A Radical Examination of the Equations Derived in Special Relativity Shows SR is compatible with Quantum Gravity

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Using the Time Dilation equation, Length Contraction equation and Mass Increase equation, all derived within Special Relativity. With a simple substitution I convert the time dilation equation to a Pythagorean equation showing the observed time consists of two time components and I convert the length contraction equation to a Pythagorean equation showing the total length of a moving object has two length components. These new forms of the time dilation and length contraction equations strongly indicate the presence of a new Time Dimension and a new Space Dimension. The additional Time dimension explains exactly what time dilation is and together with the Mass Increase equation I introduce the concept of a Newtonian velocity, which is an alternative velocity of a moving object. I propose the mass of the moving object does not change, because we are in fact measuring momentum with the wrong velocity. The additional Space dimension in fact means length contraction does not occur because we are seeing the object at an angle within a four dimensional space, which means it looks shorter when viewed in three space dimensions only. These changes mean Special relativity IS compatible with Quantum Gravity and Doubly-Special Relativity is not required.

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I. Introduction

I am particularly interested in the unusual property of light, namely it's constant speed to all observers, independent of their relative speeds and the further effects defined as a result of Albert Einstein's theory of Special Relativity [1]. It seemed evident to me that these effects are somehow telling us something about the very nature of space and time.

My starting point was to consider that if the universe was a complete Newtonian Universe. Then when an inertial frame that has a constant force applied to it, it will accelerate at a constant rate as long as the force is applied. This means the velocity of the inertial frame will continue to increase at a constant rate as long as the constant force is applied and has no maximum velocity. If instead of considering the velocity we look at the time the inertial frame takes to travel a fixed distance, the time will get less and less, getting closer and closer to zero but never reaching zero, I will call this Newtonian time.

Comparing this with reality, where there is a maximum velocity, the speed of light c. This means the time it takes to travel a fixed distance gets closer and closer to the time it takes light to travel the fixed distance, but never being able to reach this time. The question I asked myself is what form would an equation be to map the Newtonian time to our reality. My proposed equation is:

$$t = \sqrt{t_N^2 + t_c^2} \qquad (1)$$

Where t_N is the Newtonian time to travel the fixed distance and t_c is the time it takes light to travel the fixed distance. With this equation when the velocity is very low the value of t_c would be very small compared with t_N so the value of t would be very close to the value of t_N. Only when the velocity v_N is very high the value of t_N would be much smaller and t_c have a significant affect on the value of t. No matter how high the velocity v_N goes

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the moving object observed time t would always be greater than t_c.
I have found this equation can easily be derived directly from the Time Dilation equation of Special Relativity and further more a similar equation involving the length of a moving object can be derived from the Length Contraction equation of Special relativity.

II. The starting point

I will take it that the principle of relativity hold and that we have an observer in an inertial frame with no forces acting on this inertial frameA, I will call this the stationary inertial frame. I take it that the equations of Newtonian mechanics hold good and any ray of light moves in the stationary inertial frame with the determined velocity c, whether the ray be emitted by a stationary body or by a moving body. As far as we are concerned the observer in their inertial frame will be considered stationary relative to other inertial frames. The observe is going to observer a moving inertial frame, which is now moving at a constant velocity and direction and has no forces acting on it. Originally the moving inertial frame was part of the observers inertial frame and has had forces applied to it to accelerate it away from the observers inertial frame. The moving inertial frame also has an observer on it, and when the moving inertial frame was part of the stationary inertial frame the two observers calibrated and synchronised their clocks.
Both observers will measure the time the moving inertial frame takes to travel between two fixed points who's Cartesian coordinates relative to the stationary inertial frame are not changing relative to it with time. The stationary observer knowing the coordinates of the two points can work out the straight line scalar distance between these two points, I will call the distance measured by the stationary observer distance d. Both observers now measures the time it takes for the moving inertial frame to travel the straight line distance d taking into account the time it takes light to travel from the start and end fixed points, I will call the time measured by the stationary observer t, the Observed Time and I will call the time measured by the observer in the moving inertial frame t_d the "Dilated Time". Furthermore the observer in the stationary inertial frame can calculate the velocity of the moving inertial frame, which I will call v and equals d/t.

III. Time Dilation

According to special relativity the "Dilated Time" t_d and the "Observed Time" t are related with the following equation

$$t_d = t\sqrt(1 - v^2/c^2) \tag{2}$$

I am now going to introduce another time measurement t_c "Light Time", which is the time the stationary observer measures light to travel the distance d. So $v = d/t$ and $c = d/t_c$. Now substitute v and c so the equation only contains time variables and the distance d.

$$t_d = t\sqrt(1 - (d/t)^2/(d/t_c)^2) \tag{3}$$

Cancelling d^2 leaves only time variables and the equation becomes

$$t_d = t\sqrt(1 - t_c^2/t^2) \tag{4}$$

Squaring both sides and multiplying out the right hand side gives

$$t_d^2 = t^2 - t_c^2 \tag{5}$$

This equation gives us an alternative equation for determining the "Dilated Time" simply from the two time variables both of which can be measured by the observer when the moving inertial frame and light travels the distance d. As this equation has been derived from the Special Relativity "Time Dilation" equation it obviously will give the same value for t_d.
A further rearrangement of the equation means

$$t = \sqrt(t_d^2 + t_c^2) \tag{6}$$

This equation is exactly the same as my proposed equation (1) other than the fact that instead of the "Newtonian Time" t_N I have the "Dilated Time" t_d. To show that these are in fact the same I will use the law of conservation of momentum and the Special Relativity equation for Mass increase, which is:

$$m = m_0/\sqrt(1 - v^2/c^2) \tag{7}$$

Where m_0 is the mass of the moving inertial frame when it was part of the observers inertial frame and m is the mass of the moving inertial frame when it is moving at velocity v.
In a pure Newtonian Universe what velocity would the moving inertial frame need to be travelling for its rest mass m_0 to have the same momentum as it has moving at the velocity v in our universe, I will call this the "Newtonian Velocity" v_N and we know:

$$v_N m_0 = v m_0 / \sqrt{(}1 - v^2/c^2) = vm \tag{8}$$

Cancelling m_0 gives an equation that can be used to determine the Newtonian velocity v_N from v.

$$v_N = v/\sqrt{(}1 - v^2/c^2) \tag{9}$$

Now $v_N = d/t_N$ and $v = d/t$, so substitute v_N and the occurrence of v, outside the square root and we get:

$$d/t_N = (d/t)/\sqrt{(}1 - v^2/c^2) \tag{10}$$

Cancelling d from both sides and taking the reciprocal of both sides:

$$t_N = t\sqrt{(}1 - v^2/c^2) \tag{11}$$

This is the time dilation equation except we have t_N instead of t_d Q.E.D. $t_N = t_d$.

Going back to my original equation (1), which I have now shown is correct. This equation is a Pythagorean equation. Which is important because if we consider the two time components as time vectors, where the scalar magnitude of the vector is the elapsed time of that time component then the only way the two time component vectors plus a vector representing the real time can be drawn on paper is as a right angles triangle with the two right angle sides as the two time components and the hypotenuse as the "Observed time" time vector. This shows the two time components as two orthogonal time dimensions or in other words there are two time dimensions in the universe.

IV. Length Contraction

The equation for length contraction is:

$$l = l_0\sqrt{(}1 - v^2/c^2) \tag{12}$$

Where l_0 is the length of a rod on the moving inertial frame measured when the moving inertial frame was part of the observes inertial frame and l is the length of the rod in the moving inertial frame when it is moving at velocity v measured by the stationary observer with the rod in the moving inertial frame facing the direction the moving inertial frame is moving. If when we measured the length of the rod when it was in the observers inertial frame we measured the time it took light to travel the length of the rod to be t_c then $c = l_0/t_c$, also the time light takes to travel the length of rod in the moving inertial frame is the same, so l_0 is also the length an observer in the moving inertial frames measures the length of the rod when the moving inertial frame is moving at velocity v. I will also introduce the length l_{vc} to be $l_{vc} = v/t_c$ which is the length the rod travels as part of the moving inertial frame in the time t_c, the time it took light to travel the length of the rod. To be clear l_0 is the length used to determine t_c and then l_{vc}. We can now substitute v and c in the length contraction equation (11), so it becomes:

$$l = l_0\sqrt{(}1 - (l_{vc}/t_c)^2/(l_0/t_c)^2) \tag{13}$$

We can cancel t_c^2 and square and multiply out both sides

$$l^2 = l_0^2 - l_{vc}^2 \tag{14}$$

This equation having been derived from the Special relativity length contraction equation is equally valid at giving the contacted length of the rod. we can rearrange the Equation to give the Pythagorean equation

$$l_0^2 = l^2 + l_{vc}^2 \tag{15}$$

I believe this equation above shows the existence of a fourth spacial dimension, but our sensors have not evolved to to perceive this fourth dimension. All three lengths lie on a single line pointing in the direction of travel, or do they. So is l_0 the length of the rod in four dimensions and l is the length component in our three dimensional space. Which leaves l_{vc} to be the length component in the fourth dimension only. In fact the length of the rod in four space dimensions remains the same, it is only the length of the rod in three dimensional space that the rod appears to become shorter.
It is easy to see what is happening here with an illustration in three dimensional space. If a 1 metre

long rod is moving horizontally from left to right at a distance of 100m from you with the rod pointing in the direction it is moving. Then a second 1 meter rod following this rod but instead of it pointing in the direction of movement it is pointing at an angel of 45^o away from you, but still horizontal. To you the second rod looks much shorter, $1/\sqrt{2}$ metres instead of 1 metre. If you move and look down from a vertical position you will see the rods are the same length and that the second rod is at an angel of 45^o to the first rod.

So the shorting of objects predicted by special relativity is because we can see in only three dimensions, if we could see in four dimensions we would be able to see that the length of rod in the moving inertial frame does not change.

V. Aspects of the additional Dimensions

i. New time dimension and clocks

All clocks and timing mechanisms including our body clocks and our perception of time comes from only the first time dimension (the Newtonian time component). When the stationary observer is observing a moving inertial frame that contains people and clocks then the stationary observer can see the clocks running slower. The clocks the observer sees agree with Special relativities time dilation equation, that is the clocks run at the "Dilated Time" speed which I have shown is in fact the Newtonian time components. In other worlds the second time dimension makes no contribution to the speed time is passing on the moving inertial frame or in fact any moving inertial frame. The new second time dimension only contributes to the total time the moving inertial frame takes to travel over any distance it is travelling when observed from the stationary inertial frame. The people on the moving inertial frame will therefore age much slower and live much longer than the observer in the stationary inertial frame.

This is important because there have been a number of papers that declare that there cannot be a second time dimension, J Darling[2] in 1970 and M. Tegmark[3] in 1997 both conclude only one time dimension can exist. Both have one thing in common, they are making assumptions about how the multiple time dimensions will work, in particular they do not know the orthogonality of the time dimensions which is an important factor. The reason given for there not being a second time dimension is that the order of events would change depending on how the time of events from the two time dimensions occurs. In the same way that in a one dimension space there is simply one way and one distance between two points but when we have two space dimensions there are an infinite number of ways to get from one point to another and an infinite number of distances. So because only one time dimension controls the passage of time in any moving inertial frame there is still only one length of time possible that can be measured between any two events. In the stationary Inertial frame the second time component t_c is zero so the second time dimension has no affect on the time between any two events.

ii. The Mass of a Moving Inertial Frame

When Einstein was writing the paper that has become known as the paper on Special relativity, he was aware that if the law of conservation of momentum remained true the mass of the moving inertial frame had to increase. The only alternative to this was that the law of conservation of momentum was not true. With the help of the second time dimension I can now add a third very attractive option. The third option is that we are using the wrong velocity in determining the momentum of the moving inertial frame. I believe that momentum should be calculated using the Newtonian velocity, not the observed velocity. I have a number of reasons for believing this, firstly I am not comfortable with the fact that mass increases as the velocity increases. Secondly the mass increase has only been verified by measuring the momentum of a fast moving object and then deducing the mass by dividing the momentum by the observed velocity, in fact there has been no direct proof of mass increase. Thirdly the velocity a passenger on the moving inertial frame believes they are travelling the distance d is the Newtonian velocity. When the moving inertial frame and its passenger are part of the observers stationary inertial frame they know the plan is to accelerate up to velocity v and time themselves when passing the two fixed points covering the distance d. If when calculating their velocity they use the scalar value of d to be the value they were aware of when they were part of the stationary inertial frame they get the result for velocity they are travelling at to be v_N and so as far as they are concerned their momentum is the total mass of the moving inertial which they measured when they were part of the stationary inertial frame multiplied by the velocity which they have determined to be v_N.

If they instead calculate the distance light now travels in a light year, which has increased because time in their inertial frame is running slower, and they use this increased distance light travels to determine the distance d as a fraction of their new value for the distance light travels in a year they will determine their velocity to be v, the same as the observer in the stationary inertial frame has determined their velocity, where v is expressed as a fraction of the speed of light.

So I propose the mass of the moving inertial frame does not change and we should be using the Newtonian velocity to calculate the momentum of a moving inertial frame. The Newtonian velocity can be determined using the equation (9) above.

iii. The additional Space Dimension

The additional space dimension does not have the same impact as the additional time dimension, as far as Special relativity is concerned it shows that the length of a rod does not contract but the view of the rod in three dimensions only, does appear to contract. This is just an illusion due to angle of rod between the three space dimension we persevere and the direction the rod is pointing within the additional space dimension. The additional space dimension has no affect on the observed speed of a moving inertial frame, it only distorts our view of the length of the moving inertial frame.

iv. Addition of velocities

If starting with a stationary inertial frame another inertial frame IF1 leaves the stationary inertial frame moving at velocity v. Then a second inertial frame IF2 leaves the inertial frame IF1 with velocity u, and both inertial frames (IF1 and IF2) are moving in exactly the same direct. An observer in the stationary inertial frame measures the velocity of the inertial frame IF2 to be w. The observer on the stationary inertial frame was able to determine the momentum of the inertial frame IF2 when it was part of the inertial frame IF1, I will call this p_v, and an observer on the inertial frame IF1 can determine the momentum of the inertial frame IF2 once it has departed, I will call this p_u. The law of conservation of momentum means the sum these two measures of momentum must equal the momentum of IF2 determined by the stationary observer measuring the momentum of IF2 directly, which I will call p_w.

That is:

$$p_w = p_v + p_u \tag{16}$$

I proposed above that mass does not change with velocity and to determine momentum the Newtonian velocity must be used, so If the mass of IF2 is m when it was part of the stationary inertial frame then the above equation can be written in terms of Newtonian velocities w_N, v_N and u_N which are the Newtonian velocities of w, v and u, so the above becomes

$$m * w_N = m * v_N + m * u_N \tag{17}$$

Which means

$$w_N = v_N + u_N \tag{18}$$

And is exactly as we know and expect velocity addition to occur in a Newtonian Universe. Equation (9) above gives the Newtonian velocity from the observed velocity. We can use equation (9) to determine the Newtonian velocities v_N and u_N, add these velocity to give us w_N and then convert this back to the observed velocity w. The equation to do this can easily be derived from equation (9) and is:

$$v = v/\sqrt{1 + v^2/c^2} \tag{19}$$

To show this is different from Eienstien's equation for velocity addition I use equation (18) and substituting for w_N we get

$$w/\sqrt{1 - w^2/c^2} = v_N + u_N \tag{20}$$

$$1/(1/w^2 - 1/c^2) = (v_N + u_N)^2 \tag{21}$$

$$1/w^2 - 1/c^2 = 1/(v_N + u_N)^2 \tag{22}$$

$$1/w^2 = 1/c^2 + 1/(v_N + u_N)^2 \tag{23}$$

$$1/w^2 = ((v_N + u_N)^2 + c^2)/(c^2 * (v_N + u_N)^2) \tag{24}$$

$$w^2 = c^2 * (v_N + u_N)^2/((v_N + u_N)^2 + c^2) \tag{25}$$

We could now substitute for v_N and u_N, but it does come out as a quite long equation, in principle what we are doing here is to simply determine the Newtonian velocity of the two observed velocities we wish to add, add the Newtonian velocities and then convert this back to the observable velocity. This does give a different result to that calculated by equation for addition of velocities in Special relativity, which is

$$w = (u + v)/(1 + uv/c^2) \quad (26)$$

We can see the result is different if we consider the case where $u = v$ (which means $v_N = u_N$), we take equation (25) and it becomes

$$w^2 = c^2 * 4v_N^2/(4v_N^2 + c^2) \quad (27)$$

$$w^2 = c^2/(1 + c^2/4v_N^2) \quad (28)$$

Now substitute for v_N

$$w^2 = c^2/(1 + c^2/4v^2/(1 - v^2/c^2)) \quad (29)$$

$$w^2 = c^2/(1 + (c^2 - v^2)/4v^2/) \quad (30)$$

$$w^2 = 4v^2c^2/(4v^21 + c^2 - v^2) \quad (31)$$

$$w^2 = 4v^2c^2/(3v^2 + c^2) \quad (32)$$

$$w = 2v/\sqrt{3v^2/c^2 + 1} \quad (33)$$

The Special relativity equation for addition of velocities when $v = u$ is

$$w = 2v/(1 + v^2/c^2) \quad (34)$$

Clearly The equation I have derived using the law of conservation of momentum is different to the equation derived in Special Relativity. The difference I believe is due to the fact that length contraction does not affect the observed velocity of moving inertial frames, but Einstein's velocity addition equation is affected by length contraction.

We only looked here at adding the velocities when they were both in the same direction, we did this by converting the observed velocities to the Newtonian velocities, adding them and then converting them back to the observed velocity. This principle can be used when the the second inertial frame IF2 moves of at an angle from the direction the moving inertial frame IF1 is moving. Once we have converted the velocity of both inertial frames to their Newtonian velocities it is easy to combine them using simple geometry and determine the final Newtonian velocity of the second moving inertial frame IF2 relative to the stationary inertial frame and then convert this back to the actual observed velocity. Clearly if the velocities of IF1 and IF2 are reversed and the angle IF2 moves at from IF1 is the same but reversed, that is, if the angle was to the right of direction it is reversed to become to the left of direction, then the addition of velocities and direction is he same. In fact the two routes represent opposite pairs of the sides of a parallelogram. So in fact velocity addition is commutative irrespective of direction of the second moving inertial frame from the first inertial frame, unlike Einstien's velocity addition formula.
Using the law of conservation of momentum to determine a velocity addition equation has been suggested by Olivier Serret in his paper "Velocity Addition Demonstrated from the Conservation of Linear Momenta, an Alternative Expression" [9], but he is using the mass predicted by by Specail Relativity and the observed velocity. He also refers to experimental evidence that the Special Relativity velocity addition formula predicts slightly lower values than the experimentally observed value for velocity addition.

v. An Absolute Zero Velocity

In Special relativity it is accepted that there is no absolute zero velocity, and nothing I have said means this has to change, Although I propose an absolute direction is required. With regard to momentum, every observer determines the momentum of other inertial frames using the relative velocity of the observer to the particular inertial frame they wish to determine the momentum of. If an observer compares the momentum of two other inertial frames we know the difference in momentum between the two inertial frames is the momentum each of the two observed inertial frames determines the momentum of the other to be, as long as both inertial frames have the same mass. This is becaue we ae using the law of conservation of momentum for determining velocity addition. In effect every observer is their own local zero of momentum against all other inertial frames and thee is no need for an absolute zero velocity or even an absolute direction.

When we look a time dilation things are different. If we look at the case when a stationary observer observes the two moving inertial frames IF1 and IF2, if when IF2 leaves IF1 it moves back in the direction of the stationary observer at a velocity which means as far as the stationary observer is concerned IF2 is still moving away from them. Then clearly the speed of clocks on IF2 are faster than the the speed of clocks on IF1 when observed by the stationary observer. If IF2 moved away from IF1 in the same direction as IF1 relative to the stationary observer then the speed of clocks on IF2 would be slower than the speed of clocks on IF1. If in both cases the scalar value of velocity of IF2 relative an observer on IF1 was the same then the observer would need to know the direction of IF1 to predict the speed of clocks on IF2.

Interestingly there is some evidence of this happening here on Earth when we observe the clocks on GPS satellites The Earth we know is moving and so at some points in a GPS satellites orbit it could me moving in a direction which means it is moving faster than the Earth and when on the other side of Earth in same orbit it would be moving slower than Earth. As a result in some orbits and at some points in the satellite orbit the clocks would be going slower and at some point they would be going faster. This has been observed and reported in a paper entitled "Apparent clock variations of the Block IIF-1 (SVN62) GPS satellite" [4] and another paper "Characterization of periodic variations in the GPS satellite clocks" [5] both show a cyclic variation in some GPS Satellites clocks, the amount of variation did vary with the inclination of the orbit. The conclusion of both papers were not able to determine a reason, although they suggested it may be caused by variation of temperature within the satellite. I suggest it could be due to the variations in time dilation due to the satellite moving either faster or slower than the Earth.

So Direction is important, but the absolute velocity is not. If the stationary observer Has an absolute Newtonian velocity of x_N then the virtual frames IF1 and IF2 have absolute Newtonian velocities of $x_N + v_N$ and $x_N + u_N$, we have simply added absolute velocity of the stationary observer to the relative velocities of IF1 and IF2 to the stationary observer, assuming all three inertial frames are moving in the same absolute direction. I showed much earlier that the dilated time is the Newtonian time it takes for a moving inertial frame to travel the distance d, but this distance d is a stationary distance relative to the stationary observer, because the stationary observe has a Newtonian velocity x_N it is easily seen that the time for IF1 to travel the distance d which is moving with velocity x_N must still be d/v_N. So the time dilation of IF1 relative to the stationary observer does not change no matter what the absolute velocity of the stationary inertial frame is.

By observing the changes in time dilation of the GPS satellites for a year it should be possible to determine the absolute direction of the Earth. It is possible this would reveal an absolute velocity but I suspect it will not, if it does not reveal an absolute velocity there could be an absolute velocity or they may not, further experimentation would be required to determine if there is an absolute zero velocity.

vi. Doubly-Special Relativity

There are several hundred papers either totally about Doubly-Special Relativity or about some aspect of Doubly-Special Relativity, a good paper to get started with Doubly-Special Relativity is "Doubly-Special Relativity: Facts, Myths and Some Key Open Issues" [6], this paper links to over 100 other papers. Doubly-Special Relativity has come about to resolve Issues relating Special Relativity and Quantum gravity which is itself not a single theory but a number of theories. The paper "Notes for a brief history of quantum gravity" [7] is a good introduction to the various theories of Quantum Gravity and links to over 100 other papers. The issues between Special Relativity and Quantum Gravity boil down to the fact that the Quantum gravity theory's require the length and mass at the scale of the Planc length to not vary, but Einstein's theory of Special Relativity predict an object the size of the Plan length and moving at a significant speed relative to light would contact and its mass would increase. In this paper I have shown how the two additional dimensions means both length contraction and mass increase of Special relativity are illusions due to these additional dimensions, this means there are no issues between Special relativity and the various Quantum Gravity theories.

vii. Additional Papers on a Fourth Space Dimension

Independently of Special relativity there have been some speculation regarding the existence of a fourth space dimension and that we exist on the three dimensional surface of a four dimensional sphere. Eienstien suggested this in 1917 and later there have been others who suggested it, due to the even spread of high red shifted galaxies. A paper "Back to the Basis Observations Support Spherically Closed Dynamic Space"[9] by Tuomo Suntola discuses these and other reasons to support the fact that there is a fourth space dimension.

viii. $E = mc^2$

The one casualty is the famous equation $E = mc^2$, the proof from Special relativity will no longer work due to the fact that I have shown that mass does not increase. This does not mean it is wrong, but does mean an alternative proof needs to be found.

VI. Conclusion

I have shown the Special relativity equation for time dilation shows the existence of two time dimensions not one and the length contraction equation shows the existence of a new spacial dimension, meaning there are four space dimension. I introduce the concept of a Newtonian velocity which is the velocity calculated using just the time dilated time of a moving inertial frame, having shown the time dilated time is one of the time components. I then showed that the mass does not increase as an object moves faster because we have been calculating momentum wrongly and we should be using the Newtonian velocity and not the observed velocity. I also showed that length contraction was just because we are only seeing in three dimensions and as an object goes faster and faster it enters more and more into the fourth dimension, the length does not change but we only see a projection into three dimensions making it look shorter. I then showed an alternative way of calculating the addition of velocities based on the law of conservation of momentum, the new way of calculating the addition of velocities gives a different result from the Special relativity and has the advantage that it is commutative. I agree with special relativities proposal that an absolute zero velocity is not required, but I do propse that an absolute direct of travel is required. As a result of showing lentgh contraction does not occur and the mass does not increase Special relativity is now compatible with the theories on Quantum Gravity and Doubly Special relativity is redundant. The one casualty being the proof of the equation $E = mc^2$.

What appears to be happening is that as an object, let us say a spacecraft, moves faster it progressively enters a fourth spacial dimension, and the time spent in this fourth spacial dimension is not perceived by the occupants of the spacecraft so they age much slower. Also the momentum of the spacecraft is linked only to the time it is in the normal 3 dimensional space and so the momentum is higher than wat would be expected at the observed velocity. I believe light and all electromagnetic radiation is fundamentally linked to this fourth dimension as a means of propagation of electromagnetic radiation.

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