Special Theory of Relativity: Logical Inconsistencies

APS ABSTRACT: When Einstein formulated his Special Theory of Relativity he tacitly assumed that it is possible to construct systems of clock-synchronised stationary observers consistent with the Lorentz Transformation. Such systems of observers are essential to the Special Theory. By mathematically constructing an infinite system of stationary observers and forcing it to comply with the Lorentz Transformation, it follows that the observers cannot be clock-synchronised. Conversely, by mathematically constructing an infinite system of clock-synchronised observers and forcing it to comply with the Lorentz Transformation, it follows that the observers cannot be stationary. Only one element of each of the said sets of observers has the deceptive appearance of satisfying Einstein's assumption. It is this element which Einstein incorrectly allowed to speak for all observers by virtue of his assumption; but clearly not all observers are equivalent. Furthermore, a system consisting of a single observer cannot be clock-synchronised or stationary with respect to anything. Einstein defined time by means of clocks. In so doing he detached time from physical reality because time is perceived and understood by the motion of celestial bodies, which is independent of the hands of a clock.

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The Special Theory of Relativity: <u>Logical Inconsistencies</u>

<u>TIME</u> A. Einstein defined time by means of clocks:

"*Thus with the help of certain imaginary physical experiments we have settled what is to be understood by synchronous stationary clocks located at different places, and have evidently obtained a definition of 'simultaneous', or 'synchronous', and of 'time.' ... It is essential to have time defined by means of stationary clocks in the stationary system, and the time now defined being appropriate to the stationary system we call it 'the time of the stationary system.'*" [1]

But time is no more defined by a clock than pressure is defined by a pressure gauge, speed by a speedometer, or gravity by a graded spring. Time is not defined by clocks. It is naturally fixed, manifest in motion, as with the celestial bodies. By defining time by his clocks, A. Einstein detached time from physical reality.

[1] A. Einstein, On the electrodynamics of moving bodies, *Ann. Phys*., **17**, 1905

EINSTEIN'S SYSTEMS OF CLOCK-SYNCHRONISED STATIONARY OBSERVERS AND THE LORENTZ TRANSFORMATION

A. Einstein tacitly assumed that his systems of clock-synchronised stationary observers are consistent with the Lorentz Transformation:

"*To any system of values x, y, z, t, which completely defines the place and time of an event in the stationary system, there belongs a system of values* $\xi, \eta, \varsigma, \tau$ *determining that event relatively to the system k*." [1]

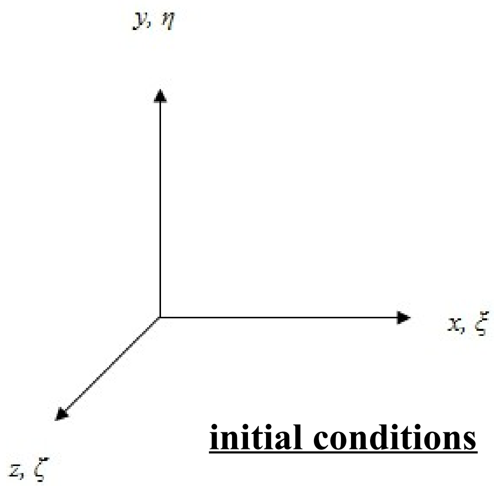
"*… as we know how to judge whether two, or more, clocks show the same time simultaneously and run in the same way, we can very well imagine as many clocks as we like in a given CS. … The clocks are all at rest relative to the CS. They are 'good' clocks and are synchronized, which means that they show the same time simultaneously*." [2] (CS ≡ Coordinate System)

The assumption is false. Systems of clock-synchronised stationary observers consistent with the Lorentz Transformation cannot be mathematically constructed – they do not exist.

[1] A. Einstein, On the electrodynamics of moving bodies, *Ann. Phys*., **17**, 1905

[2] A. Einstein and L. Infeld, *The Evolution of Physics*, Simon & Schuster, Inc., New York, 1938

EINSTEIN'S SYSTEMS OF CLOCK-SYNCHRONISED STATIONARY OBSERVERS AND THE LORENTZ TRANSFORMATION

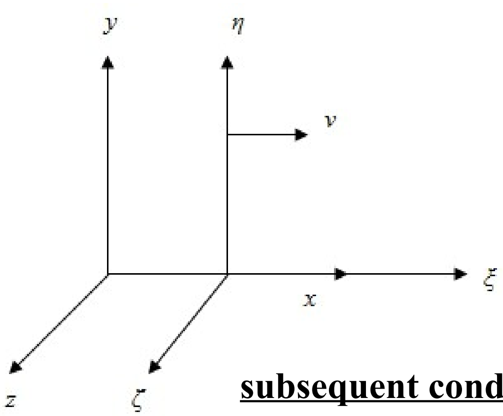


initial conditions

$$\tau = \beta\left(t - vx/c^2\right)$$
$$\xi = \beta\left(x - vt\right)$$
$$\eta = y$$
$$\varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Lorentz Transformation

$K(x,y,z,t) \equiv$ 'stationary system'
$k(\xi,\eta,\zeta,\tau) \equiv$ 'moving system'



subsequent conditions

"*At the time t = τ = 0, when the origin of the co-ordinates is common to the two systems, let a spherical wave be emitted therefrom, and be propagated with the velocity c in system K.*" [1]

[1] A. Einstein, On the electrodynamics of moving bodies, *Ann. Phys*., **17**, 1905

SYSTEMS OF STATIONARY OBSERVERS AND THE LORENTZ TRANSFORMATION

To ensure a system of stationary observers *K,* by mathematical construction, set $x_\sigma = \sigma x_1$ where $\sigma \in \Re$ labels the observer x_σ and specifies the location of that observer, and $x_1 \neq$ 0 arbitrary. All observers have a clock, reading the corresponding time t_σ. The *only way* to quantify t_σ consistent with the Lorentz Transformation is [3],

$$\tau = \beta\left(t_\sigma - vx_\sigma / c^2\right)$$
$$\xi_\sigma = \beta\left(x_\sigma - vt_\sigma\right)$$
$$x_\sigma = \sigma x_1\,, \quad t_\sigma = t_1 + \frac{(\sigma - 1)vx_1}{c^2}$$
$$\eta = y\,, \quad \varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Lorentz Transformation Stationary Systems

If $\sigma = 1$ then $\rightarrow$

$$\tau = \beta\left(t - vx/c^2\right)$$
$$\xi = \beta\left(x - vt\right)$$
$$\eta = y$$
$$\varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Particular case: $\sigma = 1$

Mathematical construction of a system of stationary observers satisfying Lorentz Transformation proves that the system of observers cannot be clock-synchronised [3].

[3] S. J. Crothers, On the Logical Inconsistency of the Special Theory of Relativity, *AJMP*. **6**, 3, (2017), http://vixra.org/pdf/1703.0047v6.pdf

SYSTEMS OF CLOCK-SYNCHRONISED OBSERVERS AND THE LORENTZ TRANSFORMATION

Let the clocks of a system x_σ of clock-synchronised observers *K* read the common 'time' *t*. The *only way* to quantify x_σ consistent with the Lorentz Transformation is by [3],

$$\tau_\sigma = \beta\left(t - vx_\sigma / c^2\right) = \sigma\tau_1$$
$$\xi_\sigma = \beta\left(x_\sigma - vt\right)$$
$$x_\sigma = \frac{\left(1-\sigma\right)c^2 t}{v} + \sigma x_1$$
$$\eta = y, \quad \varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2} \qquad \sigma \in \Re$$

If $\sigma = 1$ then $\rightarrow$

$$\tau = \beta\left(t - vx/c^2\right)$$
$$\xi = \beta\left(x - vt\right)$$
$$\eta = y$$
$$\varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Lorentz Transformation Clock-Synchronised Systems **Particular case: $\sigma = 1$**

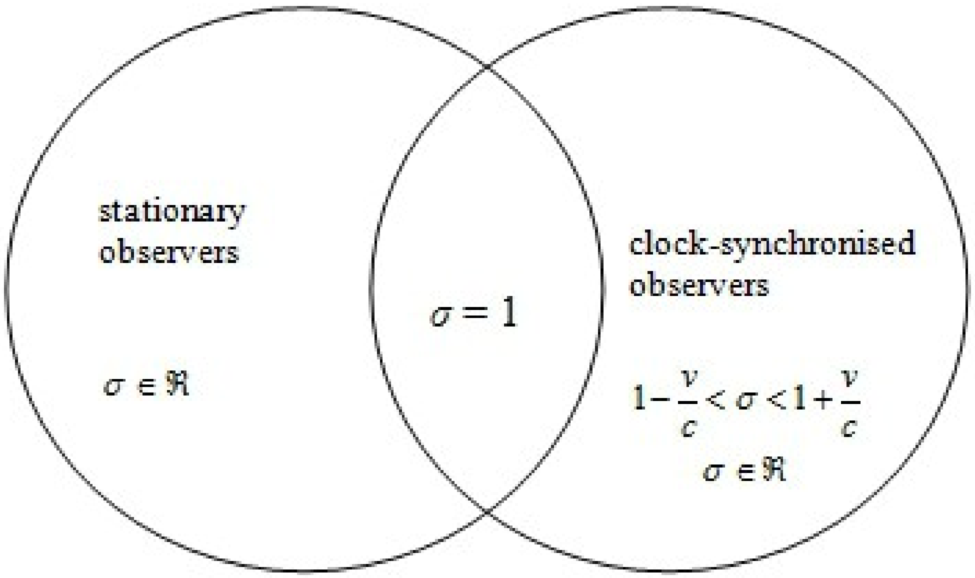
The Inverse Lorentz Transformation is obtained by interchanging coordinate systems and replacing *v* with –*v*. From the above and the inverse transformation,

$$\frac{dx_\sigma}{dt} = \frac{\left(1-\sigma\right)c^2}{v} < c \quad \text{and} \quad \frac{d\xi_\sigma}{d\tau} = \frac{\left(\sigma-1\right)c^2}{v} < c \quad \Rightarrow \quad 1 - \frac{v}{c} < \sigma < 1 + \frac{v}{c}.$$

Mathematical construction of a system of clock-synchronised observers satisfying Lorentz Transformation proves that the system of observers cannot be stationary [3].

[3] S. J. Crothers, On the Logical Inconsistency of the Special Theory of Relativity, *AJMP*. **6**, 3, (2017), http://vixra.org/pdf/1703.0047v6.pdf

SYSTEMS OF CLOCK-SYNCHRONISED STATIONARY OBSERVERS AND LORENTZ TRANSFORMATION



clock-synchronised stationary observers:
$\sigma = 1$ only

Stationary observers

$$\tau_\sigma = \beta\left(t - vx_\sigma/c^2\right) = \sigma\tau_1$$
$$\xi_\sigma = \beta\left(x_\sigma - vt\right)$$
$$x_\sigma = \frac{(1-\sigma)c^2 t}{v} + \sigma x_1$$
$$\eta = y, \quad \varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Clock-synchronised observers

$$\tau = \beta\left(t_\sigma - vx_\sigma/c^2\right)$$
$$\xi_\sigma = \beta\left(x_\sigma - vt_\sigma\right)$$
$$x_\sigma = \sigma x_1\,, \quad t_\sigma = t_1 + \frac{(\sigma-1)vx_1}{c^2}$$
$$\eta = y, \quad \varsigma = z$$
$$\beta = 1\Big/\sqrt{1 - v^2/c^2}$$

Only the case $\sigma = 1$ is common to the two different sets of inequivalent observers; in which case $v = 0$: i.e. no relative motion, by the equations above.

LORENTZ INVARIANCE – STATIONARY SYSTEMS

According to Special Relativity, the ‘spacetime interval’ is invariant for all coordinate systems:

$$x^2 + y^2 + z^2 - c^2t^2 = \xi^2 + \eta^2 + \varsigma^2 - c^2\tau^2.$$

By the Lorentz Transformation, $\eta = y$ and $\varsigma = z$. Therefore:

$$x^2 - c^2t^2 = \xi^2 - c^2\tau^2.$$

Substituting into this the coordinates for systems of stationary observers yields,

$$x_\sigma^2 - c^2t_\sigma^2 = \sigma^2x_1^2 - c^2\left[t_1 - \frac{(\sigma-1)vx_1}{c^2}\right]^2 =$$

$$= \beta^2\left\{\left[\sigma\left(1-\frac{v^2}{c^2}\right)+\frac{v^2}{c^2}\right]x_1 - vt_1\right\}^2 - c^2\beta^2\left(t_1 - \frac{vx_1}{c^1}\right)^2$$

$$= \xi_\sigma^2 - c^2\tau^2,$$

thus satisfying Lorentz Invariance [S.J. Crothers, Special Relativity: its inconsistency with the standard wave equation, *Physics Essays*, 2018, (in press) http://vixra.org/pdf/1708.0055v3.pdf].

LORENTZ INVARIANCE – CLOCK-SYNCHRONISED SYSTEMS

According to Special Relativity, the 'spacetime interval' is the same for all coordinate systems:

$$x^2 + y^2 + z^2 - c^2 t^2 = \xi^2 + \eta^2 + \varsigma^2 - c^2 \tau^2 .$$

By the Lorentz Transformation, $\eta = y$ and $\varsigma = z$. Therefore:

$$x^2 - c^2 t^2 = \xi^2 - c^2 \tau^2 .$$

Substituting into this the coordinates for systems of clock-synchronised observers yields,

$$x_\sigma^2 - c^2 t^2 = \left[\frac{(1-\sigma) c^2 t}{v} + \sigma x_1 \right]^2 - c^2 t^2 =$$

$$= \beta^2 \left[\frac{(1-\sigma) c^2 t}{v} + \sigma x_1 - vt \right]^2 - c^2 \beta^2 \sigma^2 \left(t - \frac{v x_1}{c^2} \right)^2$$

$$= \xi_\sigma^2 - c^2 \tau_\sigma^2 ,$$

thus satisfying Lorentz Invariance [S.J. Crothers, Special Relativity: its inconsistency with the standard wave equation, *Physics Essays*, 2018, (in press) http://vixra.org/pdf/1708.0055v3.pdf].

SYSTEMS OF CLOCK-SYNCHRONISED STATIONARY OBSERVERS AND LORENTZ INVARIANCE

Equating the 'spacetime' interval for systems of stationary observers to that for systems of clock-synchronised observers gives [4]:

$$\sigma^2 x_1^2 - c^2\left[t_1 - \frac{(\sigma-1)vx_1}{c^2}\right]^2 = \beta^2\left[\frac{(1-\sigma)c^2 t_1}{v} + \sigma x_1 - vt_1\right]^2 - c^2\beta^2\sigma^2\left(t_1 - \frac{vx_1}{c^2}\right)^2.$$

This expression is identically equal only for the particular case $\sigma = 1$. This is Einstein's 'system of clock-synchronised stationary observers'. Being a set containing only one observer, Einstein's observer is privileged and thereby violates the basic tenet of Special Relativity that no observer is privileged. Furthermore, a system of observers consisting of only one observer cannot be stationary and clock-synchronised with respect to any other observers.

[4] S.J. Crothers, Special Relativity: its inconsistency with the standard wave equation, *Physics Essays*, 2018, (in press) http://vixra.org/pdf/1708.0055v3.pdf

THE LORENTZ TRANSFORMATION DOES NOT MAKE THE STANDARD WAVE EQUATION INVARIANT

According to Special Relativity the standard wave equation is invariant by the Lorentz Transformation, *viz*.,

$$\frac{\partial^2 \Psi}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 \Psi}{\partial t^2} \quad \leftrightarrow \quad \frac{\partial^2 \Psi}{\partial \xi^2} = \frac{1}{c^2}\frac{\partial^2 \Psi}{\partial \tau^2}.$$

$$\frac{\partial}{\partial x_1} = \frac{\partial}{\partial \xi_\sigma}\frac{\partial \xi_\sigma}{\partial x_\sigma}\frac{\partial x_\sigma}{\partial x_1} + \frac{\partial}{\partial \tau}\frac{\partial \tau}{\partial x_\sigma}\frac{\partial x_\sigma}{\partial x_1}$$

$$= \sigma\beta\left(\frac{\partial}{\partial \xi_\sigma} - \frac{v}{c^2}\frac{\partial}{\partial \tau}\right),$$

$$\frac{\partial^2}{\partial x_1^2} = \sigma^2\beta^2\left(\frac{\partial^2}{\partial \xi_\sigma^2} - \frac{2v}{c^2}\frac{\partial^2}{\partial \xi_\sigma \partial \tau} + \frac{v^2}{c^4}\frac{\partial^2}{\partial \tau^2}\right),$$

$$\frac{\partial}{\partial t_1} = \frac{\partial}{\partial \tau}\frac{\partial \tau}{\partial t_\sigma}\frac{\partial t_\sigma}{\partial t_1} + \frac{\partial}{\partial \xi_\sigma}\frac{\partial \xi_\sigma}{\partial t_\sigma}\frac{\partial t_\sigma}{\partial t_1}$$

$$= \beta\left(-v\frac{\partial}{\partial \xi_\sigma} + \frac{\partial}{\partial \tau}\right),$$

$$\frac{\partial^2}{\partial t_1^2} = \beta^2\left(v^2\frac{\partial^2}{\partial \xi_\sigma^2} - 2v\frac{\partial^2}{\partial \xi_\sigma \partial \tau} + \frac{\partial^2}{\partial \tau^2}\right).$$

← Applying the chain rule to the coordinates for stationary systems of observers the differential operators are:

Putting them into the wave equation yields:

$$\left(\sigma^2 - \frac{v^2}{c^2}\right)\frac{\partial^2 \Psi}{\partial \xi_\sigma^2} - 2v\left(\sigma^2 - 1\right)\frac{\partial^2 \Psi}{\partial \xi_\sigma \partial \tau} = \frac{1}{c^2}\left(1 - \frac{\sigma^2 v^2}{c^2}\right)\frac{\partial^2 \Psi}{\partial \tau^2}.$$

This is 'invariant' for only one observer, $\boldsymbol{\sigma = 1}$; precisely Einstein's latent privileged observer.

The very same equations obtain using the coordinates for clock-synchronised systems of observers [S.J. Crothers, Special Relativity: its inconsistency with the standard wave equation, *Physics Essays*, 2018, (in press) http://vixra.org/pdf/1708.0055v3.pdf].

SOME ELEMENTS IN CONSEQUENCE

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