Space Time and Eternity

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Many years ago, when I was an undergraduate, I chose to take the relativity options of my mathematics course. I was taught about the concepts and the equations that arise in Einstein's theories of relativity. With some difficulty I even managed to pass my examinations but I fear like many undergraduates, I never had that feeling of really comprehending the subject. However some five years later, during an Old Testament lecture on the Hebraic concept of time at Theological College, I had one of those 'the light dawned' experiences. I suddenly recognised that this 'alien' Hebraic way of thinking about time was Einstein's way of thinking. Einstein had come to Gentile physics with a Hebraic concept of time.

This insight, which gave me a comprehension of both relativity theory and theology, never left me, especially later when I continued in my cosmological studies. Over the years my conviction that this insight is basically sound has been confirmed. The point I had realised is that, whereas Gentile physics was confined to an absolute, linear, sequential concept of time, the Hebrew Scriptures contain an idea of time that is non-linear and non-sequential, although they do also introduce linear development and historical progress, that is God's thread line of purpose running though the history of the Children of Israel.

Let me explain how Hebraic time applies to relativity theory without, hopefully, losing some readers and while not boring others for whom the following is elementary!

Einstein's Special and General theories of Relativity depend on the hypothesis that space and time cannot be separated but are both part of a four-dimensional continuum called space-time. Einstein pointed out that it is not possible to make measurements of the position of an event except at a particular moment in time, and to measure the time of an event except at a particular position in space. Furthermore in Special Relativity measurements of the separation in space and the duration of time between two events are relative to the movement of the observer. Different observers moving with respect to each other will make different measurements both of the spatial distance and of the temporal interval between two such events. A further surprising result of the theory is that the intuitively 'obvious' difference between past and future disvobes. That is because, of all the slices through space-time that can be made, that particular slice, which consists of all events that are mutually simultaneous, is itself relative to the velocity of the observer, that is, simultaneity is also relative.

On the other hand, not all things are relative, there are quantities that do not depend on the observer's motion but are invariant. One well known such invariant is the velocity of light, but another is the space-time interval between the two events, that is the four dimensional separation across space and time, where this interval has been defined by Einstein in a particular way.

In order to understand how this interval is defined it is necessary to do a little mathematics, but we shall only require Pythagoras' theorem, which most members of the Society can handle!

The length 'c' of the diagonal across the floor of a rectangular room, whose length is and breadth y are two sides of a right-angled triangle, is given by:

$c^2 = x^2 + y^2$,

which is the two-dimensional separation of two points in space. If now we add the height z and want the separation from a corner on the floor to the opposite corner on the ceiling of our room, the floor diagonal and the wall corner now form another right-angled triangle, and that diagonal length is given by:

$l^2 = x^2 + y^2 + z^2$,

which is the three-dimensional separation of two points in space. However in his theory Einstein added time as a fourth dimension, so the question arises, what is the four-dimensional equivalent of 't'? That is, what is the space-time separation, or interval, between two events at two different places and occurring at two different times? Looking at the two equations above a first guess may be:

$s^2 = x^2 + y^2 + z^2 + t^2$??

However this expression is not yet correct, there are two crucial reasons why it is wrong. The first is that we have mixed together in the equation units of space such as centimetres, and units of time such as seconds. It is like adding sterling and euros together, a conversion factor, the rate of exchange, is required. The conversion factor that converts time into distance is a velocity, which is generally labelled 'c', so the last term of the equation, t^2, should actually be c^2t^2. The second reason the above is wrong is that instead of adding this 'time' term it has to be subtracted, resulting in the following equation, or metric, for the four-dimensional space-time interval:

$s^2 = x^2 + y^2 + z^2 - c^2t^2$.

This metric describes a type of space discovered by Einstein's tutor Minkowski but it was Einstein's genius to incorporate it in his theory. We can also note that Einstein showed how gravitational forces could be re-interpreted as a curvature of the four-dimensional manifold in his later General Theory of Relativity. Such curvature modifies the coefficient of each term in the expression above.

One might understand the minus sign in the expression above to mean that although time is indeed a dimension like length, breadth or height, it is not exactly the same as a space dimension. This fact, that time is not exactly the same as space, is experientially self-evident. In actual fact the metric states that time bears the same mathematical relationship to space as the imaginary numbers bear to the real. The minus sign is the cause of the counter intuitive aspects of the theory. Einstein went on to show that the observed mass of an object increases with relative velocity. This increase of mass was a new understanding of the object's kinetic energy in which mass and energy are exchanged according to the famous relationship:

$E = mc^2$

In addition, a clock moving relative to an observer is observed to run more slowly than the observer's clock. That observed rate of 'time passing' tends to zero, and the object's mass tends to infinity, as the relative velocity tends to c. As light does not have rest mass it has to travel at that 'c' velocity, therefore 'c' is identified as the velocity of light. It is therefore impossible for a physical object to be accelerated to the speed of light.

Now, where is all this leading you might ask, and what does it have to do with an Old Testament concept of time? In order to answer that question we may calculate the four dimensional space-time separation between two events connected by a light ray, that is between, for example, the event of a distant star exploding as it becomes a supernova a thousand light-years away and the event of an astronomer photographing that supernova a thousand years later on Earth. The velocity of light, c, equals one in these units as light travels at the rate of one light year per year.

To calculate this space-time interval (squared) we square the spatial separation of a thousand (light) years and subtract the time delay of a thousand years squared with the result that the space-time interval along our light path is reduced to zero. Another way of expressing that is to say that time has 'stopped' for the light ray, as far as the photon is concerned, it has travelled across the universe instantaneously.

The parallel concept in the Old Testament is to be found in the words given for the father to say during the Passover. At the appropriate moment the child is to ask, "What do you mean by this service?" (Exodus 12:26) - or in a modern Passover *"Why is this night more special than all other nights?"* That gives the father the opportunity to rehearse the salvation history of the Children of Israel, the passing over of the angel of death and their deliverance out of slavery in Egypt. But he is given special words to say, which in Hebrew are in the first person and the present tense. The salvation event did not happen thousands of miles away and thousands of years ago, but here and now. The separation across space and time between Moses by the Red (Reed) Sea and a Jewish family celebrating the Passover today is zero. As a rabbinic saying puts it, "Every Jew is to think of himself as actually taking part in the Exodus itself."

My understanding of this is that the act of salvation, and its celebration or remembrance, are eternal events not simply confined of our space-time continuum, as God is not confined to that continuum. I believe this same understanding of space, time and eternity is implicit in the Eucharist, for in the act of remembrance, "Do this in remembrance of me", we are more than remembering the crucifixion, we are entering into the eternal event of the salvation event of Christ. In Protestant terms we are 'standing at the foot of the Cross', in Catholic terms we are experiencing the once-for-all sacrifice of Christ, the sacrifice of the Mass, in other words we are liberated from the confines of linear, sequential time.

A crucial insight is of Einstein's concept that space and time cannot be taken separately, they have to be considered together as a space-time continuum. Thus if we believe that God does not exist at any one position in space, as Zeus was believed to inhabit Mount Olympus, so too He cannot exist at any one moment in time, He must be 'beyond' both space and time.

Similarly if God is 'in, with and under' all-that-is at all points in space He must also be 'in, with and under' all-that-is in all moments of time as well, He is 'in, with and under' all-that-is at all events in the cosmological space-time continuum.

In other words, although we are creatures whose consciousness inhabits a particular sequence of events, a world-line in space-time, I believe God's consciousness cannot be so located, for if we understand that He is not restricted to a particular place in space, then we have to understand that He cannot be restricted to a particular moment in time either.

As a consequence I have a difficulty with Process Theology, in that if we are to say that 'God does not know the future for the future does not yet exist for Him to know', then we have to specify whose future it is that He does not know. For, according to Special Relativity two observers pairing each other with a relative velocity have different sets of world-events in their respective pasts and futures, and some of the events that lie in the past of one such observer would lie in the future of the other.

Conversely, I find the traditional view of the God of the Hebrew Scriptures who is both beyond Creation and also 'in, with and under' it, that is, both transcendent and immanent, a view which subsumes both the linear and the eternal concepts of time, is not only consistent with the theories of Relativity, but also, buried in Einstein's cultural background, may have been partly responsible for their birth.