Space is discrete for mass and continuous for light

Ashish Sirohi *

Abstract

Space is discrete for a moving mass and continuous for an electromagnetic wave. We introduce velocity addition rules for such motion, and from these we derive the second postulate of special relativity — namely, that each observer measures the same value of the speed of light. Thus widely accepted derivations, showing that the two postulates of special relativity necessarily lead to the Lorentz transformations, cannot be correct. We contrast the distance-time implications of our velocity addition rules with the Lorentz transformations. Our theory leads to different time measurements by observers and to special relativity's momentum-energy formulas. However, in our theory length of an object remains invariant, and we do not have a time dilation formula that applies between inertial frames. Study of timescales of quasar variability has yielded observational data showing special relativity's time dilation to be inconsistent with the model of an expanding universe; gamma-ray bursts are giving similar results. These quasars and gamma-ray bursts results are consistent with our time formulas. We suggest other experiments where special relativity and our theory give different predictions, and these can further show special relativity to be wrong and our theory to be correct.

Keywords: Special relativity; Lorentz invariance; Speed of light; Length contraction; Time dilation; Expanding universe.

1 Introduction

In recent years alternatives to special relativity [1] (hereafter "relativity") have begun to be seriously considered and many experiments to test for possible violations of relativity are being performed. Theories such as loop quantum gravity [2] suggest a need to abandon continuous space. Other theories that modify relativity include "doubly special relativity" [3], which requires Lorentz-Fitzgerald contraction to not happen at short scales, another model that puts restrictions on energy and momentum [4], and variable speed of light theories [5]. Some other recent theories are also incompatible with the Lorentz transformations [6, 7, 8].

Our removing continuity of space for motion of mass allows us to unite the two postulates of relativity with the discrete nature of quantum theory, and we do this while keeping the postulates exactly as they are. Numerous experimental tests confirming the postulates thus also support our theory.

Our simple velocity addition and distance-time rules clearly establish that the Lorentz transformations are not necessarily the only equations that follow from the postulates. Thus widely accepted derivations, a cornerstone of relativity, showing that the two postulates necessarily lead to the Lorentz transformations, cannot be correct. The other theories that seek to modify relativity accept the claim that to change the Lorentz transformations the postulates need to be modified in some way. Our equations serve as a counterexample to this claim.

*Omaxe Grand, Sector 93B, Noida 201304, India. Email: as7y@yahoo.com

In relativity, as in our theory, the speed of light effectively acts as an infinite velocity. However, unlike relativity, in the mathematics of our theory an actual infinity corresponds to the speed of light. We introduce velocity addition rules and from these, using the infinity associated with light, we derive the constancy of the speed of light; thus we do not need to postulate this constancy. Our equations lead to different time measurements by observers but they have no time dilation or length contraction formulas that apply between inertial frames. Section 2 has our velocity addition rules and section 4 has the distance-time rules which are derived from the velocity addition rules.

In section 8 we discuss recent experimental results and propose further experiments. Recent experimental observations showing no time dilation in quasars and gamma-ray bursts [13, 14] are a failure of the Lorentz transformations; on the other hand, the results from recent tests of the postulates of relativity continue to show them to be correct [7, 8, 9, 21, 22]. Such contradictory experimental results would be logically impossible if there actually existed a valid derivation showing that the postulates necessarily imply the Lorentz transformations. Sharing the widespread conviction that relativity is correct, some cosmologists are addressing the implication, which follows from its unexpected time dilation results, that the universe may not be expanding [16, 17]. In our theory, cosmic clocks such as quasars and gamma-ray bursts, though in relative motion in an expanding universe, satisfy a certain specific criterion where our equations predict that observers in different inertial frames will measure the same time; these recent quasars and gamma-ray bursts observations are in line with this prediction. We suggest other experiments whose results will also show that relativity is wrong and our theory is correct.

2 Motion and velocity addition rules

2.1 Motion of mass and light

Mass moves through space discretely, "jumping" from one point to another without passing through the points in between. For mass travelling at constant velocity the "length jumped" is constant. The higher the velocity the greater the number of jumps and the smaller the jump length. In a unit time a mass particle with constant velocity would have made N jumps (N need not, of course, be a whole number). Each jump length is Ld where L is a length that is a constant for space and d is a function of N, given by $d(N) = \dfrac{1}{\sqrt{1 + \dfrac{N^2L^2}{c^2}}}$, where c is the speed of light in matching units of distance and time. We can think of d as a function that causes "shrinkage" of the jump length.

The distance the particle travels in unit time will be $v = NLd$ (the magnitude of its displacement per time to be precise, given the nature of the movement). As the velocity of the particle increases, we have $N \to \infty$, which gives $d \to 0$ and $v \to c$.

L could be the Planck length, $L_p = \sqrt{\dfrac{\hbar G}{c^3}}$, where $\hbar$ is the reduced Planck's constant and G is the gravitational constant. In relativity Planck length is subject to Lorentz-Fitzgerald contraction. Various theorists have expressed a desire, citing different reasons, that such a fundamental constant be observer-independent, as it is in our theory. For convenience, let us choose units that give $L = 1$, thus $v = Nd$. Just as L becomes the longest length that any mass jumps, we also propose that there exists a constant representing the smallest number of jumps per unit of time, N being an integer multiple of this constant.

Unlike the discrete motion of mass, the motion of light through space is continuous. In a unit time a point mass particle moving at constant velocity will physically only be at a finite number of points and will travel a total distance of Nd; in this time light will travel continuously over all points in its path, thus having $N = \infty$ and $d = 0$. Mathematically, while we can take the limit of the product of two functions with individual limits of ∞ and 0, the actual product of ∞ and 0 is deemed to be indeterminate. However, for motion in space this indeterminate is fixed and we have $\infty \cdot 0 = c$. All continuous motion in space is at this speed.

2.2 Velocity addition rules

Given a velocity with magnitude v we can compute the jumps per unit time, N, using $N = \dfrac{v}{\sqrt{1-\frac{v^2}{c^2}}}$ (it would be $NL = \dfrac{v}{\sqrt{1-\frac{v^2}{c^2}}}$ if we did not assume $L = 1$ and used $v = NLd$).

As in relativity, we consider two observers, You and Other. We consider You to be at rest in a coordinate frame S and observing a moving object. We consider Other to be at rest in frame S', with parallel axes, which is moving with a velocity of v in the $+x$ direction relative to frame S and observing the same moving object. Given the velocity of an object as observed by You, we calculate the velocity as observed by Other.

Let us first consider motion in one dimension. Suppose You see an object moving in the $+x$ direction with some velocity u. How will Other see this object to be travelling? From u and v we calculate N_u and N_v respectively. Adding we get $N'_u = N_u - N_v$. From this we can calculate d'_u and then get the velocity as observed by Other to be $u' = N'_u d'_u$.

Again considering one dimensional motion, You see light moving in the $+x$ direction with $u = c$. For light we get $N_u = \infty$; from Other's v we get a finite value N_v. Adding we get $N'_u = N_u - N_v = \infty$. Then we calculate $d'_u = 0$ and get the velocity seen by Other to be $u' = N'_u d'_u = c$.

We note that, given N, the corresponding velocity magnitude v is the value of the function $f(N) = N \cdot d(N) = \dfrac{N}{\sqrt{1+\frac{N^2}{c^2}}}$. You see an object to be moving with velocity u and component velocities u_x, u_y, u_z, with u_x in the $+x$ direction. From u_x we calculate N_x and from Other's velocity v we calculate N_v. We have $N'_x = N_x - N_v$ and from N' we can calculate d' .

The following equations give the values of the component velocities as observed by Other in terms of those observed by You:

$$u'_x = (N_x - N_v)d'_x = \frac{N_x - N_v}{\sqrt{1 + \dfrac{{N_x - N_v}^2}{c^2}}}$$

$$u'_y = u_y \sqrt{\frac{c^2 - {u'_x}^2}{c^2 - {u_x}^2}}$$

$$u'_z = u_z \sqrt{\frac{c^2 - {u'_x}^2}{c^2 - {u_x}^2}}$$

(Note that when $N_x = \infty$ we have $\infty \cdot 0 = \frac{\infty}{\infty} = c$; for $u_x = c$ we will have $u'_x = c$ and all y and z velocities will be 0)

There is no purely mathematical reason, based on any previous statements of our theory of velocity, that leads us to arrive exclusively at these formulas for u'_y and u'_z. Keeping close to Newtonian (we take this term to also include Galilean) physics, from u we can calculate N and then get $N' = \sqrt{{N_x'}^2 + N^2 - {N_x}^2}$ from which we could have proposed $u_y' = u_y\sqrt{\dfrac{(f(N'))^2 - {u_x'}^2}{(f(N))^2 - {u_x}^2}}$ and $u_z' = u_z\sqrt{\dfrac{(f(N'))^2 - {u_x'}^2}{(f(N))^2 - {u_x}^2}}$. However, for physical reasons we choose the other formulas. A key reason is seen in section 4, where we derive a relation between time measured by the two observes. We can do this using x direction or y and z directions. The chosen u_y' and u_z' formulas give the same time relation which we get using u_x'.

3 Comparison with equations of special relativity

We consider the same observers, You and Other, as in the previous section, except that we add the following conditions: at $t' = t = 0$ the origins of S and S' coincide and a moving particle is at this common origin with its u_x in the $+x$ direction. You observe the particle and measure positions x, y, z, and time t whereas Other measures x', y', z', and time t'. Relativity obtains the Lorentz transformations:

$$x' = \frac{x - vt}{\sqrt{1 - \dfrac{v^2}{c^2}}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - \dfrac{vx}{c^2}}{\sqrt{1 - \dfrac{v^2}{c^2}}}$$

From the Lorentz transformations we get the following *relativistic velocity transformations* (we will use this term to distinguish these formulas from our "velocity addition rules" stated previously) expressing the velocity components of the particle as observed by Other in terms of those observed by You.

$$u_x' = \frac{u_x - v}{1 - \dfrac{vu_x}{c^2}}$$

$$u_y' = \frac{u_y\sqrt{1 - \dfrac{v^2}{c^2}}}{1 - \dfrac{vu_x}{c^2}}$$

$$u_z' = \frac{u_z\sqrt{1 - \dfrac{v^2}{c^2}}}{1 - \dfrac{vu_x}{c^2}}$$

We consider the setup commonly referred to as a "light clock" to look at relativistic time dilation. We have a photon as seen by You to be moving along the y-axis ($x = 0, z = 0$) and oscillating between two parallel mirrors from $y = 0$ to $y = Y$ and back to $y = 0$ with $u_x = 0$, $u_y = \pm c$, $u_z = 0$. From the relativistic velocity transformations, Other will see $u_x' = -v$, $u_y' = \pm c\sqrt{1 - \frac{v^2}{c^2}}$, $u_z' = 0$. Consider the time for the event of half an oscillation (from $y = 0$ to $y = Y$). From the Lorentz time dilation equation, Other sees this event to take a longer time by the factor of $\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$, and for this event this time dilation also follows from the smaller

y-velocity measured by Other (as indeed it must since the relativistic velocity transformations are derived from the Lorentz transformations).

Let us examine the light clock using our velocity addition rules. We have $N_x = 0$, $N'_x = N_x - N_v = -N_v$ which gives $u'_x = -v$, $u'_y = \pm c\sqrt{1 - \frac{v^2}{c^2}}$, $u'_z = 0$. In this important conceptual case our velocity formulas give the same result as relativity. But in general, our velocity addition rules give results which are different from those of the relativistic velocity transformations and experimental measurements should be able to decide the matter in our favor.

4 Distance-time rules and their physical interpretation

4.1 Distance-time rules

For observations made by You we have $x = u_x t$, $y = u_y t$, $z = u_z t$. Obtaining velocities by our velocity addition rules and assuming the same initial conditions as in the Lorentz transformations, we calculate distance as measured by Other:
$x' = u'_x t'$
$y' = u'_y t'$
$z' = u'_z t'$

Since in our equations we are observing a moving particle which we take to be at the coinciding origins at $t = t' = 0$, x and x' *represent distances travelled.* If we were observing a rigid object, we would be considering a point on the rigid object as our particle. Whichever point on the rigid object is being observed, You would see each point on the rigid object have the same x and Other would see each point have the same x'. When we talk of x, x', t, t' etc. we are referring to *distances travelled* as measured by the two observers and time for such travel. Thus, in our velocity-centric theory, these distance-time relations are *not* transformations from one set of coordinates to another that result in any contraction or dilation. If we had a rigid object of a certain shape and size with a certain velocity u as seen by You (and, of course, each point on the object would have this velocity), Other would see the same rigid object with *exactly the same shape and size* but with a different velocity u' as given by the velocity addition rules. Also, in our theory, we do not talk about how observers measure time in general — we can only talk about how they measure time for a specified event and we do not have a time formula that applies between two inertial frames. Any observed ratio between t' and t would only be ratio of the times it takes the object to travel the observed distances.

In Newtonian physics we have $u'_x = u_x - v$, $u'_y = u_y$, $u'_z = u_z$ and for $x' = x - vt$ and $y' = y$, $z' = z$ we have $t' = t$. Consider a theory with different formulas for u'_x, u'_y, u'_z. From the formulas for u'_x, u'_y, u'_z, using $x' = x - vt$ or $y' = y$, $z' = z$ we can get a relation between t' and t for that particular motion.

We consider $v < c$. Computing a time relation from $x' = x - vt = (u_x - v)t$ we get $t' = \dfrac{t(u_x - v)}{u'_x}$.
u_x and v are velocities measured by You. This $(u_x - v)$ term denoting simple "linear" addition appears in both Newtonian physics and relativity. In relativity $(u_x - v)$ is not the speed of the object as seen by either observer but is still a linear velocity addition. In our theory velocity addition is not linear. We have $u_x = N_x d_x$ and $v = N_v d_v$. When we add velocities it is not distance per time but number of jumps per time that we add — in such addition no weight is given to the length of the jumps. Then we multiply these resultant jumps per time by the observed jump length (as observed by You, each jump of the object is of length d_x and each jump of Other is of length d_v). Noting that we are comparing with u'_x, the velocity of the object as observed by Other, we choose the appropriate addition and jump length.
$t' = \dfrac{t(u_x - v)}{u'_x}$ is replaced in our theory by $t' = \dfrac{t(N_x - N_v)d_x}{u'_x}$. Putting in $u'_x = N'_x d'_x = (N_x - N_v)d'_x$ (and

also canceliing in the cases $N_x - N_v = 0, \infty$) we get $\dfrac{t'}{t} = \dfrac{d_x}{d'_x}$. Thus the different jump lengths of the object as seen by the observers is responsible for different time measurements.

Computing a time relation from $y' = y$, $z' = z$ we get $t' = \dfrac{t(u_y)}{u'_y} = \dfrac{t(u_z)}{u'_z} = t\sqrt{\dfrac{c^2 - {u_x}^2}{c^2 - {u'_x}^2}}$. Noting that for a velocity v the jump length is $\sqrt{1 - \frac{v^2}{c^2}}$, we have $\dfrac{t'}{t} = \dfrac{d_x}{d'_x}$. Thus both cases lead to one single time relation.

We have the below set of distance-time rules:

$$x' = t(N_x - N_v)d_x = t(N_x - N_v)\sqrt{1 - \frac{u_x^2}{c^2}}$$

$$y' = y$$

$$z' = z$$

$$t' = t(\frac{d_x}{d'_x}) = t\sqrt{\frac{c^2 - {u_x}^2}{c^2 - {u'_x}^2}}$$

(Note that when $N_x = \infty$ we have $\infty \cdot 0 = c$; for the time formula, in the case of $\frac{0}{0}$ the 0s cancel)

In our theory, as in relativity, two events may be simultaneous as seen by one observer but not by the other. However for the case of $u_x = c$ we will have $t' = t$ and relativity's thought experiments centered around this case will fail to create the non-simultaneity predicted by relativity. The case $u_x = c$ is special because of the ∞ that relates to c.

4.2 Time

While doing away with the concept of "absolute time," relativity presented a new thesis of "relative time flow" between inertial frames. We do not take the absolute time of Newtonian physics to have meant that time itself "flows" as an independent physical quantity — it only meant that the equations worked in such a way that all observers measured the same time for the same event. We could attempt to make a similar statement about observers in different frames and relativity's relative time flow — however, in relativity time is an independent physical quantity and we have actual time dilation.

For simplicity, let us discuss time by looking at motion in one dimension. We can consider points in space to be separated by a number of jumps instead of a number of length units. Then whatever statements are made in Newtonian physics about addition of distance per time and the observed time for motion (i.e. object travelling the distance from one point to another) hold in our theory for addition of jumps per time and observed time for jumps. Accordingly, different observers will measure the same time for jumps from one point to another. But when the event is motion i.e. going beyond counting number of jumps to distance covered by these jumps, they measure different times and the time ratio for such motion depends on the ratio of jump lengths. Thus if our theory is correct then we cannot talk of the existence of time as an independent physical quantity but can only talk of time for an observed physical event. If $d(N)$ were a constant function, motion would also involve all observers measuring the same time and we would have absolute time as in Newtonian physics.

Experiments such as those confirming time dilation in the case of the "lifetime" of a muon are confirming some physical process taking a longer time as a result of a velocity involved in the process having a different value by the velocity addition rules. We could similarly talk of one oscillation being the lifetime of the light clock discussed above. Seeking an explanation for the Doppler effect for an electromagnetic wave would suggest that we look at the orthogonal electric and magnetic fields and what is “waving” to which our velocity addition rules would apply. The current wave-model should be changed so as to assign an orthogonal velocity related to this “waving” upon which we can apply the velocity addition rules and get a changed orthogonal velocity and thus a changed frequency. The issue is what empty space is and what the wave nature of light is.

5 Momentum

In Newtonian velocity addition we add the velocities v. In our velocity addition rules it is the jumps per time N on which we perform the addition and which takes the place of v. Similarly, momentum of an object is mN and, for any observer watching a collision, we have conservation of momentum. Since $N = \dfrac{v}{\sqrt{1-\frac{v^2}{c^2}}}$ this converts to the formula given by relativity. However, there is no possibility of interpreting this formula to suggest that mass is actually changing with velocity.

From momentum we can go on to force and energy.

6 Transformations derived from the two postulates of special relativity

6.1 Counterexample to the Derivation showing that the Lorentz transformations are the only equations that follow from the postulates

It is widely accepted that from the two postulates of relativity the Lorentz transformations follow, and that relativity shows how they do. But our velocity addition rules and associated distance-time rules, stated in sections 2 and 4 respectively, are also consistent with the two postulates, and thus are a counterexample to the statement that the two postulates necessarily lead to the Lorentz transformations.

Our theory is velocity-centric and we start with velocity addition rules and from those derive distance-time rules. Einstein’s derivation first obtains distance and time formulas — the Lorentz transformations; from these follow the relativistic velocity transformations [1]. Various derivations of the Lorentz transformations have been published, and this link between the postulates and the transformations is a foundation of relativity. Reputable physics textbooks derive the Lorentz transformations, in a claimed mathematically rigorous manner, from the two postulates (assuming homogeneity and isotropy of space). Numerous papers that review or discuss relativity similarly accept that the Lorentz transformations can be derived from the postulates; popular books and articles on the subject repeat this claim. Attempts to unite the postulates with quantum theory have been greatly hampered by this constraint that the postulates necessarily imply the Lorentz transformations. Other theories that seek to modify relativity[2, 3, 4, 5, 6] accept that the postulates necessarily imply the Lorentz transformations. Thus these theories accept that to change the Lorentz transformations the postulates need to be modified in some way, and that experimentally confirming the two postulates is equivalent to confirming the Lorentz transformations. Our theory preserves both postulates exactly as they are but has equations that are different from the Lorentz transformations; further, these equations make predictions that have been experimentally verified to be correct.

Einstein had expressed an intuitive feeling that physics may need to abandon “continuous structures” (though not in the way presented here) and this would cause problems for relativity. In an overly self-deprecating manner he wrote to his friend M. Besso in a 1954 letter: "I consider it quite possible that physics cannot be based on the field concept, i.e. on continuous structures. In that case, nothing remains of my entire castle in the air, gravitation theory included" [10]. Einstein ever doubted that the postulates of relativity were true, but he seems to have realized that removing the foundation of continuity could have consequences. We have shown how we get a different set of equations by preserving both postulates but assuming space to be discrete for motion of mass but continuous for motion of light. We note, however, that removing continuity of motion for mass is not necessary to formulate our set of equations. We could have removed our statement about all continuous motion being at c and then proposed that mass also moves continuously; from v we could calculate N and we would still have these same equations.

6.2 The relativistic velocity transformations are consistent with two sets of transformations, not just the Lorentz transformations

In examining the foundations of Einstein's derivation of the Lorentz transformations we note that there are two possible sets of transformations that are consistent with the postulates and the relativistic velocity transformations, not just one as assumed by Einstein [1]. This possibility is not generally known or realized, as evidenced by examination of numerous other published versions of the derivation of the Lorentz transformations.This technical point is not a part of our counterexample to the derivation, but goes to the issue of rigor in reaching conclusions.

Relativity does not have a theory of velocity different from Newtonian, only different formulas for u'_x, u'_y, u'_z.

Let us accept our theory's physical interpretation of distance-time rules and apply its method to construct distance-time formulas from the relativistic velocity transformations. In relativity if we look for a relation between t' and t using $x' = x - vt$ we get a different relation than we would get using $y' = y$, $z' = z$.

Using the relativistic velocity transformations, computing time from the relation $x' = x - vt$, and applying our distance-time methodology we get the below *alternative transformations.* (Using $y' = y$, $z' = z$ to obtain a time relation would give us the Lorentz transformations).

$$t' = \frac{t(u_x - v)}{u'_x} = t - \frac{vx}{c^2}$$

$$x' = u'_x t' = x - vt$$

$$y' = u'_y t' = y\sqrt{1 - \tfrac{v^2}{c^2}}$$

$$z' = u'_z t' = z\sqrt{1 - \tfrac{v^2}{c^2}}$$

But our physical interpretation, which seeks to avoid transformations between coordinates that result in a dilation or contraction, will not go far here because length expansion/contraction between coordinates are needed. The problem arises that, in the given time, y' and z' fall short of the requisite distance by the $\sqrt{1 - \frac{v^2}{c^2}}$ factor. To make up for this we will need a "length expansion" along these axes.

Between the Lorentz transformations and these alternative transformations there is no purely mathematical reason to prefer one over the other, the alternative transformations have to be rejected for physical reasons. If we use the relation between t' and t as given by the Lorentz transformations, the x' length becomes excessive and we need to contract the length.

7 Experimental tests

Our theory, though yielding equations different from the Lorentz transformations, is consistent with relativity's two postulates and its momentum-energy formulas. Numerous experiments have tested and confirmed these postulates and momentum-energy equations. Highly sensitive experiments looking to test new theories which suggest modifications of the postulates have failed to find any violation of the postulates [7, 8, 9, 21, 22].

No experiments aimed at directly testing the relativistic velocity transformations have been performed; in general our velocity addition rules give different results. However, for the case of motion of light (1) along the direction of relative motion between two frames and (2) perpendicular to that direction (as seen by one of the frames) relativity's formulas give the same results as our velocity addition rules, one of these cases having been demonstrated by the light clock example. These two directions were used in the setup of Michelson-Morley experiment [11].

Relativity's time dilation formula has been experimentally confirmed in certain cases such as atomic clocks, and with increasing accuracy [12]. In certain set-ups, such as the light clock, our theory gives the same factor relating time measurements as relativity, having $t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$. But the theories differ fundamentally on the nature of time. While doing away with the concept of absolute time, relativity presented a new thesis of relative time flow between inertial frames. Our theory's equations only allow us to talk about how observers in different inertial fames measure time for a specified physical event. We do not have a time dilation formula that applies between inertial frames. In particular, for $u_x = c$ our theory predicts that we will have $t' = t$. $u_x = c$ would include the commonly encountered cosmological situation of light being emitted by a source that is moving away from Earth; cosmic objects are now being observed to show no time dilation in a violation of time dilation of the Lorentz transformations but perfectly in line with our theory's equations.

Quasars vary in brightness with time and one would expect from relativistic time dilation that timescales of such variability observed in a closer group of quasars would be stretched in a more distant group. However, study of timescales of quasar variability has yielded observational data that is inconsistent with relativity's time dilation [13] in that quasars are showing no relativistic time dilation. So strong is the belief in relativity that cosmologists, in looking for explanations for this unexpected result, exclude any suggestion that relativity could be wrong; they are willing to entertain other unlikely scenarios as explanations for the observed lack of time dilation. For example, Hawkins [13], who has spent decades doing quasar observations and analysis has been suggesting various novel explanations. Besides quasars, other cosmic candidates include gamma-ray bursts where too it is emerging that there is no relativistic time dilation [14]. Type Ia supernovae, which have been considered to be confirming time dilation, are also arguably showing this time dilation failure [15] and we believe that further analysis and experimentation with a "clean test free from selection effects" [16] will settle this matter in favor of there being no time dilation. Given such multiple emerging failures of relativistic time dilation some cosmologists, who are addressing this experimental reality, are discussing these results as being evidence that the universe is not expanding [16, 17]. Others are questioning results which show failure of relativistic time dilation [18, 19, 20].

Thus we see that relativity's time dilation has run into experimental problems. Why do cosmologists not suggest that given the evidence that the universe is expanding and given that this widely accepted expanding universe model contradicts time dilation of the Lorentz transformations, these transformations could be wrong? One reason is that cosmologists are not aware of any competing theory that predicts this unexpected time dilation failure. A second reason is that the competitors to relativity also modify the postulates; the postulates, however, continue to pass astrophysical and other tests with flying colors. Thus cosmologists and astrophysicists do not suggest that the Lorentz transformations could be wrong because they see no open theoretical door which could form an alternative explanation by making the needed new predictions while preserving the needed old ones. Our theory is consistent with both the expanding universe and the postulates of relativity.

Often testing between two competing theories drives experimentation. Testing for cosmological time dilation has not had such a driving force because the static universe theory is not something that experimentalists consider viable given the history of experimentation in favor of an expanding universe. However, astrophysical observations have emerged as a tool to test the predictions of theories which seek to modify relativity [21, 22] and, given our theory, time dilation should now be included among these tests.

Beyond being a puzzle for cosmologists and astrophysicists, this experimental situation that the postulates are correct but the Lorentz transformations are wrong poses a bigger dilemma for theoretical physicists. As discussed earlier, there is wide acceptance among physicists of Einstein's derivation which showed that the postulates necessarily imply the Lorentz transformations. If the derivation were valid then we would have a logically impossible situation because statements that are correct would necessarily imply statements that are incorrect. But through our equations, which also serve as a counterexample to the derivation, we have shown that derivation to be wrong.

It is commonly stated that a single replicable experimental observation that contradicts a physics theory's prediction is enough to prove the theory wrong. We give below additional ways to show that relativity is wrong.

Consider the traincar-and-platform thought experiment commonly used to illustrate the implications of relativity. This also is a case with $u_x = c$. This thought experiment consists of one observer midway inside a speeding traincar and another observer standing on the platform as the train moves past. A flash of light is given off at the center of the traincar just as the two observers pass each other. The observer onboard the train sees the front and back of the traincar at fixed distances from the source of light and as such, according to this observer, the light will reach the front and back of the traincar at the same time (simultaneously).The observer standing on the platform, on the other hand, sees the rear of the traincar moving (catching up) toward the point at which the flash was given off and the front of the traincar moving away from it. As the speed of light is finite and the same for all observers, the light headed for the back of the train will have less distance to cover than the light headed for the front. Thus, relativity notes, the observer on the platform will see the flashes of light strike the ends of the traincar at different times (and the event of light striking the ends will appear non-simultaneous to this observer). Again, in our theory, different observers can measure different times but not in this specific case. Here the light will be seen by both to strike the ends of the traincar simultaneously because here we have $u_x = c$ and thus we will have $t' = t$

We believe the above thought experiment can, using today's technology, actually be implemented in a table-top form. The table-top traincar will not have to travel at very high speed because the other devices in the experiment can be cameras, and high speed cameras today can take pictures at very high number of frames per second.

The $u_x = c$ case can also be used to build a clock that undergoes no time dilation. Here too, very high speed is not required [23] and results from this clock can be simultaneously compared with a traditional clock, say a standard atomic clock such as those that have been used to experimentally test time dilation.

These results will also contradict the numerous clock-based confirmations of relativity's time dilation, and will illustrate, just as cosmic clocks do, that relativity's thesis of time — that clocks in different inertial frames measure different times because time itself has undergone a relative dilation — is wrong.

Invariance of length of rigid bodies is a key feature differentiating our theory from the Lorentz transformations. No test of Lorentz-Fitzgerald contraction has been performed. The desktop traincar-and-platform experiment suggested above can also be based on measuring length and it will show no length contraction.

We note that our theory has broad implications.

References

[1] A. Einstein, "On the Electrodynamics of Moving Bodies," *Ann. Physik* **17**, 891 (1905).

[2] C. Rovelli & L. Smolin, "Discreteness of area and volume in quantum gravity," *Nucl.Phys. B* **442**, 593-622 (1995); Erratum: *Nucl.Phys. B* **456** 753-754 (1995).

[3] G. Amelino-Camelia, "Relativity in space-times with short-distance structure governed by an observer-independent (Planckian) length scale," *Int. J. Mod. Phys. D* **11**, 35 (2002); "Testable scenario for relativity with minimum length," *Phys. Lett. B* **510**, 255 (2001).

[4] J. Magueijo & L. Smolin, "Lorentz invariance with an invariant energy scale," *Phys. Rev. Lett.* **88**, 190403 (2002); "Generalized Lorentz invariance with an invariant energy scale," *Phys. Rev. D* **67**, 044017 (2003).

[5] J. Magueijo, "New varying speed of light theories," *Rept.Prog.Phys.* **66** 2025 (2003).

[6] D. Colladay & V.A. Kostelecký, "CPT Violation and the Standard Model," *Phys. Rev. D* **55**, 6760 (1997); "Lorentz-violating extension of the standard model," *Phys. Rev. D* **58**, 116002 (1998).

[7] P. Ball, "Back to the future," *Nature* **427**, 482 (2004).

[8] A. Cho, "Special Relativity Reconsidered," *Science* **307**, 866 (2005).

[9] V.A. Kostelecký & N. Russell, "Data tables for Lorentz and CPT violation," *Rev. Mod. Phys.* **83**, 11 (2011); arXiv:0801.0287 (2018).

[10] A. Pais, *Subtle is the Lord: the Science and the Life of Albert Einstein*, (Oxford University Press, Oxford, 1982), p.467.

[11] A. A. Michelson & E. W. Morley, "On the Relative Motion of the Earth and the Luminiferous Ether," *Am. J. Sci.* **34**, 333 (1887).

[12] P. Delva et al., "Test of Special Relativity Using a Fiber Network of Optical Clocks," *Phys. Rev. Lett.* **118**, 221102 (2017).

[13] M. R. S. Hawkins, "On time dilation in quasar light curves," *Mon. Not. R. Astron. Soc.* **405**, 1940 (2010).

[14] D. Kocevski & V. Petrosian, "On the Lack of Time Dilation Signatures in Gamma-Ray Burst Light Curves,"*Astrophys. J.* **765**, 116 (2013).

[15] D. Crawford, "A problem with the analysis of type Ia supernovae," *Open Astron.* **26**, 111 (2017).

[16] M. López-Corredoira, "Tests and problems of the standard model in Cosmology,"*Found.Phys.* **47**, 711 (2017).

[17] D. Crawford, "Observational evidence favors a static universe," *J.Cosmol.* **13**, 3875 (2011).

[18] D. C. Dai et al., "Using Quasars as Standard Clocks for Measuring Cosmological Redshift," *Phys. Rev. Lett.* **108**, 231302 (2012)

[19] F. W. Zhang et al., "Cosmological Time Dilation in Durations of Swift Long Gamma-Ray Bursts," *Astrophys.J.* **778**, L11 (2013)

[20] V. Z. Golkhou et al., "The Energy-Dependence of GRB Minimum Variability Timescales," *Astrophys. J.* **811**, 93 (2015)

[21] A.A. Abdo et al., "A limit on the variation of the speed of light arising from quantum gravity effects," *Nature* **462**, 331 (2009).

[22] V. Vasileiou, J. Granot, T. Piran & G. Amelino-Camelia, "A Planck-scale limit on spacetime fuzziness and stochastic Lorentz invariance violation, " *Nature Phys.* **11**, 344 (2015)

[23] J.C. Hafele & R.E. Keating, "Around-the-World Atomic Clocks: Observed Relativistic Time Gains," *Science* **177**, 168 (1972).