Proof That the Lorentz Transformation Is Incompatible with the Law of Causality

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Letter to the Editor:

The Law of Causality has played a key role in the development of science through the ages. It basically says that nothing happens without something causing it to occur. Newton's First Law of Kinetics (Law of Inertia) is a prime example. It says that a body will continue in a straight line at constant speed until it is subject to an unbalanced external force. By extension, each of the physical properties of the same object will remain constant indefinitely unless some outside force is applied. For example, the rate of such a (inertial) clock will not change unless it is acted upon by some outside force (clock-rate corollary). That being the case, one must conclude that the *ratio* of the rates of any two such clocks will be a *constant.* In other words, when these clocks are used to measure an elapsed time, their different values Δt and $\Delta t'$ will always be found to be in the same ratio, i.e. $\Delta t'=\Delta t/Q$, where Q is the rate ratio.

The cornerstone of Einstein's theory of relativity which he introduced in 1905 [1] is the Lorentz transformation (LT). It is based on the use of inertial clocks in two different rest frames. One of its main characteristics is that the elapsed time $\Delta t'$ measured on one such clock will depend on the relative speed v of the two rest frames and the location Δx of the object in one of the other rest frames as well as the time Δt measured on that clock, i.e. $\Delta t'= \gamma(v) (\Delta t- v\Delta x/c^2)$, where

$\gamma(v)=(1-v^2/c^2)^{-0.5}$ and c=299792458 m/s. It can be seen that if both v and Δx have non-zero values, then Δt' will not be proportional to Δt. This characteristic of the LT is known as *space-time mixing*. It stands in direct contradiction to the Δt'=Δt/Q relation required by the Law of Causality. *This shows that the LT is not consistent with the Law of Causality.*

One of the consequences of the space-time mixing of the LT is that it allows the two observers mentioned above to disagree on whether two events occurred simultaneously or not [2].

This is clear from the same LT equation mentioned above. Again, if both v and Δx are not equal to zero, it follows that when Δt=0 (note that Δt=0 means that the two events did occur simultaneously for the one observer), it cannot be that Δt' = 0 as well, i.e. that the two events were also simultaneous for the other observer. This situation is referred to as remote non-simultaneity (RNS). The distinction between the LT and the Δt'=Δt/Q condition required by the Law of Causality is quite clear because in the latter case when Δt'=0, so must also Δt. For this reason the latter proportionality relation is referred to as *Newtonian Simultaneity.* This is in recognition of the historical fact that Newton was a firm believer in absolute simultaneity, that is, that if two events occur simultaneously, they will also be found to be simultaneous in any other pair of rest frames throughout the universe.

The choice for physicists is clear. Either you give up on the ancient Law of Causality in order to preserve your faith in Einstein and the LT and RNS, or you accept the conclusion of the former that Newtonian Simultaneity allows us to understand why the ratio of the rates of any two inertial clocks must have a constant value. The latter conclusion is essential for the operation of the Global Positioning System (GPS) navigation methodology. Consequently, the fabulous success of GPS in our everyday lives serves as an undeniable verification of Newtonian Simultaneity and its prediction that clock rates in different rest frames are always strictly proportional to one another.

References

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

[2] Buenker, R.J. Clock-rate Corollary to Newton's Law of Inertia**,** *East Africa Scholars J. Eng. Comput. Sci.* **4 (10),** 138-142 (2021).