Time Travel

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Abstract- This research paper explores the concept of time travel and examines its theoretical possibility. It discusses the different models of time travel, including the absolute and relative time travel along with the reality crossover theory. This paper also discusses about the energy of universe via the universal information paradox.

Time travel is one of the many intriguing concepts of physics we all talk about.

What is Time Travel?

Just like we define motion through space, time travel is motion through time where we have taken the origin as the point of time we start traveling either to the past or the future.
Every object in the universe at some velocity either that of its motion with space around it taken as a reference or it be by the speed of expansion of the universe taking the center of the universe as the reference point.
The only time we consider an object not moving through time is when its velocity reaches that of the speed of light (The speed of light we take may account for the speed of expansion thus we can take c = *3 x 10^8 m/s* as the actual speed). This is because, as you can see from the equation of time dilation [2] by Einstein [2]:

$$t = \frac{\Delta t_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

Here, 't' is the time experienced by the object moving through time
't_0' is the Time taken as the frame of reference

If we put the velocity of the object equal to the velocity of light, then in infinite seconds passing through the object, 0 seconds of actual time would have been traveled by it, thus no time would be traveled.

Secondly, when the mass of the object becomes infinite, this is theorized to have happened just before 'The Big Bang', when all of the mass of the universe was concentrated at a single location, and the density was so high that even time could not have existed as illustrated by Stephen Hawking in his book 'Brief Answers to biggest Questions.'

Speed of Time:
We take the speed of time as a ratio between the actual change in time to the relative change in time therefore the dimensions of time are $[M^0L^0T^0]$

Relating of Time:
Time is related to two different frames, firstly space and secondly time itself. Like we can compare motion with two relative frames, firstly a stationary object or an object moving with a velocity comparable to the observer.

The Frame of Reference for Motion Through Time

Frame of reference for relative Time Travel:
Just like we compare our velocities in motion through space using the concept of relative velocities in the same way we can compare our velocity through time by considering an ideal body while traveling through time. An ideal body is said to be one with negligible mass and no such gravitational field of its own and its velocity equal or close to zero w.r.t. to the earth i.e. does not affect the space-time fabric around it. This can be done without breaking the laws of physics only in a positive time direction i.e. to travel to the respective future. This cannot be done to travel to the past as any velocity greater than the speed of light will result in imaginary time thus it is not possible in real life.

Frame of reference for absolute Time Travel:
This is done when we take an object stationary or close to rest w.r.t. time an example of such a reference is a black hole where the density is so much that the time around it is dilated at a very fast rate and hypothetically its center of mass must be a point where the speed of time could be taken as zero.

Types of Time Travel

Absolute Time Travel: as already defined, it is taken when we travel through time w.r.t. to an object stationary on the timeline that is an object whose speed of time is 0. Such an object is theorized to not exist on the space-time graph as its time axis is removed completely due to either its enormous mass or if its velocity is equal to that of light.
The presence of such an object is currently theoretical but a Black Hole can be believed to possess no velocity through time because its density and gravitational pull are very strong.
It is thus assumed that at the center of mass of a black hole, space-time doesn't exist.
It can be speculated that during this period, the time axis of such an object couldn't exist thus it has only a position in space.
For the time period that it has such mass or velocity, its existence at the start of the period and the end should be the same, i.e. if an object is at one point of time, then it would be existing at another simultaneously.
Thus it can be said that one can travel beyond time by existing at one location in space-time and exist at another location in the same space but at a different period.
Examples of this can be seen in many different movies, although the exact representation isn't there, but the sentiment is delivered.[2]

$$t = \frac{\Delta t_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

From this equation, we can deduct the ratio of time experienced and time passed as

$$\frac{t}{t_0} = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

Also from the mass dilation equation given by Einstein we have, [3]

$$\frac{m}{m_0} = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

Clearly then we can deduce that,

$$t = \frac{m \cdot t_0}{m_0}$$

In this equation if we put, 'm=∞', then we can also deduct 't' as infinite,

⇒ That if the relative mass experienced is infinite (Relatively taken of a black hole), then the relative time experience would be infinite for every actual second passed, thus at an infinite mass time doesn't exist.

This clearly indicates the deficiency of time scale at that point in space.
It indicates as before that existing at such point of space during that time will put us in a Schrodinger cat experiment equivalent, i.e. our existence will be at two points at a time simultaneously.
Physically, if we can achieve this, we could time travel between the time of the creation of the black hole and its time of dissolution.
This is one of the only ways where we can time travel to the past without going to an imaginary scale, but a downside is that we would not be able to travel to a time of choice, rather we would be able to travel only two periods of time. It could also be imagined as a hallway with only two ends, one of the time of the creation of the black hole, and one of its destruction, but traveling to a point of time in between is not possible.
We could do so by destroying the walls of the hallway, but due to insignificant information, any answer to the question would be just simple speculation.
This type of time travel is called Absolute because of a simple reason that motion is only between two points and motion anywhere between is not possible, thus relating this type of motion to any two points in time is irrelevant.

Relative Time Travel: as already stated before this time travel is defined for instances when we are traveling w.r.t the ideal body placed at the time of comparison from where we start defining the travel through time.

This time of time travel is possible without breaking the limits of the real world only to the future because as already explained everybody is already traveling through time w.r.t. a body not experiencing an expansion of the universe because the expansion itself provides a velocity going away from the center of the mass of the universe and when you place this velocity into the time dilation equation by Einstein we can see that we are already traveling faster w.r.t. to a body not experiencing expansion.

This type of travel is not possible for travel to the past as to do so we have to cross the planes of reality as is explained down below.

Time Travel to the Past

Time travel can be theorized to be done only when you have a velocity greater than that of the speed of light but the problem with such type of travel is that when you increase your velocity greater than that of light then the denominator in the time dilation equation becomes imaginary. [2]

$$\frac{t}{t_0} = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

In here if we put $v > c$ then the ratio of v and c becomes greater than one resulting in an even greater value that will lead time to an imaginary axis.

Traversing of time to imaginary axis

Reality Crossover theory:

As was studied above we could conclude that at the point of space-time when the velocity of a body becomes equal to that of speed of light then the mass of the body becomes infinite and relative time of the body stops existing.

Such a body cannot exist in time but only in space thus we can conclude that space-time graph at that point is broken through and a hole in the space-time continuum is created.

Now if we increase our velocity even further then the body should be able to travel in space but not in time this is so because if anything like this happens the body will escape the universe into the void between universes.

The energy that helps in the travel between the universes is found from the imaginary part of the general time dilation equation whenever such type of travel is done the total energy of the body(including the imaginary part) the imaginary part of the total energy will decrease.

This concludes that the imaginary part of the energy is responsible for this other worldly travel.

If we calculate the amount of energy(considering only kinetic and mass energy as no other form of energy is inherently there in the system) that a body of mass 1Kg holds at the speed of light after neglecting the effects of General Relativity, the amount equals to $1.35 \times 10^{17} J$.

This means that an ∞ amount of energy is added to the system just because of the effects of Relativity, which also could be defined as effect of gravity as the only value an object holds in space is its gravitational potential.

There an infinite amount of energy is used to break the space time curvature if an object reaches the speed of light.

Now, if we are able to acquire imaginary energy as discussed below in the Universal Information Paradox, then we won't need this energy as only imaginary energy is needed to cross the borders of space time as real energy can't be used to do so.

The Universal Information Paradox

'The Big Bang' was a massive event due to which distance between particles was created which today is called space. The creation of this distance was one of the major factor that we are able to move from one place to another. This increase in space between two particles is which we call expansion of the universe as stated by many theories, due to this expansion particles are moving away from each other and they must have some velocity due to which they are able to do so. It can be speculated that if we take the multiverse model of the universe then 'The Big Bang' and the expansion of the now called multiverse does not follow the rules set apart by a single theory and therefore particles between realities can travel at imaginary levels.

From this we can speculate that after the big bang, infinite other universes were created and some information must have leaked from these universes. Now if we take 'the time bounce back theory' into consideration then after sometime this information leaked must have traced its path back to the original but if 'the reality crossover theory' is taken as the fundamental theory then this information leaked could never be reinstated in our own universe.

Now it is also possible that information from some other universes could have leaked into our own and it might not follow the same rules as ours does and in return can be used to time travel, also from these hypotheses we can say that the Total Energy of the Universe is not 0 as stated by Hawking as some amount of energy must have leaked out and got into ours and any relation between them could not be stated.

REFERENCES

[1] 'Brief Answers to the Biggest Questions' by Stephen Hawking.

[2] Galli, J. Ronald; Amiri, Farhang (Apr 2012). "The Square Light Clock and Special Relativity"

[3] L. B. Okun(1989), "The Concept of Mass"

[4]https://space.mit.edu/home/tegmark/multiverse.pdf