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Time "and" Dimension(s) - Visualizing the 4th and 4+ Dimensions

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ABSTRACT As we know so far, there are 3 dimensions that we are capable of interpreting and perceiving, and there is a 4th dimension, called time, about which we don't know much yet.
We, as humans, live in the 4th dimension, not the 3rd. We travel 3 dimensionally but cannot yet travel 4 dimensionally; perhaps if we could, then visiting the past and the future would be like climbing a mountain or going down a road. So far, we humans are not even capable of imagining any higher dimensions than the three dimensions in which we can travel. We are the beings of the 4th dimension; we are the beings of time; that is why we can travel 3 dimensionally; however, if, say, there were beings of the 5th dimension, then they would easily be able to travel 4 dimensionally, i.e., they could travel in the 4th dimension as well. Beings of the 5th dimension can easily time travel. However, beings of the 4th dimension, like us, cannot time travel because we live in a 4-D world, traveling 3 dimensionally. That means to ever do time travel, we just need to go to a higher dimension and not only perceive it but also be able to travel in it. However, traveling to the past is not very possible, unlike traveling to the future. Even if traveling to the past were possible, it would be very unlikely that an event in the past would be changed. In this paper, some approaches are provided to define time, our movement in time to the future, some aspects of time travel using dimensions, and how we can perceive a higher dimension.

KEYWORDS *Time, Dimension, String Theory, Time Travel, Time Dilation, Relativity*

I. INTRODUCTION

Let's say Albert wants to meet a friend of him, and he asks him to meet him. So, for that, Albert needs to mention two things to him: "When" and "Where". "Where" are the 3 dimensions, the 3 spatial coordinates, and "When" is the 4th dimension, time. Albert cannot mention only one of these two: when or where. He has to mention both things to meet his friend at the same time and the same place or location.[1]
A similar concept is used to deflect an asteroid that would be heading toward Earth. We can either speed up the asteroid so that it reaches the point of collision before the Earth does, or we can slow down the asteroid so that the Earth reaches the point of collision before the asteroid does. The Earth and the asteroid would both be in the same place but not at the same time and hence the asteroid would get deflected. So, for an event to happen, we need both "where" and "when.
That means, we can say that:

"You would not give a time without a place, nor would you give a place without the time".

We, humans, are yet able to only travel three dimensions; we know there is a fourth dimension, time, but we don't yet know how to travel four dimensions, i.e., travel in time or time travel. When we say we can move three-dimensionally, we mean we can move in any three directions: either forward or backward, right or left, and upwards or downwards. However, we are also moving in the 4th dimension; we are also moving in time, as we are constantly traveling to the future as days and years pass. We can move anywhere in the 3 dimensions, but we cannot move wherever we want in the 4th dimension. We only move forward; we only move to the future, not physically, of course. We can say that we are prisoners in the 4th dimension, trapped in the present, and yet we are free to move anywhere we want in the 3rd dimension.

We can access any point in the 3rd dimension; however, in the 4th dimension, it is not possible; we can't access the past or the future. When we move three-dimensionally, we move, but the dimensions themselves stay stationary. Moving 3 dimensionally is like a road on which you are moving, but the road itself stays stationary. However, in the 4th dimension, the dimension moves, and we stay stationary. And this is like an accelerator or a treadmill that moves, and we move with the accelerator or the treadmill in the forward direction, similar to the future in time.

II. METHODS AND APPROACH

APPROACH 1st: Time as an accelerator

We all know that time always flows in a certain direction, toward the future. Now let's visualize this concept with the help of an example: Imagine there is an accelerator going in the forward direction. And some marks represent every moment of the accelerator on a stationary platform (i.e., marks are stationary and are not moving with the accelerator). Now that you are traveling on that accelerator, notice that you are not moving on the accelerator; it's the accelerator itself that is moving, and hence you also travel in the forward direction with the accelerator.

So, if you need to travel either forward or backward to a particular point on that accelerator, either you go with the accelerator in the forward direction, or you have the following two choices:

CHOICE 1: You choose to jump

First things first, you must be very quick and fast, and there is no guarantee that you will land "safely" after jumping on the accelerator.

Let's say you first chose to jump (vertically) into the same position on the accelerator. This would make no difference at all. Because you are moving "with respect to a stationary object", you have the accelerator's velocity.

So even if you try to jump (not a projectile jump), you will always end up in the same position (where you were before) on the accelerator.

So, by just jumping vertically, you can't travel to another point on the accelerator; it is the same as jumping in a moving bus, which would make you land in the same position where you were before.

Now let's say you chose to jump horizontally and let's say you did (ignoring the fact that it may or may not be safe).

By jumping horizontally, you can go to a certain point on that accelerator. But you must know that the accelerator is always moving, even when you are jumping and even after reaching your destination. So, after reaching that point, you would still travel in the forward direction with the accelerator. This means if you choose, say, to travel to a point in the backward direction, you would reach the same point where you first began by traveling in the forward direction (from the backward direction) with the accelerator. And similarly, if you chose to travel to a point in the forward direction, you would travel on. The same way you were doing it before. So, in this case, it is not feasible to travel.

Let's go for another choice.

CHOICE 2: You choose to STOP the accelerator

Now imagine that you have a remote with which you have control over the whole accelerator. That means you can now completely stop the movement of that accelerator, and after that, you can move wherever you want on that accelerator. Now you just need to go to a certain point; there is no need to jump anymore; just walk. And here you have it. You can now travel to whichever point you want, and after reaching your destination, you can start the accelerator again. Now, let us understand the 4th dimension: Time.

TIME – The 4th Dimension

Let's learn some basic concepts about time.

Time is the fourth dimension. We are all currently living in the 4th dimension, i.e., time, and we can travel 3 dimensions as follows:

1st Front and Back
2nd Right and Left
3rd Up and Down

And moving to the future (only) in time, being the 4th direction to travel. It should be noticed that while living in the $(3+1)^{th}$ dimension or the 4th dimension, we can travel or move in two ways: in the 3rd dimension and in time as well. We are constantly looking to the future.

However, while moving in 3-dimensionally, we have to move physically, whereas, in the 4th dimension, we do not need to move physically at all; it's the 4th dimension, time, that is moving.
So, we, as well move in time. Moving in time is the same as standing on a moving treadmill or an accelerator, where "we" stay stationary and it's the treadmill or the accelerator that moves, and we move with it. Now let us understand how the movement would be in each dimension that we have discovered so far.

DIMENSION TRAVEL

0-Dimensional Travel
– Living in the 1st Dimension

In this dimension, only a point can exist. The point would have no directions to travel. The point would be trapped with no directions to travel at all. It would be impossible for a human to even exist in this Dimension.
However, a point traveling 0 dimensionally would be living in the *1st Dimension.*

1-Dimensional Travel
– Living in the 2nd Dimension

In this dimension, all sets of straight lines would exist.
Let's say a hypothetical being exists in the 1st dimension, this being would have only one direction to move i.e., Forward-Backwards. These 1-D figures would be living in the *2nd Dimension*. And this being would be capable of perceiving any 1-D figure.

2-Dimensional Travel
– Living in the 3rd Dimension

All sets of 2-D figures would exist in this dimension, a square, circle, rectangle, triangle, etc. A hypothetical being now would have two directions to travel, and the being is now capable of perceiving a 2-D figure. This being can travel one-dimensionally, as in the 1st Dimension, plus it would also be capable of traveling right and left. All of the 2-D figures would be living in the *3rd Dimension*.

3-Dimensional Travel
– Living in the 4th Dimension

All sets of 3-D figures that we know, would exist in this dimension, a cube, cuboid, sphere, etc.
A being would now be capable of moving in all three directions that we know.
All humans travel 3 dimensionally, Forward-Backwards, Right-Left, and Upwards-Downwards. All of the 3-D figures, including us, live in the *4th Dimension*.

4-Dimensional Travel
– Living in the 5th Dimension (Hypothetical)

All sets of 4-D figures, a Tesseract would be existing in this dimension. A being would now be capable of traveling 4 dimensionally, in time. The being would be able to move anywhere in time. And similarly, any 4-D figure would be living in the 5th Dimension.

So, if a being can travel n dimensionally, then it would be living in the $(n+1)^{th}$ dimension.
If a hypothetical being is not able to travel in any direction, i.e., it can travel 0 dimensionally, then it would be living in $(0+1)^{th}$ dimension, the 1st dimension. We humans are traveling 3 dimensionally, and are living in the 4th Dimension, and the 4th Dimension is always in motion, Time is always in motion, i.e., we are moving to the future (as we discussed earlier).
So, we can say that:
"An object traveling n-dimensionally would be living in the $(n+1)^{th}$ dimension, where this $(n+1)^{th}$ dimension is always in motion."
Now let's apply those same choices, that we discussed earlier, in the case of Time to Time Travel. Imagine time is like that accelerator moving in the forward direction. And you are on that accelerator, on the Time & you are moving continuously in the forward direction, to the future with the Time. To Time Travel to a certain point in time, you would have the same two choices as we discussed earlier:

CHOICE 1: You choose to jump

First, let's ignore the fact that you cannot jump on a moving time but say you can.

Time also keeps moving so does the point of selection (where you want to travel), as we have discussed in the case of the accelerator. So, it would not be possible for you to land exactly at the point where you want to travel, you would always end up reaching slightly ahead or behind the point of selection.
For instance, if you want to travel to a point say, the year 2030 in the future, you would land somewhat ahead or behind 2030, Not at exactly 2030. The same goes for the Past.
However, in this choice, we can't be sure whether we would be able to jump & if we did then whether we would be able to land safely where we want to travel. Notice, the time would keep moving even when we would be jumping. We have another choice, which would probably be a better approach.

CHOICE 2: You choose to STOP the Time
Now imagine (yes again imagine), you have a remote by which you can stop the whole time, except for yours, that means, only you can move. Now with that remote, you stop the time and choose a point to travel on the TimeLine. Once you stopped time, you would be in a higher dimension, from where you would be able to see the whole of your TimeLine at once. You would be able to see your past and your future at once.

Now let us visualize how this would look: While traveling 3 dimensionally if someone asked where is that pole, we can simply point there however if someone would ask when you were born, you cannot point it anywhere, as it is a time coordinate not a spatial coordinate. However, while traveling 4 dimensionally, if someone asked when you were born, you can simply point there at your timeline, since, you would be the being of the 5^{th} Dimension (as we have discussed).
In the 5^{th} Dimension, "when becomes where".
Now you stopped time, and after stopping the time you would move "3 dimensionally" to a certain point on the 4^{th} Dimension i.e., Time. Now after reaching the desired point, you can start the Time again with your remote.
And GREAT SCOTT!! You Time Travelled.

Things to notice here: There would be "You's" existing at each point in Time. This means there would be "Past-You" and the "Future-You" existing at each point in the TimeLine of yours, and it would be possible for you to see them at once. However, you cannot interact with any of your versions in time, as for that you need to cross dimensions.
Now let's apply this concept of stopping Time, to some most famous paradoxes of Time Travel & see if we can resolve or provide some explanations for the paradoxes.

RESOLVING MOST OF THE FAMOUS TIME TRAVEL PARADOXES

The Grandfather Paradox
The most common paradox in this field. What if a Time Traveler killed his/her grandfather in the past before the marriage of his/her grandfather? The Time Traveler should not exist but still do but he/she shouldn't, meaning, the time traveler has prevented his/her own birth by traveling to the past. That's the Paradox.
Now let's say the Time Traveler has a remote by which he/she can stop Time, the 4^{th} Dimension, this means that everyone on that TimeLine is now stopped except for the Time Traveler. Now when the Time Traveler stopped the time (the 4^{th} Dimension is now stopped), he/she will no longer be in the 4^{th} Dimension, perhaps he/she would be in a higher dimension, the 5^{th} Dimension. And as we have discussed, in front of the Time Traveler, there would lie his/her whole TimeLine, now he would be able to re-live any moment. And here is the catch, the Time Traveler wouldn't be able to go to his/her grandfather's time. The time traveler would only be able to see his/her own TimeLine, from the moment he/she is born in the past, and the moment he/she would be dying, in the future. Nothing before born and after death. And that is how we would able to resolve not only The Grandfather Paradox but also many other similar paradoxes.

The Fermi Paradox
It states that, if time travel would be possible someday in the future, then where are the Time Traveler? The simple explanation can go this way:

There, so far, no one has been born who could be able to do Time Travel in his/her coming future. Moreover, even if there would be one, then he/she may not be able to travel right into the past, if he/she does that, then he/she would be re-living his/her past self version.

Bootstrap Paradox

What if, a time traveler handled all of Einstein's work to a younger version of Albert Einstein by time traveling to the past, then who would be the original owner of the whole of Einstein's work?
Let's say, Siddharth has written a paper entitled "The True Side of TIME TRAVEL". Now what if Siddharth handled all of his work to his younger version by visiting my past, then who would be the actual owner of the paper? That is the paradox. It should be noticed that, once he visits the past, he has to re-live his past life, so it would not be possible for him to even interact with anyone in the past. The past wouldn't be changed here.
Time would remain Constrained.

Things to notice: If, somehow, Siddharth is in the 5^{th} Dimension, that means he would be able to travel 4 dimensionally, which means that he can travel to every moment/instant in his life.
Now, to re-live any of those moments he has to come to the 4^{th} Dimension, his previous dimension. However, it would not be possible for him to re-live in the 4^{th} Dimension while being in the 5^{th} Dimension. It is the same as we cannot be in the 3^{rd} Dimension, where we would travel 2 dimensionally while being in the 4^{th} Dimension, where we travel 3 dimensionally.

APPROACH 2nd: Time as Dots

In this approach, we would consider Time as Dots. This means each & every moment is existing somewhere as dots. And dots are nothing but freeze points in Time. And it's "us" who gives meaning to these dots and connects them to create a TimeLine made of Dots. Furthermore, this also means that every dot is already existing somewhere in the Universe. That means, our Past, our Present & even our Future are already existing simultaneously in the form of Dots.
And Time Travelling would be like visiting those dots. But the problem is we don't or maybe we can't know "where" these dots are.
Let's say, we know where these dots are & we travel to these dots somehow, and even if we change any dot there would be more duplicate dots (exactly the same) replacing that dot.
That means, a TimeLine is made of dots, and each dot has infinite numbers of dots containing every possible outcome of each event on the TimeLine that can exist, and even if any dot is changed, it would then be replaced by another dot containing the actual event that has happened.
Like in the case of the grandfather paradox, even if the time traveler killed his/her grandfather traveling to the past, the dot gets changed (killing of grandfather) and will be replaced by another dot which will contain the "actual" moment that happened i.e., the existence of the grandfather. Hence the grandfather will still exist even if he is killed. That means, for every moment there will be several dots existing simultaneously. And each time any dot is altered or changed; it'll quickly get replaced by another dot containing the actual event that has happened. That means, all the dots in the TimeLine are Constrained.

APPROACH 3rd: Time is constrained

In this approach, we will be discussing an uncommon side of Time Travel. What if Time is constrained? It is impossible to alter or change any event that has already ever happened, or in layman's terms,
IT IS IMPOSSIBLE TO CHANGE THE PAST.
We believe so far, that Time flows in a "Linear" Direction (Has a linear flow, like a river), which means first comes the Past then the Present, and then the Future and it flows throughout the TimeLine and is infinite. However, this can also be interpreted in the way, The Future leads to the Past which then leads to the Future, forming a sort of loop. Like, even if you Time Travel to the past, you would be bounded & you cannot do certain things that would change the past and lead to a different future. You can't even come face to face with yourself in the past as this has never happened to you in your actual past.

However, even if you did try changing the past, things will happen in such a manner that it'll lead to the Future, and having NO CHANGE at all.[3]
Let's look at an example:
Let's say you fell from the stair, while you were reading something. You bought a Time Machine, and you used that Machine to travel to the Past to prevent the fall of Yourself into the Past, but you are not able to interact with your Past self, so you made a note warning your past self:
"Be careful, you are going to fall on the stairs."
And you somehow passed this note to your Past Self. And later it turns out that because your past self was reading the note that is given by "you", He Fell down the stairs, i.e., You Fell in the Past. And hence Nothing changed. "You" actually became the reason for your past self falling down the stairs. And hence we can say that even if Time Travel would be possible in the Future, & Future Tourist would be visiting us today yet, we haven't encountered any of them so far, but still, they influence us somehow in such a manner that whatever they do with us if they are, is actually meant to happen & Hence NO CHANGE would be there at all.[3]
That means if a time traveler, time traveled to the past he/she would be bounded and can only do certain things which would eventually be leading to the future and hence creating the same future from which the Time Travel has come here.
TIME IS CONSTRAINED AND WILL REMAIN CONSTRAINED.

APPROACH 4th: The Reverse Time (Harmonic Time)

In this approach, we will be discussing something different about Time Travelling to the Past. Here we would consider, Time, ticking "backward" when a Time Traveler travels to the Past.
Let's understand this with an example.
Consider, a girl, Time Travelled 2 Years into the past, from the Year 2022 to the Year 2020, in the year 2022 she is 22 years old, which means, she would be 20 years old in the year 2020.
Now, she somehow Time Travelled to the Past, into the Year 2020 from the Year 2022. There, in the Year 2020, she met her Past self, aged 20.
In this approach, we would be considering that she can interact with her past self. Now here comes the Main aspect.

"Her" from the Year 2020 (aged 20)
For her Time, would be moving forward as usual (No Change at all), and after two years she would turn 22 (from 20) and would be in the Year 2022 (from the year 2020)

"Her" from the Year 2022 (aged 22) – The Time Traveler (in the year 2020)
Her Time would tick in the reverse direction, which means, she would turn "younger" with time, instead of turning older, and after two years "she" would be "20 years" older (22-2=20) i.e., she has become younger.

That means as Time passed, "her" from the past gained 2 years; on the other hand, "her" from the future, the Time Traveler, lost 2 years with time. Now, this all means, in a nutshell, that, she time-traveled from the year 2022 at the age of 22, to the year 2020 to meet her past self at age 20. In the year 2020, there would be two "her's" one from the future (2022) and one from the same year (2020), but they wouldn't age the same.
The one who Time Traveled here would age in the reverse direction, i.e., "for her" Time would tick in the reverse direction and the one who belongs to the same year would age normally. And after two years, she (the time traveler) would be aged 20 (22-2=20) and will be existing in the year 2020, and the other She (belonging to the same year) would be aged 22 (20+2=22) and will be existing in the year 2022.
And eventually, she (from the future - 2022) would become the Past she (2020).
And the She (from the Past - 2020) would become the Future she (2022).
And No Paradox would be there.

THE LAST APPROACH: A Unified Approach

In this Final approach, we would try to present a unified approach by combining all of the previous approaches. We can think of each in every moment in Time as "Constrained Dots" where Time is the Higher Dimension.

That means, Time is the $(n+1)^{th}$ Dimension, where n is the dimension in which we are traveling. And traveling through Time would be like traveling through Dimensions.

To travel in time, i.e., to travel 4 dimensionally, we need to be in the 5^{th} Dimension. However, re-living any past moment or future moment would not be possible, as for that we need to cross dimensions.

And according to the String Theory

- *"Anything that can cross Dimension, including time, is Gravity"*. Even if somehow, we try to alter any event in the past, We simply can't. Because Time is Constrained and will remain Constrained. Moreover, the only thing that can interact with an event in the Past, would be Gravity. As only Gravity can cross Dimensions.

That means, even if a human is someday, somehow able to reach a higher dimension, it would not be possible for him/her to cross dimensions, the human will stay in the same dimension once it reaches one, only Gravity could interact with any event in any dimension and even then, nothing would be changed, time would remain constrained. It'll just lead to the Future. Nothing would be Changed. Furthermore, it should be noted that it would be possible to go a Higher Dimension, however going a lower dimension would not be possible for us.

III. DISCUSSION AND RESULTS

An Alternate Approach:

Let us define Time,

"Ability to move in space is defined as Time".

We all are moving into the future. How can we say that? We all are growing, and days are passing by, years are passing by. But all of that cannot be defined as Time. Days and years are passing by because Earth is rotating on its axis and revolving around the sun simultaneously. And Sun itself is revolving around the Milky Way Galaxy with the whole Solar System. Time is passing for us because Earth is moving in Space. And the Growing process is a biological process that happens. Everything is in motion and is moving in space and that is the reason, why time ticks for everything.

Now, Let's combine all of the information discussed above and seek a Unified Approach.

A FINAL UNIFIED TIME DEFINITION

Time is the 4^{th} Dimension, and stopping time somehow would allow us to cross Dimension or Travel to a Higher Dimension.

According to the String Theory, in the Universe, there could be up to 10 Dimensions.

And once reaching the 5^{th} Dimension, we would be the Masters of all the previous Dimension, which means, at that point, it would be possible for us to travel "4 dimensionally" i.e., Travel through Time, which would probably be like traveling on a Road. Going backward, to travel to the Past, or Going forward, to travel to the Future. When we would be in the 5^{th} Dimension, we can see our whole TimeLine at once, right in front of us. Each individual would possibly be having a different timeline, which would contain each and every moment of an individual from his/her birth till his/her death.

However, traveling in Time doesn't mean that we would be able to change the Past.

Time will remain "Constrained", No matter in what Dimension we would be living. We humans wouldn't be able to cross dimensions, only Gravity can do that. And when traveling 4 dimensionally, each moment in time would be represented as "Dots" which are constrained. And the only quantity that can travel through Dimension, including Time, would be Gravity.

In the 5^{th} Dimension, each moment in Time would be represented as "Constrained Dots". These dots would be showing each & every moment (Past & Future) right in front of you. It would be like a Number Line, the more you zoom in, the more you would find moments, As the more we zoom in, on a number line, the more numbers we would find.

And for the people traveling in the 3rd Dimension, a traveler would disappear from a certain location and reappear in another location instantly like teleportation. However, for the traveler him/herself, it would not be "instant", as he/she would be traveling through a higher Dimension, which other beings cannot perceive. For him/her it would be like traveling "Physically" from one location to another.

And, as discussed, it would be possible for a traveler to go a higher dimension, however, going a lower dimension would not be possible for a being in order to re-live any moment.
And in general, we talk about traveling near the speed of light, which would make our Time tick slowly relative to a stationary observer.
This Time Travel would only lead us to the Future and is real & measured. As we know this phenomenon works on the very fundamental formula of Physics: Speed = Distance/Time;
"The faster you move in space,
The slower you would move in Time".
This is the most feasible Time Travel, that humans can achieve now. As traveling faster is something that at least "can be achieved". But Time Traveling through Dimensions is not that feasible, as traveling through Dimension is not possible for us yet. And as we have discussed, according to the String Theory, Gravity can travel across dimensions, including Time. But what this means?

STRING THEORY

Although they are highly incompatible, quantum physics and Einstein's general theory of relativity perform exceptionally well in their respective fields. According to string theory, a particle called a "graviton" is thought to be a quantum mechanical particle that mediates the gravitational force. As a result, string theory is regarded as a theory of quantum gravity and a possible contender for a theory of everything.

WHAT IS A STRING?

According to the theory of strings, the universe is composed entirely of tiny, vibrating strings. They are all one-dimensional, identical objects called strings. These strings are the building blocks of every known fundamental particle, including quarks, photons, gluons, and electrons. Because they vibrate at different frequencies, quarks and electrons appear to be distinct from one another. These strings are extremely small. According to current estimates, a string would be about 10–35 meters long, or about 10–20 times the diameter of a proton, or of the order of the Planck length.
Two types of strings are used in string theory: closed and open strings.

WHAT IS A BRANE?

String theory evolved throughout time, and it was discovered that it required extra objects known as branes to function.
In string theory, a brane is an entity that extends the concept of a point particle to any number of dimensions. A point, for example, is a brane with dimension zero, a string with dimension one, a plane with dimension two, and so on.
A 0-brane is a point particle, a 1-brane is a string, and a 2-brane is a plane.

HOW COME HIGHER DIMENSIONS?

Four dimensions (3 Space + 1 Time) alone are insufficient for the string theory to function. Thus, string theory suggests that our universe must have more "hidden" dimensions. Why can't we see these extra dimensions, and where are they located? According to physicists, these extra dimensions are compressed into small areas and too small for us to observe or detect.
For mathematical consistency, various types of string theories require varying numbers of dimensions. For instance, spacetime has 26 dimensions in bosonic string theory, an older version of string theory, but only 10 dimensions in superstring theory, a more recent version of string theory. Parallel universes are another idea put forth by string theory. According to string theory, the extra dimensions can take on a variety of shapes, each of which could be a representation of a separate universe with its own unique set of physical laws.[2]

MORE ABOUT DIMENSION & DIMENSION TRAVEL

If you were asked to draw a circle on a piece of paper, what would you draw?
a 2-D figure or a 3-D figure? So, first of all, the paper is a 3-D figure existing in the 4^{th} Dimension (as the paper has a little bit of height), as we have discussed earlier, and even the 2-D figure that you have drawn on the paper is NOT a 2-D figure, as the drawing also has a little bit of height, as the pen or pencil that you have used to draw the figure, has actually added another "layer" onto the paper, and hence increasing the height of the paper a bit.

So, is it not possible to draw a 2-D figure? Yes. Not Possible while traveling 3 dimensionally. What about drawing a 3-D figure? Is it possible? Let see.

Everything that we see around us is 3-D figures. So that means, we can now say the dimension in which we are traveling, we can draw only that dimensional object. And not only can draw but "see" as well. Which means, it is not possible to perceive any lower-dimensional object.

What about going a higher dimension? Can we perceive any object from the 4th Dimension? Of course Not. Not till now at least.

Now imagine that some people can travel only 2 dimensionally, forward-backward and right-left. Let's say, an object from the 3rd Dimension, a cube, comes above them, they would see nothing, as above or beneath doesn't exist for the people who can perceive only from the 2 dimensions. Now the cube lands onto its plane of 2 dimensions, now what would they see? They would see a 2-dimensional cube, which is a square, appearing from nowhere. Same for us, we travel in the 3rd Dimension, and even if there would be any higher dimensional beings existing (if they do), or the beings of the 5th Dimension, it would be and it is impossible for us to see them while living in the 4th Dimension (Not yet so far) if we can see them then only when they interact with us, the only thing that we would see is their projections being projected in the 3rd dimension.

HOW TO GO HIGHER DIMENSIONS?

Now let's visualize how a point goes to a higher dimension.

A point is a zero-dimensional object.

Bring another point and connect these two points with a line, and there it is, a 1-dimensional object, a line. Now bring another same-length line and connect all the two points of the lines, making a right angle. Now you would end up with a 2-dimensional figure, a square. Bring another dimension, another square, and connect these squares with straight lines of equal lengths, making a right angle, and you would end up with a 3-dimensional figure, a cube.

If you go higher the same way, you would end up with a 4-dimensional figure, known as Tesseract. And similarly, you could go to a higher dimension.

FIGURES APPEARING FROM A HIGHER DIMENSION TO A LOWER DIMENSION

Let's assume there are some living beings, living in the 3rd Dimension, and can only travel and perceive 2 dimensionally. Now, let's say, a sphere from a higher dimension comes to their 3-D world. Now, those beings would be seeing a circle that appears out of nowhere, and as soon, as this 3-D figure (Sphere) passes through their plane, those beings would be seeing the circle growing in size and then its size would decrease as the sphere passes right through their plane.

That means each higher dimension figure would be seen as just a projection, to a lower-dimensional being. That means, even if there would be any 5-D being with us, we could just see a projection which would be a 3-D figure. Tesseract, for example, is a 4-D figure (existing in the 5th Dimension), its projection in our 4-D world would be a 3-D figure, which would be a Cube.[5]

A higher dimensional figure would be projecting a lower dimension projection of itself while going a lower dimension.

Let's have a look at this approach:

THE UNIVERSE GROWING INTO HIGHER DIMENSIONS

13.8 billion years ago, the universe evolved from a singularity to the whole, 93 billion light-years wide, as we have observed so far.

This is known as the BIG BANG.

In this approach, we would be considering that Big Bang will happen over and over again. And each time the universe will grow into a higher dimension. At the very beginning of the universe, there were no dimensions, zero dimensions, the universe couldn't expand in any direction, as there were "no directions" at all for the universe to expand. Now as evolution took place, the universe becomes 1 dimensional, which means, it has now only one direction to expand.

Now further, as evolution took place, 1 dimension becomes insufficient for the universe to expand, and the universe will collapse, now another dimension would be introduced, for the universe to expand further. Further, it became 2 dimensional, and now it has 2 directions to expand. And further, these 2 dimensions would become insufficient for the universe to expand any further, similarly, another dimension would be introduced. The evolution will take place again, and it will become 3 dimensional, and now it has 3 directions to expand. And further, these 3 dimensions would become insufficient for the universe to expand any further. The evolution will take place again. In this approach, the past can be represented as a lower dimension and the future can be represented as a higher dimension. However, this approach doesn't define Time at all, the dimensions will keep on increasing.

Let's discuss what "Time" meant for Sir Albert Einstein.

SPECIAL THEORY OF RELATIVITY – *Speed slowing down time*

The faster an object moves through space, the slower that object will move through time.

According to Sir Einstein, an object moving near the speed of light will experience a slower time tick as compared to the outside world or a stationary observer.

This isn't simply a hypothesis; it has been measured with the help of two twin atomic clocks (shows extremely accurate time). One is placed on a flying jet traveling with some speed, while the other is kept stationary on the Earth. Later on, the two clocks were compared, the flying clock ticked slower as compared to the other clock which was kept stationary on the Earth. However, the effect was not very noticeable in this case. Perhaps, if the jet is replaced with a spaceship that can travel 90 percent of the speed of light, then the clock on the spaceship would tick 2.6 times slower than the other stationary clock based on the formula derived by Sir Einstein.

Sir Albert Einstein derived the following formula representing Time Dilation:

$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

…(eq. 1)[6]

Here,

t_0: Stationary or Rest Time on an Object (Observer's Time)

t: Dilated Time of the Object (Object's Time)

v: Velocity of the Object

c: Speed of Light

According to the above formula, we can observe that, as the velocity of an object reaches the speed of light (i.e., 299792458 m/s), the more its time gets dilated i.e., the time of the object becomes slower and tends to reach zero, as compared to its rest time or the time of any other stationary object. It should be noted that if we replace, v with c then the dilated time of the object would become infinite i.e., for an object traveling at the exact speed of light, time wouldn't tick at all.

And we know photons, carriers of light, travel with the speed of light, their dilated time is infinite. That means for a photon, time does not tick at all.

Till the distance of 299792458 meters, photons cover the distance instantly, beyond that distance they start taking some time. This is the reason we see every star or galaxy in the sky, as they used to appear in the past, as the light coming from them is old. That means, the light coming from them would be old depending upon how far they are.

That means, *"The farther we look in the space, the more back we see in time."*

GENERAL THEORY OF RELATIVITY – *Gravity slowing down time*

This has also been measured experimentally using two twin atomic clocks, and it is found that a clock kept at a height will tick fast as compared to a clock that stayed on the ground.

Time ticks slowly as the gravity increase, which means, time for our foot ticks comparatively slower than our head.

According to Sir Einstein, there is a fabric of Space-Time, over which all the bodies exist.

The more massive a body is, the more curvature it would create over the fabric of space-time.

"Matter tells space-time how to curve, Space-time tells matter how to move"

So far, we know, Gravity is a force of attraction, however, in this theory, it can also be defined as follow: Gravity is nothing, but the phenomenon, of massive bodies curving the space-time fabric. The more massive a body is, the more it'll bend the space-time fabric, and the more gravity it will have.[7]

It should be noted that Light is also matter, i.e., it is made of particles called Photons. Light, as well, gets bent around a massive object, this is known as *Gravitational Lensing*.

Now according to Sir Einstein, the more gravity an object feels, the slower time would be ticking for it. That means the curvature of space-time fabric allows an object to travel to the future.[7]

That means we only need to move around a massive object to travel to the future. And that's what happens near a Black Hole, i.e., A Black Hole is so dense that it bends the space fabric around it so much that even light, traveling at 299792458 m/s, cannot escape it.

What about traveling to the past?

For that the space-time fabric needed to be curved in the opposite direction of the mass. Here comes, the concept of negative mass. One must need negative mass or negative entropy to travel to the past. And such a thing is not yet possible for us. This theory also suggests that a photon is a massless particle, traveling at the speed of light.

TRAVELING WITH RESPECT TO THE SPEED OF LIGHT

Now let us understand what happens when an object travels with respect to the speed of Light.

Case 1: Object traveling near the speed of Light

According to Sir Einstein's Special Theory of Relativity (eq. 1), an object traveling near the speed of light would experience a slower time tick with respect to a stationary observer. That means, since this object is closer to the speed of light, the light would be reaching this object first, before anywhere, meaning this object would perceive the future before anyone else.

Case 2: Object traveling at the speed of Light

An object traveling at the speed of light would experience no time tick at all. For the object, time would be meaningless. Photons, carriers of Light travel with the speed of light, as we have discussed earlier, and for them, time does not tick at all.

Case 3: Object traveling faster than the speed of Light

An object traveling faster than the speed of light would experience a faster time. That means that object would be reaching a point even before the light does, the light would be lagging. And hence, after reaching a point, the light that would be coming to the object would be of the past. Technically, the object would travel to the past with respect to a stationary observer.

IV. CONCLUSION

As we have discussed, We, humans, are the beings of the 4^{th} Dimension, we are the beings of Time who are traveling 3 dimensionally. We live in a $(3+1)^{th}$ Dimensional World. And an object traveling n dimensionally would be living in the $(n+1)^{th}$ dimension, where this $(n+1)^{th}$ dimension is always moving. If we are traveling 3 dimensionally, we are also moving in the $(n+1)^{th}$ dimension, Time, in our case, Time is always moving, we can stop physically in the 3 dimensions, but not in the 4^{th} dimension. And to travel in the 4^{th} Dimension, we need to be in a Higher Dimension, the 5^{th} dimension. And that is not yet possible for us. And if there would have been any beings of the 5^{th} dimension, it would not be possible for us to perceive the whole of them at once, while being in the 4^{th} dimension. The only thing that we would be seeing on our 3-dimensional plane, is their projections being projected onto our 3-dimensional plane.

Sir Einstein's Theories of Relativity allow us to Time Travel to the future.

According to his Theory of Relativity, an object could travel to the future, by either traveling near the speed of light or traveling near a very dense region like a Black Hole.

However, time traveling to the past would not be possible, Sir Stephan Hawking believed that time travel to the past is not possible, he once mentioned that "*We are yet to discover a physical law that would prevent us from traveling to the past*." And if traveling to the past would have been possible, someday in the future, I believe it would be very unlikely to change something in the past by time traveling to the past whatever has once happened cannot be changed. From the above statements following can be stated:

"If anything can happen, will happen, and once happened it can no longer be changed."

Any attempt, made to change the past would eventually lead to the future, without changing the actual future. Hence, Time would remain Constrained forever.

REFERENCES

[1] *Space and Time | AMNH*. (n.d.). American Museum of Natural History. https://www.amnh.org/explore/ology/physics/space-and-time2#:~:text=According%20to%20Einstein%20%2C%20you%20need,know%20what%20time%20it%20is.

[2] posts by astrogeekz, V. A. (2018, August 6). *String Theory explained in simple words*. Astrogeekz. https://astrogeekz.wordpress.com/2018/08/06/string-theory-explained-in-simple-words/

[3] Reece, M. (2021, April 12). *Is Time Travel in 4-D Space Logically Possible?* Woroni. https://www.woroni.com.au/words/is-time-travel-in-4-d-space-logically-possible/

[4] Siegel, E. (2019, August 27). *This Is Why Time Has To Be A Dimension*. Forbes. https://www.forbes.com/sites/startswithabang/2019/08/27/this-is-why-time-has-to-be-a-dimension/?sh=2c4164903646

[5] Ciechanowski, B. (n.d.). *Tesseract – Bartosz Ciechanowski*. https://ciechanow.ski/tesseract/

[6] Stein, V. (2022, February 1). *Einstein's Theory of Special Relativity*. Space.com. https://www.space.com/36273-theory-special-relativity.html

[7] Tillman, N. T., Bartels, M., & Dutfield, S. (2023, May 14). *What is the theory of general relativity?* Space.com. https://www.space.com/17661-theory-general-relativity.html