read the same time. The clocks of all the observers in k also read the same time: $t = \tau$. Nobody sees any change in the length of the rod.

in K see a shortened rod, of length $l'_0 = l_0\sqrt{1 - v^2/c^2}$, and that the clock in k runs slower so that $\tau = t\sqrt{1 - v^2/c^2}$; c the speed of light 'in vacuum'.

> "*We envisage a rigid sphere of radius R, at rest relatively to the moving system k, and with its centre at the origin of co-ordinates of k. . . . A rigid body which, measured in a state of rest, has the form of a sphere, therefore has in a state of motion - viewed from the stationary system - the form of an ellipsoid of revolution with the axes*
>
> $$R\sqrt{1 - v^2/c^2}, R, R.$$
>
> "*Thus, whereas the Y and Z dimensions of the sphere (and therefore of every rigid body of no matter what form) do not appear modified by the motion, the X dimension appears shortened in the ratio* $1 : \sqrt{1 - v^2/c^2}$, *i.e. the greater the value of v, the greater the shortening.*" [1, §4]
>
> "*Therefore,*
>
> $$\tau = t\sqrt{1 - v^2/c^2} = t - \left(1 - \sqrt{1 - v^2/c^2}\right)t$$
>
> "*whence it follows that the time marked by the clock (viewed in the stationary system) is slow by* $1 - \sqrt{1 - v^2/c^2}$ *seconds per second, . . .* " [1, §4]

In §1 of his paper [1], Einstein goes to great lengths to explain his method of synchronising the clocks of observers in a stationary system. It is not his method but that he requires synchronised clocks for all observers in a stationary system.

> "*We assume that this definition of sychronism is free from contradictions, and possible for any number of points.*" [1, §1]

However, his assumption is in fact false in the context of his Special Theory. In [2], by mathematical construction, I fix a system of stationary observers. I then apply the Lorentz Transformation to show that none of the clocks in the stationary system can be synchronised. In [3] and [4], by mathematical construction, I fix a system of clock-synchronised observers by the Lorentz Transformation and show that all but one observer cannot be stationary. A system of clock-synchronised stationary observers cannot be reconciled with the Lorentz Transformation. A system of clock-synchronised stationary observers is Galilean.

References

[1] Einstein, A., On the electrodynamics of moving bodies, *Annalen der Physik*, 17, 1905

[2] Crothers, S.J., On the Logical Inconsistency of the Special Theory of Relativity, 6th March 2017, http://vixra.org/abs/1703.0047

[3] Crothers, S.J., On the Logical Inconsistency of Einstein's Time Dilation, 9th March 2017, http://vixra.org/abs/1703.0093

[4] Crothers, S.J., On the Logical Inconsistency of Einstein's Length Contraction, 13th March 2017, http://vixra.org/abs/1703.0143