

# Implications of the non-existence of Time

## Abstract

Recent books have shown that time does not exist as a valid concept in physics. This paper clarifies this, and shows how this helps understanding various concepts in physics. The principle is positivism. This clarifies advanced electromagnetic potentials, equilibrium using covariant transformations, and the nature of black holes and the Big Bang. The nature of God is also discussed, and shown consistent with the notion that time does not exist. Comments on science and religion are added. Discussion of the nature of science and the wavefunction of the universe shows that all knowledge must be incomplete.

One of the fundamental ideas of physics is logical positivism. A statement is meaningful if and only if it can be proved true or false, at least in principle, by means of the experience. A theory of physics is a mathematical system whose concepts can be measured or observed experimentally. A concept that cannot be observed in principle does not exist.

Let us consider the concept of time. We all believe in the reality of this physical concept. We measure time using clocks. However, further analyses<sup>1, 2</sup> show that time cannot be a valid concept in physics. A simple discussion explains this. It is impossible to go to the past, for if we could, then the past would not be past. If time travel to the past exists, then time does not exist. This means that we cannot observe, *in principle*, the past. When we look at pictures that we took of past events, what we are looking is at the present, the pictures. The past exists only in the sense of *the records that exist now*. The future, of course, does not yet exist. If neither the past nor the future exists as valid concepts in physics, then neither does time.

When physicists speak about time, we speak about records of clocks. We see pictures *now* of clocks describing the experiments in physics. Although time exists in the equations, the reality is that the only existence is the present. Time in physics equations is merely an intermediate variable, not an actual physical quantity.

When we look at a star, the light interacts with our eyes now. This is something in the present. Consider the force of gravity of the sun on the earth. It takes light about 8+ minutes to reach us from the sun. The speed of light is the speed of information. This means that the information about the sun's location takes 8 minutes to get here. The direction of the force of gravity is towards where the sun was 8 minutes ago, according to relativity, not where it is now, as Newton's theory holds. This is called the retarded force (potential). When I tell my students this, they laugh at the word "retarded".

The picture of the universe is one that time does not exist, but that the states of the universe change continuously. Time does not flow, as we innately feel. We can write a function of the universe of the changing records, and this function will indeed be a function of time. However, this function does not describe everything. A function describing the universe cannot be a function of time if time does not exist. We cannot write the wave function of the universe as  $\psi(t)$ .

The idea that time does not exist sounds very strange. To help clarify this, let us look at two examples: time as seen by a computer, and time as seen by a living organism.

We can examine the various states of the computer, and assign time to reflect the various states. We can return the computer to a previous state (going into the past), and then continue from this point, destroying the previous subsequent states. This is true only if we store a previous state of the computer. Note that the past exists only because we now have storage of the previous state. This agrees with the idea that one cannot go into the past, that is, the past (time) does not exist.

For living organisms, the changing universe causes changes in the organism that we call memory. The organism can examine its memory. This is what gives it the feeling of time passing. The organism is examining now the states of memory. Again, there is only the present, which agrees with our statement that time does not exist.

Most subjective concepts are reflected as real physical concepts. We see red light, and this is because of the electromagnetic radiation of that particular wavelength. We feel objects, and this is due to their atomic structures. Time is different. We have a powerful, overwhelming sense of time, yet it does not exist at all. The only existence is the records that are available now. Time is the only subjective concept that is not a real physical concept.

It is clear that the idea that time is not a valid physical concept. The arguments pointing this out are clear. The issue is the conflict between our subjective feelings about time and the reality that time does not exist. The conflict between our intense sense of time and the reality that time does not exist has not yet been fully resolved. We can say several things about this.

## Human understanding of time, God, and the Big Bang

In my experience, physicists have considerable difficulty understanding time. Consider Einstein's Special Theory of Relativity, which was published in 1905, exactly one century ago. This is a very simple theory, and is taught in high schools and colleges everywhere. Scientists have verified the conclusions many times, and there are no challenges to the ideas. Yet I once tried to write papers<sup>3,4</sup> on a simple aspect of relativity, and surprisingly found considerable objection.

Picture an object on which two forces act, which cancel each other, so that the object is at equilibrium. If we zoom past in a high-speed rocket and observe the object, we must measure the two forces at *different* times, according to the equations of Special Relativity. Most physicists insisted that we measure the forces at the *same* time from the rocket. They understood relativity and taught it, yet could not make this simple connection. They wanted to take a picture from the rocket of the object, and examine the picture to determine if the object is at equilibrium. Relativity does not allow this, as, again, we must look at the covariant (different) times of the forces at each end of the object. If two forces are acting on the two ends, we need *two* pictures.

The physics of the equilibrium viewed from the rocket is this. In a moving system, we apply the Lorentz transformation at each point of the force. The times will also change. We look at  $\mathbf{F}_1$  at  $t_1$  and  $\mathbf{F}_2$  at  $t_2$ . The times are not the same.

If the simple idea of equilibrium of a moving object can cause such confusion, consider the confusion when we state that the very idea of time does not exist!

**God.** The concept of God as expressed in Jewish philosophical writings agrees with the notion that time does not exist. The timeless of God is fundamental in Judaism<sup>5</sup>. If we believe that time does exist, we must say that God created time, and *then* the universe. This is somewhat strange, as we can ask *when* did God create time. Since the question of when God created time is not consistent, we must state that indeed God did *not* create time. However, God created organisms, which experience time.

If we accept the notion that time does not exist, then God did not create the universe in time. In other words, the universe has always existed. Maimonides, the Jewish philosopher of the 12<sup>th</sup> century, said that if one accepts the notion of the eternal universe, it does not contradict belief in God.

One of the reasons for the strong religious feelings about God's existence is our belief in the reality of time. If we are willing to look at the universe more objectively, and accept the idea that time does not exist, that the universe just *is*, we would not feel as strongly the need for God. It is important for us to discuss the meaning of God, both to help our understanding of physics as well as to help the war on terror. The need for God is so strong that many people kill and die for God.

**Intelligent Design.** Our insistence on accepting the false idea of time has various ramifications. If we believe in time, then we say that there is a *before*. Before every action there was another action. Then we ask where did it all start. We are reluctant to say that before continues forever. This is the impetus to the misleading idea of biology called “Intelligent Design”. We cannot say that things evolved from other things, but that there had to be a first thing. There had to be a Designer (God) who started everything. Today, with our vast scientific knowledge, we find governments in America who try to teach the false idea of intelligent design in schools. This is because they incorrectly insist on saying that time exists.

**The Big Bang** theory of cosmology is another example of our innate acceptance of time. The Big Bang theory states that according to Einstein’s theory of gravitation, General Relativity, the universe expanded from a point to where it is today. This happened about 13.7 billion years ago. Time began at this point.

Although most physicists and nonprofessionals accept the Big Bang, it is wrong. This is a surprising point. An invalid theory is universally accepted!

A valid theory is a consistent mathematical system with conclusions that agree with experiment and observation. The Big Bang theory is not mathematically consistent. At the beginning, there was a singularity. The word “singularity” means division by zero.

Nathan Rosen from the Technion, Israel, modified the basic Einstein equations slightly, and arrived at an alternate theory to the Big Bang. In Rosen’s theory, the universe was originally very rare, then began contracting to a large, but finite object, and then bounced back. The observational consequences of Rosen’s approach are identical to Einstein. Rosen’s theory, however, does not have the unacceptable singularity Einstein has.

Although one cannot observe any differences between Rosen and Einstein, no one ever mentions Rosen. This is because, I feel, that, according to Rosen, the universe did not begin at the Big Bang. Our insistence on Einstein, not Rosen, is due to our insistence that everything has a beginning in time.

Once we can digest the idea that time does not exist, we can think more clearly about cosmology, and be more open to ideas other than Einstein’s Big Bang.

**Physics is clearer if time does not exist.**

From the standpoint of physics, once we accept that time is not real; various ideas that until now were strange become clear. In quantum mechanics, we speak about  $\Delta E \Delta t > h$ . This means that the uncertainty of the energy times the uncertainty of time must be larger than a constant, Planck's constant, which is the size of the angular momentum of an electron in an atom. This is the basis of pair production. A pair of particles can be created out of nothing in violation of energy as long as they mutually disappear quickly. The violation of energy,  $\Delta E$ , times the time they exist,  $\Delta t$ , must be less than  $h$ .

Does it make sense to talk about an uncertainty in time? What does  $\Delta t$  mean, if time is real and flows continuously? With the idea that time merely means the records of past events, we can understand this. No records are created during the time  $\Delta t$ .

An electron moves to a higher state in the atom. What happens *during* the transition? The only meanings to history are records, and there are no records of the time the electron is in transition, changing orbits. This clarifies the lack of meaning to the situation of the electron during the transition.

This can also help clarify **time dilation** in special relativity. Less time records are available to the moving clock, and therefore the time is slower.

**Advanced potentials.** In 1940, Wheeler-Feynman<sup>6</sup> discussed a problem with classical electromagnetism. The problem is that the equations are time-symmetric, yet observation shows a clear direction to time. Light shines on an object, and the object receives energy and is warmed. According to the electromagnetic equations, it is possible that first, the object was warmed, and then light shone on it. This does not make sense, and they tried to find a proper explanation. Their explanation was that the universe is an infinite absorber, absorbing the "advanced potentials." Unfortunately, it has subsequently been shown that this approach does not fully resolve the issue.

Our correct understanding of time would clarify advanced potentials. We demand that the equation of state of the universe be consistent. An advanced potential is not consistent, as the future would place records here. You would hold pictures in your hands of what will be. This is not consistent. This is in our approach that the only meaning to time is given in the records that we have of what was.

**Time travel.** This same argument would make time travel impossible. Therefore, we immediately reject the use of wormholes or any other idea, even if these ideas may be possible according to the equations of physics. The mathematical principle involved is similar to boundary conditions. If we have an air wave in a pipe, the air must be stationary on the walls of the pipe. This implies that all waves, i.e., all solutions of the equations of wave physics, are not acceptable, only those waves which are stationary on the walls. Here too, all solutions of the equations of physics do not apply, only those that are consistent. This eliminates advanced potentials and wormholes.

We often overlook this very important point. To repeat, it is not enough to examine a solution of a theory of physics. We must insist that the solution be consistent with basic ideas of physics. Even if the mathematics is valid, inconsistency is grounds for rejection. The mathematics of advanced potential is valid, but inconsistency demands that we reject this concept. Furthermore, we do not need further analysis and theories to reject this concept. We do not need the sophisticated analysis of Wheeler-Feynman to reject advanced potentials. Likewise, we must not allow ourselves to get excited about “time travel” via wormholes.

**Black holes.** Let us consider another confusing idea in physics. Consider an object falling down to a black hole. As we observe the object, we note that time slows down as the object gets closer. This is because time slows down in a gravitational field. As the object gets close to the surface (the event horizon), the gravitational field is so large that time stops completely. In other words, the object never enters the black hole, as it takes forever to reach the surface.

The strange thing about Einstein’s General Relativity is that there is another solution to the mathematical equations. Consider the situation from the point of view of the observer. The observer reaches the surface in a finite time, and continues falling until reaching the center. All discussions of black holes discuss this second solution.

There are two problems with this solution. There is a singularity at the center. This means that the solution is not valid! The other problem is that since this solution cannot be observed in principle, as all observers note that it takes forever to reach the surface, any statement about crossing the event horizon and entering the black hole is not a valid statement in physics.

In spite of these two arguments, discussions on black holes insist on mentioning this invalid solution. Why do physicists discuss invalid physical concepts? I believe that this is due to the innate and incorrect belief in the existence of time. People cannot tolerate the idea that time can stop. People like to think that the universe is such that if we travel straight, we can go forever to the “end of the universe”. It is uncomfortable to think that if we travel straight to the center of our galaxy, the Milky Way, it will also take forever to get there. (There is a black hole at the center).

As an example of a faulty discussion, consider Wikipedia<sup>7</sup>. This is an Internet encyclopedia: “A black hole is a concentration of mass great enough that the force of gravity prevents anything from escaping from it...” This is false, as physics cannot speak about the inside. We are not permitted to discuss “escaping” the black hole. How can one escape from a location that it is impossible to reach? The correct definition should be this: “A black hole is a concentration of mass great enough that the force of gravity slows time down so that objects take forever to reach the surface. It is an infinite absorber, hence the word ‘black’.”

With the correct understanding of time as records of past events, near the event horizon there are less and less records, which is the meaning that time stopped. We should not have a problem understanding the meaning of time stopping near a black hole if we accept the notion that time does not exist.

**The wave function of the universe.** The goal of scientific research is to find a mathematical function that will predict the future given the present. This means we are looking for something like  $\psi(t)$ . Since time does not exist, neither does any such function. This means that science will never succeed in the goal of predicting the future from the present. Any function  $\psi(t)$  can be a function of records currently existing. There is much more to the universe than the records that currently exist, which is what we mean by saying time does not exist. Therefore, the function  $\psi(t)$  can be only a partial description. At the very best, science can only partially describe the world.

This is an inherent limitation to our knowledge. This is in line with the work of Kurt Gödel<sup>8</sup>, which states that in any formal system questions exist that are neither provable nor disprovable on the basis of the axioms that define the system. Mathematical knowledge can never be complete. The non-existence of time implies that physical knowledge can also never be complete.

When we speak of limitations of physical knowledge, we must be careful about limitations due to errors in initial and boundary conditions, and finite computational capabilities. What we are saying here that other than these limits, knowledge *itself* is inherently incomplete.

**Science and religion.** It is logically and mathematically impossible to know everything. Therefore, it is logically impossible for God to exist. Until now, we spoke about the conflict between science and religion, that is, can a scientist who is honest with himself believe in God. Now we are saying that the conflict with religion includes mathematics. An honest mathematician cannot believe in God.

**Conclusion.** Time does not exist, except as perceived by living organisms, and in the equations of physics. We must try to accept this reality. The universe just is. That's all.

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<sup>1</sup> World Without Time, Palle Yourgrau, Basic Books, 2005.

<sup>2</sup> End of Time, Julian Barbour, Oxford Univ Press, 2000.

<sup>3</sup> "Equilibrium in Special Relativity," Sanford Aranoff, *IL Nuovo Cimento*, **10B**, 155-171 (1972).

<sup>4</sup> "More on the Right-Angled Lever at Equilibrium in Special Relativity", S. Aranoff, *American Journal of Physics*, **41**, 1108 (1973).

<sup>5</sup> See Wikipedia: <http://en.wikipedia.org/wiki/Eternity>, "Augustine of Hippo wrote that time exists only within the created universe, so that God exists outside of time; for God there is no past or future, but only an eternal present."

<sup>6</sup> Wheeler-Feynman Absorber Theory, [http://www.npl.washington.edu/npl/int\\_rep/dtime/node2.html](http://www.npl.washington.edu/npl/int_rep/dtime/node2.html), <http://www.iop.org/EJ/abstract/0305-4470/15/4/026>

<sup>7</sup> [http://en.wikipedia.org/wiki/Black\\_holes](http://en.wikipedia.org/wiki/Black_holes)

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<sup>8</sup> <http://www.exploratorium.edu/complexity/CompLexicon/godel.html>. In 1931, the mathematician and logician Kurt Gödel proved that within a formal system questions exist that are neither provable nor disprovable on the basis of the axioms that define the system. This is known as Gödel's Undecidability Theorem. He also showed that in a sufficiently rich formal system in which decidability of all questions is required, there will be contradictory statements. This is known as his Incompleteness Theorem. In establishing these theorems, Gödel showed that there are problems that cannot be solved by any set of rules or procedures; instead, for these problems one must always extend the set of axioms. This disproved a common belief at the time that the different branches of mathematics could be integrated and placed on a single logical foundation.