

Nature Of Time

Essay written for the FQXi contest on the Nature of Time

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Abstract. The aim of this essay is to present some theories regarding time's nature, from a philosophical point of view. The reader will journey, along time, from the paradoxes of past, to the existence of present and to the future of free will.

What is time?

Time is the most ambiguous concept. As long it is a concept it is not a serious problem, but wait a moment ... time is more than a concept, it is a physical reality or so others are saying. Interesting about time is that it has two main planes of existence: one is a physical plane of existence and the other one is a more conscious plane of existence.

The two planes of existence have the same importance; the first one can be seen in different areas of physics like: **Classic Physic**, the Newtonian¹ one, which is presumed to be created by a falling apple², **Relativistic Physic**³, which is created by Albert Einstein⁴ and **Quantum Physic**⁵, which is the one that deals with the probabilistic places of particles' existence. Just for the record there are more physics, much more different than the ones presented above, like: The New Physic (RF), based on virtual particles and Quiton/Perceptron (TB) one, based on perceptions. But to further go into details is beyond the scope of this essay.

¹ The person who started the classic physic is Sir Isaac Newton (1642 - 1727), also called Newtonian Physic.

² It is said that Sir Newton, sat one day under an apple tree. And suddenly an apple falls onto his head. Eureka, eureka he said and begun to run naked through the marked. Oh sorry I confused the stories, this one is Archimedes and his simple and not so simple law of Archimedean Force. Well, probably Newton didn't do that physically but he sure did it with his mind.

³ Relativistic physic deals with the space-time curvature and Non-Euclidean Geometries. A Non-Euclidean geometry is a geometry, for example, in which the sum of all angles of a triangle can be sometimes greater than 180 degrees or sometimes smaller.

⁴ Albert Einstein (1879 - 1955).

⁵ And the last one but which is the most interesting and beautiful of them all, is Quantum Physic. This kind of physic deals with particles smaller than the atom, but sometimes deals with atoms, the old and good atoms. If you didn't know the name, it means indivisible or indestructible. But the early reference to atom was found in India, 6th century BCE. The Nyaya and Vaisheshika schools developed elaborate theories of how atoms combined into more complex objects (first in pairs, then trios of pairs). The references to atoms in the West emerged a century later from Leucippus whose student, Democritus, systemized his views around year 450 BCE. (WKPD)

This physic also deals with probabilistic places of particles' existence. This way of thinking was started by the simple and complex **in the same time**, Young's double slit experiment.

The other plane of time's existence is the conscious one. This plane of existence affects us the most, because is telling us that time is passing. We were sometimes young and now we are old or how quickly is time flowing when someone is with the loved person. For us time is passing quickly or slower. Sometimes it stands still and sometimes it flies like lighting on a black night sky. Sometimes it goes backward, when we think about past times or when we remember a memory. For us there are no thoughts that time does not exists. But for a physicist the question: "**Does time exist?**" should be a very living question.

Does time exist?

The more logical question which must be answered first is this one: "**What is the nature of time?**". To answer this question I have to make an introduction to the concept of time.

The dictionary definition for time is this one: "***a dimension that enables two identical events occurring at the same point in space to be distinguished, measured by the interval between the events***". I might add that time measures also the necessary "steps" to complete an action, like movement. And, of course you can find time in many kinds of equations with the symbol **t**. Also time is made up by three main parts: **PAST, PRESENT and FUTURE**.

About the Past

Past is that part of the time which is effectuated and if someone can change it some paradoxes⁶ appears, or parallel worlds (Super String Theory⁷) to compensate to the fact that time was changed or if we don't like paradoxes or multiple dimensions we have to accept that free will does not exists and all that had happen, is happening, is going to happen or will happen is already written and we are just mere actors on a theater with the scenario already written and which can never be changed. Also the existence of no free will implies that the saying "I think therefore I exist" ⁸is not so true after all and in that case we truly are "dust in the wind".

Let's explain some of the terms described above.

- **Paradox.** Some examples of paradoxes are:
 - "I lie" – is one of the oldest paradoxes thought be people. This one was thought by a Greek philosopher. To say the truth many good things came from the Greeks like Greek letters, which are used in physic to describe angles (α ,

⁶ A paradox is something absurd or contradictory. Sometimes can be a situation that can seem to be absurd and/or contradictory **in the same time**, but in fact it is or may be true.

⁷ Derived from String Theory. This postulates that, the smallest existence is not a point in space, but a string, that oscillates in a certain manner. Also some strings are circular and others are linear ones. These two types of strings can dynamically change from one type to the other. These strings are oscillating and moving through **space and time** forming various elementary particles.

⁸ "Cogito, ergo sum" or "I think, therefore I am". These famous words were said by the French thinker René Descartes (1596 - 1650).

β , γ) or elementary particles (α is Helium, He, atom, β is an electron and γ is a photon, high energy one). Roman had their own contribution as well: just look, what language, Latin, is used to describe chemical compounds from a cure or the language in which some of the Vatican records are kept in.

- Another example is the one in which a past action is changed by a person which travels into the past prior to the beginning of that action and changes it willingly or by accident. For example let's take a look at the movie "Back into the future" where the main character goes back into the past and meets his mother, in this way, he is jeopardizing his father, because his mother begins to like him, of course not knowingly that our character is her own child. So to save the situation he builds up some events which are going to make his mother to like his father in the end. This example is a paradox which could have happen. But what if our character hadn't succeeded. What would had happen then? Well the first of all he would not had existed in the future, but who is the person for which his mother had fallen in love with, totally forgetting the father. And here is the paradox: who is the person that his mother likes? So from this on two tings can happen. First one is that the person from the future, our character, still exists after the fact that his mother would never like his father, thus negating our character's own existence. The other one is that our character would just disappear like he never existed. But this means that our character never existed, thus he never went into the past so, his mother met his father and, voila, he was born and exist once again, but now that he exists he wants to go into the past, not knowing the harm he will do. And so a loop appears, which repeats many, many times. From here we have two situations the loop loops an infinite amount of times or the loop varies each time it loops and so variances appears which could led to a solution to our paradox. In other words there is no point in going back into the past because even if you change something it will quickly be back as it was before. I don't know about you, but I am very confused.
- **Parallel worlds.** This concept was introduced by Super String Theory. And it is a solution to time travel paradoxes. It works like this: for instance, I go in the past and change something, let's say I buy some actions to Yahoo or Google, stop, I create Yahoo and Google. You can imagine that I changed "a little bit" the future. So the future from which I came didn't disappeared, it still exists (no harm done) as a parallel future (alternative future), but I am not going to be able to access it. This idea is very simple and less time expensive. Parallels worlds are created every time we make an action like: for instance I want to take a walk on the beach. At a moment I can go in three different directions: forward, to the left and to the right. I choose forward, but this is one world, there are at least two in which I go to the left and right. From the moment I make a decision (which has more than one solution); I create parallel worlds, just by the fact that I am taking decisions. Just like in the show Sliders.

- **No free will.** This sucks.

About the Present

Present is that part of the time which is happening now. But how long is this **now**? A second, no too long, a Pico second, a little short, but still too long, a Pico Second from a Pico Second, still too long, 1×10^{-36} from a second (much shorter than Plank constant which is 6.626×10^{-34} Joule · Second, if we disregard measuring units), very short but still too long. I know, what about $\frac{1}{+\infty}$ seconds? $\frac{1}{+\infty} = +0$ which means that it takes exactly +0 seconds for present to be present, but this means that present does not exist in fact. Because I can still measure that +0 seconds, thus it must be either past or future. But present is what separates Past from Future, so if there is nothing to separate Past from Future, there is no Past and Future and no time at all.

What about 0? If, the time needed will be 0, then present can not be measured. And could exist at least as a probability. Present must be perceived, present is like a perception I could say. Someone must perceive present. But, how could this perception work? It is very simple. Let's say that I am pressing some keys from the keyboard, to write this essay. And while I am pressing, I say "**now I am writing some words**". And these words, **I am saying**, are defining **Present**.

About the Future

Well it does not exist, yet. But it will exist, just after the Present. And the good part of Future is that it is influenced by the people free will, that is, if free will exists. Future does not have to be measured. You know it exists. All you have to do is to wait for the future and try to influence it with your actions. I must say that, if you are doing good things you will create a better future for you and for the others.

* * *

I have presented to you, two main philosophically ideas. The first one says that time exists. If this idea is true, we have to accept also the existence of time paradoxes, multiple worlds and the possibility of no free will. The second one says that time does not actually exist, but time can be perceived by living beings. In this last idea we have free will and what options we take influences our life. This idea has a deficiency though: **we take full responsibility for our actions**.

Where is time used!

Count of time flow

Usually time is used to measure something. We do that with the help of a device called clock. The sole purpose of this device is to measure or count time. Usually clocks measure seconds, minutes, hours, days, months. But there are ones which are measuring nanoseconds. These kinds of clocks are called Atomic Clocks and their principle of working is the decaying of atoms, mainly Cesium⁹ or transitions of atoms between two energy states. Atomic clocks are used to make extremely precise measurements. Also, molecules may be used in atomic clocks, to measure time.

Describe motion

Another use of time is to describe motion. At the first glance, motion appears to be a simple action. But, it is much more complicated.

There are three kinds of motions. Motions for which Newtonian Physic is enough, motions for which Relativistic Physic is necessary to be applied and motions for which must be applied, at least, Quantum Physic. The first type of motion is straight forward. Object A goes from point X to point Y. Departs from X at time t_1 and arrives at Y at time t_2 . This motion is described as:

$$x = x_0 + v_0 t + a \frac{t^2}{2} \quad (i) \text{ the equation of linear motion at a constant acceleration,}$$

Where:

x = the distance from X to Y,

x_0 = the initial starting position, which is often assumed to be 0.

v_0 = initial speed, which is also assumed to be 0.

t = time, which is in our case $\Delta t = (t_2 - t_1)$, but t_1 is assumed to be 0 $\Rightarrow t_2$ is the time measurement from the moment object starts from X and arrives in Y. As you can see this type of movement is described by a simple equation.

The second type is the relativistic motion, which means motion through space-time. To mention that space-time, in a relativistic vision, is made from four dimensions: three are geometric and the last is the dimension of time. About these dimensions I want to say only, that they are not separated, they are all connected to each other. And space-time is called the Space-Time Continuum. What happens when an object A travels through space-time from point X to point Y? Nothing really if the speed is small enough. In this case we can still apply the equation (i). But what if the speed of our object A

⁹ Cesium (Symbol Cs), the 55th element from the periodic table, so the Atomic Number (number of protons) is 55, the Atomic Weight is 132.9054 and was discovered by Gustav Robert Kirchhoff (1824-1887). As a curiosity Cesium, comes from the Latin word caesius, which means "sky - blue". The name was inspired by the Cesium light spectrum, which contains a pair of bright blue lines.

reaches, let's say 80% from the speed of light, which is a constant noted as c^{10} , some strange things would happen, like: time dilation, mass increase, also distance decreases and objects would appear, as they move (suppose you could see one), more contracted. Why is that happening? In order to answer this, I must tell you a thought experiment made by Einstein. He tried to imagine himself flying at the speed of light while holding a mirror in front of him. Would he see his own reflection? How could the light from his face ever reach the mirror if the mirror itself was moving away at the speed of light? His years of contemplation culminated in two simple statements known as the principles of relativity. They can be put in the following way:

- There are no experiments you could perform that would tell you whether you were standing still or moving at constant speed. All motion is relative so nothing can be said to be truly stationary.
- Light behaves like a wave in that its speed does not depend on the speed of its source. At the same time it does not require a medium to travel through like other waves [JAK, page 146 , Thought Experiments and Brain Teasers].

And the answer to the thought experiment is that he would see his own face in the mirror, because the speed of light is c , how ever you would measure it.

Another thought experiment is this one: two observers A and B are moving from point X to Y with different speeds. The observer A moves with 1000 km/h and observer B moves at 90% from c . Also they have the possibility to observe each other. What would they see? The observer A would see that observer B's time would pass more slowly as the time dilates or when he gains more speed due to acceleration. The observer B would, also, see the observer A's time passing more slowly as he (B) accelerates, causing time dilation. This is necessary to happen, because the speed of light coming from observer A to B and from B to A must still move at the speed of light for both observers. The difference is that, the observer B experiences distance contraction, so it would take for B a shorter time to complete the distance and for A a longer time, because the distance for A is greater than the distance for B. In other words for a photon to go from one side of the universe to the other would take no time at all, from the photon point of view.

But, here in a relativistic motion is a problem. There are two space-time references. For our exercise with the two observers there is the time t_1 , which is necessary for observer A to complete the distance and t_2 for B. Because they are moving through space-time and they have two different times, they must be in two different

¹⁰ The c constant can be seen also in the equation of Energy-Matter conversion $E=mc^2$, differs from

medium to medium. In void it is calculated to be $c = 3 \times 10^8 \frac{m}{s}$. In air is a little less and gets slower as

the medium gets denser. Also, c is found in the equation of electromagnetic wave characteristic: $\lambda f = c$, where λ is the wave length and f is the frequency of a wave, in our case the electromagnetic one. And, just to know, the photon energy $E = hf$, where h is the Plank constant and $h = 6.626 \times 10^{-27}$ erg-sec.

space-time references. And the problem arises when we want to combine the two time references, so when we measure the speed of light from A and B points of view would still be c . So to solve this problem I defined the following mental exercise. Let's say a person A is moving at the speed of 10000 km/s from a point X to a point Y. And an observer C observes the A motion. If we draw the A's motion trajectory, we would see a straight line from point X to Y. But if we could have the ability the zoom in on that line we could see that it is made by points which are closely packed together. I name these points as **frames of existence**. Like the line in fig.1.



Fig1. Shows, the trajectory from X to Y as a dotted line.

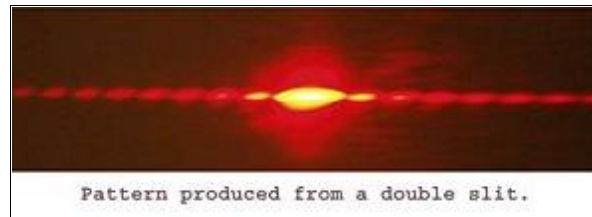
Each dot represents an existence frame, the time person A could be observed by C and the gaps between the dots represents the time the person A could not be observed by C. This means that A exists in the space-time reference of C a smaller time, defined by the time A could be observed by C, than the time C measures that A needs to go from point X to point Y, because C measures the time from the moment A starts from X to the moment A arrives in Y. In other words I could say that the time needed for A to arrive in Y from X is equal to the time defined by all the dots, from the A's point of view. And the time, needed for A to arrive in Y from X, from the point of view of C is the time defined by all the dots and all the gaps (if we suppose that a dot represents an amount of time and a gap represents another amount of time).

But, from the point of view of A the trajectory is a straight line with no gaps. As A moves he sees the external time passing more quickly, because for A the external world has it's own frames of existence just like A's trajectory seen by C. The difference is that A can always observe the external world. If A was moving at a greater speed, 80% from c , then the gaps would be bigger and so would be the time difference between the two space-time references. In other words, I am saying that the motion of A is made partially in the space-time reference of C and partially in the space-time reference of A. I call this **Two Time-References Motion**.

The third type of motion is quantum motion, which is described by quantum physic. This type of motion describes the motion of waves, like electromagnetic ones. This is the most wonderful type of motion, because of one experiment made by Young.

Young double-slit experiment

This experiment was conceived to determine if light was a wave or a corpuscle. So he fired some photons to a plate with two holes in it. The result pattern was like in the following picture. The photons were behaving like waves.



But then he thought, perhaps all the photons are influencing each other, so he fired one photon at a time, so one photon will pass through one of the slits at a given moment in time. But the result yielded the same interference pattern. And some photons seemed to pass through the both slits **at the same time**, others through only one and others were reflected by the plate. The clear implication is that something with a wavelike nature passes simultaneously through both slits and interferes with itself — even though there is only one photon present. But the wave like behavior exists only when the photons are not measured as they move, only the result is measured. (The experiment works with electrons, atoms, and even some molecules too.) [WKPDDSE]

With these in my mind, I tried to create a mind model of the quantum motion. And in one day I was making a swim in a river near my house. I was watching at the sun reflection from the water and I could clearly see the sun as a glowing yellow ball. But, suddenly something perturbed the water and formed some waves. And some of the front-waves of the waves, just formed, met exactly in the sun reflection. And surprise, interference pattern appeared. As a result I draw the following theory: what if, when a particle moves through space-time the space near it vibrates or oscillates from one state to another and this vibration or oscillation is given by the particle's motion, mass, speed, acceleration, thus leading to the fact that for an external observer the particle is seen as behaving like a wave and not as a particle, but in fact it's motion is in a straight line through space and space itself vibrates. But if we observe the external world from the point of view of the particle, we would observe that the external world behaves like a wave. So, we have here two observers: one is the particle and the other is the external world. External world sees the particle, as it moves, vibrating and the particle sees the external world vibrating, because it can not see its own vibration without an external point of reference.

To continue our analogy with the sun reflected in the river, the particle that moves is symbolized as the sun and the space-time is symbolized by the water. If the water is calm we can clearly see the sun, which means that the moving particle moves like a particle and not like a wave. But if somehow the water is perturbed we will clearly see

interference pattern. So, one could say that in fact in double-slit experiment the space itself interferes to itself and not the moving particles (in our case the photons).

To take a break, I will tell you a joke about the two slit experiment. Which could be true if my theory would be applied:

Question: What does a particle says when it goes through two slits at the same time ?

Answer: Nice slit ! :)

Conclusion

After presenting, to you, these theories and facts about time, probably you are wondering what is, in fact, **the nature of time** ? Hard question, taking the fact that time can be seen in so many different and spectacular ways. And so less pages and words allowed to be written. But, I wonder that, if I would have written 100 pages about time, would I present time's nature ? No, because I don't know what is the nature of time. And, I think that nobody knows for sure. We, all who seek the answer, are like the child from the following story:

“Some time ago two wise men walked on a beach. And, they passed near a child, who had made a hole in the sand and with a bucket took water from the ocean into the hole. They asked the child what was he doing. The child answered that he was moving the ocean into the hole.”

We are like that young child. But, that child grew up one day and we will also grow up and a new world of mysteries will unfold to us and new questions too, for which we will be, once again, children seeking the answer.

Bibliography

- JAK – Jim Al-Khalili, Black Holes, Wormholes and Time Machines
- TB – Tom Bearden, Quiton/Perceptron Physic – Perception and Physical Phenomena, <http://www.cheniere.org/techpapers/quiton/>
- RF – Ray Fleming, The New Physic, <http://www.rayfleming.com/tnp>
- WKPDA – <http://en.wikipedia.org/wiki/Atom>
- WKPDDSE - http://en.wikipedia.org/wiki/Double-slit_experiment