# 28

# The Nature of Time

Contents:



## *Introduction*

The purpose of this chapter is to describe the nature of "cosmological" time, as Professor Stephen Hawking refers to it in his book "*A Brief History of Time*", in chapter 9, "The Arrow of Time" and to distinguish this from our mental concept of time or "psychological" time that we all use for organizing the events of life into the past, present and future. Our mental concept of time is based on the perception that we are continuously moving forward in time. However, this may be an illusion.

Professor Stephen Hawking explained in his book and explained further once in a television show about our universe, that if the matter of the universe expands outward that it is possible it also moves forward through time. Further that if the universe contracts, it is possible that the matter of the universe could move backwards in time. This is one way of explaining "cosmological" time and Hawking's explanation is important in that it suggests a relationship between matter's motion in space and matter's motion in time and this is the subject of this chapter.

Hawking explains further that our psychological perception of a "forward" direction in time is determined by thermodynamic processes in which the overall entropy of a system increases in accordance with the 2nd law of thermodynamics. But it is this author's belief that there can also be spin temperature processes at work throughout nature that are not as easily recognized that can decrease the entropy of a system.

This chapter will introduce the reader to the concept of 3D time and show mathematical and physical evidence that time is 3 dimensional. It is our mind that creates the concept of forward movement in 1 dimensional time to organize experiences that we go through while spinning in 3D time.

We spin in time at the microscopic level because of all the subatomic particles we are made of that are spinning in space on their axes at the speed of light. It is this spin motion in 3D space that causes motion in 3D time. Of course all motion including orbital motion and thermal agitation contribute to matter's motion in time relative to other matter.

According to quantum physics the classical concept of spin cannot be applied to atomic and subatomic particles. It is the author's contention that the classical concept of spin can be used; however, the spin characteristics of particles must be described not only in 3D space but also in 3D time.

The direction of motion considered forward in time is completely relative just as the direction of motion in space considered forward is relative to the chosen coordinate system orientation. To understand what is meant by this we need to see how time can be represented using the same 3 dimensions that space uses.

## *3 Dimensional Vectors in Time*

The purpose of this section is to demonstrate that time can be represented with 3 dimensional vectors. In Diagram 28-1, there is an object at the center of an x, y, and z coordinate system representing 3 dimensional space. The object emits a pulse of light that propagates out spherically.

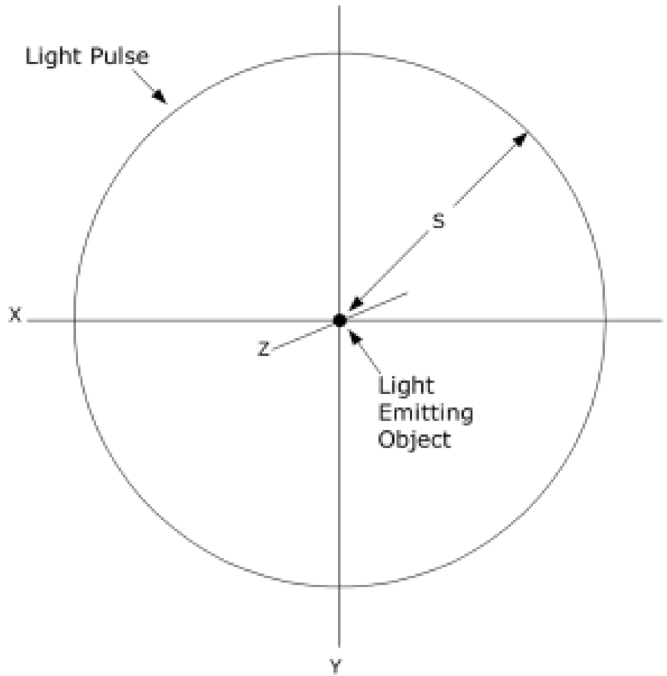


DIAGRAM 28-1
Spherical Propagation of a Light Pulse

The distance that the pulse has traveled out in any direction is represented by the variable “s”. The distance “s” to reach any particular point in space will be the vector summation of the x, y and z coordinates for that point such that:

$$s^2 = x^2 + y^2 + z^2.$$

We know that the light pulse propagates out in any particular direction at the velocity “c” or $3*10^8$ meters/second so:

$$c = s/t \text{ therefore } ct = s.$$

Substituting above:

$$c^2t^2 = x^2 + y^2 + z^2$$

$$t^2 = (x^2 + y^2 + z^2)/ c^2$$

$$t^2 = (x^2/c^2) + (y^2/c^2) + (z^2/c^2)$$

The term: $(x^2/c^2)$

is really: ($x^2$ meters$^2$)/($c^2$ meters$^2$/seconds$^2$).

This reduces to: ($x^2/c^2$ seconds$^2$).

This represents the square of how far the light pulse travels through time in the x direction. In the same manner, the light pulse also travels through time in the y and z directions. If we use $t_x$, $t_y$ and $t_z$ to represent these intervals of time then:

$$(x^2/c^2) = t_x^2$$

$$(y^2/c^2) = t_y^2$$

$$(z^2/c^2) = t_z^2$$

therefore

$$t^2 = t_x^2 + t_y^2 + t_z^2.$$

We can see from this equation that the interval of time required for light to propagate to any particular point in space can be expressed in terms of the amount of time required to travel in the x direction, y direction and z direction. This does not prove that time is 3 dimensional, however it makes it clear that the time "t" can be broken down into 3 dimensional components.

## *The Velocity of Light vs. the Speed of Light*

For the purpose of understanding the nature of time it will be necessary to discuss the velocity of light rather than the speed of light. The purpose of this section is to clarify the difference between the speed of light and the velocity of light. While discussing the speed of light, the constant "c" is normally used for the speed of light in a vacuum. This is often rounded up to $c = 3*10^8$ meters/second. There is no directional information included since "speed" represents only the magnitude portion of a velocity vector.

Einstein introduces his special theory of relativity in his paper "*On the Electrodynamics of Moving Bodies*"[45]. In this paper Einstein says that the <u>velocity</u> of light is the same for all inertial frames of reference. Since then, most people including Einstein himself, have more often referred to the <u>speed</u> of light being constant. However, to be more

[45] Principle of Relativity", Albert Einstein, Dover Pubns; (June 1924), section title: "On the Electrodynamics of Moving Bodies", or online at: http://www.fourmilab.ch/etexts/einstein/specrel/www

accurate, it may indeed be correct to say the velocity of light is the same for all inertial frames of reference. The following is an example of the implications of using "c" to represent the velocity of light.

If we let: $c = x/t_x$

then if we set $x = 3*10^8$ meters

it follows that $t_x = 1$ second.

Now if we set $x = -3*10^8$ meters

it follows that $t_x = -1$ second.

The implication is that if light propagates in a negative "x" direction in space then it also must propagate in a negative "$t_x$" direction in time. Similarly, if light propagates in a negative "y" or "z" direction it also propagates in a negative "$t_y$" or "$t_z$" direction. Normally when discussing the velocity of light or the velocity of most anything, we assume the direction of motion in time is positive and set it this way in our math. This is because it is our perception that we are always moving forward in time.

It is the author's contention that it is an illusion that we are always moving forward in time. If we ignore this illusion and study the mathematics that follows, we will see that the mathematics can accurately describe the physics of the physical universe. Therefore, the following discussions are based on the assumption that the velocity of light is constant for all inertial frames of reference. Accordingly, we can say:

There is no preferred direction of motion in time.

We know that time(t) can be expressed as:

$$t^2 = t_x^2 + t_y^2 + t_z^2.$$

Also, a distance in space (s) can be expressed as:

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

Therefore, we can express the propagation of light in any direction in both time and space as:

$$c^2 = s^2/t^2 = (x^2 + y^2 + z^2) / (t_x^2 + t_y^2 + t_z^2)$$

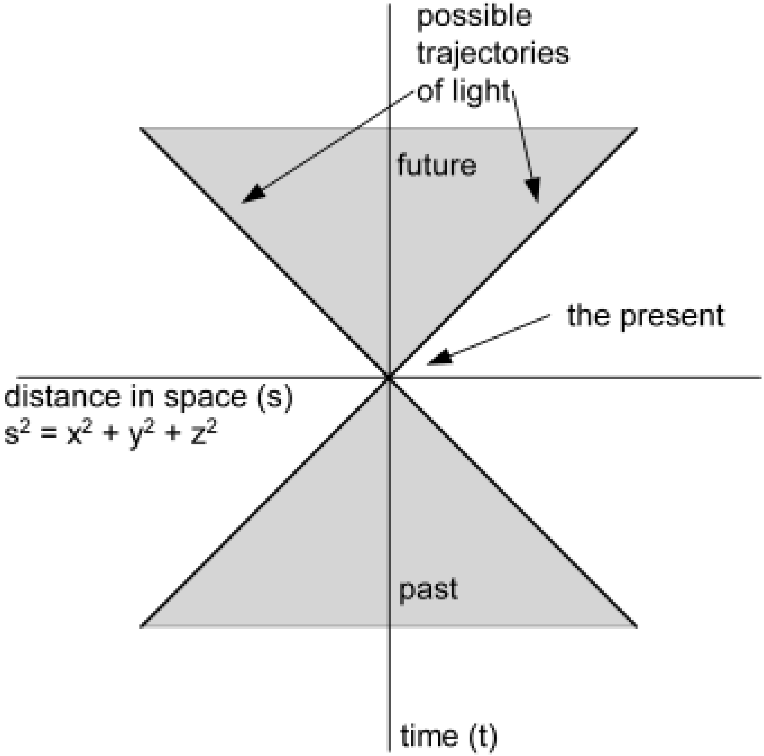


DIAGRAM 28-2
Light Cone

*Minkowski Space-time versus 3D Space - 3D Time*

In Minkowski space-time, time is considered to be a 4th dimension that is mathematically thought of as being at rights angles to the 3 dimensions of space. In order to describe light moving through space and time, time is scaled by a factor of "c" and light moves at a 45 degree angle between the ct direction and the s direction where,

$$s = (x^2 + y^2 + z^2)^{1/2}.$$

The light cone is used to show the area in which objects can move without exceeding the speed of light. The motion of objects is assumed to be from the past into the future for matter and from the future into the past for antimatter. For more information on the current thinking about time and light cones please go to:

http://www.uwinnipeg.ca/~vincent/Cosmology/time.htm

When describing the speed of light using Minkowski space-time mathematics, we make the unwritten assumption that when we write;

$c = s/t$ , we really mean, $c = |s|/|t|$.

This is because division of a vector by another vector is not defined unless both vectors are in the same direction and if time is a 4th dimension, a magnitude of motion in time's direction must be a vector just as is motion in the x, y or z direction of space. We must therefore use only the magnitudes of the vectors.

In 3D Space-3D Time, time is 3 dimensional. Therefore, when light moves in the s direction in space it also moves through time in the same direction. There is no need to make the unwritten assumption used with Minkowski space-time that only the magnitudes are to be used. This means that $c = s/t$ is a correct statement and;

$$c = s/t = ((x^2 + y^2 + z^2)/(t_x^2 + t_y^2 + t_z^2))^{1/2} .$$

When a particle spins in space it also spins in time. When light travels through 3D space it is also travels through 3D time. When light reflects back to the same place in space it also reflects back to the same place in time. No time has passed for the light yet the object that is the light source has been spinning in time all the while. The passage of time is experienced for the light source since the particles that it is made of are all spinning in time and space. It is while spinning in time that all things experience continuous change and experience the passage of time. Rather than time being a 4th dimension considered at right angles to the other 3 dimensions, it is 3 dimensional just as space is.

## *Relative Motion between Objects in 3D Space - 3D Time*

In Diagram 28-3, two objects are used to demonstrate the relative motion in both time and space between them. The mathematics that follows is based on the two postulates of Einstein's theory of special relativity:

1. The laws of physics are the same for all inertial frames of reference.

2. The <u>velocity</u> of light is the same for all inertial frames of reference.

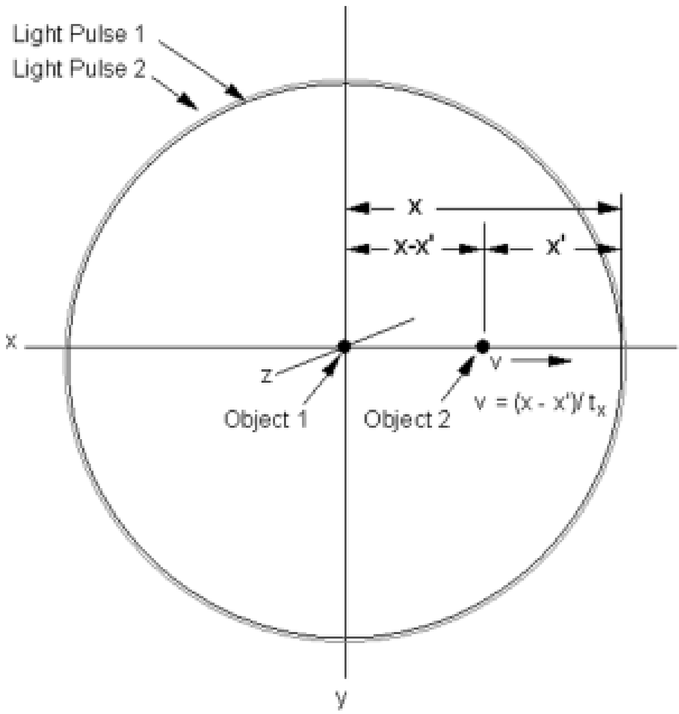


DIAGRAM 28-3
Spherical Propagation of Light Pulses

Object 2 passes object 1 at velocity "v" from object 1's point of view. When they are at the same x position both objects emit a pulse of light and they propagate out with spherical wave fronts. The equations that follow show the passage of time necessary for each object to perceive the velocity of light to be "c". Notice that the velocity of light will be used as opposed to the speed of light.

In Diagram 28-3,

$x = ct_x$ and $x' = ct_x'$

so then

$(x-x') = ct_x - ct_x'$

$(x-x') = c(t_x-t_x')$

so $(x-x')/(t_x-t_x') = c$

or $c = (x-x')/(t_x-t_x')$

If object 2 were to come to a stop, then it would be separated in space from object 1 by the amount (x-x'). It would be separated in time (in the x direction) from object 1 by the amount $(t_x - t_x')$.

If object 2 were to now move in the -x direction, to the left, then for c to remain a positive number, object 2 must move in the $-t_x$ direction relative to object 1. It is important to note that travel through time in the negative direction is allowed and the direction considered negative is relative to the chosen coordinate system orientation.

If there were a clock on object 2 it would always indicate forward movement in time even when object 2 moves in the -x direction. The clock is actually measuring the spin motion in time of the atomic and subatomic particles that make up object 2. Even while at a macroscopic level object 2 moves in the -x direction in time and space, at the microscopic level its particles are spinning continuously +x and then -x. They could also be moving + or - in the y and z directions depending on any particular particle's spin axis orientation. Our minds interpret this + and - motion in time as continuous forward motion in time.

So far we have only considered time as observed along the x-axis as represented by $t_x$. Likewise, an observer in the y direction observing any movement in the +y or -y direction will see a change in object 2's position in the $t_y$ position according to the equation:

$$c = (y-y')/(t_y - t_y')$$

Next consider an observer that is in the +z direction, i.e. coming out of the page, and perpendicular to both objects when they emit their light and still almost perpendicular to both when object 2 has moved the distance (x-x'). If object 2 were to be moving in the +z or -z direction by any amount at the same time that it moves in the +x or -x direction then it would move to a new $t_z$ position according to the equation:

$$c = (z-z')/(t_z - t_z')$$

If we use (s - s') to represent object 2's change in position in space in any direction then:

$$(s-s')^2 = (x-x')^2 + (y-y')^2 + (z-z')^2 .$$

Since

$$(x-x')/(t_x - t_x') = c \text{ and}$$

$$(y-y')/(t_y - t_y') = c \text{ and}$$

$$(z-z')/(t_z - t_z') = c$$

then

$$(x-x') = c *(t_x-t_x')$$

$$(y-y') = c *(t_y-t_y')$$

$$(z-z') = c *(t_z-t_z').$$

Substituting we get

$$(s-s')^2 = (c(t_x-t_x'))^2 + (c(t_y-t_y'))^2 + (c(t_z-t_z'))^2$$

so

$$(s-s')^2 = c^2((t_x-t_x')^2 + (t_y-t_y')^2 + (t_z-t_z')^2)$$

so

$$c^2((t_x-t_x')^2+(t_y-t_y')^2+(t_z-t_z')^2) = (x-x')^2 + (y-y')^2 + (z-z')^2$$

so then

$$c^2 = ((x-x')^2+(y-y')^2+(z-z')^2 )/((t_x-t_x')^2+(t_y-t_y')^2+(t_z-t_z')^2).$$

If an observer is not directly in line with the movement of an object then the vector of the object's movement that is directly toward or away from the observer will determine how much the object is changing its position in time relative to the observer. This is another way of describing the Doppler shift that causes the familiar red shift of light from moving objects.

## *Spin Motion in 3D Time*

Notice in the equation:

$$c^2 = ((x-x')^2+(y-y')^2+(z-z')^2 )/((t_x-t_x')^2+(t_y-t_y')^2+(t_z-t_z')^2),$$

once the time terms are squared the negative direction in time is not apparent since the results only represent a magnitude. A positive direction in time has always been assumed in the past since that is the way our minds interpret reality. It is the spin of particles that give us the sensation of continuous forward movement through time when in fact we spin in circles in 3 dimensional time and space.

The linear movement of an object through space causes linear movement through time as well. It is the spin motion of a particle in space that changes its position in space relative to all other things in space and likewise, it is the spin motion of a particle in time that changes its position in time relative to all other things in time. This is how spin motion in time causes the sensation of continuous movement through time.

The “clock” of an object moving linearly at almost the speed of light will be almost stopped yet time passes for particles spinning at the speed of light. This is because it is this spin that is responsible for the passage of time to begin with. When all of a particle’s spin motion in time is transferred to linear motion in time it is only its spin motion in time that stops while it is still moving linearly to a new position in 3D space and 3D time.

If we consider ourselves as an observer and examine any particular part of any particle of matter that is spinning with its axis perpendicular to us, we find that part of the particle is moving toward and then away from us in its spin motion. To the same extent it is moving toward and away from us in time as well. A graph of that particular part of a particle would be a sinewave for both its motion in space relative so us and likewise for its motion in time relative to us. The two sinewaves would be in phase with one another.

## *Matter, Antimatter and Dark Matter*

The spin of a particle of antimatter can also be described using the concept of both 3 dimensional space and 3 dimensional time. Feynman is noted for saying that antimatter is the same as matter except that it is moving backwards in time. The formula:

$$c^2 = \frac{(x-x')^2 + (y-y')^2 + (z-z')^2}{(t_x-t_x')^2 + (t_y-t_y')^2 + (t_z-t_z')^2}$$

represents how matter moves in time and space relative to other objects with both its vectors in time and in space in the same direction. To represent a vector in time for antimatter its vector in time should be 180 degrees in the opposite direction from the vector in time for normal matter. So the equation for the motion of antimatter is:

$$c^2 = \frac{(x-x')^2 + (y-y')^2 + (z-z')^2}{(-(t_x-t_x'))^2 + (-(t_y-t_y'))^2 + (-(t_z-t_z'))^2}.$$

Note the minus sign for the time vectors that is not present for matter. When solving equations for time dilation, we normally square the time terms. This causes us to lose any evidence that the time term was negative. But if we consider a particular part of a particle of antimatter moving only in the x direction and only observed along the x-axis then the equation reduces to:

$$c^2 = (x-x')^2 / (-(t_x-t_x'))^2$$

so $c = (x-x') / -(t_x-t_x')$

or $-c = (x-x') / (t_x-t_x')$

Matter's motion in both space and time can be explained as having its directional vector in space and directional vector in time both pointing the same direction. Antimatter's motion in space can be explained as having a directional vector that is 180 degrees in the opposite direction from its directional vector in time as just explained.

However, there are many more possible directional vector combinations between time and space. Matter does not have to necessarily exist only as normal matter or antimatter. Dark matter may consist of matter with a direction vector of motion in time that is neither in phase or 180 degrees out phase with its motion in space. Using the equation:

$$c^2 = \frac{(x-x')^2 + (y-y')^2 + (z-z')^2}{(t_x-t_x')^2 + (t_y-t_y')^2 + (t_z-t_z')^2},$$

c is a real number for matter and a real number for antimatter, however if matter's motion in time is neither in phase or 180 degrees out of phase with its motion in space then the result "c" is an imaginary number. The effect may be that this matter (dark matter) will not be visible to normal matter. In other words, photons emitted from normal matter may pass right through dark matter and vice-versa.

It may be possible to shift the phase of matter's motion in time relative to its motion in space. It is possible to use rotating electromagnetic fields to perform this phase shift. If there is any truth to the Philadelphia Experiment, the reported invisibility may have been performed in this manner. Furthermore, if the phase of motion of matter in space compared to its motion in time is shifted far enough then matter's motion in time can start going more in a negative phase direction compared to its motion in space. In other words, the matter would start becoming more like antimatter in its characteristics. This phase shifted matter could then be combined with matter to release photon energy.

## *Density Changes in 3D Space and 3D Time*

In flat space-time: c = 3D space density / 3D time density.

To explain gravity, the ratio of the density of space compared to the density of time no longer equals "c". A gravitational field is caused when the density of time is greater compared to the density of space.

This causes “c” to change value toward the center of the density difference. Light passing through a gravitational field slows down on the side towards the density difference and thus curves toward the center of this density gradient.

When the density of both space and time change in equal proportion then the value of “c” will stay the same. However, both time and space could be either denser or less dense compared to some other region of space. This could be the source of positive or negative charge. Since the change in density is proportional, light is not bent while passing through these density gradients.

## *Conclusion*

The time(t) needed to describe the physical universe is 3 dimensional. The concepts of past and future do not apply to this 3 dimensional time. The motion of an object to a new place in 3D space causes motion to a new place in 3D time and vice versa. We experience change because of all subatomic particles that are spinning in both time and space. The past and future exist only as concepts in our minds that we use to make sense of the experiences we go through while spinning in time. Change occurs in the present due to the spin, thermal agitation, linear motion, etc. of matter. Our brains change in the present to record our experiences while also always in the present.

Even if time travel were possible, there is no past or future to go to as often depicted in science fiction stories. They exist only as concepts in our mind. All the subatomic particles that make up the matter of the universe can be thought of as going into the past and back into the future with each revolution that they make on their axes while spinning at the speed of light.

There is no preferred direction of motion in time just as there is no preferred direction of motion in space.