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Time Dilation

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Abstract- The explanation of Time in Einstein's Special Theory of Relativity[1] is different from the explanation of Time in Classical Mechanics. In Relativity[1], Time is considered as fourth dimension. But, I argue against Einstein's concept of Time as I do not see Time as a separate dimension. In this paper, I would explain Time Dilation and details of when and why it happens.

Index Terms- Spacetime, Special Relativity, Time, Time Dilation

1) Introduction

Albert Einstein said in his Special Theory of Relativity[1] that we live in a 4 dimensional world, which has 3 space dimensions and the fourth dimension is called 'Spacetime'. The theory says motion of a reference frame in space dimension reduces the passage through time dimension which results in time running slow in a moving reference frame.

I do not agree with Einstein's view of time. According to me "Time is just a measure of duration of events and time is measured by the pace at which some activities happen". For example the vibration of Cesium atom is an activity and we measure time using this activity in a Cesium atomic clock.

In this paper, I will explain time dilation and details of when and why time dilation happens.

2) What is Time?

I would describe 'Time' similar to what a layman describes it as. As said above, Time is just a measure of duration of events and time is measured by the pace at which some activities happen. For example, the vibration of Cesium atom is an activity and we measure time using this activity in a Cesium atomic clock. I do not think time is a separate dimension as said in relativity[1].

2.1 What is Time Dilation?

Under some circumstances almost all activities slowdown which results in Time Dilation, because Time is measured by the pace at which the activities happen.

3) When does Time Dilation happen?

The passage of time is affected in the following cases:

1. When the frame of reference is in motion.
2. When a force is acting on the frame of reference.
3. In a denser medium [Time dilation as a result of restriction by an ideal medium].

*3.1 Case 1***:** *When the frame of reference is in motion.*

Time is measured by the pace at which some activities happen, these activities which measure time are related to motion. For example in case of atomic clocks we measure time by vibrations of an atom. Vibration is a motion, and this motion is reduced by the linear motion of entire frame of reference. So the Time in a moving reference frame runs slower than Time in a stationary reference frame.

But, why does this happen? Time Dilation by motion happens when there is a relative motion between fabric of space and the reference frame. This is quite intuitive because the fabric of space restricts/opposes the motion or activity.

Note: This case of Time Dilation by motion does not happen in absolute emptiness, but we do not know whether such a place exists where there is no matter or gravitational field or any other field or any other equivalent of mass.

We also know that light travels at the speed of c, where c equals 299,792,458 m/s. Have you ever wondered why light travels at this speed in vacuum?? That's because the fabric of space itself restricts light from travelling any faster than this. The space also restricts any massive body from travelling at the speed of light, that's why an object with a non-zero mass cannot travel at the speed of light.

By the way, the equations of time dilation will be same as that of Special theory of Relativity[1]. This is because in both cases the equations are derived considering speed of light as the base. However, the reason for time dilation is completely different from what was described by Einstein.

If the fabric of space itself restricts any matter from travelling at the speed of light or any faster, the fastest possible speed should be said as 'Speed of light with respect to the fabric of non-empty space'.

3.2 Case 2: When a force is acting on the frame of reference.

Imagine you are on a spaceship, suppose a force is acting on the spaceship and on everything inside it. Then the clock inside spaceship ticks slower. This happens only if the force is acting on the reference frame and "everything inside it".

This case of Time Dilation is because of the Force acting on the reference frame and everything inside it.

3.2.1 An Example:

Inertial force (sometimes called pseudo force) is one such force that acts on everything. Like gravity, when inertial force acts on an object it acts on every particle in it and it affects the time in that reference frame. So, inertial force acting on a reference frame slows down the clock inside the reference frame. Centrifugal force is also an inertial force and hence it will affect the passage of time.

To test 'Time Dilation by Force' one can tie/attach an atomic clock to a wing of a rotating fan in the absence of gravity.

3.2.2 Special Cases:

3.2.2.1 Opposite Forces:

Time Dilation happens if two forces act on every particle inside the reference frame in opposite directions and even if they cancel out each other resulting in net force of zero. But the factor by which Time slows down may not be always same as compared to the case when the resultant force is non-zero and the time dilation factor will also vary based on the magnitude of the forces.

3.2.2.2 Freely falling reference frame

When the frame of reference is freely falling under gravity the time dilation will happen. However, in this case, Time Dilation will be very infinitesimal & negligible (very hard to measure).

3.3 Case 3: In a denser medium [Time dilation as a result of restriction by an ideal medium]

Don't be fooled by the word 'medium' here. We are not talking about the medium we usually refer to. Let's assume an ideal medium (such as a field itself) which can be present in the minutest of the space, such as the space between the sub atomic particles and spaces that are even smaller. The time in such a medium runs slower than the time where there is no such medium at all (a prefect empty space not having any field or any equivalent of mass). Going ahead when I say 'Medium', I would be referring to such an 'Ideal Medium'.

Here, Time Dilation happens because of the force exerted by an ideal medium against the activity/motion. Denser the medium more will be the Time Dilation. The medium is assumed to be static relative to the clock (or frame of reference).

For the sake of thought experiment the medium is assumed to be static relative to the clock. However, a moving medium may also slow down a static clock (gravitational Time dilation is one such example). In most cases time dilation happens even when the medium is moving relative to the clock.

At this point of time, let's not debate whether any such ideal medium exist. My perception is "Clock in such an ideal medium ticks slowly". And more the 'mass/field' density of such a medium more will be the 'Time Dilation'. [I say Field density because 'Field, according to me, is an equivalent of mass. And a gravitational Field, according to me is an ideal medium. I will talk more about Gravity in my next paper]

Note: Basically, in all above cases Time Dilation happens as a result of 'Force' against the activity used to measure the time.
In none of these above cases of Time Dilation, time goes backwards. Even at speeds faster than light (if it is possible), time does not go backwards. What I mean is 'activities or events will not be reversed/rewinded'.

4) LIMITATIONS

4.1 According to me, time dilation by motion (first case) will not happen in perfect space (nothingness) where there is absolutely NO mass or gravitational field or any other field or any other equivalent of mass. Actually, field has its own mass and Gravity is property of mass and not the space itself (I will be explaining this in one of my next papers). At this point of time, let us not worry about whether such place of nothingness exist or not.

4.2 In second case of time dilation, time slows down when the direction of force is not same as the direction of activity. If the direction of force is same as the direction of activity, the time may not slowdown in all cases. For example, imagine a static spaceship and consider an activity which is 'linear uniform motion of a ball' inside the spaceship. [This activity is unidirectional – ball moving only in one direction, it is NOT 'to-and-fro' motion of the ball]. Now if there is a force on the spaceship (and on everything inside it) in the direction of motion of the ball, then the ball would not always slow down relative to an observer inside spaceship. However, other activities inside the spaceship may slow down.

4.3 Similarly in the first case of time dilation if the direction of unidirectional activity is parallel to the direction of motion, the activity may not slowdown in all cases.

4.4 And in the third case of time dilation, if the medium itself is moving relative to the observer and the direction of a unidirectional activity is parallel to the direction of motion of the medium, then that unidirectional activity may not slowdown in all cases.

5) EXPERIMENT TO TEST 'TIME DILATION BY FORCE' (2ND CASE OF TIME DILATION)

5.1 Apparatus required:

Two synchronized atomic clocks and a rotating fan to which one of the clocks can be attached.

5.2 Procedure:

Attach an atomic clock to the wing of fan (or a centrifuge) and turn-on the fan for considerable period, the fan should rotate with very high RPM (rotations per minute).
During this period, the locus of moving clock (attached to fan's wing) will be a circle and faster the fan rotates more will be the centrifugal force exerted on the reference frame (clock, in this case). The centrifugal force slows down the vibration inside the atomic clock, which is attached to fan. And if this slowing down in vibration is accurately measured, the slowing down of clock and hence slowdown of time can be easily observed.

5.3 Conclusion of the experiment:

Force causes Time Dilation, as said in Case 2 of Time dilation above.

5.4 Notes

5.4.1 It is good to have short wings for the fan as the centrifugal force will be high if the wings are short. Also, if the wings are short, time dilation by motion would be less and time dilation by centrifugal force can be easily noticeable.

5.4.2 The above test must be performed in the absence of gravity or in negligible gravity. It can also be performed in the presence of gravity (on the surface of earth), but for better results the magnitude of centrifugal force acting on the clock should be considerably higher than the gravitational force acting on the clock.

5.4.3 In the above experiment, Time Dilation is because of the Centrifugal Force acting on the reference frame and the force acted by the ideal medium against motion of the clock [Here, I am assuming that Space is not completely empty and it has mass (or equivalent of mass), however its mass density is very less].

5.4.4 Gravitational Time dilation is a result of Time Dilation by Force and not the bending of Space-time. So, one might ask me "if time is not a dimension then how does gravity work?" This will be the question I will attempt to answer in my next paper on Gravity.

5.4.5 The Third case of Time Dilation (Time Dilation by Medium) also contributes to Time dilation in the above experiment though it will be very small and negligible. Also, since this Time Dilation by Medium affects both clocks this effect can be neglected in this experiment.

5.4.6 The difference between Gravitational Time Dilation and Time Dilation in the above experiment is, in Gravitational Time Dilation Gravity acts on the radiation emitted from vibrating atom where as in the above experiment there will not be any centrifugal force on the radiation emitted from vibrating atom.

6) Differences between My View and Einstein's View of Time

6.1 According to Einstein's Special theory of Relativity[1], Time is a separate dimension. But according to me, Time is just a measure of duration of events and it is measured by the pace at which some activities happen.

6.2 According to Einstein, Time Dilation is a result of motion in space dimension or it is a result of curvature of space-time fabric. According to me time dilation is a result of 'force' acting on the reference frame and everything inside it.

6.3 According to me, Time Dilation happens even when the reference frame is freely falling under gravity (as there would be a negligible infinitesimal upward force on a freely falling object under gravity. The factor of time dilation in this case will be very minute/infinitesimal (almost zero/negligible). To understand why this happens one should understand gravity.

6.4 According to Special theory of Relativity[1], Time Dilation happens everywhere if the reference frame is in motion. According to me, as said above, time dilation by motion (first case) may not happen in perfectly empty space (nothingness – where there is absolutely no mass or any type of field or any other equivalent of mass).

6.5 According to Special theory of Relativity[1], Time should run backwards at speeds faster than light. However, Einstein also stated that it is impossible for any object to travel faster than light. According to me, even at speeds faster than light (if such speed can be achieved) time does not go backwards. What I mean is 'activities or events will not be reversed/rewinded' at speeds faster than light.

7) CONCLUSIONS

7.1 Time is just a measure of duration of events and it is measured by the pace at which some activities happen. These activities can be vibrations of an atom and so on.

So, Time Dilation is just slowing down of these activities under some circumstances. With these activities almost all activities slow down giving us an impression that the time itself slows down.

7.2 Time Dilation happens as a result of 'Force'.

7.3 Time dilation happens because the space, as far as we have come across, is not absolutely empty.

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