A Second Time Dimension, Hidden in Plain Sight

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In this paper I postulate the existence of a second time dimension, making five dimensions, three space dimensions and two time dimensions. I will postulate some basic properties based on a smoking gun and then use these basic properties to derive the time dilation equations of "Special Relativity", which helps define additional properties of the second time dimension. The conclusion being that the Universe has five dimensions but that we only perceive four dimensions. Further more I will demonstrate that Newton's second law of motion still holds if you ignore the time contribution from the second time dimension and additionally as a result of this paper we will understand a little bit more about the very nature of time. I believe this to be quiet a significant paper.

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I. Introduction

I Postulate there is a second time dimension, giving five dimensions, three space dimensions and two time dimensions. I base this on the existence of a smoking gun. In the same way that a two dimensional creature living on the surface of a sphere would have no idea what a tree dimensional object was and in particular what a sphere was. There would be some clues that all was not correct, such as the fact they could walk in a straight line in one direction and end up back where they started, plus the fact that triangles drawn over long distances will have the sum of the angles exceeding 180 degrees. What is the smoking gun for the second time dimension, it is "Special Relativity" [1], in particular the fact that "Special Relativity" means the speed of light is an absolute maximum for the speed of any object with mass and also time dilation.

I will Postulate the basic properties of this second time dimension, which will explain the absolute maximum for the speed of any object with mass. I will then use these basic properties to derive the time dilation equation derived within Einstein's "Special Relativity".

I will then derive further properties of the second time dimension and expand on the affects of this time dimension in our universe.

There have been papers [2][3] that purport to prove a second time dimension cannot exist, I will explain how they have missed the mark later. There have also been papers [4] that purport that a second time dimension could be possible.

II. The Nature of Time

Before talking about the second time dimension I wish to talk about the nature of time and clocks. Unlike a spacial dimension we do not appear to be able to move freely in the time dimension, time moves forward at a constant rate and we appear powerless to alter this. We measure the movement of time with clocks, there are many types of clocks, mechanical clocks, natural clocks, light clocks, atomic clocks and more but whatever clock we use once a clock is calibrated it agrees with all other clocks in measuring the changing of time to within the accuracy of the clock. We take it that the time dimension somehow imparts this passage of time to the clock via its mechanism. So when I talk about an observe measuring the passage of time I mean the observer is using a clock, any clock he uses, assuming it has been correctly calibrated, will measure the same amount of time as any other clock to the degree of accuracy of the clock and so using the most accurate clock is best.

We have found that there are two ways that the

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passage of time changes, meaning that a clocks measure of time changes under either of these two conditions and when compared with other clocks not affected by these conditions the clocks no longer agree. The two ways that the passage of time change are as described by "Special Relativity" and "General Relativity". In this paper I will be looking at "Special Relativities" time dilation and explaining exactly what this is and how clocks are affected. "Genral elativity" is beyond the scope of this paper.

III. Basic Properties of the second Time Dimensions

I will take it that the principle of relativity hold and at this stage I am only going to look at the affect of the second time dimension on the movement of objects relative to an observer. To do this we need an observer and the observer is in an inertial frame with no forces acting on the 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 or by a moving body of light. As far as we are concerned the observer and their inertial frame will be considered stationary relative to other inertial frames that will be observed. 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 accelerate it away from the observers inertial frame. The observer will measure the time the moving inertial frame takes to travel between two fixed points who's Cartesian coordinates relative to the observer are not changing relative to the observer with time. The observer knowing the coordinates of the two points can work out the straight line scalar distance between these two points, I will call this distance d. The observer 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 this time t_r or the "Real Time".

Because I am postulating there are two time dimensions I expect this "Real Time" to have two time components and I will call these t_x the time component from the first time dimension and t_y the time component from the second time dimension. Furthermore I postulate to obtain the scalar value of the "Real Time" from these two time components we take the square root of the sum of the squares, the same as we do to combine two spacial dimensions.

Thus:

$$t_r = \sqrt{t_x^2 + t_y^2} \tag{1}$$

Now I am going to postulate the exact contribution of the second time component, it is in fact the time the observer measures light will travel between the two fixed points the scalar distance d, so $t_y = \frac{d}{c}$. This of course means it is impossible to travel the distance d faster than it takes light to travel this distance because even if the time component from the first time dimension is zero we get the "Real Time" to be the same as it takes light to travel the distance d, which agrees with "Special Relativity".

And now the equation for the "Real Time" becomes

$$t_r = \sqrt{t_x^2 + \frac{d^2}{c^2}} \tag{2}$$

IV. Time Dilation

I am now going to derive the time dilation equation derived by Einstein's theory of "Special Relativity". There have been many papers discussing the results of "Specail Relativity" or extending "Specail Relativity", but the core results of "Specail Relativity" still hold and in particular time dilation, which has a volume of experimental results confirming it to a high degree including a paper [5] in 2014.
starting with the above equation (2) for "Real Time". I will divide both sides of the equation by the distance d so that I can convert the time variables to velocity variables.

$$\frac{t_r}{d} = \frac{\sqrt{t_x^2 + \frac{d^2}{c^2}}}{d} \tag{3}$$

Now t_r/d is the scalar value of the velocity the observer observes the moving inertial frame travelling the distance d and I am going to call the v_r the

"Real Velocity", so

$$\frac{1}{v_r} = \sqrt{\frac{t_x^2}{d^2} + \frac{1}{c^2}} \tag{4}$$

$$\frac{1}{v_r^2} = \frac{t_x^2}{d^2} + \frac{1}{c^2} \tag{5}$$

$$\frac{1}{v_r^2} - \frac{1}{c^2} = \frac{t_x^2}{d^2} \tag{6}$$

$$\frac{1}{v_r^2}(1 - \frac{v_r^2}{c^2}) = \frac{t_x^2}{d^2} \tag{7}$$

$$\frac{d^2}{v_r^2}(1 - \frac{v_r^2}{c^2}) = t_x^2 \tag{8}$$

$\frac{d}{v_r} = t_r$ so

$$t_r^2(1 - \frac{v_r^2}{c^2}) = t_x^2 \tag{9}$$

$$t_x = t_r\sqrt{1 - \frac{v_r^2}{c^2}} \tag{10}$$

This equation (10) tells the observer the time contributed by the first of the time dimension for the moving inertial frame to travel the distance d at the observed "Real Velocity" v_r taking the "Real Time" t_r,**BUT** it is also the equation derived by Einstein in his theory of "Special Relativity", for time dilation. What does this tell us, well it is telling us that the time dilation predicted by Einstein and verified experimentally [5] with considerable accuracy is the time component from the first time dimension alone. The second time dimension although being a component in the "Real Time" it takes the moving inertial frame to move the distance d, does not contribute anything to the time perceived by an observer or a clock in the moving inertial frame.

V. Newton's Second law of Motion

Another aspect of "Special Relativity" is that Newton's second law of motion, no longer holds true. This is another affect of the second time dimension, and by using the law of conservation of momentum we can deduce what the velocity of the moving inertial frame would be if Newton's second law of motion remained true, I will call this velocity the "Actual Velocity". According to "Special Relativity" the mass of the moving inertial frame as observed by the observer in the stationary inertial frame will have increased when it is travelling at the "Real Velocity", I will call this mass m_r the "Real Mass". When the Moving inertial frame was part of the observers inertial frame the initial mass of the moving inertial frame was m_0. The current momentum of the moving inertial frame moving at velocity v_r is $m_r v_r$, if Newton's second law remained true then the velocity of the moving inertial frame would be v_a and the momentum would be $m_0 v_a$. Because of the law of conservation of momentum these two momentums are equal, so

$$m_0 v_a = m_r v_r \tag{11}$$

and so the "Actual Velocity" is

$$v_r \frac{m_r}{m_0} = v_a \tag{12}$$

The equation for mass increase from "Special Relativity" is

$$m_r = \frac{m_0}{\sqrt{1 - \frac{v_r^2}{c^2}}} \tag{13}$$

we can remove $\frac{m_r}{m_0}$ by combining equations (12) and (13) which gives

$$v_r \frac{1}{\sqrt{1 - \frac{v_r^2}{c^2}}} = v_a \tag{14}$$

Now take the reciprical of both sides and multiply both sides by the distance d

$$\frac{d}{v_r}\sqrt{1 - \frac{v_r^2}{c^2}} = \frac{d}{v_a} \tag{15}$$

$\frac{d}{v_r}$ is t_r so

$$t_r\sqrt{1 - \frac{v_r^2}{c^2}} = \frac{d}{v_a} \tag{16}$$

$\frac{d}{v_a}$ is a time and the equation(16) above is the same as as equation (10) so

$$\frac{d}{v_a} = t_x \tag{17}$$

which means

$$\frac{d}{t_x} = v_a \tag{18}$$

In other words the "Actual Velocity", the velocity the moving inertial frame would be travelling at if

Newton's second law of motion still holds is the velocity the moving inertial frame is travelling in the first time dimension alone. In effect when the moving inertial frame travels the distance d the time component contributed from the first time dimension is time it would have taken the moving inertial frame at the "Actual Velocity".

VI. An Example

An observer watches a spacecraft travelling at $\frac{4}{5}c$ for a distance of one light year. So the observer perceives it takes 1.25 years to travel this distance. Using equation (14) to calculate the "Actual Velocity" this speed is $1\frac{1}{3}c$ which at this speed would only take 0.75 years to travel the one light year, which is the length of time the passengers would perceive has passed according to "Special Relativity". The two time components are 0.75 and 1 year, taking the square root of the sum of the squares of these two components gives 1.25 years the length of time the observer measures it takes the space craft to travel the one light year.

VII. Properties of Second Time Dimension Revisited

Previously we Postulated the basic properties of the second time dimension. These were:

1 A time component from the second time dimensions is only contributed to a the time measured by an observer of a moving inertial frame.

2 The scalar value of the second time dimension component when the observe measure the time a moving inertial frames travels a distance d in a straight line at a constant velocity the second time dimensions contribution is the time light takes to travel the same path and distance the moving inertial frame is timed over.

Further to these properties are the properties of Orthogonality of the two time two time dimensions, which we can now deduce.

3 The second time component makes no contribution to the total measured time if the observed inertial frame is not in motion in any direction relative to the observer, that is t_y is zero. Also any point in the observers own inertial frame is not in motion in any direction relative to the observer and so the second time dimension is not contributing any time within the observers own inertial frame. Further more this is true of any observer in their own inertial frame and I showed this above when I showed that Einstein's time dilation from his theory of "Special Relativity" is the time contribution of the first time dimension in the observed moving inertial frame. In particular Einstein said and it has been shown experientially to a high degree that an observer in the moving inertial frame only experiences the time from the first time dimension, the second time dimension makes no contrition to an observer within the moving inertial frame.

4 The first time dimension makes no contribution to the time any electromagnetic wave/particle takes to travel any distance, that is t_x is zero. What this appears to mean is that electromagnetic waves/particulars and the second time dimension are very closely linked

5 to combine the two time contributions take the square root of the sum of the squares of the scalar values of the two time contributions.

VIII. Papers stating there can only be one time dimension

There have been a number of papers that have proposed that there can only be one time dimension, J Darling[2] in 1970 and M. Tegmark[3] in 1997 both suggest only one time dimension is possible. Both have one thing in common, they are making assumptions of how multiple time dimensions will work, in particular they do not know the orthogonality of the time dimensions which is an important factor.
In the list of properties revisited above, I listed the properties of the orthogonality of the two time dimensions and in particular property number 3 is that the second time dimension does not contribute any time to any observers own inertial frame. The two papers above [2] and [3] both assume that any additional time dimensions will affect time in an inertial frame, in particular they suggest the time a

particle decays will not be the same because there would be multiple time paths. BUT the orthogonality of the second time dimension to any inertial frame means there are no multiple time paths because the second time dimension does not contribute time within an inertial frame and so the order of events within an inertial frame are unchanged.
This therefore invalidates their argument that only one time dimension is possible.
Additionally the paper by Steven Weinstein[4] 2008, suggests multiple time dimensions are possible.

IX. Do we live in four or five dimensions

I have put forward the proposition that there is a second time dimension and I believe I have given some strong proof of it's existence. I am now proposing that we still exist in four dimensions only, and there is a smoking gun showing the existence of the second time dimension. I mentioned in my introduction that two dimensional creatures living on the surface of a sphere would have no idea what three dimension objects were, in effect although they would exist in three dimensional space they only perceived two dimensional space and in effect lived in only two dimensions. In the same way the second time dimension is not perceived by us, and further more the laws of physics are unaffected by the second time dimension in our local inertial frame.
In effect the Universe is a five dimensional continuum, three space dimensions and two time dimensions. BUT we live in and only perceive four dimensions, three space dimensions and one time dimension.

X. Conclusions

In summary I have described the properties of the second time dimension and used the combination of the time components from the two time dimensions to derive Einstein's time dilation equation that he derived in his theory of "Special Relativity". The fact that I was able to derive Einstein's equation for time dilation from the combination of the two time components of the two time dimensions, tells us that Einstein's time dilation is actually the time contributed from the first time dimension meaning that only time from the first time dimension is perceived in any inertial frame and helping define properties of orthogonality of the two time dimensions. The orthogonality tells us we only perceive the first time dimension and so only live in a four dimensional continuum although the universe has five dimensions.
Another interesting conclusion relates to the way the time dimension affects the passage of time, up until now we believe that "Special Relativities" time dilation meant that time within the time dimension actually slows down which meant the clocks run slower. The conclusion of this paper is different to this, only the first time dimension controls the perceived passage of time and within the moving inertial frame only part of the "Real Time" as observed by an observer in the stationary inertial frame is due to the first time dimension. The passage of time within the first time dimension is still passing at the same rate but because only a part of the "Real time" is from the first time dimension the observer observes the clocks running slower. I would like to illustrate this with an example with older style microwave oven. If I place a clock in a microwave oven, but the clock only works when irradiated by microwaves, and I put the microwave on 20% power for 5 minutes. Older style microwave ovens can only irradiate at full power and in effect irradiate at 20% power by irradiating at full power but only for 20% of the time. I used to have an oven like this and you could hear when the microwave irradiation was occurring so when on 20% power you could hear the microwaves continually being turned on and off. The affect of this on the clock I put in the microwave is that when you take the clock out of the oven after 5 minutes it shows only one minute has passed, when the clock was working inside the microwave it was measuring the passage of time at exactly the same rate as the clock timing the total time the microwave was going to be on, but it only worked for the one minute the microwave was on full power. Time dilation works like this, the first time dimension is like the clock in the oven the passage of time changes at the same rate but because it is only a portion of the "Real time" clocks in the moving inertial frame run slower. When I said in the section on the nature of time that there were two ways that passage

of time changes in the time dimension, I was wrong, the passage of time in the first time dimension does not change as a result of "Special Relativity". This just leaves "General Relativity" as the only way the passage of time can change, unless the second time dimension is involved in this as well.
This paper does not conflict with "Special Relativity" in any way, The principle of relativity hold. The paper does explains what "Special Relativity" time dilation really is, while all the equations of "Special Relativity" are still valid.
I believe this is a very novel and significant paper and I plan to look more deeply into what this means with regards the nature of the universe.

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