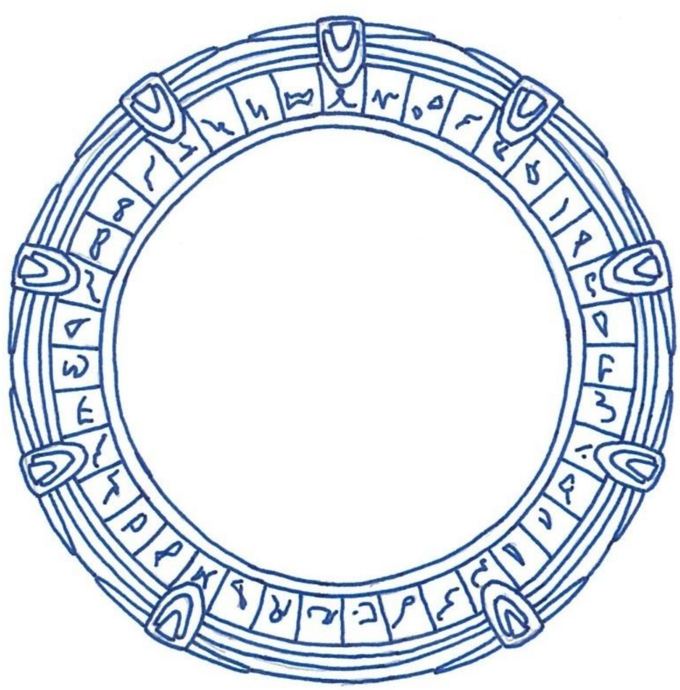
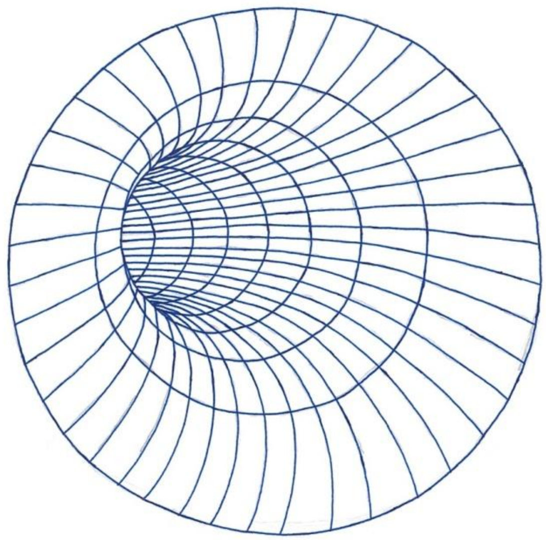
Marek-Lars Kruusen's
technology and science

An introduction to the physics of time travel





Company: MLK Technology and Science Ltd

Date and location: September 2024, Tallinn, Estonia (EE), European Union (EU).

Author (including graphic design): Marek-Lars Kruusen

Official website: *https://www.technologyandscience.eu*

NOTE: This is the fourth part and the second version. Previous episodes and versions can be found here: (1).

Ministry of Education and Research of Estonia: *https://www.etis.ee/CV/Marek-Lars_Kruusen/eng/*

All rights reserved. This (literary and visual) work is protected by copyright and international law. No part of this work may be reproduced by mechanical or electronic means or used in any other way, including photo reproduction and information storage presented in the work, without the permission of the copyright owner (i.e. the author of the given work). Unauthorized reproduction and distribution, or parts thereof, may result in severe civil and criminal penalties, subject to the maximum statutory penalty. The author can be contacted by **email**: *mlk@technologyandscience.eu*.

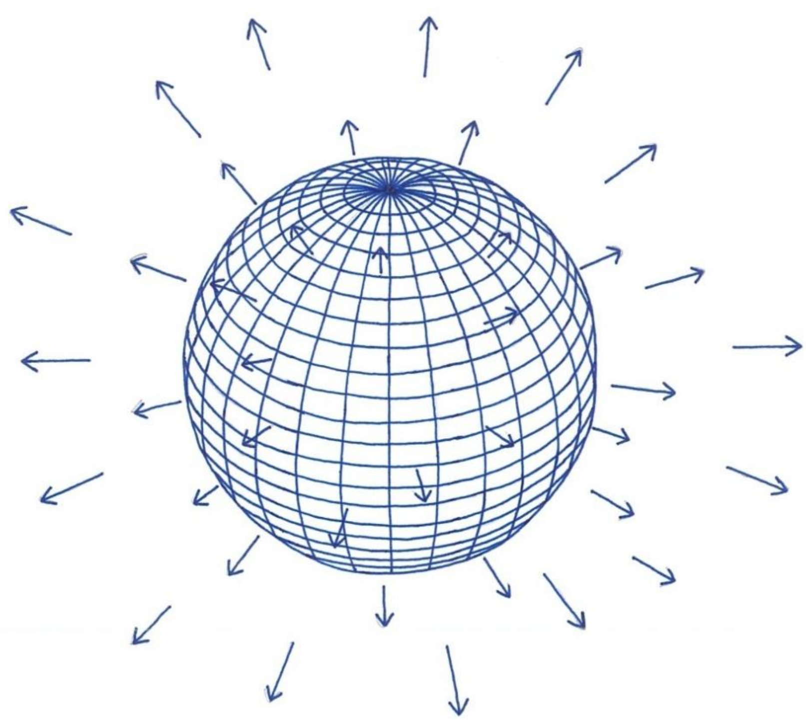
General introduction

Spacetime tunnels are such physical objects that allow any bodies to move very large distances in space in an instant or to move from one moment in time to another. In Albert Einstein's theory of general relativity, these tunnels are derived from the geometry of curved spacetimes in which mathematical differential equations and tensors occur. However, this work shows that spacetime tunnels cannot be described by Albert Einstein's theory of general relativity alone. This means that relativity is not sufficient to describe all aspects of a tunnel in spacetime. This requires new approaches and understandings of the physics of the universe. The new understanding is the physical theory of time travel, which, according to the best current knowledge, describes spacetime tunnels in the most accurate and objective way. The physics of spacetime tunnels is a part of the physics theory of time travel (3), which is briefly presented in this paper. In this work, the focus is not on the technical possibility of creating spacetime tunnels, but on those aspects that determine the lengths and directions of spacetime tunnels. For example, the length of the tunnels depends on how far the bodies move in a moment in space or time. However, the directions of the tunnels determine whether the bodies move in space or time to the past/future. These aspects must be known if we want to technically create the world's first tunnel in spacetime.

Wormholes and the Mini Standard Model of Elementary Particles are part of the physics theory of time travel (3). Marek-Lars Kruusen's time travel physics theory and technology is extremely voluminous, containing a lot of details. This paper presents only a small part of this theory. Since this is the third part of the series, the following parts will present more comprehensive and detailed reviews of the physics of time travel. This paper describes the physical nature of wormholes and its relation to the physics of time travel. The physics of time travel is actually much more voluminous and detailed than it appears in this work. It is important to understand that time travel is enabled by the physical system of hyperspace and normal space, which manifests in reality as the cosmological expansion of the universe. The mathematical parameters of a tunnel in spacetime, or wormhole, such as length and direction, follow from the above. The physics theory of time travel shows very strongly that the universe must be expanding at a constant speed of light c, but as we know, it doesn't look like that. Therefore, time must have slowed down throughout the universe, which is speeding up over time. As a result, the rate of expansion of the universe increases over time, which we know in cosmology as the concept of "dark energy".

CONTENTS

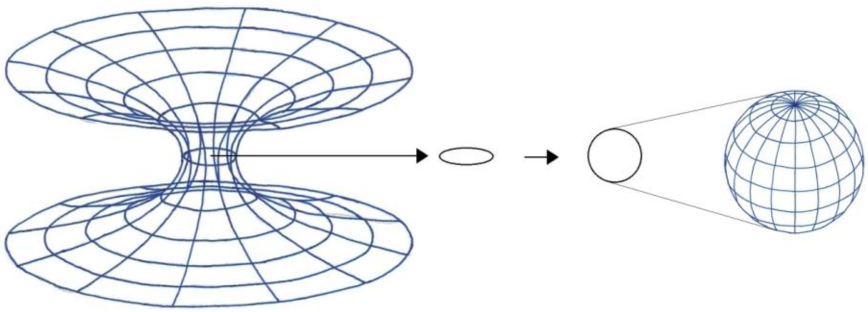
The physics theory of time travel



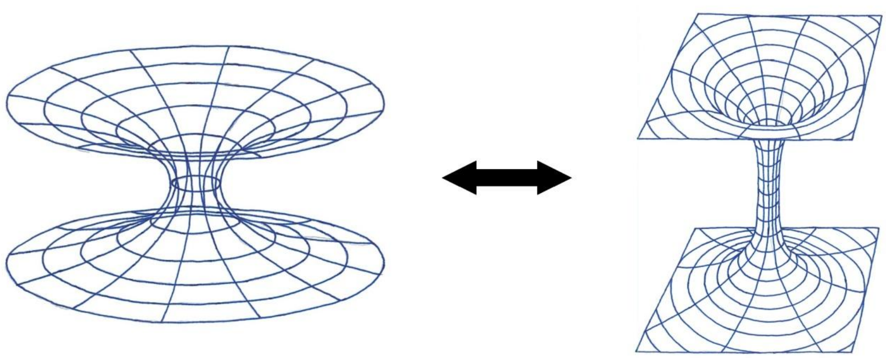
1 The foundations of the physics theory of time travel

1.1 Introduction

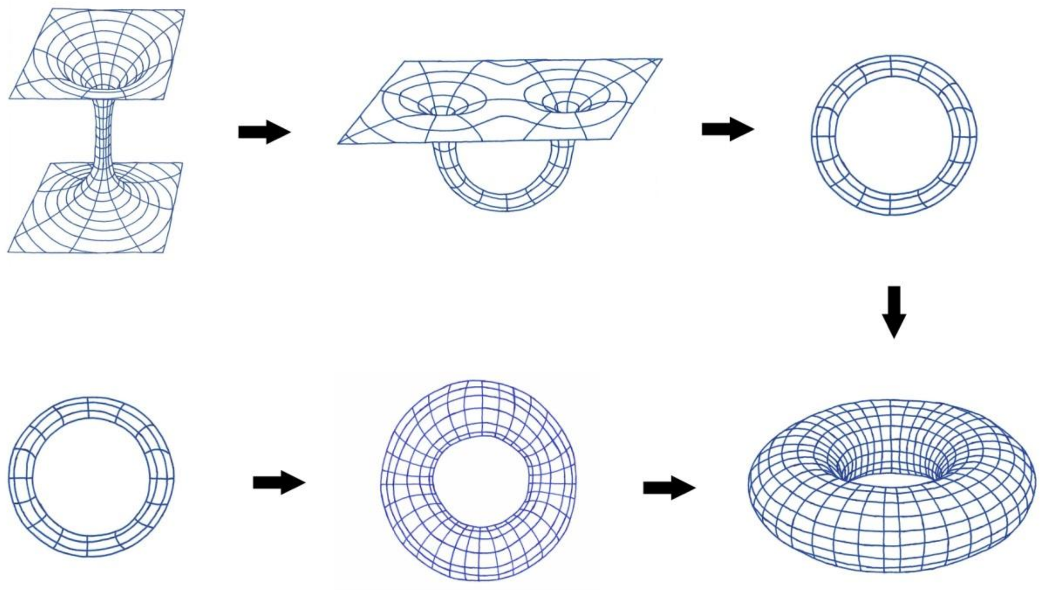
In order to understand the following material, it is first necessary to understand that in many physical models a wormhole is represented as a tunnel in spacetime, but in reality a wormhole is spherical. This is what the following figure tries to represent, showing a two-dimensional hole in space-time. A two-dimensional hole in space-time can be imagined as the entrance and exit of a three-dimensional tunnel in spacetime, but the hole in space-time itself is still three-dimensional, i.e. spherical:



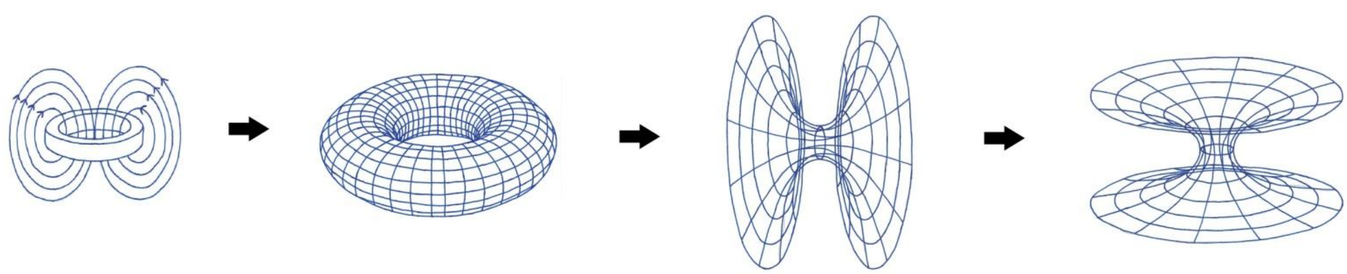
In most models, a wormhole is depicted quite similarly:



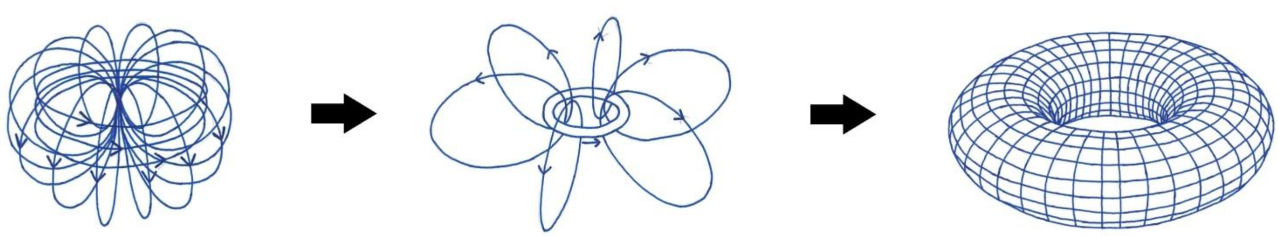
It can clearly be seen on the figures how an annular tunnel in spacetime is obtained. This means that the figure shows the physical nature of an annular trapped surface in spacetime, which was represented and used hereinabove:



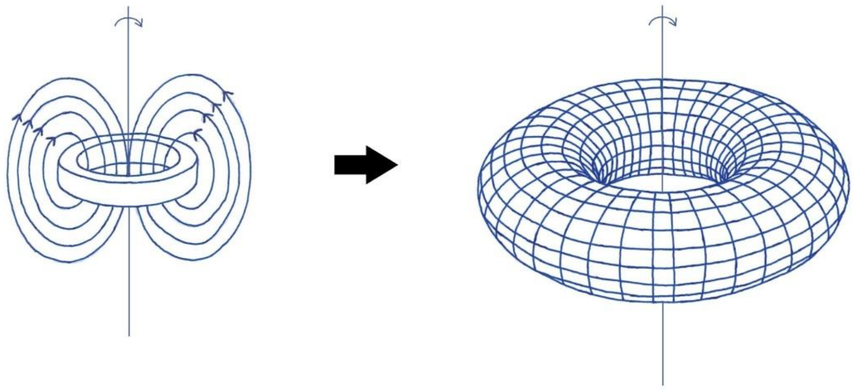
The magnetic field surrounding the metal ring is geometrically similar to the shape of the trapped surface in spacetime, which resembles a doughnut. This means that the closed magnetic field lines form a doughnut-shaped energy field around the metal ring, which also determines the geometric shape of the space-time trap surface. Figure:



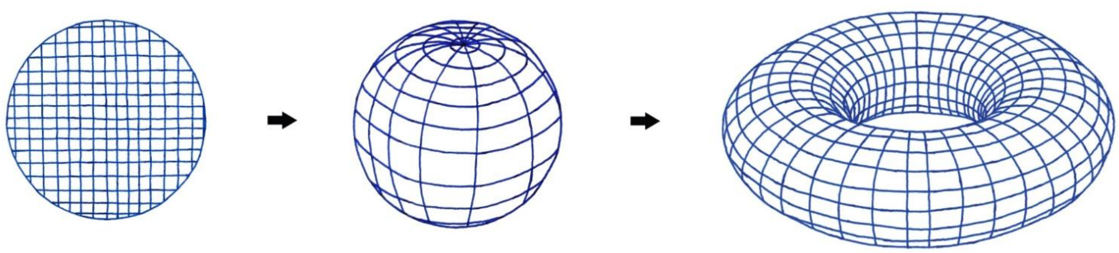
The closed magnetic field lines determine the geometrical shape of the trapped surface in spacetime:



Since in this case, the creation of a magnetic field, i.e., the creation of an electric field moving in space, is also accompanied by the creation of a trapped surface in spacetime, the resulting trapped surface in spacetime (i.e. a tunnel in space-time) should also move in space, or in this case "rotate" in the same direction as the metal ring. Figure:



One could assume that how far one travels in time depends on the length of the doughnut-shaped tunnel in spacetime. It could also be assumed that the direction in which time travel would occur would also depend on the rotation of the tunnel in spacetime or its position in space. In fact, this is not the case, because in this case the "doughnut-shaped" shape of the tunnel in spacetime is simply caused by the geometric form of the body, which makes us think that something depends on the length of this "loop-shaped" tunnel. Instead of the shape of a doughnut, one should take into account the spherical tunnel in spacetime and the quantum mechanical properties of its trapped surface (figure below). In the following, we will justify and analyse it in much greater detail.



According to the physics theory of time travel, the universe's dark energy and tunnels in spacetime, or wormholes, are physically connected. The nature of dark energy of the universe lies in the expansion rate of the universe increasing over time. This is because time across the entire universe has changed exactly as many times as the difference between the speed of light c and the expansion rate of the universe. However, this difference in time changes due to the motion of normal space K with respect to hyperspace K'. This means that the universe is actually expanding at the speed of light c, but astronomical observations show a much lower expansion rate, which does increase with time. This is caused by the transformation of time all over the universe. Tunnels in spacetime are related to holes in spacetime. For example, a black hole can also be interpreted as a hole in spacetime, because on its "surface", spacetime is curved to infinity, i.e. spacetime has ceased to exist. The length of a tunnel in spacetime cannot be calculated from the curvature of spacetime in spacetime, but is a much more abstract physics than Albert Einstein's general theory of relativity. A hole in spacetime exists for a very short period of time, so it travels a certain distance in hyperspace. This distance can be interpreted as the length of the wormhole tunnel. The longer the length of the tunnel in spacetime, the further in time or space one can teleport. Since time has uniformly transformed billions of times throughout the universe, the dark energy of the universe must also be taken into account when calculating the length of the tunnel. Calculations show that if a hole in spacetime exists in spacetime for, for example, 10^{-9} seconds, then the length of the tunnel in spacetime also results from this, which allows the body to move in time to the past or future, for example, for centuries, or to teleport hundreds of light years in space. In this way, the dark energy of the universe and wormholes are physically connected. Through the dark energy of the universe, we can calculate the lengths of tunnels in spacetime, which determines how far in time or space one teleports.

Since it is possible to calculate the lengths of tunnels in spacetime through the dark energy of the universe, which determines how far you can teleport in time or space, then the physical nature of dark energy can also be proven with the teleportation of bodies through tunnels in spacetime. For example, the length of a tunnel in spacetime is determined by two factors: the time period of the existence of the hole in spacetime and the difference in the expansion rate of the universe from the speed of light c, or the multiplier y. This means that through tunnels in spacetime, the physical nature of the dark energy of the universe can be proven, which is related to time and space itself, and not to some previously unknown form of energy (for example, vacuum energy). This is a very important argument. For example, if such a theoretical concept of dark energy were wrong and it was caused by vacuum energy (which many scientists now support), then understanding the nature of wormholes would be difficult. In this case, it would not be possible to calculate the lengths of tunnels in spacetime, which in turn makes their use in technology very difficult.

It can be argued that "dark energy" as a term does not correspond to its physical content. For example, the expansion rate of the universe is increasing over time, so it is believed that something is causing such a phenomenon. Any movement is related to energy, but in case of dark energy, it is more related to time and space itself. Throughout the universe, time has slowed down billions of times, which is why we see the expansion rate of the universe much slower than the speed of light c. However, it becomes faster in time due to the movement of normal space K with respect to hyperspace K', whereas the speed of movement of normal space is constant in time. According to such a theory, the change in the rate of expansion of the universe over time is related to time and space itself, and not to an unknown form of energy. However, the concept of "dark energy" continues to be used, because the concept is already so established in physics, cosmology, and also in the wider audience that there is no point in changing it. Similarly, it is the same with the concept of the "Big Bang" of the universe, where there was no real big bang or explosion, but the concept is still in circulation. The Big Bang of the universe marks the beginning of the universe, or its birth.

1.2 An introduction to the physics of time travel

Newtonian mechanics, or classical mechanics, was the first branch of physics to treat time and space scientifically. It was the only physical theory describing time and space for centuries. However, changes took place at the beginning of the 20th century, when two completely new physical theories describing time and space appeared - they were the theory of relativity and quantum mechanics.

One of the main claims of the theory of relativity is that time and space together form a single entity called "spacetime". This is proven by the constancy of the speed of light c in vacuum with respect to any observer. In the vicinity of large masses and also in case of extremely fast movement of masses in vacuum, time and space begin to change, i.e. transform, in which case time slows down and the lengths of bodies shorten relative to the external observer.

In quantum mechanics, it is possible to describe the physical state of bodies (i.e. particles) only probabilistically. This means that, for example, the physical parameters of the movement of bodies, such as speed, position or coordinate, etc., cannot be precisely known in advance, because so-called uncertainty relations apply. From the beginning of the 20th century until the present time, there has been no progress beyond these notions that could be experimentally proven. However, the physics theory of time travel presents new insights that try to explain the seemingly irrational physical phenomena found in the theory of relativity and quantum mechanics.

In the physics theory of time travel, such a science of physics is presented that would allow a person to move in real time to the past and the future. The development of time travel technology creates new opportunities for the study of human history and also for movement in space. The general research method and construction of the physics theory of time travel is similar to theoretical physics that thousands of scientists around the world are working on. For example, hypotheses are made that are derived theoretically, but at the same time, all these hypotheses are fully consistent with existing generally accepted physical theories.

> In science, a "hypothesis" is an assumption that has not yet been proven. If the hypothesis has been confirmed, it is a scientific "theory". For the sake of simplicity and clarity, however, the hypotheses set forth in the physical theory of time travel are called theories, not hypotheses. The term "theory" is better known to the general public than the term "hypothesis".

In the physics theory of time travel, the topic of time travel is approached in a non-traditional way at the beginning, because it is concluded that the basis of time travel is the understanding of the physical system of ordinary space and hyperspace. This in turn shows the reality of wormholes and also its necessity for understanding time travel.

All existing physics theories, which deal with the real possibility of human travel in time, are based on the mathematical theories of wormholes, or tunnels in spacetime. The conclusions of the hypotheses established in the physical theory of time travel allow us to describe these wormholes very precisely, predicting their real existence. In the physical theory of time travel, possible further developments of existing generally accepted physical theories (for example the theory of relativity and quantum mechanics) are also presented, because without them it is not possible to physically understand time travel.

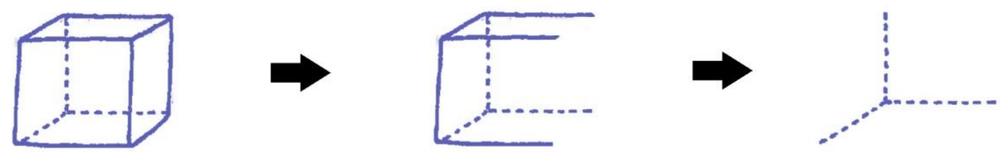
The physics theory of time travel reveals the surprising fact that a person's time travel (for example, to the past) is very possible in its nature and it is also technically completely feasible. This is also the most surprising conclusion in all of the physics theory, as time travel is generally considered impossible and absurd. Traveling through time turns out to be really possible only if the two main theories of modern physics are further developed: the theory of relativity and quantum mechanics. At the same time, it has been possible to develop even further than the physical theory of time travel. Time travel would inevitably change our current physical view of the universe. For example, time travel shows that time does not actually exist in the universe as we know it.

Until now, all physics theories of time travel were exclusively based on Albert Einstein's theory of general relativity. This theory predicts the existence of wormholes, or tunnels in spacetime. For example, two points in space (or also in time) are connected by a "tunnel in spacetime", through which it is possible to cross huge distances in space in a very short time. Wormholes allow bodies to move through space as well as time. This physical understanding of time travel still exists today. Marek-Lars Kruusen's Physics Theory of Time Travel does not refute such common understanding, but it does present new insights into wormholes and their significance in the physics of time travel. This means that older theories are further developed, in which the final result shows that a body teleports from one point in space to another or from one point in time to another by passing through a tunnel in spacetime. Teleportation of bodies is only possible outside of spacetime. Later it will be seen that teleportation in spacetime causes, for example, the probabilistic behavior of particles, i.e. the emergence of uncertainty relations in quantum mechanics.

In Marek-Lars Kruusen's physics theory of time travel, one of the basic physical foundations is the statement known from the theory of special relativity, that time and space together form a single whole, which is called spacetime. This is one of the basic claims of the special theory of relativity. However, the direct conclusion of this would be that if you move in time, for example to the past, you must also move in some kind of hitherto unknown spatial dimension. This means that time travel must be enabled by space travel. This space "exists" outside of our normal everyday perceived space. The equations of general relativity lose their validity when studying this space, because time and space no longer exist in such a space, which physically manifests itself in time dilation and length contraction. Therefore, the movements of bodies in such a space dimension no longer take time, and teleportation of bodies appears. According to it, it is possible to teleport to the past, the future and even "in the present". Teleportation in the present manifests as teleportation in normal space.

The cessation of existences of time and space occurs, for example, in black holes, in the centers of which the passage of time slows down to infinity and the lengths of space contract into infinitesimally small ones. In such a region of space and time, a person is able to move in time, that is, the phenomenon of teleportation can manifest itself, if a person could somehow get into the center of a black hole. More precisely, black holes exist as a "hole in spacetime" through which it is possible to enter a timeless and spaceless dimension, or outside spacetime. This dimension is called "hyperspace" in the physics theory of time travel. The dimension of hyperspace that allows time travel is very necessary to understand wormholes.

Currently, the world's top scientists are developing string theory, which is believed to be the best candidate for a "theory of everything". One of the central ideas in string theory is that spacetime has many more dimensions than four. For example, ten dimensions of space and one dimension of time are predicted. In total, this makes the 11-dimensional spacetime that string theory predicts for us based on the best of our current knowledge. However, the theories (i.e. hypotheses) derived in Marek-Lars Kruusen's physical theory of time travel prove the opposite: the dimensions of spacetime do not increase, but actually decrease, or cease to exist, when we try to understand the physics of time travel. For example, such a fact manifests itself when time slows down and length of bodies shortens in the immediate vicinity of large masses, or when mass moves more and more rapidly with respect to light.



Time and space exist. Classic mechanics apply.

Time and space begin to disappear. The theory of relativity applies.

Time and space no longer exist. Quantum mechanics applies.

Figure: Time and space in different theories of physics.

The cessation of the dimensions of time and space is also very clearly manifested in the physical phenomena described in quantum mechanics. At the present time, it is fairly safe to say that the experiments known so far show that particles can exist "outside of spacetime". Physically speaking, time and space no longer exist outside of spacetime, which may at first seem like a philosophical utopia. However, the physical theory of time travel shows us quite convincingly that the wave properties of particles are the result of their continuous teleportation in spacetime. The theory shows that any particle is also a wave, since the physical parameters describing its wave coincide very precisely with the parameters of the body's continuous teleportation in time and space. It is known from history that wave properties of particles have been proven in diffraction and interference experiments.

The relativistic effects described in the theory of relativity result from transformations of time and space, i.e. changes in which the cessation of the dimensions of time and space are manifested. In general relativity, the slowing down of time and the shortening of the distance between two points in space is described by Riemannian geometry, which is caused by the presence of large masses in spacetime. The curvature of spacetime is the basis of all general relativity, as large masses warp the surrounding spacetime. The seemingly irrational effects described in quantum mechanics manifest themselves precisely because time and space no longer exist for particles, and therefore particle teleportation occurs in our perceived spacetime. All known effects in quantum physics result from the constant teleportation of particles in spacetime, and that is why it is necessary to learn about the physical basis of teleportation, which is also presented very precisely and demonstrably in the physical theory of time travel. All of this is completely consistent with the generally accepted theories of physics and the general interpretation of the physics of time travel.

Since all bodies in the universe move in time towards the future and all phenomena in the universe take place in time and space, it can therefore be said that the physical theory of time travel presents the fundamental foundations of the existence of the entire universe. Consequently, the physical theory of time travel must explain practically all physical phenomena in the universe: from the Big Bang of the universe to its hypothetical "death", from black holes to atomic physics, from various interactions to extra dimensions of spacetime, etc.

Therefore, it can also be argued that the physical theory of time travel is the world's largest physical theory and the most comprehensive physical science, as it includes all branches of fundamental physics, such as: classical mechanics, quantum mechanics, relativity, electromagnetism, quantum field theory, thermodynamics, astronomy, cosmology, particle physics, nuclear physics, black hole physics and more. Since the mentioned theory also contains a technical solution for time travel, the fields of engineering and electrical engineering are also presented in it. Therefore, the literary work is extremely voluminous, reaching more than 1500 pages today.

> The physical theory of time travel exists as a "theory of everything", that is, a physical interpretation of the universe that tries to explain the functioning of the entire world.

Therefore, the physics theory of time travel is a great competitor to string theory, since string theory also claims to be the theory of the universe. If at the beginning of the 20th century, relativity theory and quantum mechanics emerged, which could not be combined, then it seems that the same situation will arise at the beginning of the 21st century: the physical theory of time travel and string theory cannot be combined either. However, both combine relativity and quantum mechanics in a unique way. It is safe to say that the physics theory of time travel is the biggest competitor to string theory. The physics theory of time travel tries to explain how the whole world works.

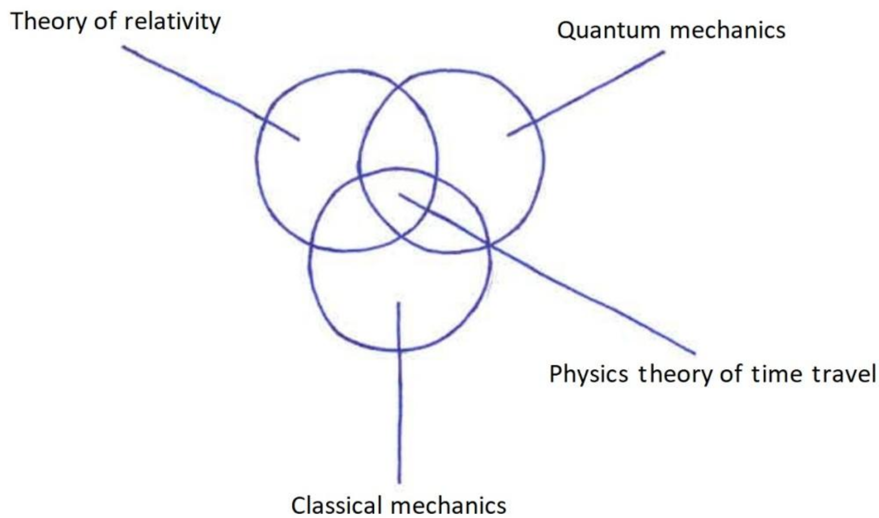


Figure: Physics theories of time and space.

The author of this theory confirms that the physical theory of time travel can do a relatively good job of describing all aspects of the universe, but even so it must be noted that the dark matter of the universe and the various time paradoxes are the only two major areas in which the truth of the explanatory theories cannot be completely certain. Descriptive theories created to explain these phenomena are presented in this work (that is, in the series), but there are no solid arguments to defend these theories. This does not mean that these theories are wrong, but there are so many theories that it is difficult to choose the right one, since they all seem to be equally correct (at least in theory). Only one theory can be correct, so different theories cannot be accepted at the same time. Only experiment or observation can provide certainty. However, in the author's opinion, the physics theory of time travel can handle the explanation of the rest of the physical aspects of the universe relatively well and believably.

In the literary work describing the physics theory of time travel, there are quite a lot of repetitions, in which many chapters contain similar or even identical texts. There are three main reasons why such repetitions occur. One of the reasons is that the chapters in the said work could be read and studied independently, i.e. separately from the given work. Another reason may be that the mathematical formulas are not numerically counted or ordered throughout the work. The third reason is that with the publication of new versions of the said literary work, older versions of the chapters are presented at the same time, so the new and the old can exist simultaneously in the same work. This is how the historical development of the work can be seen. The said work is extremely voluminous, reaching more than a thousand pages today, so the table of contents above provides the best overview of this literary work.

In this work, the theory of quantum fields is presented in three different chapters, the contents of which do not differ greatly from each other, but were created during different time periods:

1. "Fundamentals of quantum cosmology and introduction to quantum field theory"

2. "Mathematics of Lagrangians"

3. "Effect of electric charge on spacetime metrics, unified field theory and quantum field theory"

Since this work was written over a very long period of time (more than 13 years), the physical concepts contained in it have developed a lot in the meantime. For example, the third point is the oldest of them, and therefore it may be an outdated theory today, in which the physical insights presented are no longer so adequate. Nevertheless, it has been presented and brought to the end of the sequence in this work in order to show the historical development of the physical theory of time travel. The second point is the most recent, which can be considered the most advanced and the most perfect. It does not contain contradictions with itself or with the basic principles of the physics theory of time travel. The first point is also quite important, although it is historically a bit older than the second point. The first point is important in the sense that it shows the connection between the physics of time travel and the physics of matter, which is basically also shown by the second point.

The simplicity and comprehensibility of the basic ideas of the physics theory of time travel is quite astounding. Throughout history, there has been a general understanding that time travel is very difficult to do or even impossible to create. However, new insights in fundamental physics suggest just the opposite. Modern physics defines "time" as "duration". In the theory of relativity, time passes more slowly when the speed of bodies increases relative to light or when large masses are in close proximity. One of the central ideas of the physics theory of time travel is that it is only possible to move through time if time does not exist, i.e. "outside of time".

It seems impossible at first glance, but there are regions in spacetime of the universe where time runs infinitely slowly, i.e. time has "stood still" there. This means that time no longer exists. Such regions of spacetime exist, for example, in the centers of black holes, which is now known as a scientific fact. In them, time travel turns out to be possible. More precisely, black holes represent themselves as "holes in spacetime", through which it is possible to enter a timeless and spaceless dimension, i.e. outside of spacetime. This dimension is called "hyperspace" in the physics theory of time travel. This is shown by the hypotheses derived in the mentioned theory, which are also fully consistent with generally accepted physics theories and are, in turn, their "supplements". A lot of innovations and additions occur in, for example, quantum mechanics.

It is safe to say that the physics theory of time travel can be combined with quantum mechanics and the theory of relativity. The theory of general relativity itself describes traveling in time with the geometry of curved spacetimes (for example, wormholes), but movement in time is also a teleportation phenomenon, since movement in time itself does not take time. All processes that occur outside of time and space no longer take time, and therefore bodies are able to teleport in time or space. This is also clearly seen in quantum mechanics.

For example, the quantum entanglement of particles described in quantum mechanics turns out to be possible only when time no longer exists. Particles teleport in spacetime that we perceive, and this also results in their uncertainty relations, which are also the basis for quantum entanglements of particles. Therefore, quantum mechanics actually turns out to be a special case of "teleport mechanics". Mathematically, teleportation can also be described with the metric used in general relativity. For example, the distance ds between two points becomes infinitesimally small in space (for example, in the centers of black holes), which also means bringing distant locations closer, where it is possible to reach a certain destination in only a few moments. From this it is possible to calculate the physical parameters of teleportation.

The beginning of the development of the physics theory of time travel can be considered to be 2006, but its prehistory actually goes back to 2005. In 2005, the physics of the universe was systematically and purposefully studied, but in 2006, the physical possibility of time travel was also systematically studied. This means that in the beginning, the research directions of the physics of time travel and the physics of the universe were separate from each other. However, in later years it was understood that the physics of time travel is also suitable for describing the physics of the entire universe. In 2026, the physics theory of time travel will be 20 years old. The physics theory of time travel was first released to the general public in January 2013, when the very first version of history came out. It was then seven years later than the beginning of the formation of the theory. Since then, a new version has come out almost every year. It is only one literary work, the volume of which has only increased over time, and each new version is more developed and improved than the previous one. For example, in 2013, the volume of this work was a little over 100 pages, but nowadays the volume of this work is already extremely large, reaching over 1500 pages. The mathematical analyzes alone (derivations and calculations) are hundreds of pages long. All versions are written in Estonian, but only recently (since 2022) has it been actively translated into English:

1. https://zenodo.org/communities/time_travel

2. https://www.cambridge.org/engage/coe/search-dashboard?authors=Marek-Lars%20Kruusen

In 2023, it will be ten years since this work will be publicly available to everyone.

Various versions of the physics theory of time travel can be found on the internet. The very first version was released in January 2013. Since the physics theory of time travel is part of a larger project entitled "World Perception", it was initially published as a single work. Since the sixth version, the physics theory of time travel has also been published in the digital archive of the Estonian National Library. Since the ninth version, The Physical Theory of Time Travel has been published as a stand-alone publication, meaning that it has been published separately from the Perception of the World project. In the eleventh version, a literary work crossed the thousand-page mark for the first time in history. New versions will continue to be released in the future.

1.2.1 Peculiarities of mathematical physics and hidden physics

In theoretical and mathematical physics, "mathematical peculiarities" must be taken into account. For example, the calculations may not be very accurate with the data obtained during the experiments. This is especially characteristic of the physical theory of time travel, in which the calculated predictions of the equations obtained through mathematical analyzes may not be in exact agreement with the experimental data, or the derived equations may initially seem downright irrational. Some of the fundamental equations derived in the physical theory of time travel may initially appear unusable or unrealistic, but this is primarily because these equations must be used in the context of how they were obtained and what they will be used for in the future, not out of context. In the following, we will show the nature and reason of such mathematical peculiarities, which are specific to the physics theory of time travel. The physics theory of time travel generally doesn't use very complicated equations, probably just doesn't need to, but the mathematical analyzes on the other hand are very long and detailed.

For example, the quantum theory of fields described in the physics theory of time travel is generally presented approximately, not exactly. This means, above all, that many calculations that have been made and will be made are approximate and do not exactly match the experimentally obtained data. We will explain the result of this through the following short mathematical analysis, in which the appearance of approximation due to the use of different physics equations in describing the same phenomenon or law can be seen. Let's look at the following computational analysis for this example. For example, if the field energy E generated by an electrically charged spherical surface

$$E = \frac{q^2}{8\pi\varepsilon_0 r}$$

is 6,2 * 10^{43} J and the radius of the sphere is one meter (and ε_0 is approximately 8.85 * 10^{-12} C^2/Nm^2 and ε is approximately one), then we get the charge Q of the sphere to be 1.1 * 10^{17} C. In vacuum, ε is one, but in air it is 1.00057 (only at 20^0C). If the given electric field has an energy of 6.2 * 10^{43} J, then according to the relation between mass and energy $E = mc^2$, the mass of such amount of energy is 6.9 * 10^{26} kg, which can be the mass of some celestial body. Consequently, the mass of such a celestial body has a Schwarzschild radius

$$R = \frac{2GM}{c^2}$$

one meter and therefore such a Schwarzschild radius of one meter must also occur for a given electrically charged sphere. The radius of the electric charge horizon derived above

$$r_q = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

according to this, we get the charge Q to be 1.1 * 10^{17} C, if the radius is one meter and ε is approximately one. In this case, the magnitudes of the electric charge coincide exactly, although different equations have been used. The same end result has been obtained through different equations. However, the difference comes in when the prime numbers are different. For example, if the Schwarzschild radius R

$$R = \frac{2GM}{c^2}$$

is three meters (not one meter anymore), then the mass

$$M = \frac{Rc^2}{2G}$$

can be found in the following way:

$$M = 2{,}023 * 10^{27} \text{ kg}$$

Since the principle of equivalence of energy and mass or $E = mc^2$ applies, we get the following quantity for energy:

$$E = 1{,}8207 * 10^{44} \text{ J}$$

Such an amount of energy can be the energy E of the electric field of some cosmic celestial body

$$E = \frac{q^2}{2C} = mc^2$$

from which we get the magnitude of the charge q:

$$q = \sqrt{E(8\pi\varepsilon_0\varepsilon R)} = \sqrt{mc^2(8\pi\varepsilon_0\varepsilon R)} = 3{,}46649 * 10^{17}\ C$$

We can also find a charge q of almost the same size by calculating the Nordström radius according to the equation, if the radius R is also three meters:

$$q = \sqrt{\frac{R^2 4\pi\varepsilon_0 c^4}{G}} = 3{,}48551 * 10^{17}\ C$$

Compared to the previous one, it is not exactly the same charge. This is because different equations are used to produce the same result. Here you can see that the difference comes in, although it is very small. The most important is the first digit (one place before the decimal point), one place after the decimal point is approximately equal to five in both cases. However, there are also situations where there are different numbers one place after the decimal point, even though they are not very different from each other. Since the exponent is very large or in some other cases very small, the accuracy of the first number is basically sufficient.

Mathematical analyzes have shown that the larger the prime numbers and the more complex the equations used, the greater the differences. Although differences do come in, the physical understandings behind them are not wrong. This means that you simply have to take into account the peculiarities (mathematical regularities, not physical regularities) that inevitably accompany mathematics.

The electric field energy E is also related to the electric field strength:

$$E = \frac{\varepsilon\varepsilon_0 {E_T}^2}{2}$$

where V = 1 m^3. For a given amount of electric field energy, we can find the field strength E_T as follows:

$$E_T = \sqrt{\frac{2E}{\varepsilon\varepsilon_0}} = 6{,}4144 * 10^{27}\ V/m$$

Since the gravitational potential U can be equal to the quantum energy E:

$$\frac{GMm}{R} = h\frac{c}{R}$$

from which the equation of Planck's mass m is derived, it is concluded from this in the physics theory of time travel that an extremely small black hole can form at any point in the gravitational field. This means that gravitational fields create black holes with diameters equal to four times the Planck length, and they appear and disappear in a very short period of time. Because they are so small, they have no effect on ordinary matter. For example, if the Planck mass is represented in the Schwarzschild radius R equation:

$$R = \frac{2GM}{c^2} = \frac{2{,}905236 * 10^{-18}}{299792458^2} = 3{,}23251 * 10^{-35}\ m$$

and divide the resulting number by two:

$$\frac{3{,}23251 * 10^{-35}}{2} = 1{,}616255 * 10^{-35}\ m$$

then we get the expression for the Planck length l as a result:

$$l = \sqrt{\frac{Gh}{c^3}} = 1{,}616\ 229(38) * 10^{-35}\ m$$

This shows that the Schwarzschild radius R is equal to twice the Planck length l:

$$R = 2l$$

due to which the diameter d of the black hole is equal to four times the Planck length l:

$$d = 4l$$

Such a result is not really logical, since the diameter d of the black hole should still be equal to the Planck length l or only twice, not four times larger. In the following, we show how mathematical analysis allows us to reach a different result without violating the physical truth. The diameter of the smallest black hole cannot be four Planck lengths. For example, in the Schwarzschild radius R equation:

$$R = 2\frac{GM}{c^2}$$

there is an equation for Planck's length l:

$$l = \frac{GM}{c^2}$$

or

$$\frac{GM}{l} = c^2$$

where M is the Planck mass. The latter expression is obtained through a mathematical analysis of the physics theory of time travel as follows:

$$\frac{GMm}{R} = \frac{mc^2}{2} = mc^2 = hf = h\frac{c}{\lambda} = h\frac{c}{R}$$

In this, it can be seen that:

$$\frac{GM}{R} = \frac{c^2}{2} = c^2$$

or

$$\frac{GM}{R} = c^2$$

If M is the Planck mass, we see that $R = l$:

$$\frac{GM}{l} = c^2$$

In this case, the Schwarzschild radius R is equal to the Planck length l, so the diameter d of the black hole can be equal to twice the Planck length, no longer four times longer. Such a result is already much more logical, since the radius R of the smallest black hole can only be equal to the Planck length l, and it cannot be smaller or larger than it. The Planck length l is the smallest possible length in the entire universe, so the radius of the smallest black hole must be at least equal to the Planck length, not smaller than it. Such an understanding corresponds to physical truth, which can only be reached through the particularity of mathematics.

In the physics theory of time travel, the general equation of time travel is derived mathematically

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

from which in turn is derived the following energy equation E:

$$E = mc^2 = \frac{mc^2}{2}$$

Such an equation initially seems irrational or illogical if the masses m were equal. In the equation, it can be seen that on one side of the equal sign there is the static energy equation known in special relativity, but on the other side of the equal sign there is the kinetic energy equation known from classical mechanics. Despite the apparent illogic (the masses m are actually equal), such an equation is still correct and is used in many mathematical analyzes of fundamental physics. In the following, we will show that such an expression also comes from, for example, the special theory of relativity (not only the physics theory of time travel), which describes relativistic mechanics. For example, Newton's second law is expressed in relativistic mechanics as follows:

$$mya + my^3(\vec{\beta}a)\vec{\beta} = F$$

in this we multiply β:

$$mya + my^3a\beta^2 = F$$

and bring mya in front of parenthesis:

$$mya(1 + y^2\beta^2) = F$$

The expression in parentheses is mathematically transformed as follows:

$$mya(1 + y^2\beta^2) = mya\left(1 + \frac{\beta^2}{1-\beta^2}\right) = mya\left(1 + \frac{v^2}{\left(1-\frac{v^2}{c^2}\right)c^2}\right) = mya\left(1 + \frac{v^2}{c^2 - v^2}\right)$$

As a result, we get the expression for the relativistic force F:

$$mya\left(1 + \frac{v^2}{c^2 - v^2}\right) = F$$

or

$$\frac{F}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{F}{1 + \frac{v^2}{c^2 - v^2}}$$

We can factor out the force F:

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

and move one of the members to the other side of the equal sign:

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

Let's set the equation equal to one:

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

and let's open the parentheses:

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

We transfer the last term and the square root to the other side of the equation:

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

As a result, we obtain:

$$\frac{c^2-v^2}{v^2}y=\frac{c^2-v^2}{v^2}$$

or

$$\frac{v^2}{v^2}y=\frac{c^2-v^2}{c^2-v^2}$$

It can be seen from the resulting equation that $y=1$ and:

$$v^2=c^2-v^2$$

When transforming the latter equation:

$$v^2+v^2=2v^2=c^2$$

we get the expression for the square of the speed:

$$v^2=\frac{c^2}{2}$$

If we now multiply both sides of the equation by mass m and v = c, we get the expression for the static energy E:

$$E=mc^2=\frac{mc^2}{2}$$

which is exactly equal to the energy E equation given above. This shows the correctness of the physics theory of time travel and also that the theory of relativity is derived from the physics of time travel.

Previously, we saw that the energy E equation can also be derived from the special theory of relativity itself, but through a certain specific mathematical analysis. Similarly, this equation is derived in other mathematical analyzes (for example, in cosmology and quantum field theory), and this equation is also used in the derivation of other important equations and mathematical analyses. For example, from the energy equation E (in this case with the negative side):

$$E=-\frac{mc^2}{2}=mc^2$$

the Higgs field can be directly derived (and with it the spontaneous breaking of symmetry). This means that from the latter we can directly derive the Higgs field particle, which in turn is inextricably linked to spontaneous symmetry breaking. For example, the equation for energy E presented earlier is derived from the relation:

$$0=-\frac{c^2}{2}-c^2$$

Now, if we multiply both sides of this equation by m^2:

$$0=-\frac{m^2c^2}{2}-m^2c^2$$

then we get the following expression as a result:

$$-\frac{m^2c^2}{2}=m^2c^2$$

where we can see that c^2 cancels out from the equation nicely:

$$-\frac{m^2}{2}=m^2\frac{c^2}{c^2}$$

or

$$-\frac{m^2}{2}=m^2$$

Let us presume that the masses cannot be equal to each other $m^2 \neq m^2$ and therefore we introduce the new notation μ for mass m:

$$m^2 \neq \mu^2$$

In the resulting equation

$$-\frac{m^2}{2}=\mu^2$$

we take $-\frac{1}{2}$ to the other side of the equal sign:

$$m^2=-2\mu^2$$

and take a square root of both sides of the equation:

$$m=\sqrt{-2\mu^2}$$

In the resulting equation, the square root of a negative number is taken, and such a result completely coincides with the expression that would describe the Higgs boson mass m. The Higgs boson is a particle of the Higgs field, or the "excited state" of the Higgs field. The Higgs field, as an energy field, in turn gives mass to all elementary particles, except for photons and gluons. The Higgs field is inextricably linked to the mathematical and physical system describing the spontaneous violation of the vacuum.

In principle, we can also derive the energy E of the electric field from the expression for the mass m of the energy field

$$E = \frac{q\varphi}{2}$$

and the rest energy E mentioned above

$$-\frac{mc^2}{2} = mc^2 = E$$

from the mutual equality of the equations:

$$-\frac{mc^2}{2} = \frac{q\varphi}{2}$$

For example, let's square both sides of the latter equation:

$$\frac{m^2c^4}{4} = \frac{q^2\varphi^2}{4}$$

multiply both sides of the equation by 2 and consider the relationship between the speed of light c and Planck's constant h derived in quantum field theory:

$$\frac{1}{c^4} \approx \bar{h} = \frac{h}{2\pi}$$

As a result, we obtain the following equation:

$$\frac{m^2}{2} = \bar{h}\frac{q^2}{2}\varphi^2$$

In the following, we assume that the electric charge q is equal to the elementary charge, i.e. the constant e:

$$\frac{m^2}{2} = \bar{h}\frac{e^2}{2}\varphi^2$$

and as a result we have a more general constant which we can denote by λ:

$$\bar{h}\frac{e^2}{2} = const = \lambda$$

The constant λ is not a wavelength, but is a symbol for a constant, which can also represent an unknown constant. This gives us the general form of the equation:

$$\frac{m^2}{2} = \lambda\varphi^2$$

Let's move two to the other side of the equal sign:

$$m^2 = 2\lambda\varphi^2$$

and take the square root of both sides of the equation:

$$m = \sqrt{2\lambda\varphi^2}$$

Now, if instead of the electric field potential φ in the latter equation, it were the energy field potential v:

$$m = \sqrt{2\lambda v^2}$$

then the result would also coincide with the expression that would describe the Higgs boson mass m.

In the physics theory of time travel, many such connections have been presented and described, which have so far remained "overshadowed" in theoretical physics. It can be argued that there is a great deal of "hidden physics" in the visible universe. These are such physical laws that are not apparent at first glance. The theories that describe them initially seem contradictory, which do not seem to coincide with experimental data or observations. However, the claims of such theories cannot actually be wrong because they emerge from rigorous physical and mathematical analysis of fundamental physics and may be proven correct by experiments or observations at some point in the future.

Here we give one more example. The physics of time travel is based on the physical system of hyperspace and normal space, which is realized in nature as the cosmological expansion of the universe. Consequently, the universe must expand at the speed of light c, since ordinary space moves at the speed of light c relative to hyperspace. However, astronomical observations do not show that the universe is expanding at the speed of light. The expansion rate of the universe is indicated in modern cosmology by the Hubble constant H, which is clearly a much lower rate compared to the speed of light in vacuum. There is only one solution to such a contradiction: it simply "seems" to the observer that the universe is expanding much slower than the speed of light. Therefore, the physics theory of time travel states that time has changed all over the universe, which causes the universe to expand much slower than the speed of light to the observer. The universe is actually expanding at exactly the speed of light c, and this is one of the cornerstones of the physics of time travel that cannot be overlooked. The nature of dark energy, which was one of the biggest mysteries of modern cosmology until now, follows from the transformation of the universe's cosmological time and its change in time.

The physics theory of time travel states that the universe is actually expanding at the speed of light c, i.e. the Hubble constant H must be equal to the speed c. We demonstrate this through the following brief mathematical analysis presented in The Physics Theory of Time Travel. For example, as in the fundamental equation of cosmology derived in theoretical physics

$$\frac{\dot{a}^2}{2} - \frac{8\pi G}{6}\rho_{AE} a^2 = -\frac{kc^2}{2} + \frac{\Lambda c^2}{6} a^2$$

the equation holds:

$$\frac{1}{2}(\dot{a})^2 = -\frac{4\pi G}{3}\rho a^2$$

then we would also get such an equation, which in this case is presented as a "postulate":

$$\frac{1}{2}(\dot{a})^2\frac{1}{a} = -\frac{4\pi G}{3}\rho a \ = \ddot{a} = \frac{d^2 a}{dt^2}$$

or

$$\ddot{a} = \frac{1}{2}\frac{(\dot{a})^2}{a}$$

The latter relation is known in cosmology as the Friedmann equation in the case when the pressure of the universe is zero, i.e. p = 0. This directly results from the fact that collisions between galaxies are extremely rare at the present time compared to the events that took place in the first billion years of the universe. From the Robertson-Walker metric, the Hubble constant H can be represented as follows:

$$H = \frac{\dot{a}}{a}$$

where

$$\dot{a} = Ha$$

Consequently, we get the latter equation in the following form

$$\ddot{a} = \frac{1}{2}H^2 a$$

or

$$\frac{\ddot{a}}{a} = \frac{1}{2}H^2 = \frac{H^2}{2}$$

If we take from the Hubble´s constant H

$$H = \frac{\dot{a}}{a}$$

first derivative by time, then we get

$$\dot{H} = \frac{d}{dt}\left(\frac{\dot{a}}{a}\right) = \frac{\ddot{a}a - \ddot{a}\dot{a}}{a^2} = \frac{\ddot{a}a}{a^2} - \frac{\dot{a}^2}{a^2} = \frac{\ddot{a}}{a} - \left(\frac{\dot{a}}{a}\right)^2 = \frac{\ddot{a}}{a} - H^2$$

or

$$\dot{H} = \frac{\ddot{a}}{a} - H^2$$

Since the term in the latter equation can be presented based on the previously obtained relation

$$\frac{\ddot{a}}{a} = \frac{H^2}{2}$$

then we get the following very important equation:

$$\dot{H} = \frac{H^2}{2} - H^2$$

Next, we consider that the universe is actually expanding at the speed of light c:

$$H = v = c$$

and thus we obtain

$$\dot{c} = \frac{c^2}{2} - c^2$$

The physical and mathematical analysis of the equation of the pressure p of the universe derived in cosmology showed that all the basic equations in cosmology lead to the fact that the universe actually expands at the speed of light c:

$$-\frac{2H^2}{2} = -H^2 = -\frac{8\pi G}{c^2} p = -\frac{3}{\rho} p = -c^2$$

or

$$-H^2 = -c^2$$

which shows that H = c. Such a coincidence could not be accidental, and this is what we actually see when we apply the equation H = c.

Since the derivative of the constant c is zero

$$0 = \frac{c^2}{2} - c^2$$

and if we multiply both sides of the latter equation by the mass m, we get

$$0 = \frac{mc^2}{2} - mc^2$$

Let's move the equals sign to the other side of the member $-mc^2$ in the equation

$$mc^2 = \frac{mc^2}{2}$$

and consider the connection resulting from special relativity

$$c^2 = v^2$$

and finally we obtain the equation

$$\frac{mv^2}{2} = mc^2$$

Since the classical equation for kinetic energy can be expressed as follows:

$$\frac{mv^2}{2} = E$$

then we can present the equation of rest energy:

$$E = mc^2$$

which can be understood as the "definition" of kinetic energy. This means that the universe actually expands in time at the speed of light, and therefore all bodies in the universe have kinetic energy, which in this case is manifested as the equation for static energy. The previously presented and derived equality of the expansion rate of the universe with the speed of light c shows that it basically also comes out of traditional cosmology, although it is kind of hidden there. The physics theory of time travel predicts this, that is, it shows it openly, which gives a credible testimony for the validity of the statement.

1.3 The foundations of the physical theory of time travel

1.3.1 Introduction

The absolute basis for understanding the physics of time travel is the physical system of ordinary space K and hyperspace K', which manifests itself in nature as the cosmological expansion of the universe. This is a theoretical concept consistent with astronomical observations, which is inevitable for the further development of fundamental physics in the future. The concept of ordinary space refers to ordinary spacetime, which is four-dimensional and in which all bodies in the universe exist. However, hyperspace represents an external dimension of spacetime that is related to the dimension of time and relative to which our normal space "moves". The physical system of ordinary space K and hyperspace K' can be derived from several circumstances: physical considerations and mathematical regularities. These circumstances are presented and described to us in the following three chapters:

1. Basic principles of the physics theory of time travel

2. A physical and mathematical in-depth analysis of the relationship between time travel and the cosmological expansion of the universe

3. The physical system of normal space and hyperspace

The first chapter is related to special relativity, but it contains only physical analysis. It is a supporting material that shows the derivation of the physical system of ordinary space K and hyperspace K' from the continuum of time and space. The continuum of time and space in turn results from the constancy of the speed of light c. The first chapter shows that the physics of the spacetime continuum based on special relativity supports, rather than contradicts, the theoretic concept of normal and hyperspace system. Transformations of time and space are also described in the special theory of relativity (for example, time dilation and body length contraction), which can be explained by the system of ordinary space and hyperspace, but this will be described in other chapters.

The second chapter shows us how the system of ordinary space and hyperspace can be derived only from physical consideration, that is, from a physical analysis of the coordinates of bodies in relation to the universe. In the simplest terms, the system of normal and hyperspace results from the expansion of the universe. Since the universe as a whole is expanding, therefore all bodies in the universe have different spatial coordinates at any given time. The event can also be represented as spatial coordinates. Such a fact shows the existence of a moving space, from which the system of spacetime and its external dimension can be seen.

The third chapter is related to the special theory of relativity, which is based on the constancy of the speed of light with respect to any observer. Its math shows the existence of imaginary space if you exceed the speed of light c. It turns out that this space is actually the hyperspace described in the second chapter. Therefore, it can be argued that if the second chapter is based on physical analysis, then the third chapter is the mathematical content of the second chapter. This means that the physical content of the imaginary equations in the special theory of relativity is presented in the second chapter.

1.3.2 Basic principles of the physics theory of time travel

Albert Einstein's theory of special relativity shows us that the speed of light in vacuum is a constant quantity relative to any observer and in any background systems (including inertial background systems). Such a fact arises from the co-transformation of time and space: the faster the body moves, i.e. the closer it gets to the speed of light in vacuum, the more time slows down and the length of the body shortens relative to a stationary observer. It follows directly from this that time and space cannot be separate from each other, but these two together form a single unit, which is called "spacetime". Time and space are parts of the same continuum, so it is not possible for time to exist, but not space, and *vice versa*.

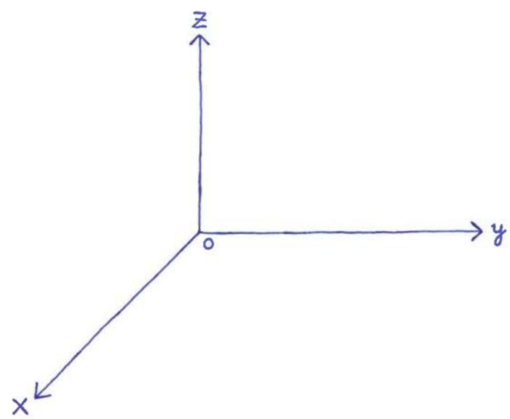
In his special theory of relativity published in 1905, Albert Einstein combined time and space into a single "spacetime". This means that time and space are completely inextricably linked, which comes directly from the constancy of the speed of light in vacuum. But according to the physics theory of time travel, there should actually be "motion" among the continuum of time and space, because motion cannot exist without the existence of time and space, and *vice versa*: time and space also cannot exist if there is no "motion of something". That is why time, space and movement must be inextricably linked.

Such principle of inseparability can be further extended. For example, spacetime and matter can also be considered inextricably linked. As an example of this, we can assume that if all the bodies in the universe were to suddenly disappear (evaporate into the air), then in this case spacetime would no longer exist. This would also be true in the opposite case, in which the disappearance of spacetime would also cause all matter to cease to exist. All bodies in the universe have dimensions in space and duration in time.

If time and space are inextricably linked, then it follows that when we move in time (for example to the past), we must also move in space. This means that if we travel in time, we must also move in some kind of unknown dimension of space. Such a conclusion is one of the most important in the physics theory of time travel. This is one of the most fundamental concepts without which time travel cannot be understood. The speed of light in vacuum is the same for all observers at any point in the universe. It is the movement of something and the speed at which it can be seen that duration (or time) and spatial extent (in space) exist together depending, in other words: to some duration (or time period) that corresponds to some kind of spatial extent "in space". All movements always take place in space, so time travel itself must also take place in some kind of space.

The above-mentioned conclusion leads to the understanding that time is the duration of physical processes, but there is a certain location in space, or a point in space, for each moment of time. For example, the further a certain moment in time is in the past, the further its coordinate in "space" is. At the same time, any kind of duration (or time period) corresponds to some kind of "extent" in space. The obtained purely physical conclusion is in its nature one of the fundamental laws of time travel. All further conclusions follow from the fact stated above. Later we will see that such regularity manifests itself in nature as the cosmological expansion of the universe. For example, the further in the past some kind of event took place at any point in the universe, the further it exists in space (that is, the smaller the volume of the universe was). Time does not exist "separately" from space, just as space does not exist separately from time.

Each moment of time has its own definite coordinate in space, but the points of this space cannot be the points of our normal, or everyday, experienced space. This is also a very important conclusion. For example, if a person moves from one location in space to another, this does not cause the person to move, for example, to the past in time. Therefore, the spatial points of moments in time are not the points of the space in which people live on a daily basis. The space we experience on a daily basis is three-dimensional (x, y and z):



It follows from the above that these spatial points of time moments must be "outside" the three-dimensional space in which we live on a daily basis.

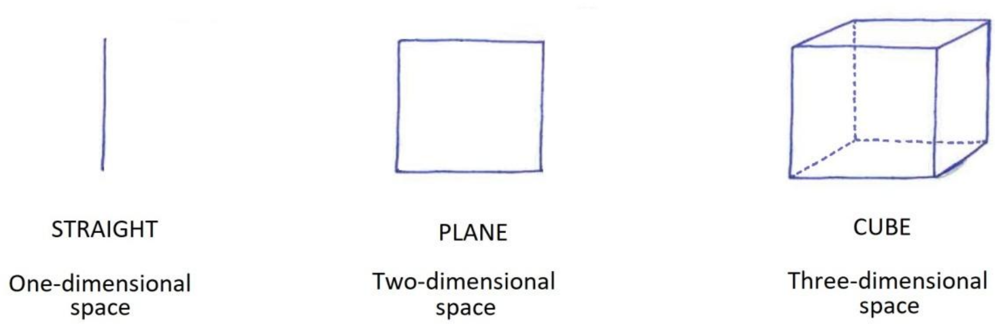


Figure 2 The three-dimensionality of space.

From geometry, we know that a line is one-dimensional, a plane is two-dimensional, and a cube is three-dimensional. A point has no spatial dimensions. Time is believed to have only one dimension, as until now it was believed that time cannot travel. One-dimensionality follows from the arrow of time from the past to the future. So ordinary spacetime has four dimensions.

Unfortunately, it is difficult to imagine dimensions that exist outside of space and time, or a spacetime with more dimensions. The same problem actually occurs in string theory, where 10-dimensional space cannot be imagined. In Albert Einstein's theory of general relativity, an analogy with the surfaces of a sphere is brought out to better understand curved spaces. Later we will see that bodies outside of space are actually located in other dimensions of space. The following are some examples of higher dimensional spaces that have been tried to be represented geometrically in physics. These are coordinate systems in 3-, 4-, and 5-dimensional space:

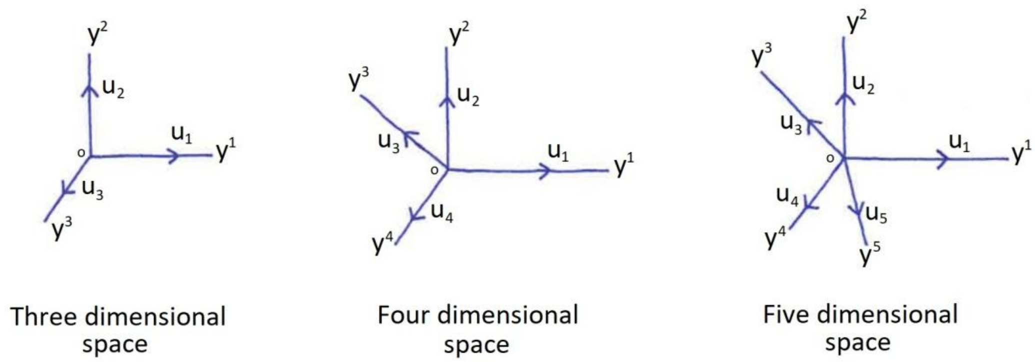


Figure 3 These are coordinate systems in 3-, 4- and 5-dimensional space.

If the spatial points of time moments are located outside the points of our normal space, then we are already dealing with a space with more dimensions, no longer a three-dimensional space. This means that our space cannot actually be three-dimensional, but must be at least four-dimensional. The fourth dimension of space is related to time in such a way that different points of the dimension of space are also different moments of time. For example, a point P might be in 4-dimensional space with the following coordinates:

$$P = (y_1, y_2, y_3, y_4)$$

In it, y_1, y_2, and y_3 are the three coordinates of our normal three-dimensional space: x, y, and z. The fourth component y_4 is actually also a space coordinate, but it also corresponds to a time coordinate, so we can write: $y_4 = t$. It follows that 4-dimensional space (not 4-dimensional spacetime) is actually the usual spacetime we know, that is, the coordinates of point P can be written as follows:

$$P = (x, y, z, t)$$

In geometry, it is possible to represent the basic forms of an n-dimensional Euclidean space, which, in the case of four dimensions, can be represented as follows:

$$s^2 = (y_1)^2 + (y_2)^2 + (y_3)^2 + (y_4)^2$$

$$s^2 = (y_1{}^2 - y_1{}^1)^2 + (y_2{}^2 - y_2{}^1)^2 + (y_3{}^2 - y_3{}^1)^2 + (y_4{}^2 - y_4{}^1)^2$$

$$ds^2 = (dy_1)^2 + (dy_2)^2 + (dy_3)^2 + (dy_4)^2$$

However, they do not apply to the physical system of hyperspace K' and normal space K. They are valid only if these equations are presented as follows:

$$s^2 = (y_1)^2 + (y_2)^2 + (y_3)^2 \quad \text{ja} \quad y_4$$

$$s^2 = (y_1{}^2 - y_1{}^1)^2 + (y_2{}^2 - y_2{}^1)^2 + (y_3{}^2 - y_3{}^1)^2 \quad \text{ja} \quad y_4$$

$$ds^2 = (dy_1)^2 + (dy_2)^2 + (dy_3)^2 \quad \text{ja} \quad y_4$$

This is because the coordinate y_4 is also related to time, and when moving in a normal 3-dimensional space, a person does not move in time, for example, to the past. Therefore, current knowledge of geometry cannot be applied to such a 4-dimensional space. However, if we consider pseudo-Euclidean geometry, Minkowski spacetime can describe a pseudo-Euclidean 4-space, where the square of the interval between two events is a metric invariant:

$$(\triangle s_{12})^2=(\triangle x_1)^2+(\triangle x_2)^2+(\triangle x_3)^2+(\triangle x_4)^2$$

in which there is an imaginary time coordinate:

$$x_4=ix_0=ict$$

The other three coordinates (x_1, x_2 and x_3) are standard Cartesian space coordinates. This form is already much closer to describing the system of hyperspace and normal space, but we will look at it much more thoroughly later.

Above we stated that every moment of time has its own specific spatial coordinate. Time is a duration that never ceases, or never "stands still". This also means that with the change of moments in time (for example, the first second, the second, the third second, etc.), the points in space also change (for example, at location x_1, location x_2, location x_3, etc.). But the change of position in space over some period of time is what we understand in physics as the definition of motion. Consequently, some kind of movement appears. This clearly indicates that the three dimensions of space must "move" relative to the fourth dimension of space. This is difficult to imagine, so some geometric features of 4-dimensional space appear as "expanded drawings". We will show this in the following.

It was concluded above that every moment of time must have some kind of spatial coordinate, which is expressed mathematically quite simply:

$$t_1 = (y_1)$$
$$t_2 = (y_2)$$
$$t_3 = (y_3)$$
$$t_4 = (y_4)$$
$$\dots \dots \dots$$

Since the three dimensions of space "move" in relation to one (that is, the fourth) dimension of space, i.e. the ordinary space K "moves" in relation to the hyperspace K', it can be simply imagined as follows:

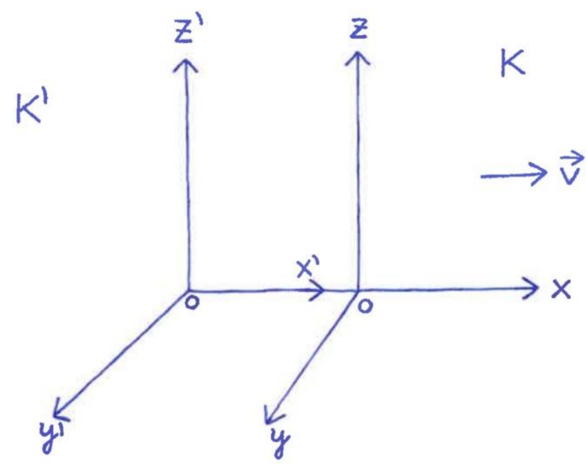


Figure 4 Hyperspace K' and normal space K. Hyperspace and normal space are not background systems (neither inertial nor non-inertial background systems).

The previously presented figure is a simplified model of the physical system between hyperspace K' and normal space K, which is a pictorialized concept of time and space that exists in reality. It is a physical model that helps to better understand and remember the relationship between spacetime and hyperspace. In reality, the physical system of hyperspace K' and ordinary space K manifests as a cosmological expansion of the universe. The model is made in such a way that normal space K moving relative to hyperspace K' is the normal three-dimensional space of the universe, and hyperspace K' is the fourth dimension of space, which is related to time. Since time is "moving", the model also shows movement of ordinary space relative to hyperspace.

> It is known from the history of physics that the Hungarian-born philosopher and mathematician **Menyhért Palagyi** (1859-1924) developed the idea of the unity of time and space and treated time as an imaginary coordinate of a four-space ("running space"), which is actually very similar to the present physical system of ordinary space K and hyperspace K´. The only difference is that Palagy did not associate the imaginary coordinate of four spaces with a dimension that allows for time travel.

In the last figure, it can be seen that the hyperspace K´ and the normal space K are both represented as three-dimensional. This is because the model would be simpler, more understandable and more handy for us. The figure shows that ordinary space K moves at some speed relative to hyperspace K´. It is important to note that normal space and hyperspace are not background systems: neither inertial nor non-inertial background systems.

> In the case of a four-dimensional coordinate system (that is, Einstein's curved spacetime), three spatial axes and one time axis are used. The moment of time is multiplied by the speed of light c to make it the fourth dimension of space. The result is four (spatial) coordinates: x, y, z and ct. Such a concept would also be suitable to describe the system of hyperspace and normal space, but we will look at it more closely later, in which case the connections of the theory of relativity with this system will be described.

According to the physical system of hyperspace K' and normal space K, we move in time to the past, for example, if we move in the K' dimension of hyperspace, not in the K dimensions of our normal space. This means that the movement must be in hyperspace in order to travel in time. If we want to move in time to the past or the future, this can only be done "outside" our usual perceived 4-dimensional spacetime, i.e. outside 3-dimensional space. It is the "extra dimensions" of space that cannot be described in classical mechanics or even in relativity that allow the body to move through time. Space has another dimension, and this makes a 3-dimensional space actually a 4-dimensional space. In this case, time has become a spatial dimension, but not in the sense that it is presented to us by the geometry described in the theory of relativity. It can also be said that in order to travel in time, we have to move outside of (3-dimensional) space, because then one additional dimension of space appears, which is related to the "moving" time dimension. "Outside" of our normal 3-dimensional space it is possible to move in other dimension(s) of space.

In addition to the physical system of hyperspace K' and ordinary space K, it is worth presenting here another important regularity, which is not directly related to the previously mentioned system. For example, the laws of time, space and motion show that time and space are actually illusions created by motion. This means that the movements of the bodies themselves in the universe leave such an "impression" that they take place in space and last for a certain period of time. Therefore, time and space do not really exist in reality. Their existence is actually an illusion. Such an understanding is not directly visible in our visible world, because the physics of time and space described in relativity and quantum mechanics is actually based on the illusion of the existence of time and space. This is proven to us by the physical theory of time travel, one of the fundamental foundations of which is that time is related to the moving space dimension outside of spacetime.

In the special theory of relativity, time and space are combined into one unit, which is called spacetime. But according to this system, motion is also added to spacetime. There are phenomena in nature that force this to happen, such as time dilation. Why do we see the slowing down of time precisely as a slowing down of the movement speeds of bodies? When time stops, the movements of bodies cease completely. Therefore, the question arises, why is there such a connection between spacetime and the movement of a body? It is clear that time and space cannot be separated from each other, but the previously described phenomena lead us to think that this is also the case with spacetime and movement. Time, space and motion are three "components" that cannot be separated from each other. This is one aspect of the inextricable connection between spacetime and movement. We covered the second aspect when we described the physical system of hyperspace K' and ordinary space K. Even in this case, the inseparable connection between spacetime and movement is visible.

Although time and space no longer exist in hyperspace, because according to the theory of relativity their dimensions are equal to zero, we can nevertheless imagine hyperspace as, for example, one-dimensional space. By moving forward or backward in it, the body travels in time to the future or the past, respectively. Therefore, time is rather two-dimensional there. But hyperspace can also be imagined as a three-dimensional space, because it is possible to "enter" it from any coordinate point in normal space, and besides, bodies teleport "from there" to any point in normal space. We will look at and describe these aspects in more detail in the future.

> Since it is possible to move in time to the past and future in hyperspace, we can treat time t as a "vector" and no longer as a scalar:

$$t \to \vec{t}$$

It can be argued that hyperspace is a hypothetical spacetime that exists outside of our everyday perceived time and space. Although hyperspace (and therefore hypertime) contains the everyday concepts of time and space, in reality, hyperspace does not contain any time and space dimensions. Nevertheless, hyperspace can be represented in geometrical models as a three- or even four-dimensional coordinate system that exists parallel to our normal spacetime. Hyperspace is like a parallel spacetime, not to be confused with a parallel world. There is no time or space in it, which is expressed in the fact that it is possible to move in hyperspace only momentarily and by passing any distance. Hyperspace is a timeless and spaceless dimension that exists outside of spacetime.

According to the physical system of ordinary space K and hyperspace K', ordinary space is the three-dimensional space we experience on a daily basis. Thus, ordinary space can be called "spacetime", which is four-dimensional and in which time and space exist. The concept of spacetime is also used in Albert Einstein's theory of relativity. However, hyperspace is an outer dimension of spacetime in which time and space no longer exist. Since movement in hyperspace causes time travel to the past or future, then such a dimension can be called "time space". It is the dimension of space that allows for time travel. Spacetime and time space are not the same, as normal space and hyperspace are very different dimensions. When we talk about "time space", we mean hyperspace. When we talk about "spacetime", we mean ordinary space. The concepts of spacetime and time space are fundamental to understanding time travel.

1.3.3 A physical and mathematical in-depth analysis of the relationship between time travel and the cosmological expansion of the universe

1.3.3.1 Relativity of motion

The movements of all bodies in the universe is relative, which means that the movement of any body is always described in relation to some kind of background system. For example, the motion of a person on the deck of a ship sailing on a river is "relative", because the motion of the person is relative to the ship. However, the movement of the ship with the passenger relative to the river bank is called “co-motion”. However, the movement of the traveler relative to the river bank is called "absolute movement".

This principle of relativity of the movement of bodies also appears in Albert Einstein's special theory of relativity. For example, a person is not able to move independently without means of transport at 200 km/h relative to stationary ground. However, if a person runs from one end of the train to the other in the direction of the train, which is moving at about 190 km/h relative to the ground, then a person can run at about 200 km/h relative to the ground. Compared to the train, however, the human speed is only 10 km/h. In principle, it does not matter in which way the movement of a person with respect to the earth is carried out. A person is moving at 10 km/h relative to the train, but ultimately the person is still moving at 200 km/h relative to the ground. This means that a person only needs to move at a speed of 10 km/h to reach a speed of 200 km/h. The rest of the "work" is done by the "side forces", which in this example is the movement of the train relative to the ground.

According to mechanics, all motion is relative, meaning that any motion can only be described in relation to some other body, motion, or background system. However, the expansion of the universe is not relative, but can be considered absolute, as the universe expands relative to an observer at any point in the universe. For example, in any galaxy we would see a redshift caused by the cosmological expansion of the universe. Furthermore, the motions of all bodies eventually come down to the expansion of the universe, since all bodies in the universe move along with this expansion, and no body can outpace the rate of expansion of the universe. The further apart galaxies or their clusters are, the faster they are moving away from each other.

When a person moves from spatial point A to spatial point B, it always takes some time and always covers some kind of path length in space. For example, if a person moves from the kitchen to the living room in his house, and after some time he moves back from the living room to the kitchen, it seems that the kitchen is in exactly the same location in the room where it was before. However, it only appears that way, because it is not actually correct. The kitchen is not exactly in the same location in the room as it was some time ago, and that is because the kitchen, the living room, the house and the person himself have moved along with the planet in space to a new location in space. Planet Earth in turn moves forward with the Solar System, which in turn moves with the Milky Way Galaxy, and so on. However, the real former location of the kitchen in the room remains very far away. Hence the moment in time. The space of the universe as a whole is expanding, which is said to have been caused by the Big Bang billions of years ago. All matter in the universe moves along with this general expansion. For example, the planet Earth a hundred years ago is very far away in space. The actual former location of the kitchen is constantly further away from us in space because we are constantly moving along with the expansion of the universe. If a person wants to move back to the actual former location of the kitchen in space, then he has to "break free" from the curvature of spacetime (or gravity), which constantly pulls him along with everything. To do this, he has to move in a space that remains constantly out of our reach. Only in this way is it possible to go to the real former location of the kitchen in the room. It can be argued that this would also allow you to travel back in time. Such space, called hyperspace, remains inaccessible to us all the time, because we are constantly moving along with the space of the cosmically expanding universe.

In the following, we assume that the planet Earth is ordinary space K and bodies M and m are objects on it, for example people. However, hyperspace K´ is the rest of the expanding universe. The K of ordinary space can also be seen as the ordinary space(time) in which people live on a daily basis, but K' is hyperspace, or the external dimension of space(time). In the following, we will look at and mathematically describe how bodies move in ordinary space K and hyperspace K'. In the following, we prove that when moving in hyperspace, the body also moves in time. In doing so, we must take into account the basic rules of time and space physics, which derive directly from Albert Einstein's special theory of relativity:

1. Time and space exist inextricably together. This is confirmed by the principle of the constancy of the speed of light in the special theory of relativity. The speed of light c in vacuum is constant relative to any observer.

2. It follows from the above that when moving, for example, to the past in time, we must also move in space. This space cannot be the space we experience on a daily basis, so it must be an external dimension of spacetime.

3. In turn, it follows from the above that every moment in time has its own point in space. This essentially means that when moving, for example, back in time, the bodies must also be in their true former positions relative to the entire universe.

Hyperspace is a hypothetical spacetime that must exist outside of our everyday perceived time and space. Although hyperspace (and also hypertime) contains everyday concepts of time and space, hyperspace does not actually contain any time and space dimensions. Nevertheless, hyperspace is represented in geometrical models as a three- or even four-dimensional coordinate system that exists parallel to our ordinary, or everyday, spacetime. Hyperspace is similar to parallel spacetime, not to be confused with a parallel world. Time and space do not exist in it, as hyperspace is a timeless and spaceless dimension that exists outside of spacetime.

All figures are made in the Cartesian cross coordinate system, in which the following mechanical system is represented: bodies M and m and normal space K and hyperspace K'. In the real world, the normal space K and the hyperspace K´ can be considered the same size:

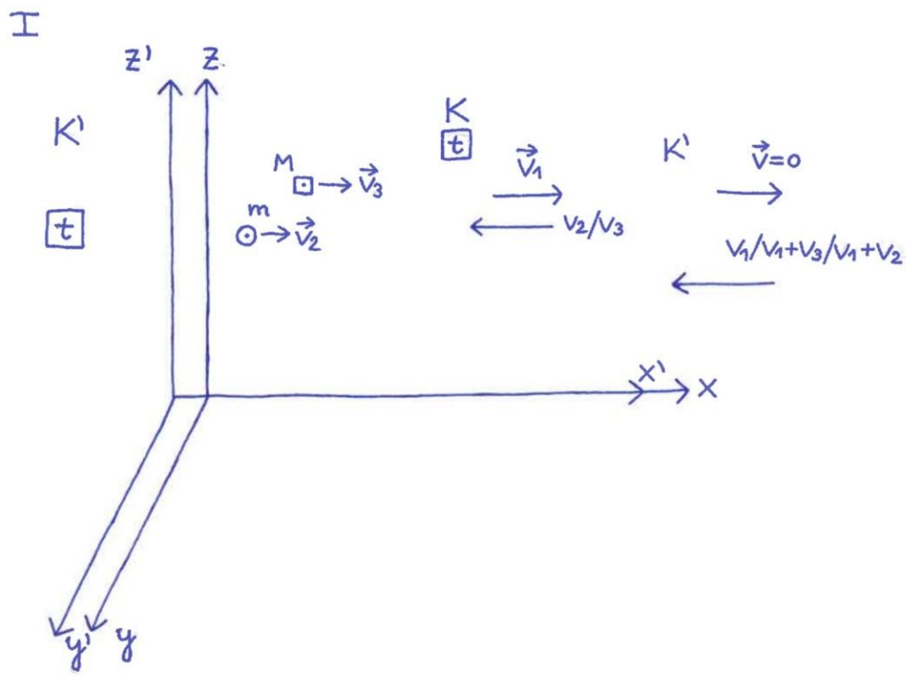


Figure 1 Bodies m and M move in ordinary space K and hyperspace K´.

It can be seen from the figures that body m exists in normal space K with coordinates m(x, y, z, t), but in hyperspace K´ the coordinates of body m are: m(x´, y´, z´, t). Body M also exists in normal space K, but with coordinates $M(x_1, y_1, z_1, t)$. In the hyperspace K´, the coordinates of the body M are $M(x_1´, y_1´, z_1´, t)$. Normal space K exists with respect to hyperspace K´ with coordinates $K(x_2´, y_2´, z_2´, t)$. We present these coordinates of bodies and "spaces" here and hereafter as follows:

In normal space K:	In hyperspace K´:
m(x, y, z, t)	m(x´, y´, z´, t)

$M(x_1, y_1, z_1, t)$ $M(x_1', y_1', z_1', t)$
$K(x_2', y_2', z_2', t)$

It can be seen from the figures that all movement occurs only in a straight line in the direction of the x-axis. The movements are uniform, i.e. the numerical values of the movement speeds do not change over time. Hence v represents velocity and a represents acceleration. Hyperspace K´ is absolutely stationary, i.e. v = 0, only K, m and M move in the direction of the x-axis. In the future, it is not important to describe or observe the movement of these bodies m and M and the normal space K, but it is important to observe the changes in their coordinates in space and in time. Since all movement takes place only in the direction of the x-axis, other coordinates can be neglected:

$$y = y_1 = y' = y_1' = y_2' = 0 \quad \text{and} \quad z = z_1 = z' = z_1' = z_2' = 0$$

Consequently, the coordinates of the positions of the bodies m and M and the normal space K can be written as follows:

In normal space K:

$m(x, 0, 0, t)$
$M(x_1, 0, 0, t)$

In hyperspace K´:

$m(x', 0, 0, t)$
$M(x_1', 0, 0, t)$
$K(x_2', 0, 0, t)$

From now on, we will only use the form of such a representation.

In this case, we observe the coordinates of the bodies m and M and the normal space K in space at a certain time t. If the bodies m and M and the normal space K move relative to each other, the hyperspace K' actually moves relative to them as well. If the bodies m and M and the normal space K move in the direction of the x-axis, the hyperspace K´ moves in the opposite direction of the x-axis with respect to m, M and K. The hyperspace K´ itself is actually still in place, that is, absolutely still. Only m, M and K move, the rest of the movements are due to relativity.

It is important to note that the speed of movement of the body m is relative. For example, in normal space K, its speed is v_2, but relative to hyperspace K', it is $v_2 + v_1$. The same is the case with the speed of movement of the body M. In normal space K, its velocity is v_3, but relative to hyperspace K', the velocity is $v_3 + v_1$. Normal space K moves relative to hyperspace K´ at speed v_1. Normal space K moves at velocity v_2 relative to body m and v_3 relative to body M. But the normal space K moves in the opposite direction of the x-axis with respect to the bodies m and M.

It can be seen from the figures that the bodies m and M and the normal space K have made a shift, i.e. moved a certain distance in the direction of the x-axis, because we are now observing the given mechanical system from another time instant t_2, which is different from the previous time instant t:

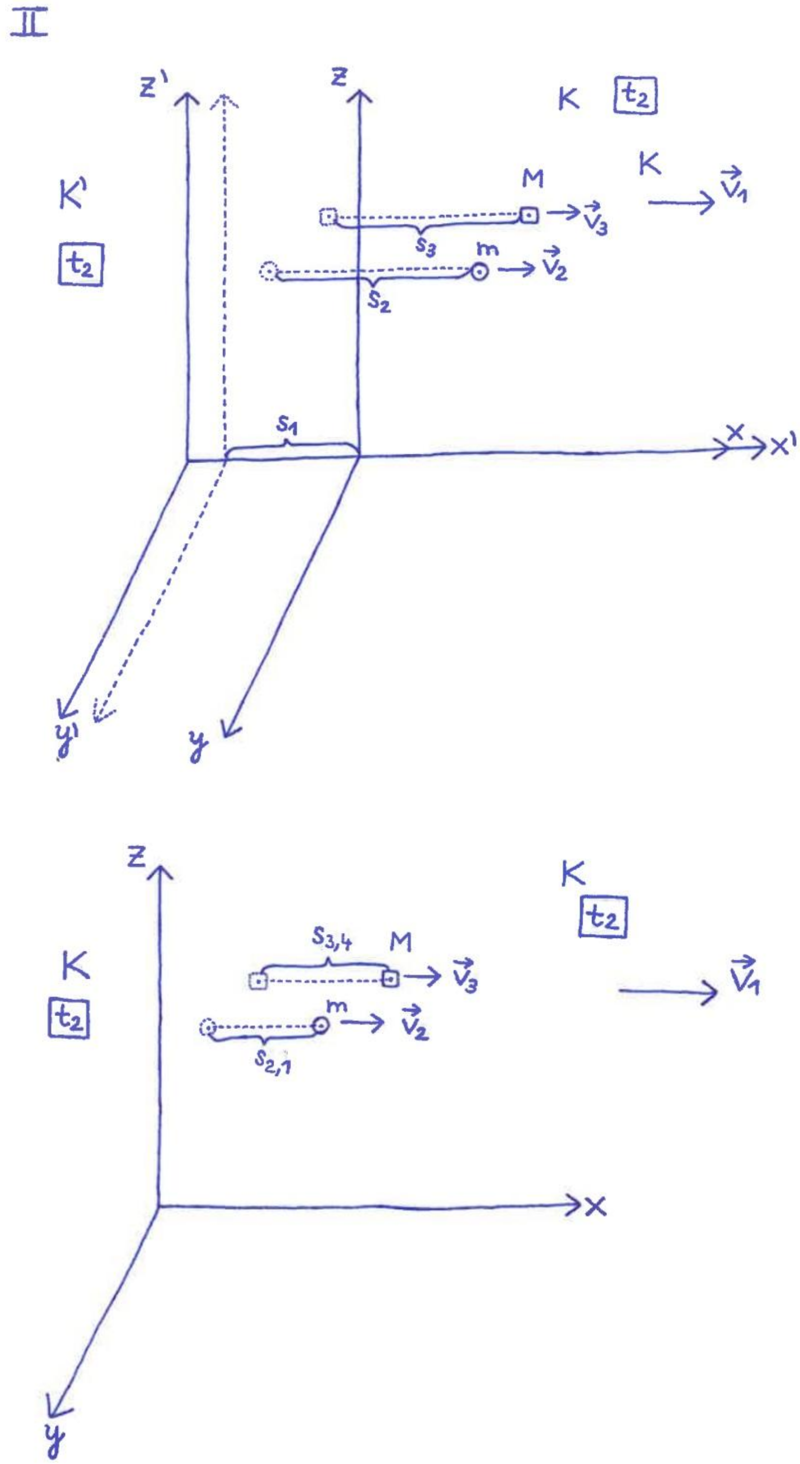


Figure 2 Bodies m and M move with respect to K and K´.

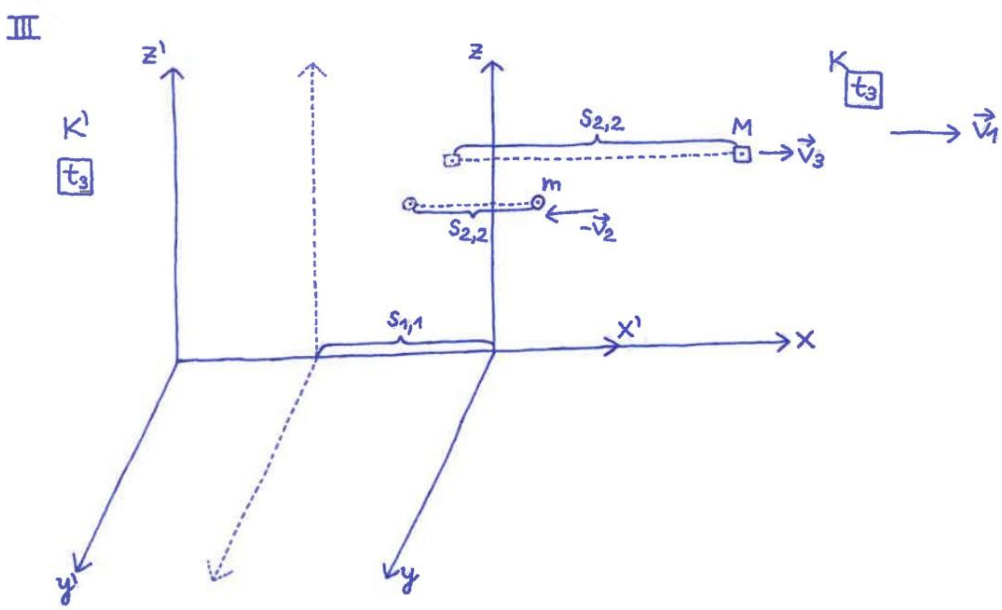
In this case, body m is located in normal space K with coordinates m(x_a, y, z, t_2), but with respect to hyperspace K', it is m(x_a', y', z', t_2). Body M is located in normal space K with coordinates M(x_b, y_1, z_1, t_2), but in hyperspace K´ with coordinates M($x_b´$, $y_1´$, $z_1´$, t_2). The normal space K itself now exists with respect to the hyperspace K´ with coordinates K(x_3´, y_2´, z_2´, t_2). All this can be presented in the following form:

In normal space K:	In hyperspace K´:
m(x_a, 0, 0, t_2)	m(x_a´, 0, 0, t_2)
M(x_b, 0, 0, t_2)	M(x_b´, 0, 0, t_2)
	K(x_3´, 0, 0, t_2)

The bodies m and M shifted, that is, they moved forward a certain distance. Body m moved a distance of $s_{2,1}$ relative to normal space K, but s_2 relative to hyperspace K´. Body M moved a distance of $s_{3,1}$ relative to normal space K, but s_3 relative to hyperspace K´. Normal space K moved a distance of s_1 relative to hyperspace K´. Bodies m and M are located at time t_2, i.e. after moving in new time and space coordinates, both relative to normal space K and hyperspace K'. In the same way, normal space K is located in new coordinates of time and space, i.e. spacetime, in relation to hyperspace K´. Here and from now on, we can present all this as the following non-proportional relations, which emphasize the existence of different spatial coordinates at different moments in time:

In normal space K:	In hyperspace K´:
m(x, 0, 0, t) $\neq$ m(x_a, 0, 0, t_2)	m(x´, 0, 0, t) $\neq$ m(x_a´, 0, 0, t_2)
M(x_1, 0, 0, t) $\neq$ M(x_b, 0, 0, t_2)	M(x_1´, 0, 0, t) $\neq$ M(x_b´, 0, 0, t_2)
	K(x_2´, 0, 0, t) $\neq$ K(x_3´, 0, 0, t_2)

The bodies m and M and the ordinary space K moved forward once more, i.e. it is the same mechanical system observed from the third moment of time t_3:



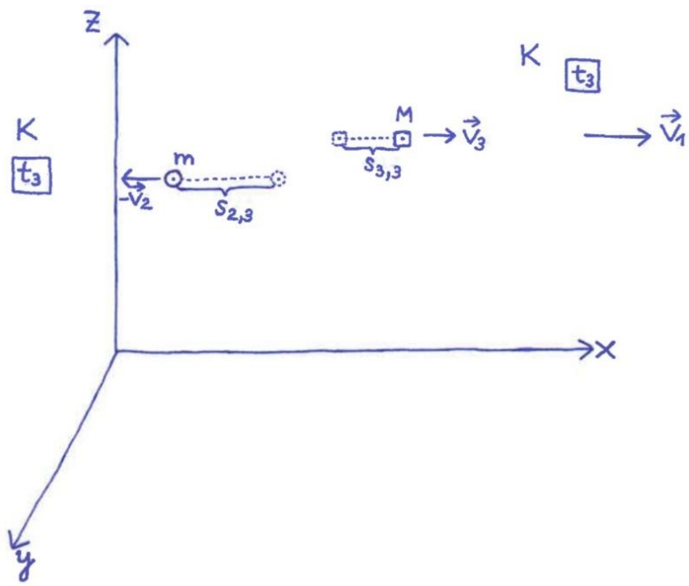


Figure 3 Body m moved back in relation to K.

Body m is now located in normal space K with coordinates m(x, 0, 0, t_3), but with respect to hyperspace K', it is m(x_c', 0, 0, t_3). The body M is located in normal space K with coordinates M(x_d, 0, 0, t_3), but in hyperspace K´ it is M(x_4´, 0, 0, t_3). The normal space K itself now exists with respect to the hyperspace K´ with coordinates K(x_5´, 0, 0, t_3). Consequently, we can write as follows:

In normal space K:	In hyperspace K´:
m(x, 0, 0, t_3)	m(x_c´, 0, 0, t_3)
M(x_d, 0, 0, t_3)	M(x_4´, 0, 0, t_3)
	K(x_5´, 0, 0, t_3)

The new coordinates show that the bodies m and M and the ordinary space K shifted, that is, they moved forward again. For example, body m moved a distance of $s_{2,3}$ relative to normal space K, but $s_{2,2}$ relative to hyperspace K´. Body M moved a distance of $s_{3,3}$ relative to normal space K, but $s_{3,2}$ relative to hyperspace K´. Normal space K moved relative to hyperspace K' by a distance of $s_{1.1}$. It can be seen from the figures that the body m moved back in the opposite direction of the x-axis relative to the normal space K, but still moved forward in the direction of the x-axis relative to the hyperspace K´.

As a result, the body m is back in the initial spatial coordinate relative to the normal space K at the time t_3. We represent this mathematically as follows:

$$[m(x, 0, 0) = m(x, 0, 0)] \neq m(x_a, 0, 0)$$

However, relative to the hyperspace K', the body m is still in a new spatial coordinate

$$m(x_c´, 0, 0, t_3)$$

This means that body m made a back-and-forth shift relative to normal space K, but despite this, body m is actually in a new space (and therefore time) coordinate. This is not directly visible in relation to the normal space K:

$$m(x, 0, 0, t) \neq m(x_a, 0, 0, t_2) \neq m(x, 0, 0, t_3)$$

This is only visible if we consider the whole system relative to the hyperspace K´. Since it is a new location in space, a new moment in time also exists. The body m appears to be in its former spatial position with respect to normal space K, but in fact it is not. The real former location in space (and consequently also the former moment in time) lies "outside" the ordinary space K. The true former location is within the "direct range" of hyperspace K'. Relative to normal space K, body m apparently moved back to its former position, but in fact body m did not move back to its former coordinate. Observing the hyperspace with respect to K' proves that the body m moved forward in space instead of backward.

In normal space K:

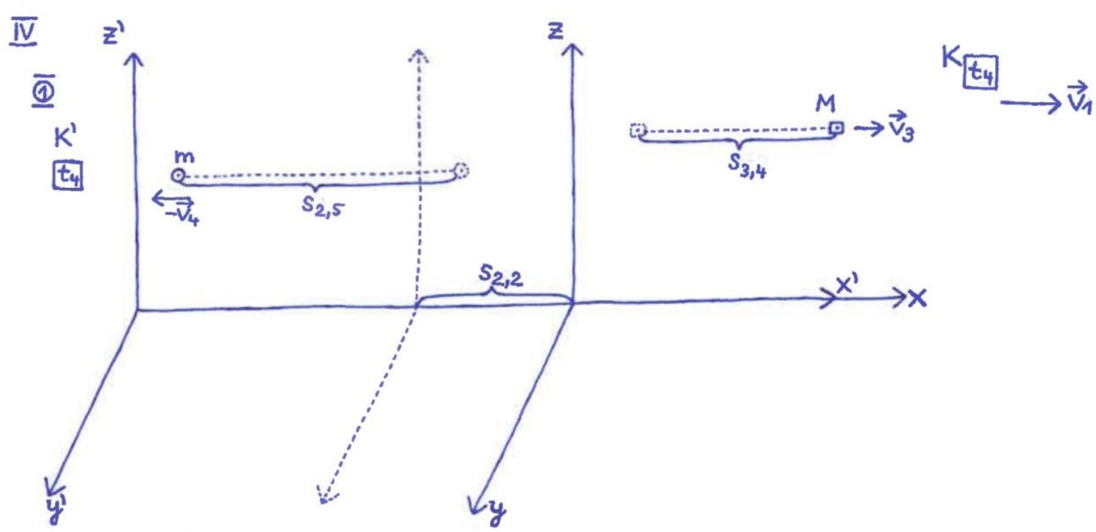
$$M(x_1, 0, 0, t) \neq M(x_b, 0, 0, t_2) \neq M(x_d, 0, 0, t_3)$$

In hyperspace K´:

$$m(x', 0, 0, t) \neq m(x_a', 0, 0, t_2) \neq m(x_c', 0, 0, t_3)$$
$$M(x_1', 0, 0, t) \neq M(x_b', 0, 0, t_2) \neq M(x_4', 0, 0, t_3)$$
$$K(x_2', 0, 0, t) \neq K(x_3', 0, 0, t_2) \neq K(x_5', 0, 0, t_3)$$

The apparent trajectories of the movements of bodies m and M in space result from the fact that we consider them only in relation to normal space K. The real trajectories become apparent when we look at the movements of the bodies relative to the hyperspace K'. Normal space K moves with speed v_1 relative to hyperspace K', and bodies m and M are located in normal space K. Albert Einstein's theory of relativity tells us that any body in the universe can go back to the former spatial coordinates (x, y, z), but not back to the former time moments (t). On the face of it, it seems so, but in reality it is not.

It can be seen from the figures that the bodies m and M and the normal space K moved forward again:



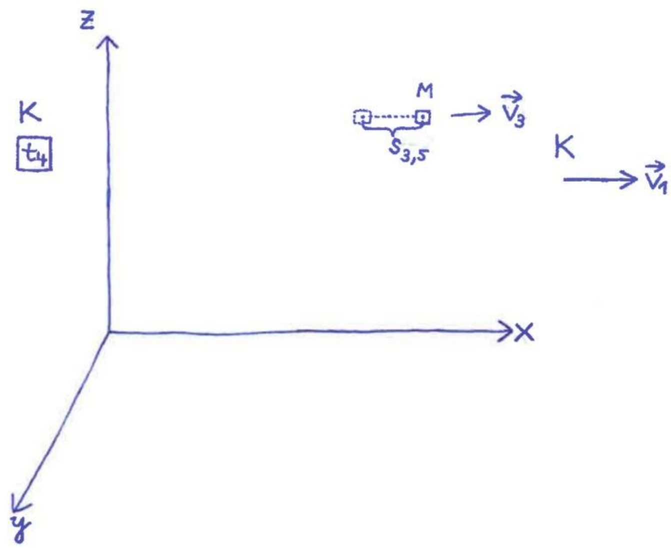


Figure 4 Body m has disappeared in relation to K.

It is the same mechanical coordinate system observed from the fourth time instant t_4. Normal space K moved relative to hyperspace K' by a distance of $s_{1,2}$. Body M moved a distance of $s_{3,5}$ relative to normal space K, but $s_{3,4}$ relative to hyperspace K'. Normal space K exists with respect to hyperspace K´ with coordinates K(x_6´, 0, 0, t_4). Body M exists in normal space K with coordinates M(x_f, 0, 0, t_4), but with respect to hyperspace K´ with coordinates M(x_g´, 0, 0, t_4). Mathematically, all of the above can be represented as follows:

In normal space K:	In hyperspace K`:
M(x_f, 0, 0, t_4)	M(x_g´, 0, 0, t_4)
m(0, 0, 0, 0)	K(x_6´, 0, 0, t_4)
	m(x´, 0, 0, t)

The spatial coordinates of bodies m and M are very different in time with respect to normal space K and hyperspace K´. Similarly, the "spatial coordinates" of the normal space K are different in time with respect to the hyperspace K' and the bodies m and M. We present all this mathematically as follows:

In hyperspace K´:

$$M(x_1', 0, 0, t) \neq M(x_b', 0, 0, t_2) \neq M(x_4', 0, 0, t_3) \neq M(x_g', 0, 0, t_4)$$
$$K(x_2', 0, 0, t) \neq K(x_3', 0, 0, t_2) \neq K(x_5', 0, 0, t_3) \neq K(x_6', 0, 0, t_4)$$

In normal space K:

$$M(x_1, 0, 0, t) \neq M(x_b, 0, 0, t_2) \neq M(x_d, 0, 0, t_3) \neq M(x_f, 0, 0, t_4)$$
$$m(x, 0, 0, t) \neq m(x_a, 0, 0, t_2) \neq m(x, 0, 0, t_3) \neq m(0, 0, 0, 0)$$

It can be seen from the figures that body m moved a distance of $s_{2,5}$ in relation to hyperspace K´, but in relation to ordinary space K, body m ceased to exist, i.e. no movement took place, therefore s = 0. This means that body m no longer exists in ordinary space at time t_4. The coordinates of K and thus of the body m in standard space K at time t_4 can be written as follows: m(0, 0, 0, 0). However, relative to the hyperspace K', the body m still exists in this respect, and thus the coordinates of the body m relative to the hyperspace K' can be written as: m(x', 0, 0, t). It also follows that the distance m of the body (or displacement s) in "space" is now described by time t. This means that the body m moved back in time to the moment t, because the spatial coordinates of the body m with respect to the hyperspace K´

m(x´, 0, 0)

correspond to the time t:

m(x´, 0, 0, t)

Figure 8 must be viewed primarily with respect to body M, but figure 9 with respect to body m:

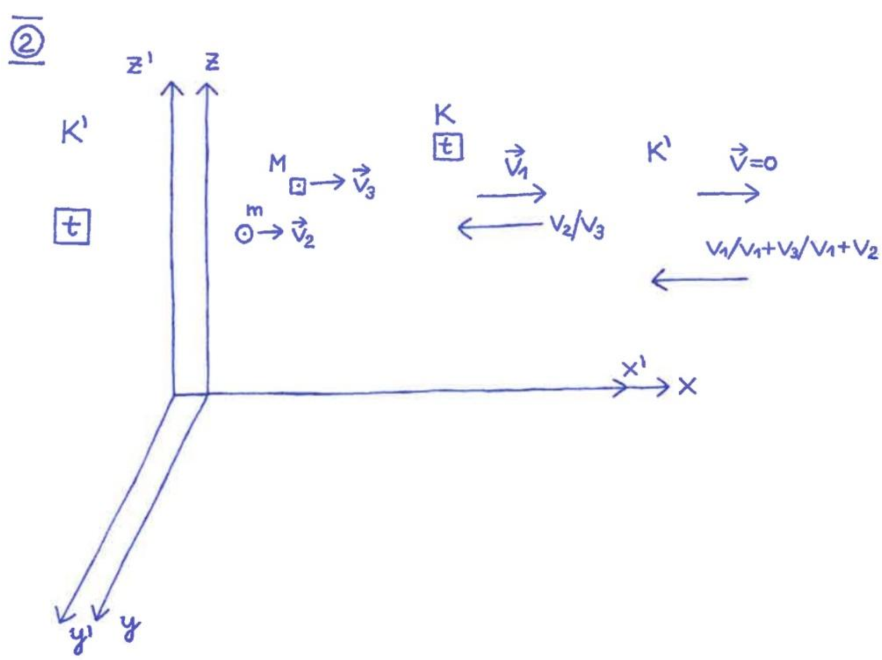


Figure 5 Body m has moved back in time.

In this chapter, we ignore the fact that when a body travels back in time, it also meets its "counterpart". We will look at such a case and describe it in more detail in the future. But the figures show that the body m moves into the past in time. In case of time travel, the body must "move" to its actual former (or future) locations in space. Such a condition has been realized here.

In figure 8, the body m is no longer in the normal space K, so the coordinates of the body m are: m(0, 0, 0, 0). The time coordinate t here is also equal to 0, because the body m is no longer present in the normal space K at time t_4. The body has "vanished" there. But the body m is located relative to the hyperspace K´ with spatial coordinates m(x´, 0, 0). Therefore, the body m exists in hyperspace K´. The moment in time is equal to t with respect to body m, because body m is now in its actual former position in space, and therefore we get m(x´, 0, 0, t) as the final spacetime coordinate of body m. This means that if the body m has coordinates with respect to hyperspace K´

$$m(x', 0, 0, t)$$

then the coordinates of the body m with respect to normal space K will be

$$m(x, 0, 0, t)$$

This is so, because if the body m has spatial coordinates relative to hyperspace K´

$$m(x', 0, 0)$$

then the moment of time t corresponds to this spatial coordinate, which is why we finally get the final coordinate of the body m

$$m(x', 0, 0, t)$$

It can also be understood as the relationship between space and time coordinates of the body m

$$m(x', 0, 0) = m(t)$$

The above is valid if we look at the system only with respect to the body m. The body m is located at the time t_4 relative to the hyperspace K' in spatial coordinates m(x', 0, 0). Since for body m the instant of time is equal to t, the spacetime coordinates of body M and normal space K in relation to body m are as follows:

In hyperspace K´:	In normal space K:
$M(x_1', 0, 0, t)$	$M(x_1, 0, 0, t)$
$K(x_2', 0, 0, t)$	

This is because at the first time instant (t) they were in such spatial coordinates. Previously, we only looked relative to body m, which is moving backwards in time. However, when viewed relative to the body M, according to Figure 8, the spacetime coordinates are as follows:

In normal space K:	In hyperspace K`:
$m(0, 0, 0, 0)$	$m(x', 0, 0, t)$
$M(x_f, 0, 0, t_4)$	$M(x_g', 0, 0, t_4)$
	$K(x_6', 0, 0, t_4)$

Drawings and analyzes of coordinate systems show that body m has moved relative to body M and normal space K into the past in time. It is only possible to travel in time relative to other bodies, just as the motions of bodies are described in mechanics only relative to other bodies. According to Figure 8, the bodies m and M are now located in different space (and therefore also time) coordinates. Body m is in the past with respect to body M, and body M is in the future with respect to body m. Time and space are very closely related, so moving in time must also mean moving in space. This means that real locations in space determine what moment in time it is. Since it was a case of body m moving in time to the past, it works analogously in case of time travel to the future as well. In this case, the directions of the movements are opposite. But the stopping of time is described in parts of the theory of relativity.

1.3.3.2 The expansion of the universe

When a person moves from spatial point A to spatial point B, it always takes some time and always covers some kind of path length in space. For example, let's look at a situation in which a person changes the location in his house during some period of time. For example, if a person moves from the kitchen to the living room, when he returns to the kitchen after some time, the kitchen is not actually "exactly the same" or "in the same location" as it was before. The reason is that everything in the universe is in constant motion. Before a person returned from the living room to the kitchen, this same kitchen has already traveled thousands or even millions of kilometers in space, depending on how long the person has been away from the kitchen. But not only the kitchen has traveled huge distances in space, but also the living room, the person himself, the house, etc. The reason is that we all move along with the rotation of the planet Earth around its imaginary axis, we also move along with the rotation of the Earth around the Sun, the rotation of the Solar System around the center of the Milky Way galaxy, the movement of the Galaxy in space, and finally the continuous expansion of the universe in space-time. Absolutely all bodies in the universe are moving simply because of the expansion of the universe. As a result, there is a so-called "apparent" and "real" former (and also future) locations in space. For example, if a person moves from the kitchen to the living room and after some time he returns from the living room to the kitchen, then this kitchen (as well as all the other regions of the spacetime of the universe) is not exactly in the same location in space. All bodies in the universe move along with the general movement of the universe. The universe is constantly changing and moving. The kitchen has moved at least millions of kilometers in space during the person's absence (actually all the time). However, if a person still wants to come back, i.e. to the "real former" kitchen (not the apparent former kitchen), from where he left some time ago to the living room, in this case he has to "break free" from spacetime, which constantly drags him (and everything else) along. But the "true" former location of the kitchen has remained very far in space and is also constantly moving away due to the cosmological expansion of the universe. For example, the planet Earth a hundred years ago is very far away in "space". The "apparent" former location of the kitchen in space always exists when we visit it at any given time. It follows that visiting not "apparent" but "real" former (and also future) locations in "space" is actually time travel in its essence.

Based on the above analysis, there are only two possible movements in the universe:

1. By moving to apparent former (or future) locations in space. In this case, time travel does not occur, but only the usual movement in the universe, which we all see and experience on a daily basis.

   For example, it is known from astronomy that the orbit of the Earth's companion, the Moon, has a precession period, which means that the Moon's columnar and ascending nodes return to the exact same point in relation to the orbit (not to the universe) every 18.6 years. In astronomy, this period is called the saurian cycle. This kind of movement is relative, since in reality you do not reach exactly the same point. It is apparent.

2. By moving to real past (or future) locations in space. In this case, time travel manifests itself, as it is no longer relative movement, but absolute movement. In this case, the principle of the inseparability of time and space, known from the special theory of relativity, also applies. Such an analysis shows that it is possible to travel in time to the past and the future.

At this point, the reason why we can't travel in time when we normally move in space also becomes apparent. This is because the true former locations in space of regions of spacetime are constantly moving away from us due to the cosmological expansion of the universe, and so they simply remain constantly out of our reach. All bodies in the universe are in a state of motion. For example, the planet Earth makes one full rotation around its imaginary axis in one day. That is why days and nights alternate on Earth. All planets, stars, moons and other cosmic bodies in the universe rotate around their axis, and during rotation they also move in outer space. For example, the Earth makes one complete revolution around the Sun in a year. At the same time, the entire Solar System revolves around the center of the Milky Way Galaxy. Galaxies form clusters that move away from each other. The more distant the galaxy cluster, the faster it is moving away from us. The entire universe as a whole is expanding and has been since the Big Bang.

According to cosmology, the universe actually expands kind of "metrically". This means that the galaxies "themselves" do not actually move, but only the volume of the universe increases over time, which is why the galaxies also move. This is also called "metric expansion". For example, two clusters of galaxies moving away from each other is like an increase in the distance between two points in space, which also occurs, for example, in gravitational fields, i.e. in curved spacetime: the distance between two points in space increases more and more when moving away from the center of gravity of a celestial body with a large mass. That is why the expansion of the universe is also described by metrics, which is why it is called the metric expansion of the universe or the metric model of the expansion of the universe.

However, the expansion of the volume of the universe is often represented in models as the expansion of the volume of a sphere. In this case, two points on the surface of a sphere, which may be galaxies, move away from each other as the sphere expands. An expanding universe has no center, but an expanding sphere does. That's also the only difference. The expansion of a sphere is called in cosmology the classical expansion of the universe or the classical model of the expansion of the universe.

The figure below represents the classical model of the expansion of the universe:

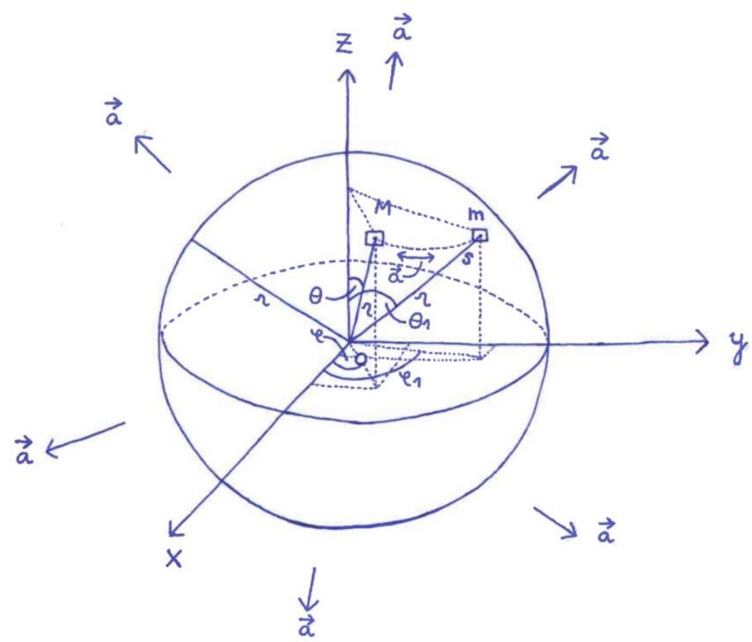


Figure 6 Expansion of the universe as an expansion of a sphere.

The sphere represents the entire known universe, and the "bodies" M and m on the surface of the sphere are, for example, some kind of completely arbitrary galaxies. The bodies M and m are considered in this physical model as galaxies or their clusters. In astrophysics and cosmology, galaxies are not considered "bodies", because a galaxy is too sparse and too large an object to do so, especially galaxy clusters and superclusters. However, such a definition is still relative. For example, relative to the Earth, a galaxy is not really a "body", but relative to the larger universe, a galaxy is a point that can already be considered a "body". The large-scale universe has a honeycomb-like structure made up of trillions of galaxy clusters and giant voids.

The expansion of a sphere, as a universe, is accelerating in time, i.e. with a uniform acceleration a. Figure 13 is like a snapshot at time t_1. The radius r of the sphere increases continuously with time, and due to the expansion of the sphere, bodies such as galaxies M and m are also moving away from each other with an acceleration a. The acceleration of expansion of a sphere is equivalent to the acceleration of the bodies M and m moving away from each other on the surface of the sphere. The bodies M and m themselves do not move on the surface of the sphere, but their movement away from each other is caused by the expansion of the sphere. It can be seen from the given model that the relationship between the distance between the bodies m and M and the radius of the sphere does not actually change over time, even though the bodies m and M move away from each other. It is known from geometry that the ratio between the radius of the sphere and the circle does not change over time, if the circle (and therefore its radius) should increase or decrease over time.

The intersection of a sphere with the plane passing through the center of the sphere is called the great circle of the sphere in geometry. The radius r of the great circle of this sphere is also the radius of the entire sphere, which is expressed by the equation:

$$r = \sqrt{x^2+y^2}$$

In three-dimensional space, the form of this equation would be following:

$$r = \sqrt{x^2+y^2+z^2}$$

In this chapter, we present the spherical coordinates of body M at time t_1 as a set of equations:

$$\begin{cases} x'' = r\sin\theta\cos\varphi \\ y'' = r\sin\theta\sin\varphi \\ z'' = r\cos\theta \end{cases}$$

Consequently, we can present the spherical coordinates of body m at time t_1 as a set as well:

$$\begin{cases} x' = r\sin\theta_1\cos\varphi_1 \\ y' = r\sin\theta_1\sin\varphi_1 \\ z' = r\cos\theta_1 \end{cases}$$

Since the sphere expands in time, we can write the equation for the acceleration a as follows:

$$a = \frac{r}{t^2} = \frac{\sqrt{x^2+y^2+z^2}}{t^2}$$

The resulting equation describes the acceleration a of the expansion of a sphere. Since the acceleration of the sphere's expansion and the accelerations of the bodies M and m moving away from each other are equivalent, the equation is also valid for the acceleration of the bodies M and m moving away from each other. The rate of expansion of a sphere increases uniformly over time. Consequently, the farther the bodies, or galaxies M and m, are from each other, the faster they move away from each other. The distance s between the bodies M and m indicates the length of the smallest arc along the surface of the sphere on which the bodies M and m are located. It does not show the connecting line between the bodies, which remains within the volume of the sphere.

Spherical expansion is the classic model of the expansion of the universe. In reality, the universe has no expansion center or "rim". If you look at these drawings of the expansion of a sphere, in reality the sphere as the expansion center of the universe, or the expansion center as a point, "fills" the entire space. There are an infinite number of these points. This is how the space of the universe expands in time all at once: there is no middle, edge or any preferred direction. The entire volume of the universe increases in time everywhere at once.

Figure 14 shows that the sphere has expanded by $r_2 - r$ and the distance between bodies M and m has increased by $s_2 - s$:

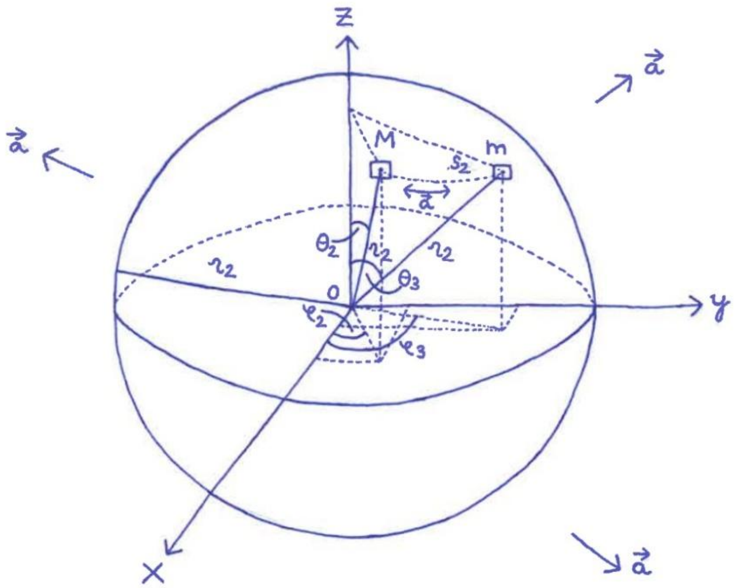


Figure 7 When the sphere expands, the coordinates of the bodies m and M change.

It is time t_2. The radius of the sphere has increased in time by $r_2 - r$. The universe as a sphere K has expanded and the galaxies M and m have moved away from each other. The radius r of the sphere at time t_2 can be represented as follows:

$$r_2 = \sqrt{{x_1}^2 + {y_1}^2 + {z_1}^2}$$

Therefore, the spherical coordinates of body M at time t_2 are:

$$\begin{cases} x_2 = r_2 sin\theta_2 cos\varphi_2 \\ y_2 = r_2 sin\theta_2 sin\varphi_2 \\ z_2 = r_2 cos\theta_2 \end{cases}$$

and spherical coordinates of body m at time t_2:

$$\begin{cases} x_3 = r_2 sin\theta_3 cos\varphi_3 \\ y_3 = r_2 sin\theta_3 sin\varphi_3 \\ z_3 = r_2 cos\theta_3 \end{cases}$$

It can be seen from the figures that the volume of the sphere increased by a certain unit over time, which is why the positions of bodies M and m with respect to the transverse coordinate system at time t_2 are different compared to time t_1. Likewise, the length of the radius of the sphere has changed. In the following, we compare the moments t_1 and t_2.

Since the sphere expands in time, the length of the radius r of the sphere at time t_1 is different compared to time t_2. We represent this mathematically as follows:

$$r \neq r_2 = \sqrt{{x_1}^2+{y_1}^2 + {z_1}^2} \neq \sqrt{x^{\,2}+y^{\,2} + z^{\,2}} = r$$

As a result, the spherical coordinates of the body M are different at times t_1 and t_2. We show this as a set of equations:

$$t_1 \begin{cases} x'' = r sin\theta cos\varphi \\ y'' = r sin\theta sin\varphi \\ z'' = r cos\theta \end{cases}$$

$$t_2 \begin{cases} x_2 = r_2 sin\theta_2 cos\varphi_2 \\ y_2 = r_2 sin\theta_2 sin\varphi_2 \\ z_2 = r_2 cos\theta_2 \end{cases}$$

Mathematically, it can also be represented like this:

$$\begin{aligned} x'' &= r sin\theta cos\varphi \neq x_2 = r_2 sin\theta_2 cos\varphi_2 \\ y'' &= r sin\theta sin\varphi \neq y_2 = r_2 sin\theta_2 sin\varphi_2 \\ z'' &= r cos\theta \qquad \neq z_2 = r_2 cos\theta_2 \end{aligned}$$

The spherical coordinates of body m are also different at times t_1 and t_2:

$$t_1 \begin{cases} x' = r sin\theta_1 cos\varphi_1 \\ y' = r sin\theta_1 sin\varphi_1 \\ z' = r cos\theta_1 \end{cases}$$

$$t_2 \begin{cases} x_3 = r_2 sin\theta_3 cos\varphi_3 \\ y_3 = r_2 sin\theta_3 sin\varphi_3 \\ z_3 = r_2 cos\theta_3 \end{cases}$$

which can also be represented mathematically as follows:

$$\begin{aligned} x' &= r sin\theta_1 cos\varphi_1 \neq x_3 = r_2 sin\theta_3 cos\varphi_3 \\ y' &= r sin\theta_1 sin\varphi_1 \neq y_3 = r_2 sin\theta_3 sin\varphi_3 \\ z' &= r cos\theta_1 \qquad \neq z_3 = r_2 cos\theta_3 \end{aligned}$$

This is because the spherical coordinates of the bodies M and m are different in time due to the expansion of the sphere.

Figure 15 shows that the sphere has expanded by $r_3 - r_2$ and the distance between bodies M and m has also increased by $s_3 - s_2$:

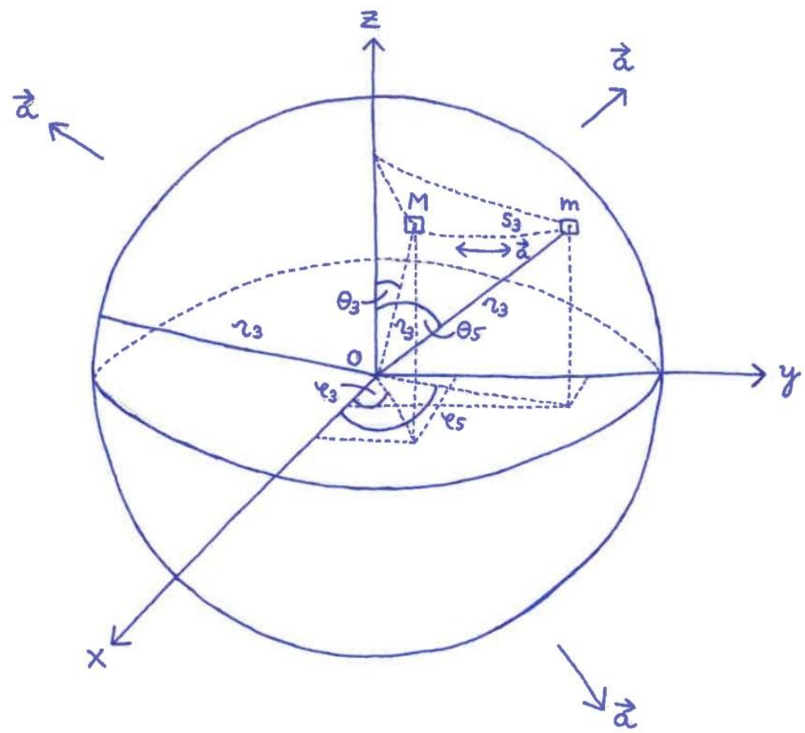


Figure 8 A sphere is continuously expanding in time.

This is at time t_3. The radius of the sphere has increased in time by $r_3 - r_2$, which means that the universe has expanded again and the galaxies M and m have moved further away from each other.

Consequently, it can be written that the radius r of the sphere at time t_3 can be represented as follows:

$$r_3 = \sqrt{{x_{11}}^2 + {y_{11}}^2 + {z_{11}}^2}$$

Similar to what was presented above, we can write that the spherical coordinates of the body M at time t_3 are:

$$\begin{cases} x_4 = r_3 sin\theta_4 cos\varphi_4 \\ y_4 = r_3 sin\theta_4 sin\varphi_4 \\ z_4 = r_3 cos\theta_4 \end{cases}$$

and the spherical coordinates of body m at time t_3 are:

$$\begin{cases} x_5 = r_3 sin\theta_5 cos\varphi_5 \\ y_5 = r_3 sin\theta_5 sin\varphi_5 \\ z_5 = r_3 cos\theta_5 \end{cases}$$

The volume of the sphere increased over time, which is why the positions of the bodies M and m in relation to the cross-coordinate system at time t_3 are different compared to time t_2. The length of the radius of the sphere has also changed. In the following, we again compare instants t_1 and t_2, but together with instant t_3.

Due to the expansion of the sphere, the radius r of the sphere is of different length at different times:

$$r \neq r_2 = \sqrt{{x_1}^2+{y_1}^2+{z_1}^2} \neq \sqrt{x^2+y^2+z^2} = r \neq r_3 = \sqrt{{x_{11}}^2+{y_{11}}^2+{z_{11}}^2}$$

The spherical coordinates of the body M are different at different time points (i.e. t_1, t_2 and t_3), which can be represented as sets of equations:

$$t_1\begin{cases} x'' = rsin\theta cos\varphi \\ y'' = rsin\theta sin\varphi \\ z'' = rcos\theta \end{cases}$$

$$t_2\begin{cases} x_2 = r_2 sin\theta_2 cos\varphi_2 \\ y_2 = r_2 sin\theta_2 sin\varphi_2 \\ z_2 = r_2 cos\theta_2 \end{cases}$$

$$t_3\begin{cases} x_4 = r_3 sin\theta_4 cos\varphi_4 \\ y_4 = r_3 sin\theta_4 sin\varphi_4 \\ z_4 = r_3 cos\theta_4 \end{cases}$$

It can also be presented like this, which actually shows the same content:

$$\begin{matrix} x'' = rsin\theta cos\varphi \neq x_2 = r_2 sin\theta_2 cos\varphi_2 \neq x_4 = r_3 sin\theta_4 cos\varphi_4 \\ y'' = rsin\theta sin\varphi \neq y_2 = r_2 sin\theta_2 sin\varphi_2 \neq y_4 = r_3 sin\theta_4 sin\varphi_4 \\ z'' = rcos\theta \quad \neq z_2 = r_2 cos\theta_2 \quad \neq z_4 = r_3 cos\theta_4 \end{matrix}$$

The spherical coordinates of the body m are also different at different time points (i.e. t_1, t_2 and t_3):

$$t_1\begin{cases} x' = rsin\theta_1 cos\varphi_1 \\ y' = rsin\theta_1 sin\varphi_1 \\ z' = rcos\theta_1 \end{cases}$$

$$t_2\begin{cases} x_3 = r_2 sin\theta_3 cos\varphi_3 \\ y_3 = r_2 sin\theta_3 sin\varphi_3 \\ z_3 = r_2 cos\theta_3 \end{cases}$$

$$t_3\begin{cases} x_5 = r_3 sin\theta_5 cos\varphi_5 \\ y_5 = r_3 sin\theta_5 sin\varphi_5 \\ z_5 = r_3 cos\theta_5 \end{cases}$$

We also write it in the following form:

$$\begin{matrix} x' = rsin\theta_1 cos\varphi_1 \neq x_3 = r_2 sin\theta_3 cos\varphi_3 \neq x_5 = r_3 sin\theta_5 cos\varphi_5 \\ y' = rsin\theta_1 sin\varphi_1 \neq y_3 = r_2 sin\theta_3 sin\varphi_3 \neq y_5 = r_3 sin\theta_5 sin\varphi_5 \\ z' = rcos\theta_1 \quad \neq z_3 = r_2 cos\theta_3 \quad \neq z_5 = r_3 cos\theta_5 \end{matrix}$$

All of the above is because a sphere as a universe expands in time. This is also illustrated for us by various drawings:

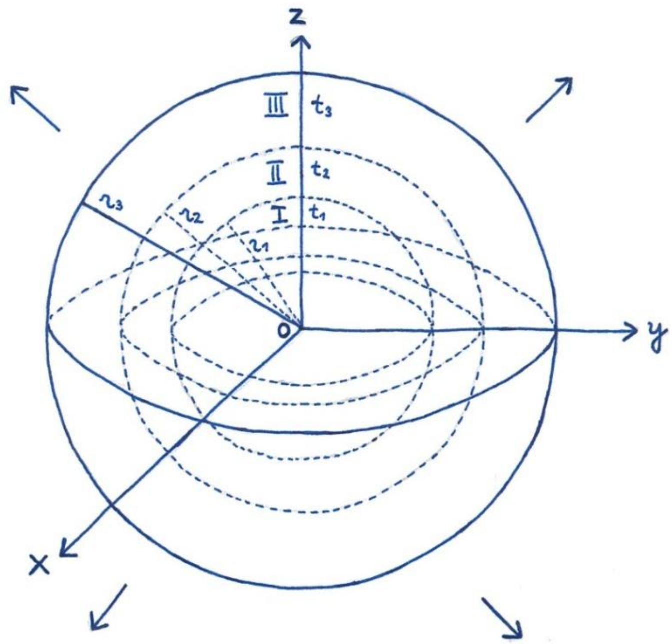


Figure 9 At different points in time, the radius of the sphere is of different length.

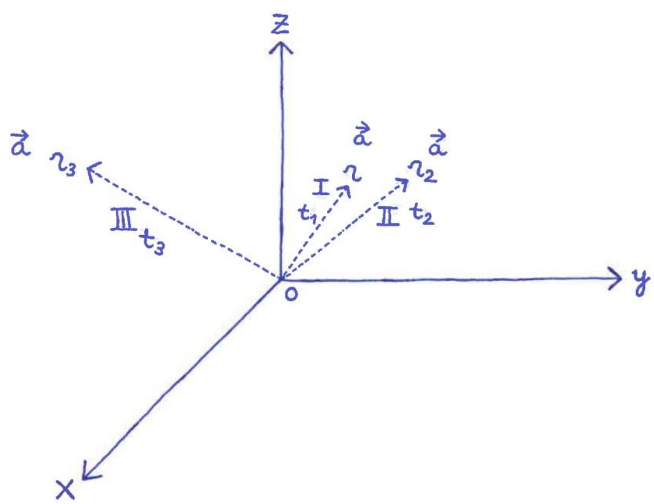


Figure 10 Expansion of the universe in spherical coordinates.

The movements of bodies M and m on the surface of the sphere represent the movements of bodies in our ordinary spacetime. The sphere of the sphere is two-dimensional, but the space of the universe is three-dimensional. The volume of a sphere increases over time due to expansion. However, if the bodies moved only along the radius of the sphere, it can be said that the bodies would move in hyperspace, and no longer in normal spacetime. If the movements of bodies take place in hyperspace, it can be concluded that time travel to the past or the future manifests itself with these movements.

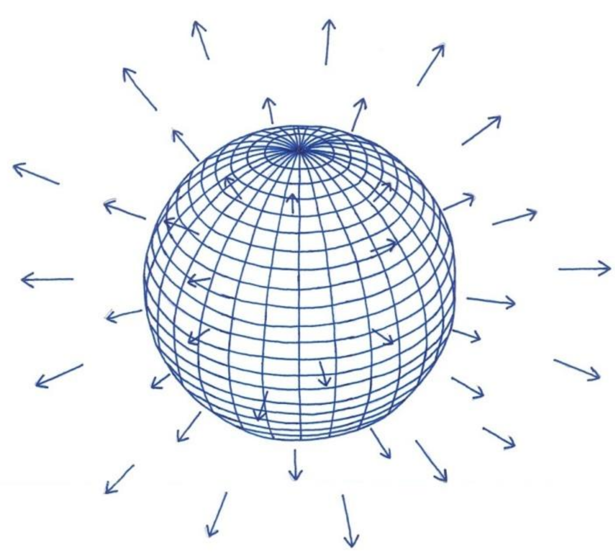
This shows how the expansion of the universe is related to time travel. Due to the increase in the volume of the universe, there is constant movement in the universe, therefore no body in the universe can be absolutely still. All movement is relative to something. Since the expansion of the universe is related to time travel, the expansion of the universe can also be called time dilation. Absolutely all bodies in the universe move along with this universal expansion.

The classic model of the expansion of the universe was previously described, in which the movements of bodies M and m along the radius of the sphere would represent movement in hyperspace K´, and the movements of bodies on the surface of the sphere would represent movement in normal space K. Normal space moves continuously along the x-, y- and z-axes. The bodies M and m can be thought of as galaxies or clusters of galaxies. These bodies do not move on the surface of the sphere themselves, but they only move along with the expansion of the sphere, i.e. continuously along the radius of the sphere, away from the center of the sphere.

It is clear from the pictures that each sphere of the sphere is a snapshot of a specific moment in time. In this case, it can be seen that if we move only along the radius of the sphere, for example towards the center, we would end up in such spheres of the sphere that would be in different moments of time. It can be seen from the figures that these moments of time would be earlier moments of the universe, i.e. the movement would take place in time into the past. Figure 16 shows us this. Therefore, the different spheres of the sphere can be called the time spheres of the universe. There are probably an infinite number of these time spheres in the universe. The sphere of each sphere is at some kind of fixed point in time, because the volume of the sphere increases over time and does so without ceasing.

1.3.3.3 Physical model

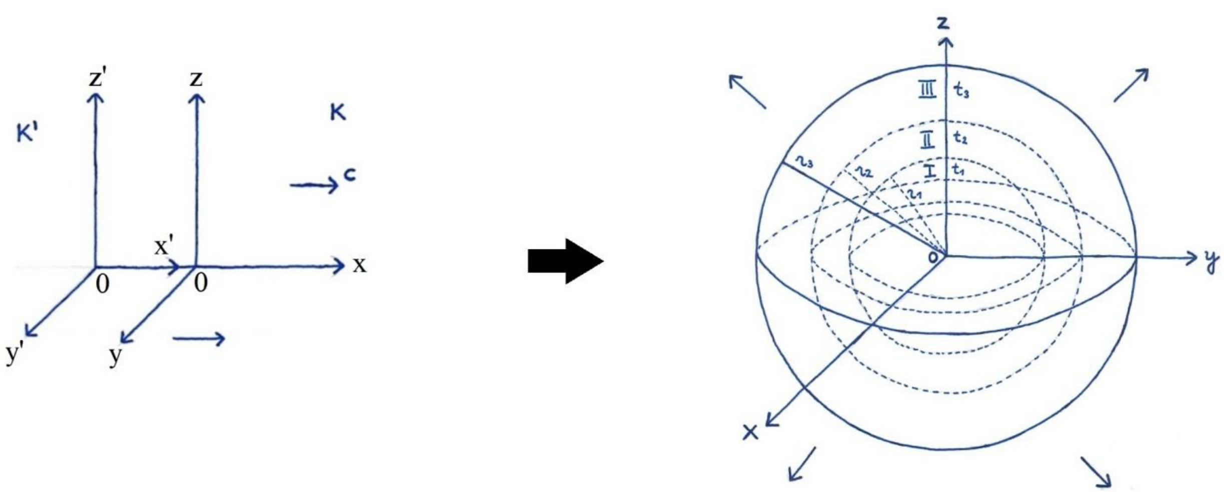
The volume expansion of the universe is often represented in models as the expansion of the volume of a sphere. In this case, two points on the surface of the sphere, which may be galaxies, move away from each other as the sphere expands. Figure:



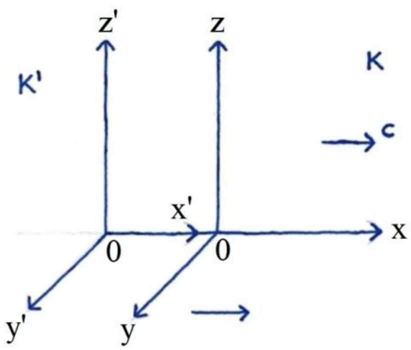
An expanding universe has no center, but an expanding sphere does. That's also the only difference. In the case of expansion of a sphere, there is no edge on the surface of the sphere, but nevertheless the total area of the surface of the sphere, i.e. its size, has a finite value (i.e. not infinitely large). From any point on the surface of the sphere, moving continuously straight ahead along the surface of the sphere, we return to the exact same point. This is not the case with the expanding space of the universe, as the universe is infinitely large. The existence of dark energy indicates that the space of the universe is flat on a very large scale and thus the volume of the universe is infinitely large. Therefore, the universe has no edge, which also results from the lack of a center of the universe. The expanding three-dimensional space of the universe can actually be thought of as a three-dimensional version of the two-dimensional surface of an expanding three-dimensional sphere, although it may be infinitely large. The expansion of the sphere is called in cosmology the classical expansion of the universe or the classical model of the expansion of the universe.

According to mechanics, all motion is relative, meaning that any motion can only be described in relation to some other body, motion, or background system. However, the expansion of the universe is not relative, but can be considered absolute, as the universe expands relative to an observer at any point in the universe. For example, in any galaxy we would see a redshift caused by the cosmological expansion of the universe. Furthermore, the motions of all bodies eventually come down to the expansion of the universe, since all bodies in the universe move along with this expansion, and no body can outpace the rate of expansion of the universe. The further apart galaxies or their clusters are, the faster they are moving away from each other.

However, the basis for understanding the physics of time travel is the physical system of ordinary space K and hyperspace K', which manifests itself in nature as the cosmological expansion of the universe. Figure:



The previously presented figure is a simplified model of the physical system between hyperspace K' and normal space K, which is a pictorial concept of time and space that exists in reality. It is a physical model that helps to better understand and remember the relationship between spacetime and hyperspace. For example, this is similar to the physical model of the cosmological expansion of the universe, which is mostly the expansion of a sphere or balloon in space, although in fact the expansion of the universe and the expansion of a sphere are completely different phenomena from each other in a physical sense. There are both similarities and completely different traits between the two. But in reality, the physical system of hyperspace K' and ordinary space K manifests as a cosmological expansion of the universe. The model is made in such a way that the normal space K moving relative to the hyperspace K' is the normal three-dimensional space of the universe, and the hyperspace K' is the fourth dimension of space, which is related to time. Since time is "moving", the model also shows movement of ordinary space relative to hyperspace.



In the latter figure, it can be seen that the hyperspace K´ and the normal space K are both represented as three-dimensional. This is because the model would be simpler, more understandable and more handy for us. The figure shows that ordinary space K moves with some speed relative to hyperspace K´. It is important to note that normal space and hyperspace are not background systems: neither inertial nor non-inertial background systems.

Although time and space no longer exist in hyperspace, because according to the theory of relativity their dimensions are equal to zero, we can nevertheless imagine hyperspace as, for example, one-dimensional space. By moving forward or backward in it, the body travels in time to the future or the past, respectively. Therefore, time there is rather two-dimensional. But hyperspace can also be imagined as a three-dimensional space, because it is possible to "enter" it from any coordinate point in normal space, and besides, bodies teleport "from there" to any point in normal space. We will look at and describe these aspects in more detail later.

It can be argued that hyperspace is a hypothetical spacetime that exists outside of our everyday perceived time and space. Although hyperspace (and therefore hypertime) contain the everyday concepts of time and space, in reality, hyperspace does not contain any time and space dimensions. Nevertheless, hyperspace can be represented in geometrical models as a three- or even four-dimensional coordinate system that exists parallel to our normal spacetime. Hyperspace is like a parallel time space, not to be confused with a parallel world. There is no time or space in it, which is expressed in the fact that it is possible to move in hyperspace only momentarily and by passing any distance. Hyperspace is a timeless and spaceless dimension that exists outside of spacetime.

The physics theory of time travel is based on the physical system of ordinary space K and hyperspace K', which manifests itself in nature as the cosmological expansion of the universe. According to such a theoretical concept, normal space is the three-dimensional space we perceive on a daily basis, i.e. normal spacetime, but hyperspace is an external dimension of spacetime in which neither time nor space exists. The non-existence of time and space comes precisely from the fact that hyperspace exists outside of spacetime. With such a theoretical concept, two facts must be taken into account. First, the system of normal space and hyperspace presupposes the existence of some kind of moving space: normal space moves relative to hyperspace at the speed of light c. Since the universe expands as a whole, so the existence of moving space is proven. As the universe expands, space expands, which shows the presence of moving space. When the universe expands, the galaxies themselves do not move away from each other, although the galaxies themselves can also move in space under the influence of the gravitational force. Galaxies move away from each other due to the movement of space. Second, there is no empirical evidence that when traveling in hyperspace we actually time travel to the past or the future. But... even so, it can still be argued that there is at least circumstantial evidence. These are the existence of moving space, on which the theoretical concept of normal space and hyperspace is based, and a physical-mathematical in-depth analysis that objectively shows and describes that when moving in hyperspace we really travel through time. Mathematical relations describe a physical analysis based on astronomical observations. Therefore, the physical theory of time travel must be taken scientifically seriously, and not considered as science fiction or even a fantasy novel.

Normal space K moves relative to hyperspace K' at the speed of light c. In the form of the movement of ordinary space K, it is a moving space whose existence can be proven by the expansion of the universe. As the universe expands, galaxies move away from each other because of the expansion of the universe, not because of the motion of the galaxies themselves. While the existence of moving space can be proven by astronomical observations, the existence of stationary space relative to which movement takes place cannot be proven. The stationary space is the hyperspace K'. In fact, it does not exist in a sense, but only exists in the physical model. This is because the model helps to better understand the interrelationships between time, space and movement. A physical model "translates" the laws of nature into human language in order to better understand the laws of nature. For example, in a model of an atom, electrons orbit the atomic nucleus, but in reality this orbiting does not exist. An electron probability cloud or field exists around the atomic nucleus. If the planet Earth rotates around its imaginary axis, then the universe can also expand with respect to an imaginary stationary space. In this case, the stationary space can be, for example, the volume of the universe itself, which existed at a past moment in time.

The balloon expansion model has an expansion center, but the expansion of the universe does not. In fact, any observer can be conventionally at the center of the universe. A balloon expands into pre-existing space, but does not exist when the universe expands. As the universe expands, "extra space" is created that didn't exist before. Physical models are like translation mechanisms in physics through which the human mind understands the complex laws of nature. They don't actually have to be exactly one-to-one with the laws of nature themselves, but they have to be able to describe the laws of nature in such a way that they match reality from a certain perspective.

The analysis of the physical system of ordinary space K and hyperspace K' is presented only in the direction of the x-axis, leaving out the y- and z-axes. For example, what would happen to body m if it moved only in the y-axis or z-axis direction? The reason for not taking them into account is that the physical system of normal space and hyperspace is described only in the direction of the x-axis, since it best corresponds to real conditions. For example, in reality there is not only one-way space movement, because the expansion of the universe has no center of expansion, and the speed of light c is constant relative to any observer. In this sense, space movement in the direction of the x-axis occurs in any spacetime projection, i.e. viewed from any perspective, in which case the y- or z-axis does not actually exist. This means that the description of the movement of space along the x-axis is a part of the movement of space that we understand as expansion, which does not have a center of expansion.

> For example, according to the theory of special relativity, body length contraction occurs only in the direction of body movement, in which case the body dimensions do not contract in the

> direction of other spatial dimensions (for example, the y- and z-axes). However, the movement of the body itself can take place in any direction in space, so in this sense the contraction of the body can also take place in any direction in space. In this sense, contraction does not have any preferred direction in space, nor does it have a non-occurrence in any specific direction of movement in the universe. This also means that the physical system of normal space and hyperspace is described only in the direction of the x-axis, since its physical conclusions in the real world are valid for any direction in space.

If two points move away from each other due to the expansion of space, and this expansion does not have a center of expansion, then this changes our perception of the dimensionality of ordinary space. At a smaller scale, where the expansion of space is not seen, space appears static and three-dimensional. As a result, the following two facts have been concluded, which are no longer generally accepted today. First, three-dimensional normal space must actually derive from one-dimensional space. Hyperspace itself is zero-dimensional because neither time nor space exists in it. Second, three-dimensional ordinary space is not really three-dimensional, but rather one-dimensional, since the other two dimensions do not actually exist. This is due to the fact that space movement in the x-axis direction occurs in the universe in any spacetime projection, i.e. viewed from any perspective, in which the y- or z-axis does not actually exist. It just creates the illusion of having y and z axes. If time and space are both one-dimensional, then this can mean identification, not just a continuum. We can call such a combination "time space", no longer "spacetime". Such a theoretical concept is no longer generally accepted today, because the expansion of the universe has no center or preferred direction, which makes the space three-dimensional or is caused by it.

Some researchers have concluded in their scientific papers that space may actually be two-dimensional, as the dimensions of the body become more planar as the length of the body contracts. In case of infinite contraction, the body loses its spatial dimensions, from which some scientists conclude that space does not exist at all. If time travel to the past and future were possible, time would be two-dimensional, not one-dimensional. Such conclusions are not quite correct according to the physics theory of time travel, since the transformations of time and space known in the theory of relativity and the possibilities of time travel to the past and future arise only from the physical system of ordinary space and hyperspace. According to this, both normal space and hyperspace are three-dimensional, but time in hyperspace turns out to be two-dimensional indeed.

The physical system of ordinary space K and hyperspace K' manifests itself in nature as the cosmological expansion of the universe. Since ordinary space K moves with respect to hyperspace K' at the speed of light c, therefore the universe should also expand at the speed of light c, so time over the entire universe has changed exactly as many times as the difference between the speed of light c and the expansion speed of the universe. This is what the gamma factor y shows us:

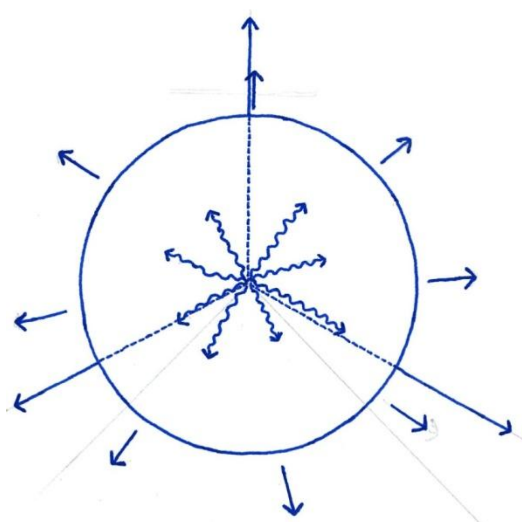
$$y = \frac{c}{H}$$

where c is the speed of light in vacuum and H is the Hubble constant. However, such difference in time changes due to the motion of normal space K with respect to hyperspace K'. This means that the universe is actually expanding at the speed of light c, but astronomical observations show us a much lower rate of expansion, which does increase in time. This is caused by the transformation of time all over the universe. The nature of the dark energy of the universe consists in the expansion rate of the universe increasing in time, which in turn is related to the change in the transformation of time throughout the universe. The physical nature of the dark energy of the universe is therefore related to time and space itself, and not to some previously unknown form of energy (for example, vacuum energy).

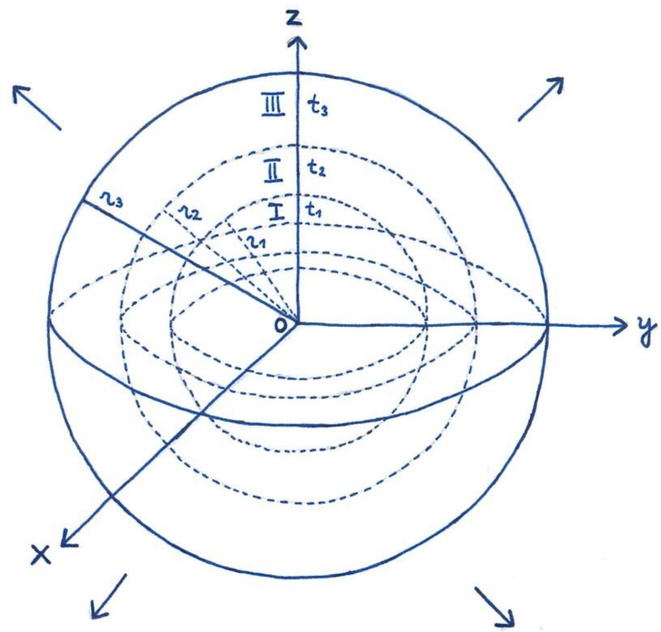
Cosmology is a part or branch of astronomy, but it plays an extremely large role in the physics theory of time travel. Previously, we have repeatedly stated that the physical system of ordinary space K and hyperspace manifests itself in nature as the cosmological expansion of the universe, and the physical nature of dark energy consists in the change of time and space throughout the universe, and not in the form of some previously unknown energy. By studying such a theoretical concept, it turns out that dark energy can describe the entire cosmology of the universe: from the Big Bang to scenarios of the future of the universe. Since this is an extremely long and voluminous physical and mathematical analysis, with differential and tensor equations, we will not present or describe it in this section. In the following sections, we will describe the connections of dark energy with the physics of time travel and the cosmology of the universe in greater length and depth.

1.3.3.4 *Hubble's law*

In reality, the kinematic system of ordinary space K and hyperspace K' manifests itself as a cosmological expansion of the universe, which could be presented as follows:



Such a figure shows the expansion of the sphere with the movements of light waves. All light waves move away from the center of the sphere. <u>The expansion of the sphere in this case illustrates the cosmological expansion of the universe, in which the volume of the sphere is different at different points in time:</u>



Wavy arrows illustrate light waves. The figure clearly shows that if the speed of expansion of the sphere and the speed of the light waves are equal, it can be concluded that the light waves do not disperse away from each other in relation to the expanding sphere.

All electromagnetic waves move along with the cosmological expansion of the universe. However, at this point, the following question may arise: how can there be a cosmological expansion of the universe, if there is no visible expansion of space in the human space scale? The expansion of the universe only manifests itself on a very large spatial scale - for example, on the spatial scale of galaxy clusters and superclusters. Nevertheless, the cosmological expansion of the universe also occurs at the human spatial scale. How is such a fact possible? In the following, we will show the functioning and possibility of such a pattern.

Since the universe is expanding at such a speed, which is shown to us by the Hubble constant H, then as a result, the expansion of the universe manifests itself only on a very large spatial scale - for example, on the scale of galaxy clusters and superclusters. This means that the greater the distance between two points in space (i.e. the further away the clusters of galaxies are from each other), the faster they are moving away from each other. The speeds at which points in space in the universe are moving away from each other approach zero on a very small spatial scale (for example, on the scale of planets and stars), but on a very, very large spatial scale (for example, even on a larger spatial scale than galaxy superclusters), they already approach the speed of light in vacuum:

1. For example, if the distance between two points in space is 1 Mpc, or 3.2 million light-years, then the speed at which they move away from each other is about 50 - 80 km/s.

2. However, if the distance between them is one meter, then the speed at which they move away from each other is $2 * 10^{-18}$ m/s, since the value of the Hubble constant (50 - 80 (km/s)Mpc) in the SI system is $2 * 10^{-18}$ m/s per one meter. This is roughly like the planet Earth increasing by one micrometer per year.

The expansion of the universe manifests itself on a very large spatial scale: in the space between galaxy clusters and superclusters. The further away galaxies are from each other, the faster they are moving away from each other. However, in fact, the expansion of the universe, i.e. the increase of the distance between two points in time, also occurs on the scale of human space. For example, two people are moving away from each other in space, and the further they are from each other, the faster they are moving away from each other. However, this effect is extremely small, but still mathematically calculable. It is not possible to perceive it, because this effect is extremely small. For example, two nearby people will attract each other with the force of gravity, but this effect is also extremely small. Nevertheless, it is mathematically calculable.

As the universe expands, clusters and superclusters of galaxies move away from each other. At this point it seems that we cannot use a concept like "point in space", since galaxies and their clusters cannot be considered as "points". Actually, you can. The expansion of the universe can be thought of as an increase in the distance between two points in space over time, but from when the distance between two points in space reaches the distances in the order of those between clusters of galaxies. However, it would be more correct to consider the distances between spatial points, not only the distance between two spatial points. Such insights are applied to new models that describe the cosmological expansion of the universe.

The cosmological expansion of the universe is represented in various models as the expansion of a sphere with an expansion center. In reality, however, the expansion of the universe has no center, which means that the entire space of the universe is expanding everywhere simultaneously in time. This means that the entire space of the universe would expand at once. There is no center of expansion or any preferred direction. The entire space V of the universe would consist of an infinite number of expansion centers.

It follows from the theory of relativity that ordinary space K moves with respect to hyperspace K' constantly at the speed of light c. Since the system between normal space and hyperspace manifests itself in reality as the cosmological expansion of the universe, then the universe should expand constantly at the speed of light. However, in reality, the universe is expanding at a rate that is shown to us by the Hubble constant H. This is why we get the false impression that the universe is not expanding at the speed of light. However, in fact it is not so. This means that the universe is actually expanding at the speed of light c, but we perceive this speed to be much lower, since time has changed or slowed down by a factor of y all over the universe:

$$H = \frac{c}{y}$$

Figuratively speaking, we all live in slow motion (the speed of which is accelerating), and therefore we perceive the expansion of the universe to be much slower than the speed of light. However, in fact, the universe is constantly expanding at the speed of light c.

The cosmological expansion of the universe is described by Hubble's law known in physics:

$$v = HR$$

in which case it can be seen that the greater the distance R in space, the greater the expansion rate v of the universe. The Hubble constant H changes only in time, not in space. From Hubble's law v, we get the definition of Hubble's constant H:

$$\frac{v}{R} = H = const$$

in which it can be seen that the Hubble constant H does not change when the distances R change. The variables are only v and R. Since the universe expands according to the physical system of normal space K and hyperspace K', it actually expands at the speed of light c:

$$H = c$$

therefore, the cosmological expansion of the universe at speed c also manifests itself in the human spatial scale, although humans do not perceive it directly.

It should be noted here that the cosmological expansion of the universe is described by Hubble's law:

$$v = HR$$

in which the rate of expansion of the universe v depends on the spatial scale R and the Hubble constant H. However, this is not the actual rate of expansion of the universe that must be taken into account. In the case of the rate of expansion of the universe, we actually only have to consider the Hubble constant H:

$$H = \frac{v}{R} = const$$

which no longer depends on the spatial scale of the universe R. The Hubble constant H depends only on time t.

1.3.4 The physical system of normal space and hyperspace

The answer to the question of what is "time" is that time is "duration", just as a person perceives it on a daily basis. Most of the time this is the answer, but actually the main question is not what time is. Time is duration, and the basic forms of time are past, present, and future. The main question is, instead, what creates time, or what creates the time dimension in the universe. Through this we would also understand time itself. The same principle also applies to the concept of space. Space is the “container of matter” and is known to be three-dimensional, but which gives rise to the dimension of space in the universe?

Understanding the nature of time and space is of fundamental importance, since all phenomena in the universe exist in time and space, and all processes in the universe take time and space. Time and space are the basic forms of existence of matter, but the basic forms of matter are matter and field. The theory of relativity describes the interrelationships between time and space and matter in the universe. In the theory of special relativity, time dilation and body length contraction apply. Time dilation means that the closer the body's speed reaches to the speed of light in vacuum c, the slower the clock moves relative to a stationary observer:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

or there exists an effect of slowing time. If the body moves exactly at the speed of light c, then time has slowed down to infinity, i.e. time itself no longer exists:

$$\sqrt{1 - \frac{c^2}{c^2}} t' = t = 0$$

This means that the body reaches any space point in the universe in "its own time" in 0 seconds. Time no longer exists for it. The same is the case with the length of the body, in which case the length of the body contracts or shortens to zero when the body moves at the speed of light c:

$$l' = l\sqrt{1 - \frac{v^2}{c^2}} = l\sqrt{1 - \frac{c^2}{c^2}} = 0$$

The length of the body equals zero in relation to a stationary external observer.

> Whereas the transformations of time and space are not "apparent", they are completely real phenomena. For example, if one of the twin brothers goes on a space trip and later returns to Earth, then the brothers are no longer the same age (twin paradox in special relativity). The space traveler has become younger than his brother. In theory, the age gap can be increased indefinitely.
>
> > For example, if an observer traveled in his starship into space at a speed approaching the speed of light in vacuum and returned to earth 22 years later, almost 1,000 years would have passed on earth during that time. Thus, the observer actually traveled in time to the future.

Since time is equal to zero $t = 0$ and also the length of the body (i.e. "space") is equal to zero $l' = 0$ and therefore, these two in this case are equal to each other:

$$t = l'$$

Such an equation is valid only under the condition that time and space no longer exist, i.e. time has slowed down to infinity and the length of "space" has shortened to an infinitely small, i.e. zero.

> In the case of such an equation $= l'$, it can be clearly seen that the longer the time period t, the longer the path length l'. From this follows the fact that the increase of the length of the path l' in accordance with the increase of the time period t indicates the existence of some hitherto unknown dimension of moving space, which is closely

related to the dimension of time. In this case, the coordinates of time correspond to the coordinates of space, which clearly shows that when we move in space, we also move in time. The only variables are time and space. Such an expression very clearly shows the fundamental connection between time, space and movement, which manifests itself in nature as the cosmological expansion of the universe. In the case of the expansion of the universe, the presence of moving space is also seen, because space itself is expanding, but the galaxies themselves are not moving away from each other.

It follows from the latter equation that:

$$1 = \frac{l'}{t}$$

in which we don't directly take zeros into consideration or $\frac{l'}{t} = \frac{0}{0} \neq 1$. We know from classical mechanics that the quotient of the road section l and the time t defines the speed v, i.e. $\frac{l}{t} = v$, so the last equation must actually show some kind of speed v. Since the strict condition of this situation is that time and space do not exist, then the speed v must be exactly equal to the speed of light c, because when moving at the speed of light c, neither time nor space no longer exists:

$$v = c$$

This now means that if both sides of the equation

$$1 = \frac{l'}{t}$$

will be multiplied by the speed of light c, we get as a result:

$$c = c\frac{l'}{t}$$

Since $l' = t$, we get $c = c$ or

$$c = \frac{l}{t}$$

The obtained result shows the speed of light c. The question arises, what speed does it show? This shows that some kind of hitherto unknown space "moves" relative to something at the speed of light c. This is actually what the formula for the definition of speed c describes:

$$ct = l$$

in which case it can be clearly seen that the longer the time period t (time is "moving"), the longer the distance l, i.e. the "more" space moves. It can also be said that the longer the distance l, i.e. the "more" the space moves, the longer the time period t. The speed of light c is constant, so the only variables are time and space. The speed of light c indicates the "scale": for example, after one second has passed, space has "moved" a distance of 300,000 kilometres. Such an expression shows very clearly the fundamental relationship between time, space and movement.

Time dilation depended on the speed v of the physical body relative to the speed c of light as follows:

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

in which case the speed of movement of the body v is always lower than the speed of light c, i.e. $v < c$. In the case of a body moving at the speed of light c, i.e. at the "boundary of space-time", time dilation equals infinity:

$$t` = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \frac{t}{\sqrt{1-1}} = \infty$$

in which $v = c$. Mathematically, however, it is possible to analyze further. For example, a negative number can appear under the square root in the time dilation equation:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{2c^2}{c^2}}} = \frac{t}{\sqrt{1-2}} = \frac{t}{\sqrt{-1}} = \frac{t}{i}$$

if the speed is faster than the speed of light: $v^2 = 2c^2$.

> COMMENT: Hereafter, we can derive the following equation for the energy:
>
> $$\frac{mv^2}{2} = mc^2$$
>
> in case of cancelling out the masses:
>
> $$\frac{v^2}{2} = c^2$$
>
> we get the equation for the square of the speed presented above:
>
> $$v^2 = 2c^2$$
>
> It is probably a coincidence, but nevertheless a rather remarkable coincidence, which can show that the mathematical derivations and expressions presented in this work are all connected and harmoniously consistent.

In this way, a complex number is created that contains an imaginary unit: $i = \sqrt{-1}$. In this case, we see that the dimension of time has become "imaginary":

$$t = t'i$$

Since time is imaginary in such a case, therefore we have to use the mathematics of complex numbers, which includes the imaginary unit i. For example, a complex number is represented in mathematics by the following equation

$$z = a + bi$$

and its co-complex number can be expressed as:

$$z^* = a - bi$$

The square of a complex number equals to:

$$z^2 = a^2 + 2abi - b^2$$

in which i is the imaginary unit $i = \sqrt{-1}$, the real part of the equation is

$$z^2 = a^2 - b^2$$

and its imaginary part

$$z^2 = 2ab$$

However, a member a of the equation for a complex number

$$z = a + bi$$

is the real part of the equation and the member bi is the imaginary part and a and b themselves are real numbers.

The imaginary unit i of a complex number can also be expressed as a geometric function in mathematical analysis:

$$\sqrt{-1} = e^{i\frac{\pi}{2}} = i$$

or

$$\sqrt{-1} = e^{i\frac{3}{2}\pi} = -i$$

Imaginary unit i can be positive or negative: $\sqrt{-1} = \pm i$.

The dimension of time, or temporal dimension, became imaginary for us in this case:

$$t` = \frac{t}{\pm i}$$

or

$$t = t`i$$

However, as a complex number equation, it is expressed as follows:

$$t = z = 0 + t`i = t`i$$

or

$$t = t`i$$

in which the real part of the equation is zero and the imaginary part is t`i. In this case, in equation:

$$t = z = a + bi$$

a = 0 and b = t`. Since the real part of the equation is equal to zero, it is therefore not possible to draw physical conclusions, because physical phenomena or laws can only be described by the real part of the equation. For example, the Schrödinger equation

$$-\frac{h^2}{2m}\Delta\Psi + U\Psi = ih\frac{d\Psi}{dt}$$

contains an imaginary unit, and thus all solutions to this equation are generally with complex values. Only the real part of the equation needs to be considered. It is not possible to order complex numbers.

Complex numbers in physics themselves do not actually have any physical meaning, but only derive from mathematics. Many physics equations are often written in complex form, because then it is easier to perform calculations (such as derivations and integration). Since the Schrödinger equation is the fundamental equation of quantum mechanics, which is also in complex form, almost all other mathematical expressions of quantum mechanics are also complex. For example, the equation for a flat wave propagating in the positive direction of the x-axis

$$\xi(x,t) = acos\left(\omega t - \frac{2\pi}{\lambda}x\right)$$

is also expressed in complex form:

$$\xi(x,t) = ae^{-i\left(\omega t - \frac{2\pi}{\lambda}x\right)}$$

> In quantum mechanics, each physical quantity (energy, momentum, etc.) corresponds to a specific operator. In order to obtain the operators of physical quantities, it is usually necessary to know only the coordinate and momentum operators. The coordinate operators (in cross-coordinates) are the corresponding coordinates themselves. These are the multiplication operators. But in the case of the impulse operator, it is already the product of the multiplication operator and the differentiation operator. Each physical quantity corresponds to a certain operator, and the eigenvalues of the operator give the measurable values of this physical quantity. The eigenvalues of physical operators must be real, not imaginary, because all physically measurable quantities are real. But in quantum mechanics there are also such eigenvalues of the linear operator that are not real. For a Hermitian operator, the co-operator is equal to the operator itself. Operators of physical quantities must be Hermitian in quantum mechanics, in which case its eigenvalues are real.

If the real part of the equation of a complex number is equal to zero, then it cannot describe the laws of physics, because physical phenomena or laws can only be described with the real part of the equation. Consequently, we try to present such a mathematical and physical analysis, in which the real part and the imaginary part of a complex number can be seen. We show that this is possible in the following.

For example, if we transfer in the following equation obtained above

$$t = t`i$$

one member to the other side on the equals sign:

$$t - t'i = 0$$

then we can “apply” the equation for the co-complex number:

$$z^* = a - bi$$

or

$$z^* = t - t'i$$

In this co-complex number equation, the constant is zero:

$$z^* = 0 = const$$

and the real part $t = a$ and imaginary part $-bi = -t'i$. Since above we got the expression for the equality of time and space:

$$t = l'$$

and the expression in this topic:

$$t = t'i$$

then thus we can write the co-complex number equation in the following form:

$$z^* = t - l'$$

in which $l' = t'i$. In the resulting co-complex number z* equation, we can see that the real part of the equation is t and the imaginary part is l'. Since the co-complex number z* is a constant, i.e. it must always be equal to zero, so when the time t changes, the length l' must also change. This shows that the longer the time period t (time is like "moving"), the longer the distance l', i.e. the "more" space moves. It can also be said that the longer the distance l’, i.e. the "more" the space moves, the longer the time period t. The co-complex number z* is a constant, i.e. it always equals zero, so only time and space are variables. The equation shows that time t is real and therefore can describe the time we experience on a daily basis. But the length l' is imaginary, and therefore such a spatial dimension cannot describe our everyday perceived space, but it must describe some kind of hitherto unknown spatial dimension, which must remain "outside" of our everyday perceived space.

> COMMENT 1: It should be noted here that if the previous analysis was valid for the co-complex number equation:
>
> $$z^* = a - bi$$
>
> then exactly the same analysis cannot apply in case of a "normal" complex number equation:
>
> $$z = a + bi$$
>
> because in this case z can no longer be equal to zero and z cannot be any kind of constant.
>
> COMMENT 2: In the case of a body moving at the speed of light c, i.e. at the "boundary of spacetime", time dilation was equal to infinity:

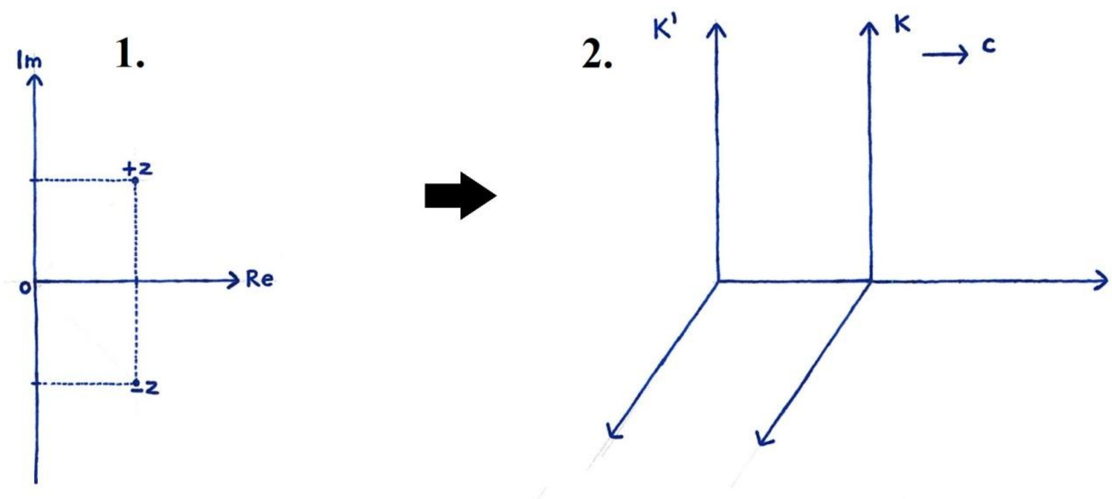
$$t` = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}} = \frac{t}{\sqrt{1-1}} = \infty$$

in which $v = c$. In this case, i.e. when time and space cease to exist, we are able to derive the equation for time and space: $t = l'$. Such a connection showed that in order to travel in time, one must move in a space that "exists" outside of “ordinary space” and in which time and space no longer exist. But a negative number could appear under the square root in the time dilation equation:

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{t}{\sqrt{1-\frac{2c^2}{c^2}}} = \frac{t}{\sqrt{1-2}} = \frac{t}{\sqrt{-1}} = \frac{t}{i}$$

if the speed were faster than the speed of light: $v^2 = 2c^2$. In this case, it doesn’t matter how large this negative number is, it can even reach negative infinity ($-\infty$). This shows that the space outside the normal space is actually "imaginary space" and the infinity of time dilation $t' = \infty$ indicates the starting point of the imaginary axis. This means that the cessation of the existence of time and space is manifested throughout the entire imaginary space, i.e. the entire imaginary axis, i.e. $t' = \infty$, for example.

The graph/figure below shows the graphical representation of the complex number +z and –z (in point 1.), showing the real axis Re and the imaginary axis Im. The co-complex number is –z. Since the real axis shows time t and the imaginary axis shows space (length) l', it follows directly that every moment of time has its own spatial point, i.e. "when traveling in time, we have to move in some kind of spatial dimension". As a result, we can present a much more understandable figure (point 2.), which shows the coordinate system of the hyperspace K' and normal space K. In this case, normal space K moves with respect to hyperspace K' at speed c, i.e. the longer the time lasts (the longer the time period), the longer the path we have traveled in hyperspace K'. In this case, hyperspace K' would be "imaginary space" and normal space K would be our everyday perceived space, i.e. the "real space". Figure:



Since the real axis shows time t and the imaginary axis shows space (length) l', it follows directly that every moment of time has its own spatial point, i.e. "when traveling in time, we have to move in some kind of hitherto unknown spatial dimension". Consequently, we will show a little more how to derive the diagram of normal space and hyperspace (2.) from the diagrams of the imaginary and real axes (1.):

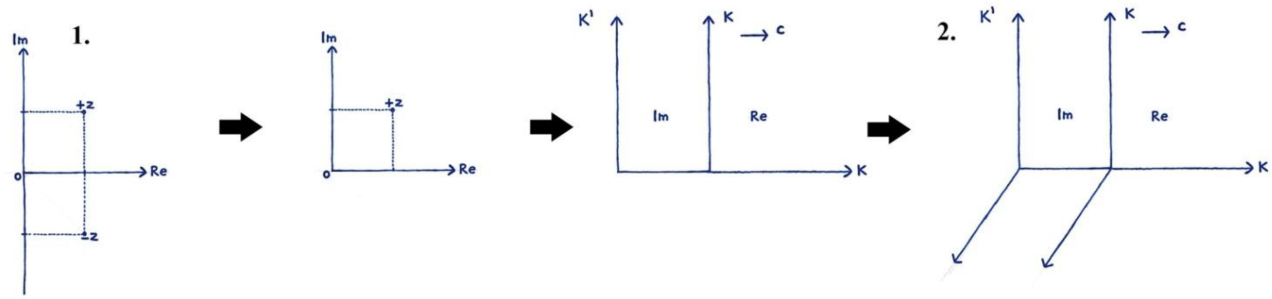
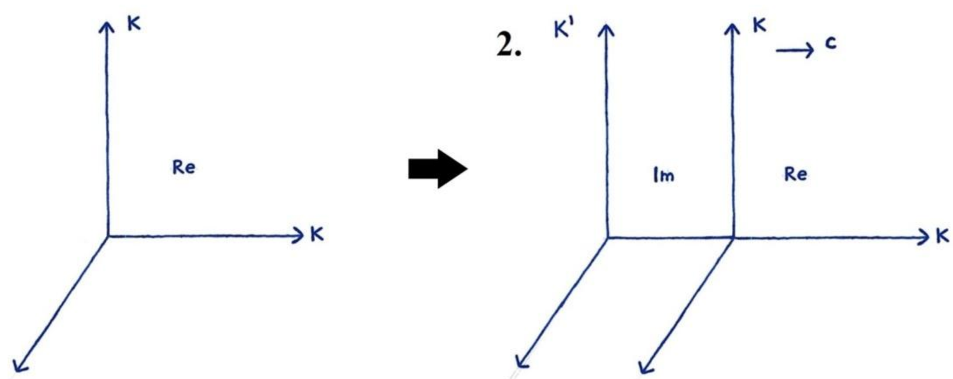


Figure 2 shows the coordinate systems of hyperspace K' and normal space K, where normal space K moves relative to hyperspace K' at speed c, i.e. the longer the time lasts (the longer the time period), the longer the path we have traveled in hyperspace K'. In this case, hyperspace K' would be "imaginary space" and ordinary space K would be our everyday perceived space, i.e. "real space". The space of the universe is not limited to the space that we, for example, experience on a daily basis. In its "shadow" lies hyperspace K', i.e. an imaginary space that "exists" outside normal space K. Hyperspace K' and normal space K are "separated" by motion, in which case normal space moves at speed c relative to hyperspace. Figure:



Here we give an example from mathematics. For example, an equation containing three variables is called a surface equation in the rectilinear coordinate system:

$$F(x, y, z) = 0$$

which is satisfied by the coordinates of every point P (x,y,z) on this surface and only these. This equation is called the implicit equation of the surface, the explicit equation is: $z = f(x, y)$. However, if the equation is such that there is no point in space whose coordinates satisfy this equation, then this equation is said to represent an imaginary surface. An imaginary surface exists in an imaginary space, and this means that imaginary objects, or imaginary bodies, exist in an imaginary space. Imaginary phenomena can also exist in imaginary space (i.e. an imaginary world).

System comprised of two equations:

$$\begin{cases} F(x, y, z) = 0 \\ \varphi(x, y, z) = 0 \end{cases}$$

represents a line in real space. If such a system is not consistent, the surfaces do not intersect, and in mathematics we speak of an imaginary line of intersection.

Let's give an example of an imaginary object. For example, the general equation of a sphere or spherical surface is presented in mathematics as follows:

$$x^2 + y^2 + z^2 + 2ax + 2by + 2cz + d = 0$$

This equation presents a sphere with a entre $K\ (-a, -b, -c)$ and radius:

$$r = \sqrt{a^2 + b^2 + c^2 - d}$$

in which the following can be expressed:

$$a^2 + b^2 + c^2 > d$$

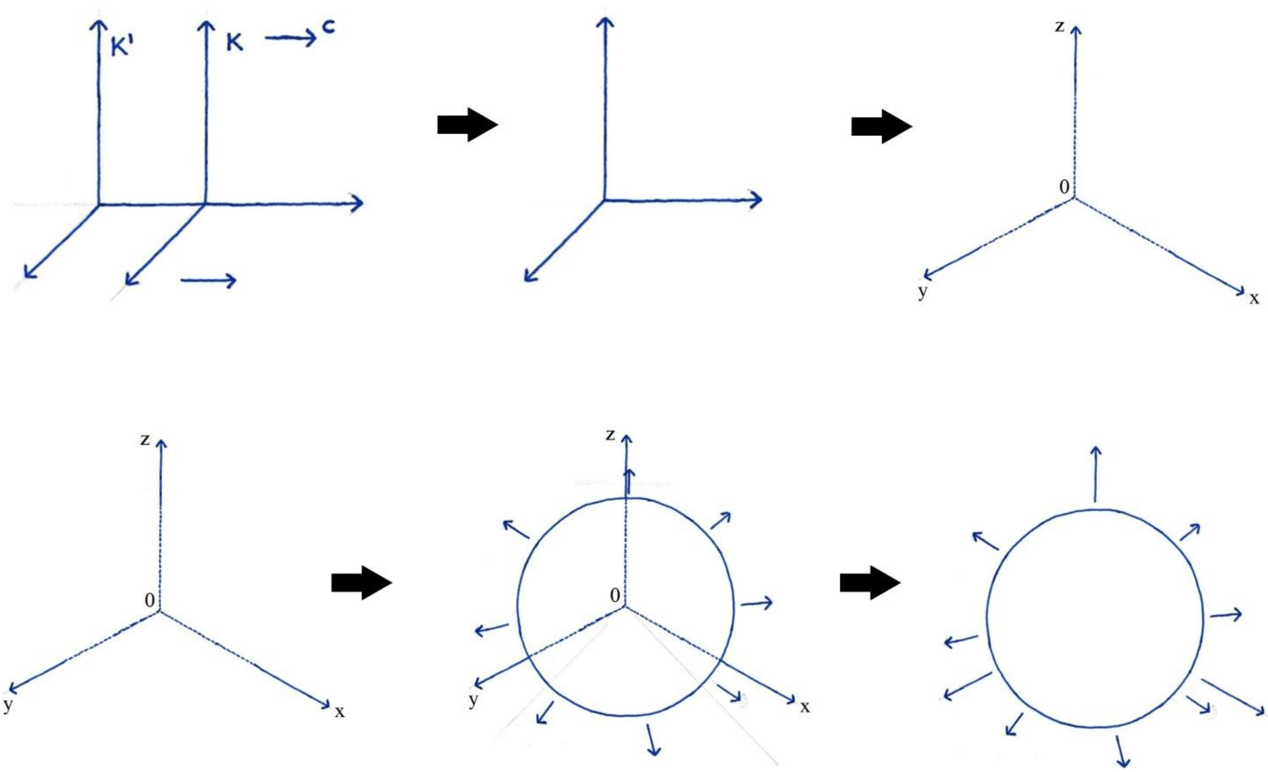
$$a^2 + b^2 + c^2 = d$$

If in the equation for the radius, the following situation occurs:

$$a^2 + b^2 + c^2 < d$$

then we are dealing with the surface of an imaginary sphere, which has no real points. In this case, it is an imaginary sphere, that is, an imaginary object that does not exist in the real rectilinear coordinate system. Imaginary objects exist in an imaginary space.

The analysis of the co-complex number shows very clearly the fundamental connection between time, space and motion, which manifests itself in nature as the movement of normal space K in relation to hyperspace K', i.e. as the cosmological expansion of the universe. Figure:



Its nature is explained in more detail in the physical theory of time travel (3), in which the principle of the inseparability of time and space from Albert Einstein's theory of special relativity is taken as one of the fundamental bases.

> We called the "imaginary space" "hyperspace", in which it is said to be possible to move in time to the past and the future. We saw above that the system of hyperspace K' and normal space K can be derived mathematically from Albert Einstein's theory of special relativity. It was a mathematical derivation and analysis, but the physical content of it all is given by the kind of analysis presented in the physical theory of time travel (3). In this large-scale research, a mathematically derived imaginary space, or therefore hyperspace, is given a physical meaning. This means that the strict mathematical derivation was provided by the theory of special relativity, but understanding time travel actually requires these two seemingly different analyses together, not separately.

1.3.4.1 Time dilation and length contraction

The closer the body's speed is to the speed of light in vacuum, the slower time passes.

Mathematically, this is described by the following equation: $t^{'} = yt$, where the multiplier y, which depends only on the speed v

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

is called the kinematic factor. This shows that many times physical processes move more slowly in a moving system. It also shows the movement of clocks in different systems, i.e. how many times a moving clock runs slower than a non-moving clock. The kinematic factor differs very little from one when the velocities v are very small. The kinematic factor shows the slowing down of time, i.e. the cessation of time's existence. However, using the following binomial expansion known in mathematics:

$$(a + x)^n = a^n + na^{n-1}x + \frac{n(n-1)}{2}a^{n-2}x^2 + \cdots + x^n$$

i.e. by writing it out as a sum

$$(a + x)^n = \sum_{k=0}^{n} \frac{n!}{(n-k)!\,k!} a^{n-k}x^k$$

and taking into account mathematical regularities

$$n! = 1 * 2 * 3 * \ldots * n \text{ and } 0! = 1$$

we can write the kinematic factor y in the following form:

$$y = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} = 1 + \frac{1v^2}{2c^2} + \frac{3v^4}{8c^4} + \cdots$$

However, if we replace the v/c expression with β, we can write the equation like this:

$$y = 1 + \frac{\beta^2}{2} + \frac{3\beta^4}{8} + \cdots$$

It is also possible to use approximate equations. For example, when the kinematic factor y manifests as

$$y \sim 1 + \frac{v^2}{2c^2}$$

then thus we get the time dilation equation

$$T \approx T_0\left[1 + \frac{v^2}{2c^2}\right]$$

However, in the case of 1/y, the kinematic factor manifests itself in approximate equations as follows:

$$\frac{1}{y} \sim 1 - \frac{v^2}{2c^2}$$

This is the mathematical version of the slowing down of time due to the large increase in the speed of movement of bodies. The transformations of time and space, discovered by A. Einstein in 1905 in the special theory of relativity, were mathematical expressions of the cessation of time and space in the case of an increase in the speed of movement of bodies. They show the slowing down of time and the shortening of length, or their ceasing to exist as mathematical equations. For example, if a body moves at the speed of light in vacuum, time and space cease to exist altogether:

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

and

$$l = l_0 \sqrt{1 - \frac{c^2}{c^2}} = 0$$

and it is because v = c. Here it is clearly seen that time and space do not exist when a body moves in vacuum at the speed of light c. Consequently, when approaching it (the speed of light in vacuum), time and space begin to disappear, which is expressed in the slowing down of time and the shortening of the length of the body.

Time dilation depended on the speed v of the physical body moving relative to the speed c of light as follows:

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

in which case the speed of movement of the body v is always lower than the speed of light c, i.e. $v < c$. In case of a body moving at the speed of light c, i.e. at the "space-time boundary", time dilation equals infinity:

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

where $v = c$. Mathematically, however, it is possible to analyze further. For example, if a physical body were to move faster than light in vacuum, i.e. $v > c$, then time would become "imaginary" in this case:

$$t` = \frac{t}{\sqrt{1 - 2}} = \frac{t}{\sqrt{-1}} = \frac{t}{\pm i}$$

Time is imaginary in this case, and therefore we have to use complex math, which includes the imaginary unit i. For example, a complex number is represented in mathematics by the following equation $z = a + bi$ and its co-complex number manifests as: $z^* = a - bi$. The square of a complex number equals:

$$z^2 = a^2 + 2abi - b^2$$

where i is the imaginary unit $i = \sqrt{-1}$, the real part of the equation is $z^2 = a^2 - b^2$ and imaginary part is $z^2 = 2ab$. However, in the complex number equation $z = a + bi$, the a term is the real part of the equation and the bi term is the imaginary part, and a and b are themselves real numbers. The dimension of time, or temporal dimension, became imaginary for us in this case:

$$t` = \frac{t}{\pm i}$$

or $t = t`i$. However, as a complex number equation, it is expressed as follows:

$$t = z = 0 + t`i = t`i$$

or $t = t`i$, in which the real part of the equation is zero and the imaginary part is t`i. In this case, in the equation:

$$t = z = a + bi$$

a = 0 and b = t`. Since the real part of the equation is equal to zero, it is therefore not possible to draw physical conclusions, because physical phenomena or laws can only be described with the real part of the equation. In mathematical analysis, the imaginary unit i of a complex number is also expressed as a geometric function:

$$\sqrt{-1} = e^{i\frac{\pi}{2}} = i$$

or

$$\sqrt{-1} = e^{i\frac{3}{2}\pi} = -i$$

The imaginary unit i can be positive or negative: $\sqrt{-1} = \pm i$.

In special relativity, time dilation depended on the body's speed v relative to the speed of light c:

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

but in general relativity, time dilation depends on the position of the body r relative to the center R of the gravitational field:

$$t` = \frac{t}{\sqrt{1 - \frac{R}{r}}}$$

in which case the gravitational radius R is always smaller than the celestial body's dimensions r, i.e. $R < r$. On the Schwarzschild surface that exists in the center of the gravitational field, or the trapped surface in spacetime, time dilation is equal to infinity:

$$t` = \frac{t}{\sqrt{1 - \frac{R}{R}}} = \frac{t}{\sqrt{1 - 1}} = \infty$$

where $R = r$. Mathematically, however, it is possible to analyze further. For example, if some physical body were to fall into the Schwarzschild surface, or $R > r$, then time would become imaginary in this case:

$$t` = \frac{t}{\sqrt{1 - 2}} = \frac{t}{\sqrt{-1}} = \frac{t}{\pm i}$$

or

$$t` = \frac{t}{\pm i}$$

Time is imaginary in this case, and therefore we have to use complex math, which includes the imaginary unit i. The dimension of time became imaginary for us: $t` = \frac{t}{\pm i}$ or $t = t`i$. However, as a complex number equation, it is expressed as follows:

$$t = z = 0 + t`i = t`i$$

or $t = t`i$, in which the real part of the equation is zero and the imaginary part is t`i. In this case, in the equation:

$$t = z = a + bi$$

a = 0 and b = t`. Since the real part of the equation is equal to zero, it is therefore not possible to draw physical conclusions, because physical phenomena or laws can only be described with the real part of the equation.

An exception can also be made here, in which case a complex number does not arise at all, i.e. time does not become imaginary:

$$t` = \frac{t}{\sqrt{1 - \frac{R}{r}}} = \frac{t}{\sqrt{1 - \frac{R}{0}}} = \frac{t}{\sqrt{1 - \infty}}$$

We square both sides of the latter equation:

$$t`^2 = \frac{t^2}{(1 - \infty)} = \frac{t^2}{-\infty} = 0$$

and we see that time is no longer imaginary, but is instead equal to zero: $t` = 0$. This means that the value of the multiplier y is zero:

$$y = \frac{1}{\sqrt{1 - \frac{R}{r}}} = 0$$

if r = 0. At the same time, it doesn't really matter whether the multiplier y is squared: $y^2 = 0$ or not: $y = 0$. The mathematics of complex numbers are also accompanied by the so-called mathematical paradoxes for which there are no rational solutions. A good example is the following equation:

$$\frac{1}{i} = \frac{1}{\sqrt{-1}} = \frac{\sqrt{1}}{\sqrt{-1}} = \sqrt{\frac{1}{-1}} = \sqrt{-1} = i$$

or $\frac{1}{i} = i$. Consequently, we can also write the following equation:

$$\frac{1}{2i} = \frac{1}{2}\frac{1}{i} = \frac{1}{2}i = \frac{i}{2}$$

or

$$\frac{1}{2i} = \frac{i}{2}$$

Let's move the real numbers and imaginary units to the other side of the equal sign of the equation: $\frac{2}{2} = ii$. As a result, we obtain the equation: $+1 = i^2$, which is not equal to the real value of the imaginary unit i: $i^2 = -1$ or $i = \sqrt{-1}$. Unfortunately, it is not possible to rationally explain such a contradiction, and therefore it is a mathematical paradox. The above-mentioned relation can also be equal to the following:

$$\frac{1}{2i} = \frac{1}{2}\frac{1}{i} = \frac{1}{i+i}$$

in which the exact same contradiction also manifests itself: $\frac{1}{i} = i$ or $+1 = i^2$.

Above we saw that if a physical body were to move faster than light in vacuum, i.e. $v > c$, then time would become "imaginary" in this case:

$$t` = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1-2}} = \frac{t}{\sqrt{-1}} = \frac{t}{\pm i}$$

However, if the body were to fall into the Schwarzschild surface, or $R > r$, then time would also become imaginary in this case:

$$t` = \frac{t}{\sqrt{1 - \frac{R}{r}}} = \frac{t}{\sqrt{1-2}} = \frac{t}{\sqrt{-1}} = \frac{t}{\pm i}$$

Analogously, exactly the same thing happens with the contraction of lengths, in which case the length of the body shortens when its speed of movement approaches the speed of light c in vacuum or the position of the body in space approaches the Schwarzschild surface in spacetime. In this case, it is not imaginary time, but imaginary space, or the imaginary length of the body in imaginary space.

1.3.4.2 Concept of hyperspace

The term “common space” refers to the dimension of space in which people exist on a daily basis. This means that the entire material world of the universe exists in ordinary space. Sometimes the concepts of normal space and vacuum are equated with each other, but this is not quite correct. Vacuum is an empty space that contains no atoms or molecules. However, it can be said that vacuum exists in ordinary space, that is, it is a part of ordinary space. Therefore, the concept of vacuum sometimes also involves the meaning of ordinary space.

Hyperspace is a hypothetical spacetime that exists outside of our everyday perceived time and space. Although hyperspace (and also hypertime) contains everyday concepts of time and space, in reality, hyperspace does not contain any time and space dimensions. Nevertheless, hyperspace is represented in geometrical models as a three- or even four-dimensional coordinate system that exists parallel to our normal spacetime. Hyperspace is like a parallel spacetime (not to be confused with a parallel world) in which neither time nor space exists. Hyperspace is like a timeless and spaceless dimension that exists outside of spacetime.

We all exist in time and space, or spacetime. However, outside of spacetime, time and space no longer exist. Physically, the cessation of the existence of time and space manifests itself in such a way that time has stopped or slowed down to infinity and the distance between two points in space has also decreased to infinity. Such phenomena are found, for example, in the centers of black holes and when moving at the speed of light in vacuum. When entering such regions of spacetime, the body exists "outside of spacetime", because time and space have ceased to exist, which is only possible outside of time and space.

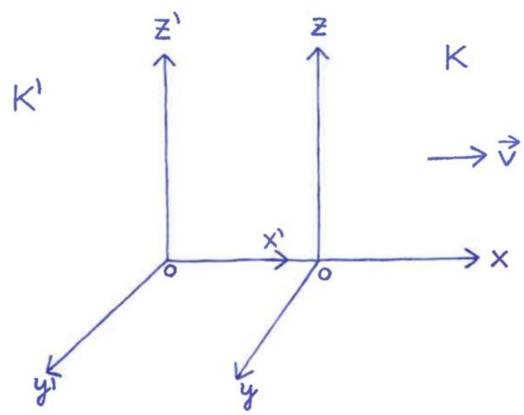


Figure: Normal space K moves at speed c relative to hyperspace K´.

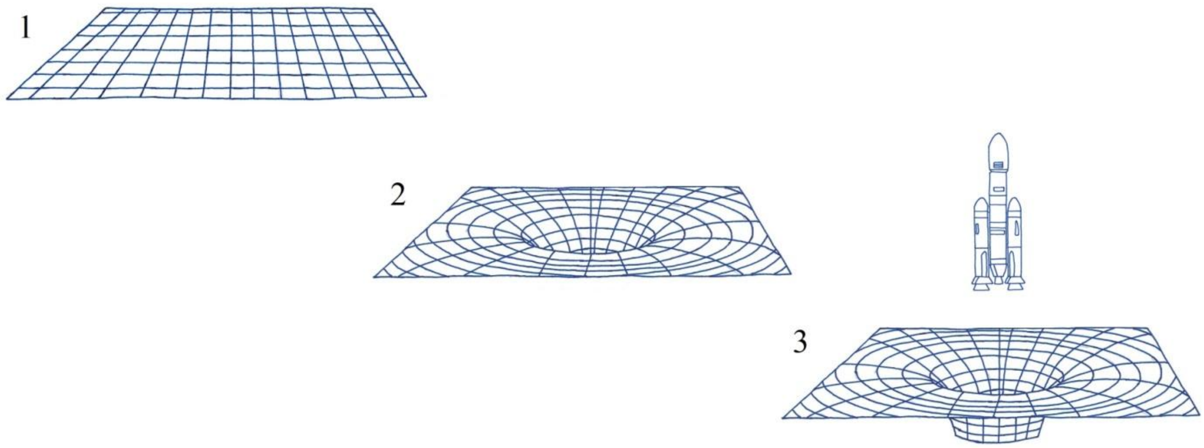
The fact that time and space in hyperspace cease to exist means that the "movement" of a body in hyperspace no longer takes up time or space. However, in various figures, hyperspace is still represented as a normal spacetime coordinate system. Hyperspace can be figuratively imagined as a spacetime coordinate system, which exists "outside" our normal spacetime. Something that is "out there" is something completely different. For example, time and space no longer exist "outside" spacetime. This is the physical reason why there is no more time or space in hyperspace and why bodies teleport when they "move" in hyperspace. If you move "out of time and space", that time and space no longer exist. It is possible to travel in time only if you "exit" it, like a character "exiting" a movie and starts to wind the film tape in the desired direction.

String theory assumes that spacetime has more than four dimensions. This is one of the fundamentals of string theory. However, with the time travel theory, it's the other way around. Spacetime dimensions do not increase, but rather decrease (i.e. cease to exist). And therefore it is the “opposite theory” of string theory. For example, the closer the speed of a train gets to the speed of light in vacuum, the more time in the train slows down and the length of the train shortens for an observer watching the train move from the side. However, to an observer inside the train, time moves at normal speed and the length of the train is the same as when it is stationary. If time in the train moves to infinity for an outside observer (that is, time has stopped, that is, there is no more time) and the length of the train has decreased to infinity (that is, decreased to zero), then the observer inside the train and the observer outside the train can no longer be in contact with each other. This essentially means that in case of any co-transformation of time and space, the contact between the body and the spacetime in which the body exists begins to disappear. The body seems to "come out" of time and space. In case of time travel, the body must be out of time in order for it to be able to move at all from one point in time to another. This is the first physical condition for real time travel.

The physics theory of time travel tells us that a person can travel back in time only in hyperspace, i.e. outside of spacetime. However, what does physically outside of spacetime mean? How to really understand it? The physics of time and space is described by Albert Einstein's theory of relativity. For example, general relativity describes curved spacetimes caused by very large masses. The closer you get to the center of a gravitational field, the more time slows down and the more space contracts. A Schwarzschild surface exists at the center of a gravitational field:

with time slowed to infinity and space contracted to zero. This means that time and space cease to exist. From this, the validity of general relativity ends and the dimension of hyperspace described in the physical theory of time travel begins. Thus, we can understand the outer dimension of spacetime as a dimension outside of spacetime in which the differential equations of Albert Einstein's theory of general relativity with their real numbers are no longer valid, but only imaginary numbers are valid. Since the outer dimension of spacetime is described only by imaginary numbers, we can understand such a dimension as an imaginary dimension.

A black hole is an extreme example of general relativity, as spacetime at its center curves to infinity. Since in the center of a black hole, or on the Schwarzschild surface, time and space curve to infinity, i.e. spacetime ceases to exist, so black holes are like holes in spacetime, through which it is possible to reach outside of spacetime. The following figure illustrates this for us:



1.3.4.3 Hyperspace and the "time arrow"

The second law of thermodynamics tells us that all natural processes proceed in the direction of increasing probability of these states. Thus, the concept of entropy consists in reaching a state with the highest probability, which is determined by the passage of time from the past to the future, or the "arrow of time". This means that time is "asymmetric". Since the violation of temporal symmetry occurs in some weak force processes between microparticles, it is therefore concluded that the law of entropy growth may be due to the "direction of time". The law of increasing entropy is of cosmological origin and it determines the direction of processes throughout the universe.

For example, the entropy of the universe as a whole only increases over time, during which local complex regular structures (for example, stars, life, planets, etc.) also arise. The emergence of orderly structures means a local decrease in the entropy of the universe, which occurs at the expense of the quality of energy that is obtained from outside or given away. This causes entropy to increase somewhere else. The law of increasing entropy is only valid for a sufficiently large collection of particles, i.e. with a single molecule this does not occur. Therefore, the second law of thermodynamics is statistical in nature, which actually states the relationship between entropy and a large number of particles.

In physics, entropy helps to find temperature, chemical potential, pressure and other thermodynamic parameters. Therefore, entropy is one of the basic concepts of statistical thermodynamics, which has many different definitions:

> The definition of the second principle of thermodynamics using the concept of entropy sounds like "the entropy of an isolated system increases until it reaches its maximum value under the given conditions". Such a fact suggests that entropy can also be understood as a measure of the irreversibility of processes.
>
> "The entropy of a thermally isolated system can only increase or remain constant."

> "Heat cannot transfer by itself from a colder body to a warmer body."
>
> "The law of conservation of energy operates independently of the second law of thermodynamics."

All processes and phenomena in the universe take place in time and space, with the exception of some phenomena belonging to the field of quantum physics (for example, quantum entanglements of particles). Time flows everywhere from the past to the future, which in physics is generally understood as "duration". Therefore, there is an "imaginary" arrow of time in the entire universe, which apparently "started" with the Big Bang of the universe. The regularity of the arrow of time is cosmological in origin and does not change over time. All physical laws must obey the regularity of the arrow of time, i.e. be consistent with it, not contradict it. Time traveling to the past would seem to contradict the legitimacy of the time arrow, but learning the reason for the creation of the time arrow would definitely disprove such a notion.

The emergence of the "arrow of time" in the universe is shown by the transformations of time and space in different dimensions. Transformations of time and space are manifested, for example, in case of movement at the speed of light. For example, the closer we get to the body's speed c in normal space, the slower time gets, i.e. the movement approaches the timeless and spaceless dimension, which is hyperspace. When moving in ordinary space at the speed of light c, the time difference t' becomes infinitely large, because in this case it is equal to being stationary in hyperspace:

$$t' = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \infty$$

This physically means that when a body is stationary in hyperspace, infinite transformations of time and space occur, for example, time has slowed down to infinity. However, when moving at the speed of light in hyperspace, the transformations of time and space are no longer manifested, because in this case the body is stationary relative to normal space. Time and space exist in ordinary space. Therefore, time and space exist (without any transformation) also for those bodies that move along with normal space at speed c.

If a body is stationary in hyperspace, then, for example, time has slowed down to infinity, so time does not exist. If, however, the body moves in hyperspace at the speed of light c, then in this case time proceeds according to a normal sequence, i.e. time has not slowed down. In normal space, such phenomena (transformations of time and space) occur exactly the opposite. For example, if a body is stationary in vacuum, time has not slowed down. However, if a body moves in vacuum at the speed of light c, then time has slowed down to infinity, i.e. time has ceased to exist.

Since the transformations of time and space are manifested differently in normal space and hyperspace, this proves that in normal space, "existence in time" or the progression from the past to the future occurs. Normal space "moves" in relation to hyperspace in only one direction, and this causes the existence of a "time arrow" in normal space, which manifests itself as the existence of physical phenomena from the past to the future. This can be proven through the transformations of time and space. For example, if a body is stationary in hyperspace, then time has slowed down to infinity, so time does not exist. Hyperspace is an outer dimension of spacetime in which neither time nor space exists. If, however, the body moves in hyperspace at the speed of light c, then in this case time proceeds according to a normal sequence, i.e. time has not slowed down. In this case, existence in time arises. In a normal room, such phenomena occur exactly the opposite. For example, if a body is stationary in vacuum (relative to hyperspace it moves at the speed of light c), then time has not slowed down. However, if a body moves in vacuum at the speed of light c (is stationary relative to hyperspace), then time has slowed down to infinity, i.e. time has ceased to exist.

Transformations of time and space in different dimensions (i.e. normal space and hyperspace) are the reason for the transformations of time and space described in special relativity. The special theory of relativity says that in case of a body moving in vacuum at speed c, time passes infinitely slowly, i.e. time dilation equals infinity. Such a circumstance is due to the fact that the body is stationary in relation to hyperspace in this case, so time must have slowed down to infinity. In this case, time no longer exists. It shows the interrelationship between the causes and effects of the transformations of time and space. For example, the transformations of time and space in hyperspace and ordinary space do not result from the transformations of time and space described in the theory of special relativity, but the transformations of time and space described in the theory of special relativity themselves result from the transformations of time and space of different dimensions, i.e. the physical system of hyperspace and ordinary space. It can also be said that the theory of relativity derives from the physical theory of time travel, since the physical theory of time travel is based on the physical system of hyperspace and ordinary space, which is actually the basis of the transformations of time and space described in the theory of relativity.

It should be noted that all bodies in the universe also move at speed c relative to light. This may give the false impression that the physical system of hyperspace and normal space is not really needed. It is enough only if we take into account such physics, in which all bodies in the universe move with respect to light at speed c. In fact, this is not correct. The reason is that the physical system of hyperspace and normal space, which is the basis of the entire physics theory of time travel, is a much deeper physics and a physical model with much more far-reaching consequences, in which a great many physical phenomena can be explained. If we were to consider only the movements of bodies with respect to light, we would not get very far. Some simple physical phenomena could be explained, but many others would remain unexplained.

In Albert Einstein's special theory of relativity, transformations of time and space are manifested when a body moves at or nears the speed of light c. For example, the closer the body's speed gets to the speed of light c in vacuum, the slower time "moves" relative to an external observer. However, time and space transformations can also occur in different dimensions. For example, if a body is stationary in hyperspace, time has slowed down to infinity, so time does not exist. Since hyperspace is an external dimension of spacetime, therefore, the non-existence of time in hyperspace is completely understandable. However, if a body moves in hyperspace at the speed of light c, then the transformation of time no longer takes place, i.e. time runs in a normal sequence. In this case, it is already an ordinary space in which time exists. In special relativity, the transformations of time and space are manifested in different background systems in which they occur in relation to something or someone. In this case, relativity must be taken into account. However, the transformations of time and space can also manifest themselves in different dimensions, in which case they do not occur in relation to anything or anyone, but have an absolute character. In this case, relativity is no longer taken into account.

Since hyperspace and ordinary space are not background systems and the speed of light c is constant with respect to any observer or background system, i.e. absolute in all ordinary space, therefore the transformations of time and space in different dimensions are absolute, not relative. Normal space is a dimension that encompasses the entire known universe at once. The principle of the constancy of the speed of light c applies everywhere in ordinary space, for example with respect to any observer or background system. It can also be said that ordinary space is a dimension in which the principle of the constancy of the speed of light c is manifested. Hyperspace is a dimension outside of spacetime, i.e. outside of normal space.

1.4 Planck time and Planck length

The quotient of the Planck length l and the Planck time t gives us the speed of light c in vacuum:

$$v^2 = \frac{l^2}{t^2} = \frac{Ghc^5}{c^3 Gh} = c^2$$

or

$$c = \frac{l}{t}$$

Therefore, the speed of light c can also be called the "Planck speed" c.

The existence of the Planck time and the Planck length, i.e. its derivation from the physics of spacetime, shows that the dimension of hyperspace "exists" outside spacetime, which can be understood as the dimension "after" the Planck time and the Planck length. This means that hyperspace "begins" where our perceived spacetime ends. Our perceived spacetime is "bounded" by the Planck time and the Planck length.

The derivation of the Planck time t and the Planck length l from the physics of spacetime actually begins with the general equation of time travel:

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

From this in turn we get the following expression:

$$ct = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

where vt` = 0. The obtained result fully coincides with the kinematic time dilation equation known from the theory of special relativity:

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

from which it is possible to "derive" the gravitational time dilation equation:

$$t` = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{t}{\sqrt{1-\frac{2GM}{c^2 r}}} = \frac{t}{\sqrt{1-\frac{R}{r}}}$$

The latter expression uses the Schwarzschild radius R:

$$R = \frac{2GM}{c^2}$$

escape velocity of the planet v:

$$v^2 = \frac{2GM}{r}$$

and the expression for gravitational potential U:

$$\frac{GM}{r} = U$$

We can directly derive Planck length l and Planck time t from the equation for gravitational potential U:

$$U = \frac{GM}{R}$$

We express the mass M in turn from the rest energy relation:

$$M = \frac{E}{c^2}$$

and energy E in turn from the uncertainty relation between time t and energy E:

$$E = \frac{h}{2}\frac{1}{t}$$

Equation for the gravitational potential thus takes the following form:

$$U = G\frac{h}{2}\frac{1}{c^2 t}\frac{1}{R} = G\frac{h}{2}\frac{1}{l^2 c}$$

The gravitational potential is related to the Schwarzschild radius R as follows:

$$c^2 = \frac{2GM}{R} = 2U$$

which in turn gives us the greatest possible gravitational potential in the entire universe:

$$\frac{c^2}{2} = U$$

Consequently, we can write the equation U:

$$U = G\frac{h}{2}\frac{1}{l^2 c}$$

in the following form:

$$l^2 = \frac{Gh}{c^3}$$

Indeed, this is the Planck length:

$$l_p = \sqrt{\frac{Gh}{c^3}} = \sqrt{\frac{h\frac{l_p^2 c^3}{h}}{c^3}} = 1{,}616\ 229(38) * 10^{-35}\ m$$

on the smaller space scales of which there is no longer any physical reality or the existence of the universe. Knowing the definition of time t from classical mechanics:

$$t = \frac{l}{v}$$

we can also derive the Planck time period:

$$t^2 = \frac{l^2}{c^2} = \frac{Gh}{c^5}$$

or

$$t_p = \sqrt{\frac{Gh}{c^5}} = 5{,}39121 * 10^{-44}\ s$$

time periods smaller than which no longer make physical sense in the universe.

This means that in the range of the volume of the universe:

$$0 \ldots 10^{-35}\ m$$

and the time of existence in the range:

$$0 \ldots 10^{-44}\ s$$

makes absolutely no sense physically, but does make mathematical sense.

The quotient of the Planck length and the Planck time gives us the speed of light c, or "Planck speed v":

$$v^2 = \frac{l^2}{t^2} = \frac{Ghc^5}{c^3 Gh} = c^2$$

or

$$c = \frac{l_p}{t_p} = 2{,}99792458 * 10^8\ \frac{m}{s}$$

If we consider the formula for the quantum energy E:

$$E = hf = h\frac{c}{\lambda} = h\frac{c}{r}$$

to be equal to the potential energy U of a gravitational field:

$$U = E = \frac{GMm}{r} = \frac{Gm^2}{r} = \frac{hc}{r}$$

then we immediately get the value of the Planck mass:

$$m_p = \sqrt{\frac{hc}{G}} = \sqrt{\frac{hc}{\frac{l_p^2 c^3}{h}}} = \frac{h}{l_p}\frac{1}{c} = 2{,}176435 * 10^{-8}\ kg$$

In the mathematical derivation of the Planck time and the Planck length, we used the relation of the rest energy E:

$$M = \frac{E}{c^2}$$

and the uncertainty relation between quantum energy E and time t:

$$E = \frac{h}{2}\frac{1}{t}$$

Both connections can be mathematically derived and analyzed from the general equation of time travel, which in turn confirms that the dimension of hyperspace is outside of our daily perceived time space, i.e. ordinary space, on from the Planck time and the Planck length. Ordinary space itself is perceptible to us up to the Planck time and the Planck length. The rest energy and uncertainty relationship between quantum energy and time is more thoroughly analyzed and derived in the physical theory of time travel.

> Here it is worth mentioning that Planck time t and Planck length l are the basis for all other quantities that start with the name "Planck" (for example, Planck energy, Planck temperature, Planck density, Planck mass, etc.).

The interrelationships between the elementary charge e, the Planck length l and the Planck mass m show that all fundamental constants of the universe are inextricably linked.

The equations show that time and space cease to exist on the scale of the Planck length l:

$$l = \sqrt{\frac{Gh}{c^3}} = 1{,}616 * 10^{-35}\ m$$

This means that on scales smaller than the Planck length l, the universe no longer has a physical existence, but can only have a mathematical meaning. In this way, the Planck length l forms the smallest possible scale of space that uniformly covers the entire three-dimensional space of the universe. We can imagine this as a "Planck surface S": the smaller the scale of space, the closer we get to the Planck surface S. Since the surface is two-dimensional (the Planck length l has two dimensions), but space is three-dimensional, the Planck surface is primarily a physical model for better visualization of the smallest spatial scale beyond which the universe no longer has physical existence.

On the Planck surface S, time and space cease to exist. Similarly, on the Schwarzschild surface S at the center of a black hole, time and space cease to exist. Consequently, they are physically equivalent:

$$S = S$$

We will show this briefly as follows. If we put the gravitational potential U in the equation:

$$U = \frac{GM}{R}$$

we express the mass M through the energy E relation:

$$M = \frac{E}{c^2}$$

and that same energy E through the uncertainty relation:

$$E = \frac{h}{2}\frac{1}{t}$$

then we get the following result:

$$U = G\frac{h}{2}\frac{1}{c^2 t}\frac{1}{R} = G\frac{h}{2}\frac{1}{l^2 c}$$

Schwarzschild radius R of a black hole:

$$c^2 = \frac{2GM}{R} = 2U$$

shows the size of a hole in spacetime. Its surface S has the highest possible value of gravitational potential U in the universe:

$$\frac{c^2}{2} = U$$

If we now put this value into the equation derived above:

$$U = G\frac{h}{2}\frac{1}{l^2 c}$$

we get the value of the Planck length l:

$$l = \sqrt{\frac{Gh}{c^3}} = 1{,}616\ 229(38) * 10^{-35}\ m$$

which shows the scale of the Planck surface S in the universe. Such a mathematical analysis shows the physical equivalence of the Planck surface S and the Schwarzschild surface S, whereas in both cases time and space cease to exist.

1.5 The boundaries of the universe

This chapter describes the physical boundaries of the universe in order to understand the reality beyond it. In the following, we will show how the boundaries of the universe are related to the physical system of normal space and hyperspace. The former follows from the latter and is easily seen through trivial mathematical analysis. The limits of the universe are indicated by Planck's constants, which are well known in physics. However, its connections with the physical system of normal space and hyperspace have not yet been known. This is important, because it shows the applicability of the physical system of normal space and hyperspace to the real world. This means that we are describing the real world, not a hypothetical reality that doesn't actually exist.

The speed of light c in vacuum

The speed of light c in vacuum is known to be the fastest speed in the universe. This speed cannot be exceeded by bodies with standing mass. Bodies with zero rest mass can move at the speed of light c. The numerical value of the speed of light and its constancy in the entire spacetime results from the fact that ordinary space K moves with respect to hyperspace K' exactly at the speed of light c, which is why phenomena such as time dilation and contraction of body lengths occur. This means that by exceeding the speed of light in spacetime, you reach hyperspace, i.e. outside of spacetime. In this sense, the role of the speed of light in relation to the physical system of hyperspace and normal space is easy to understand. It has no internal contradictions and is relatively easy for physicists to imagine.

Planck time t and Planck length l

Normal space K moves with respect to hyperspace K' at the speed of light c. This speed is equal to the quotient of the Planck length l and the Planck time t, i.e. the "Planck speed v":

$$v^2 = \frac{l^2}{t^2} = \frac{Ghc^5}{c^3 Gh} = c^2$$

or

$$c = \frac{l}{t}$$

This means that the physical laws of the universe begin to apply only from the "Planck length l" scale:

$$l = \sqrt{\frac{Gh}{c^3}} = 1{,}616\ 229(38) * 10^{-35}\ m$$

on smaller spatial scales, there is no longer a perceptible physical reality, or the existence of the universe. The Planck time period t is also related to the speed of light c:

$$t^2 = \frac{l^2}{c^2} = \frac{Gh}{c^5}$$

or

$$t = \sqrt{\frac{Gh}{c^5}} = 5{,}39121 * 10^{-44}\ s$$

Time periods smaller than this have no perceptible physical meaning in the universe.

We can also derive the value of the Planck time t from the Max Planck quantum energy E equation:

$$E = hf = \frac{h}{t}$$

or

$$t = \frac{h}{E}$$

This is the case if the energy E is equal to the product of the square of the mass m and the speed c:

$$t = \frac{h}{mc^2}$$

where h is Planck's constant, c is the speed of light in vacuum, and m is Planck's mass. In this case, the expression is equal to the value of the Planck time t:

$$t = \frac{h}{E} = \frac{h}{mc^2} = 5{,}39124 * 10^{-44}\ sec$$

Such a coincidence shows that all constants in the universe are closely related. If we in the Planck time t equation above:

$$t = \frac{h}{mc^2} = \frac{h}{\sqrt{\frac{hc}{G}}}\frac{1}{c^2}$$

express the mass m as the Planck mass, then we see that the Planck time t equals the Planck length l divided by the speed of light c:

$$t = \sqrt{\frac{hG}{c^5}} = \frac{l}{c} = \sqrt{\frac{hG}{c^3}}\frac{1}{c}$$

The Planck time t and the Planck mass m are both also related to the Planck force F, which can be presented as:

$$F = \frac{c^4}{G} = \frac{p}{t} = \frac{mc}{t} = ma$$

In the latter, p is impulse and a is acceleration. The value of the Planck force F is obtained in physics by expressing the radius r in the equation of the Newtonian gravitational force F as the Schwarzschild radius R, which in turn is divided by two:

$$F = \frac{Gm^2}{r^2} = \frac{Gm^2}{\left(\frac{Gm}{c^2}\right)^2} = \frac{Gm^2c^4}{G^2m^2} = \frac{c^4}{G} = 1{,}2 * 10^{44}\ N$$

The Planck force F is also related to the Planck constant h, the Planck length l and the speed of light c:

$$F = \frac{c^4}{G} = \frac{E}{l} = \frac{mc^2}{l} = \frac{hf}{l} = \frac{h}{t}\frac{1}{l} = \frac{h}{l}\frac{c}{l} = \frac{hc}{l^2}$$

The definition of the gravitational constant G through the fundamental constants is also evident from the latter:

$$G = \frac{l^2c^3}{h}$$

in which the speed of light c, the Planck length l and the Planck constant h are present. Let it be said here that the speed of light c is in turn related to the Planck mass m and the Planck length l:

$$\frac{Gm}{l} = c^2$$

or

$$\sqrt{\frac{GM}{l}} = c$$

All of the above clearly shows that all fundamental constants are very closely related. The above shows it in a small way, but it is enough to understand it.

Planck speed v

The relation of the Planck time t and the Planck length l to the speed of light c:

$$v^2 = \frac{l^2}{t^2} = \frac{Ghc^5}{c^3 Gh} = c^2$$

and the physical system of normal space and hyperspace show that the dimension of hyperspace "exists" outside of spacetime, which can be understood as a dimension "after" Planck time and Planck length. This means that hyperspace "begins" where our perceived spacetime ends. Our perceived spacetime is "bounded" by the Planck length and the Planck time, the quotient of which is equal to the speed of light c.

The dimension of hyperspace exists outside of our everyday perceived spacetime, or ordinary space, from the Planck length and the Planck time. Ordinary space itself is perceptible to us up to the Planck time and the Planck length.

The Planck time t and Planck length l are the basis for all other quantities that begin with the name "Planck" (for example, Planck energy, Planck temperature, Planck density, Planck mass, Planck force, etc.).

Planck’s surface S

On scales smaller than the Planck length l, the universe no longer has a physical existence. In this way, the Planck length l forms the smallest possible scale of space that uniformly covers the entire three-dimensional space of the universe. We can imagine this as the "Planck surface S": the smaller the scale of space, the closer we get to the Planck surface S. Since the surface is two-dimensional (the Planck length l has two dimensions), but space is three-dimensional, therefore the Planck surface is primarily a physical model for better visualization from the smallest spatial scale beyond which the universe no longer has physical existence. That is why it can be said that the Planck surface S is the limit of the spacetime we perceive on a daily basis.

A hole in spacetime with Schwarzschild radius R

The Schwarzschild radius R, known in the theory of relativity:

$$R = \frac{2GM}{c^2}$$

indicates the size of a black hole in our perceived spacetime. The Schwarzschild radius R forms the Schwarzschild surface S on which spacetime is curved to infinity. Time and space no longer exist "within" it. Therefore, it can be interpreted as a "hole in spacetime", passing through which would allow moving into hyperspace, i.e. outside of spacetime. Therefore, black holes are so-called "gates" (not stargates) through which one enters hyperspace dimensions. Such an interpretation is consistent with the physical system of hyperspace and normal space.

On the Schwarzschild surface S of a black hole, according to general relativity, spacetime is curved to infinity, which physically means that time and space have ceased to exist. But even so, this imaginary surface has dimensions in spacetime. For example, a black hole can be as large as the Earth.

That's why it can be said that the Schwarzschild surface S is the limit of our daily perceived spacetime (the edge of time and space), if you cross it, you reach the outside of spacetime.

Schwarzschild's surface and Planck's surface

The Schwarzschild radius R:

$$R = \frac{2GM}{c^2}$$

is a very important equation, because it forms the Schwarzschild surface S in spacetime. Such an equation is known primarily from the Schwarzschild metric:

$$ds^2 = \left(1 - \frac{R}{r}\right) c^2 dt^2 - \frac{1}{\left(1 - \frac{R}{r}\right)} dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

where the Schwarzschild radius R indicates the radius of the (geometric) spherical surface on which time and space are "curved" to infinity, i.e. the existences of time and space have ceased to exist. This manifests itself in gravitational time dilation:

$$ds^2 = \left(1 - \frac{R}{r}\right) c^2 dt^2$$

or

$$t` = \frac{t}{\sqrt{1 - \frac{R}{r}}} = \frac{t}{\sqrt{1 - \frac{R}{R}}} = \infty$$

and in gravitational space contraction:

$$ds^2 = \frac{1}{\left(1 - \frac{R}{r}\right)} dr^2$$

or

$$l = l_0 \sqrt{1 - \frac{R}{r}} = l_0 \sqrt{1 - \frac{R}{R}} = 0$$

A Schwarzschild surface S exists at the center of every black hole, and arguably even at the center of every gravitational field.

From the Schwarzschild metrics:

$$ds^2 = \left(1 - \frac{2GM}{c^2 r}\right) c^2 dt^2 - \frac{1}{\left(1 - \frac{2GM}{c^2 r}\right)} dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

it can be seen that if the gravitational potential U equals:

$$\frac{GM}{r} = U = \frac{c^2}{2}$$

then the curvature of spacetime equals infinity, i.e. time and space have ceased to exist. If mass M is expressed as energy E in the expression of gravitational potential U presented last:

$$M = \frac{E}{c^2}$$

and the energy E, in turn, as an expression known from the quantum energy equation:

$$E = hf = \frac{h}{t}$$

then we immediately get the equation for the Planck length l:

$$l = \sqrt{\frac{Gh}{c^3}}$$

Such an analysis shows quite clearly that at the scale of the Planck length l, time and space cease to exist. This is shown by the connection of the Planck length with the theory of general relativity.

Above we stated that the Planck length l forms the smallest possible scale of space, which uniformly covers the entire three-dimensional space of the universe. It can be imagined as the "Planck surface S": the smaller the spatial scale we get, the closer we get to the Planck surface S. The Planck surface S is a physical model of the smallest spatial scale beyond which the universe no longer has a physical existence. The connection between the Planck length l equation and the Schwarzschild metric shows that time and space cease to exist at the Planck length l scale. That is why it can be said that the Planck surface S is the limit of spacetime we perceive on a daily basis and in case of crossing it, the outside of spacetime is reached.

On the Planck surface S and on the Schwarzschild surface S of a black hole, according to general relativity, spacetime is curved to infinity, that is, time and space have ceased to exist. Therefore, it can also be argued that the Schwarzschild surface S and the Planck surface S are physically equivalent, although geometrically very different.

Mathematical equations and analyzes using them show us quite convincingly that time and space cease to exist on the scale of the Planck length l, therefore time and space do not exist on the Planck surface S. This means that space scales smaller than the Planck length no longer have perceptible physical reality, that is, the existence of the universe, and time periods smaller than the Planck time period no longer have a perceptible physical meaning in the universe. Schwarzschild surfaces S exist at the centers of black holes, on which time and space also cease to exist. However, the cessation of time and space also shows the application limit of relativity as a physical theory. This means that the limit of validity of Albert Einstein's theory of relativity "extends" to, for example, the Planck surface S and the Schwarzschild surface S, where the equations lose their validity in the form of the cessation of time and space. When the theory of relativity expires, the physical theory of time travel must be used, because, for example, the Schwarzschild surfaces of black holes can also be interpreted as holes in spacetime, which, if "passed through", can lead to hyperspace, i.e., outside of spacetime. The theory of relativity has no description of the outer dimension of spacetime, even though the theory of relativity itself is a part or sub-branch of the physics theory of time travel that describes the outer dimension of spacetime. Similarly, for example, Newton's classical mechanics is a special case of relativity, thus being a sub-branch of relativity.

Electric force and gravitational force

On the scale of the Planck length l, the electric force and the gravitational force are equal:

$$F_m = \frac{Gm^2}{l^2} = k\frac{q^2}{l^2} = F_q$$

Consequently, it can be said that the electric force and the gravitational force must be equal to each other on the trapped surface in spacetime as well. This can be shown by the following equation, derived from the previous equation, which shows the equality of the Schwarzschild radius to the Nordström radius:

$$R = \frac{GM}{c^2} = \sqrt{\frac{e^2G}{4\pi\varepsilon_0 c^4}}$$

in which e is the elementary electric charge:

$$e = 1{,}602 * 10^{-19}\ C$$

and the radius R indicates the radius of a spherical trapped surface in spacetime:

$$R = 1{,}3807 * 10^{-36}\ m$$

If we multiply the latter expression by 4π:

$$4\pi R = 1{,}73415 * 10^{-35}\ m$$

then the algebraic result almost coincides with the value of the Planck length l:

$$l_p = \sqrt{\frac{Gh}{c^3}} = 1{,}616 * 10^{-35}\ m$$

Through 4πR, we could also learn the value of the mass M:

$$\frac{4\pi R}{G}c^2 = M = 2{,}3 * 10^{-8}\ kg$$

This almost coincides with the value of Planck's mass m:

$$m_p = \sqrt{\frac{hc}{G}} \approx 2{,}2 * 10^{-8}\ kg$$

The interrelationships between the elementary charge e, the Planck length l and the Planck mass m show that all fundamental constants of the universe are inextricably linked.

In the following, we explain how 4πR "appears" in the equation and why the multiplier 2 disappears:

$$\frac{4\pi R}{G} c^2 = M$$

It's actually very simple. For example, from the mutual equality of the Schwarzschild and Nordström radii:

$$R = \frac{GM}{c^2} = \sqrt{\frac{e^2 G}{4\pi\varepsilon_0 c^4}}$$

or

$$R^2 = \frac{e^2 G}{4\pi\varepsilon_0 c^4}$$

we will immediately obtain 4πR:

$$4\pi R = \frac{e^2 G}{R\varepsilon_0 c^4} = 4\pi \frac{GM}{c^2}$$

Since an equivalence principle applies to mass and energy:

$$E = mc^2 = \frac{mc^2}{2} = \frac{E}{2}$$

and there is also a relationship between the speed of light c and Planck's constant h:

$$\frac{1}{c^4} \approx \frac{h}{2\pi}$$

then we see that 4π cancels out nicely on one side of the equation:

$$4\pi R = 4\pi \frac{GM}{c^2} = 4\pi \frac{h}{2\pi} G \frac{E}{2} = hGE$$

As a result, we get the relation used above:

$$4\pi R = \frac{GM}{c^2}$$

or

$$\frac{4\pi R}{G} c^2 = M$$

where this time: $E = mc^2$ and $\frac{1}{c^4} \to h$.

Above we used different radii, both of which are assigned the meanings of the Schwarzschild radius R:

$$R = \frac{2GM}{c^2}$$

and

$$R = \frac{GM}{c^2}$$

The difference between the two is that the latter is not multiplied by two. This follows directly from the different form of the energy equation in the physics theory of time travel:

$$E = mc^2$$

and

$$E = \frac{mc^2}{2}$$

Such an energy E equation:

$$E = \frac{mc^2}{2} = mc^2$$

can be derived from the general equation of the physics theory of time travel, the validity and necessity of which has been mathematically proven in fundamental physics.

Such an equation for energy E:

$$E = -\frac{mc^2}{2} = mc^2$$

is also derived from the general time travel equation. Since energy cannot have a negative sign in physics, the latter equation must be mathematically transformed into a positive one. To do this, we square all sides of the latter equation:

$$E^2 = \frac{m^2c^4}{4} = m^2c^4$$

and after that we take the square root of all sides of the equation:

$$E = \frac{mc^2}{2} = mc^2$$

With such a simple mathematical method, we got a positive equation, that is, we got rid of the negative sign.

On the scale of the Planck length l, the electric force and the gravitational force are equal:

$$F_m = \frac{Gm^2}{l^2} = k\frac{q^2}{l^2} = F_q$$

In the latter, the Planck length l, the Planck mass m and the Planck electric charge q appear. This is also the definition of Planck's charge q:

$$q = \sqrt{\frac{Gm^2}{k}}$$

where m is the Planck mass, G is the gravitational constant, and k is the electric coefficient. Such a Planck charge q is represented in terms of the gravitational potential U, but in terms of electric field energy it is represented as:

$$k\frac{q^2}{r} = E = hf = h\frac{1}{t}$$

or

$$q = \sqrt{\frac{hc}{k}}$$

It is also the expression of Planck's charge q, which is more applicable.

1.6 The fundamental equation of the physical theory of time travel

As the universe expands, there are actually two forms of time. Firstly the fact that one represents the lifetime of the universe (that is, the duration of the existence of the universe itself), and, secondly, time also occurs at the rate of expansion of the universe (that is, how fast the universe expands). There is also a physical connection between these two times - namely, the longer the universe exists (i.e. the longer the life of the universe increases), the faster the universe expands (i.e. the expansion of the universe accelerates).

One of the fundamental foundations of the theory of time travel is the statement that different moments in time are also different points in space (3). Such regularity manifests itself in nature as the expansion of the universe. For example, if the universe expands (i.e. the volume of the universe increases over time), then at different (cosmological) moments in time, the volume of the universe is different, and thus the coordinates of the spatial points of the universe are also different. The expansion of the universe is often imagined as the expansion of a sphere or balloon. Then it can be seen very clearly that the spherical coordinates of a sphere (i.e. the coordinates of spatial points) and the radius of the sphere are different at different moments in time.

The fundamental connection between time and space emerges from the phenomenon of time dilation, which consists in the fact that the closer the speed of movement of a body gets to the speed of light c in vacuum, the slower the clock moves relative to a stationary observer:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

or there is a time-slowing effect. If the body moves exactly at the speed of light c, then time has slowed down to infinity, i.e. time itself no longer exists:

$$t' = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}} = \infty$$

This means that the body reaches any space point in the universe in "its own time" t in 0 seconds. Time no longer exists for it. The same is the case with the length of the body, in which case the length of the body l' contracts or shortens to zero when the body moves at the speed of light c:

$$\frac{l'}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l'}{\sqrt{1-\frac{c^2}{c^2}}} = l = \infty$$

The length l' of the body is equal to zero with respect to a stationary external observer. Since time is equal to infinity $t' = \infty$ and also the length of the body (i.e. "space") is equal to infinity $l = \infty$, so the two in this case are equal to each other:

$$t' = l$$

Such an equation is valid only under the condition that time and space no longer exist, i.e. time has slowed down to infinity and the length of "space" has shortened to an infinitesimally small, i.e. zero. From the latter equation we get:

$$1 = \frac{l}{t'}$$

in which we do not directly consider infinities, i.e. $\frac{l}{t\prime} = \frac{\infty}{\infty} = 1$. We know from classical mechanics that the quotient of the road section l and the time t defines the speed v, i.e. $\frac{l}{t} = v$, so the latter equation must actually show some kind of speed v. Since the strict condition of this situation is that time and space do not exist, then the speed v must be exactly equal to the speed of light c, because when light moves at the speed c, time and space no longer exist:

$$v = c$$

This now means that if we multiply both sides of the equation

$$1 = \frac{l}{t'}$$

by the speed of light c, we obtain as a result:

$$c = c\frac{l}{t'}$$

or

$$ct' = cl = d$$

The obtained result shows the speed of light c, which indicates that some kind of hitherto unknown space "moves" with respect to something at the speed of light c. This is actually described by the equation for the definition of speed c:

$$ct' = d$$

in which case it can be clearly seen that the longer the time period t' (time is like "moving"), the longer the distance d, i.e. the "more" the space moves. It can also be said that the longer the distance d, i.e. the "more" the space moves, the longer the time period t'. The speed of light c is constant, so the only variables are time and space. The speed of light c shows a "measurement": for example, after one second, space has "moved" a distance of 300 000 kilometers. Such an expression very clearly shows the fundamental connection between time, space and movement, which manifests itself in nature as the movement of ordinary space K in relation to hyperspace K', i.e. as the cosmological expansion of the universe.

Let us model the expansion of the universe as the expansion of a sphere that does not rotate. In this case, the two-dimensional surface of the three-dimensional sphere is a three-dimensional version of our three-dimensional universe. The sphere expands and the body m moves along the surface of the sphere, i.e. on the surface of the sphere. The body always moves perpendicular to the radius of the sphere. For simplicity, a body moves along the circumference of a sphere with a length of 2πR. The expansion of the sphere illustrates the expansion of the universe, but the movement of the body m on the surface of the sphere illustrates the course of events and processes in the universe. Nothing can travel faster than light. The speed of light in vacuum and the rate of expansion of a sphere are both equal to c. The closer the speed of movement of the body gets to the speed of light c, i.e. the speed of expansion of the sphere, the slower the body m moves relative to the surface of the expanding sphere. This illustrates the slowing down of events and processes in the universe. If the speed of expansion of the sphere and the speed of movement of the body on the surface of the sphere match each other, then the body m will no longer move at all and thus time has stopped. It should be noted again that the sphere expands, not rotates.

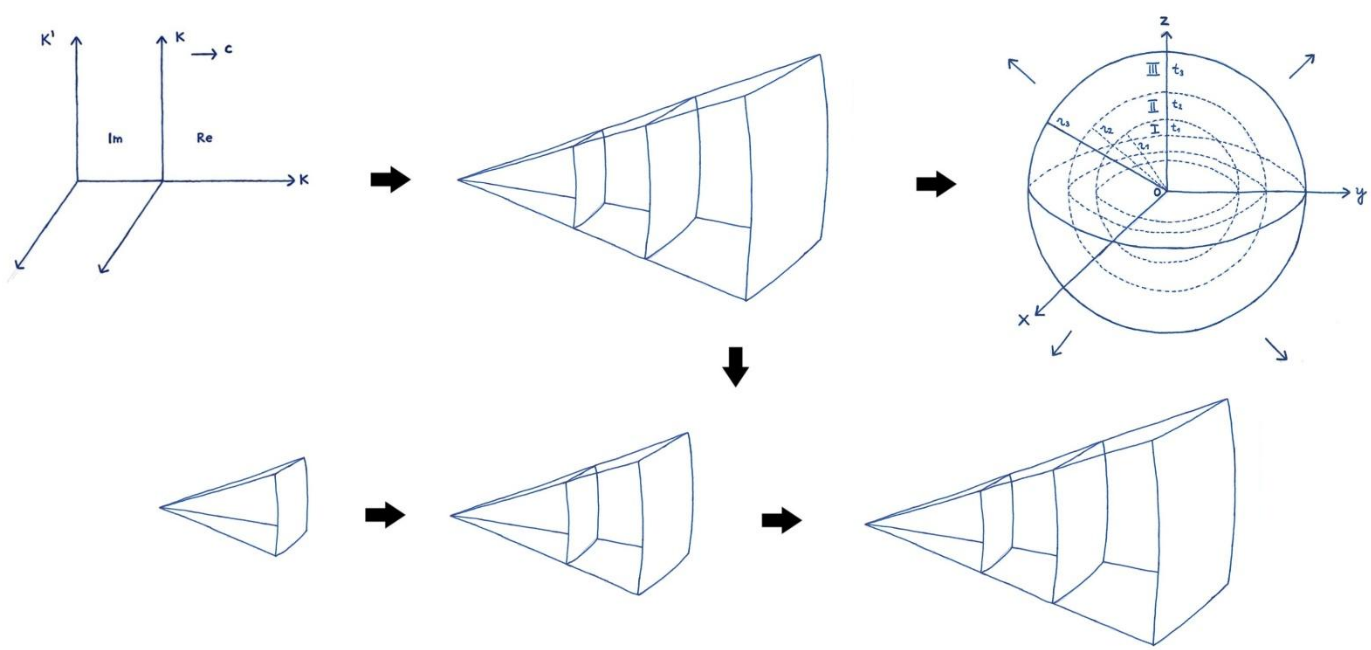


Figure: The physical system of ordinary space K ja hyperspace K´ manifests itself in nature as the *cosmological expansion of the universe.*

Since the body m always moves perpendicular to the radius of the sphere and at the same time always along with the expansion of the sphere, the movement of the body on the surface of the expanding sphere can be described by the Pythagorean theorem as follows:

$$d^2 = l^2 + (vt')^2$$

or

$$d = \sqrt{(ct + vt')^2 + (vt')^2}$$

where c is the speed of the expansion of the sphere (which matches the speed of light in vacuum), d is the (resultant) distance due to the movement of the body m and the expansion of the sphere, vt´ is the distance due to the movement of the body only, ct is the distance due to the expansion of the sphere, $l = ct + vt'$ is the distance of the body m on the surface of the expanding sphere, at the same time taking into account the increase in the distance due to the expansion of the sphere, i.e. ct, t and t´ are different moments of time, i.e. the moments of the non-expanding and expanding states of the sphere, respectively. Nothing can move faster than light, i.e. faster than the expansion of the sphere, and therefore d = ct´, which means that the body m had to travel the distance d at speed c (not faster than that).

It is worth noting here that the derived relation:

$$ct' = d$$

was actually derived above: $ct' = cl = d$, in which case it was derived from the time dilation equation. This shows that the current and subsequent mathematical and physical analysis is based on the existence of moving space, i.e. the physical system of ordinary space K and hyperspace K', and not on the theory of special relativity.

Next, we perform a series of mathematical transformations to obtain the final equation that describes the given system mathematically. Since d = ct´, we express the rate of expansion c of the sphere from the Pythagorean theorem as follows:

$$\frac{\sqrt{l^2 + (vt')^2}}{t'} = c,$$

l is the distance of the body m on the surface of the expanding sphere, taking into account also the increase in the distance due to the expansion of the sphere, i.e. ct:

$$l = ct + vt'$$

and so we can rewrite the latter equation as follows:

$$\frac{\sqrt{(ct + vt')^2 + (vt')^2}}{t'} = c$$

Let’s move t' to the other side of the equation, square both sides of the equation and write the expression of the quadratic equation:

$$(ct)^2+2(ct)(vt') + (vt')^2+(vt')^2 = (ct')^2$$

Let's move one member $(vt')^2$ to the other side and we get

$$(ct)^2+2(ct)(vt') + (vt')^2 = (ct')^2-(vt')^2$$

or

$$(ct')^2-(vt')^2 = (c^2-v^2)t'^2,$$

divide both sides of the latter obtained equation by c^2:

$$\frac{(ct)^2+2(ct)(vt') + (vt')^2}{c^2} = \frac{(c^2-v^2)t'^2}{c^2}$$

or

$$\frac{(c^2-v^2)t'^2}{c^2} = \frac{c^2-v^2}{c^2}t'^2$$

or

$$\frac{c^2-v^2}{c^2}t'^2 = \left[1-\frac{v^2}{c^2}\right]t'^2.$$

Since the mathematical relationship of the quadratic equation holds

$$(ct)^2+2(ct)(vt') + (vt')^2 = (ct+vt')^2,$$

then we obtain the latter equation in the form of the following expression:

$$(ct+vt')^2 = \left[1-\frac{v^2}{c^2}\right]t'^2c^2$$

that is, by taking a square root of both sides of the equation:

$$ct+vt' = \sqrt{1-\frac{v^2}{c^2}}t'c.$$

The latter expression is the final equation we are looking for, which describes the given physical system. It is actually a general equation from which a whole series of very important fundamental physical and mathematical connections and conclusions can be derived. It can also be said that it is one of the basic equations, the conclusions of which are in good agreement with the basic principles of the theory of time travel. These conclusions have been further studied and analyzed in terms of relativity and quantum mechanics.

> The theory of relativity did not disprove Newtonian mechanics, but showed that Newtonian mechanics is derived from relativistic mechanics. In this sense, relativity

complemented Newtonian mechanics, not overturned it. The same principle actually applies to the physics theory of time travel (3). The theory of time travel does not disprove relativity or quantum mechanics, it simply shows that relativity and quantum mechanics derive from the theory of time travel. In this sense, the theory of time travel complements the theory of relativity and quantum mechanics, rather than rejecting them. If Newtonian mechanics was derived from the theory of relativity, then the theory of relativity (and also quantum mechanics) itself derives from the theory of time travel.

However, in the following we will nevertheless do a small mathematical analysis, which is otherwise presented in the section on special and general relativity. This is necessary to finally reach an understanding of the kinematics of the expansion of the universe. For example, in the previously mathematically derived general time travel equation

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

A member in it equaled as follows:

$$ct + vt` = l$$

In the equation thus obtained:

$$l = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

or

$$l = ct`\sqrt{1 - \frac{v^2}{c^2}}$$

there are only four possible exact solutions. For example, if:

$$l = vt`$$

Then, accordingly, we get

$$vt` = ct`\sqrt{1 - \frac{v^2}{c^2}}$$

or

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

However, we will analyze such an equation much more thoroughly in the future. However, if $l = ct`$, then we get:

$$ct` = ct`\sqrt{1 - \frac{v^2}{c^2}}$$

The resulting equation must reduce to only one:

$$1 = \frac{ct`}{ct`} = \sqrt{1 - \frac{v^2}{c^2}}$$

where $v = 0$. However, if $l = vt$, we will obtain the relation:

$$vt = ct`\sqrt{1 - \frac{v^2}{c^2}}$$

or

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

Since the equation for kinematic time dilation was expressed in the special theory of relativity in the following form:

$$t` = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \frac{t}{\sqrt{1 - 1}} = \frac{t}{0} = \infty$$

where v = c, then therefore the equation can only be equal to one:

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

where $v = c$. However, if $l = ct$, then we obtain the equation in the following form:

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

1.6.1 Spacetime interval

The length or the distance between two spatial points l in three-dimensional space is described by an equation known to us from mathematics:

$$l^2 = \Delta x^2 + \Delta y^2 + \Delta z^2$$

in which the three-dimensional space coordinates appear as follows:

$$\Delta x = x_2 - x_1$$

$$\Delta y = y_2 - y_1$$

$$\Delta z = z_2 - z_1$$

Consequently, we can write out the time coordinate as follows:

$$t' = \Delta t = t_2 - t_1$$

Considering the previous relations, we get the definition of velocity v in classical mechanics:

$$v = \frac{l}{\Delta t}$$

Let's square the equation for velocity v

$$v^2 = \frac{l^2}{\Delta t^2} = \frac{\Delta x^2 + \Delta y^2 + \Delta z^2}{\Delta t^2}$$

and we also square the general time travel equation in which $vt' = 0$:

$$(ct)^2 = \left(1 - \frac{v^2}{c^2}\right)(t'c)^2$$

From the latter expression, we write down the definition of velocity v through the previously derived relations:

$$(ct)^2 = \left(1 - \frac{\Delta x^2 + \Delta y^2 + \Delta z^2}{\Delta t^2 c^2}\right)(\Delta tc)^2 = \Delta t^2 c^2 - (\Delta x^2 + \Delta y^2 + \Delta z^2)$$

The obtained metric equation

$$c^2 t^2 = \Delta t^2 c^2 - \Delta x^2 - \Delta y^2 - \Delta z^2$$

is called the "spacetime interval" in the theory of relativity, which shows the distance in spacetime between two events or two points in space in the theory of relativity. It is clearly seen in this derived equation that the time t

$$t = \tau$$

is directly related to the speed of light c

$$c\tau = s$$

or

$$c = \frac{s}{\tau}$$

However, according to the interpretation of the physics theory of time travel, it can be related to the physical system of ordinary space and hyperspace, where it shows the "movement" of ordinary space K with respect to hyperspace K' at the speed of light c. It is also possible to interpret it in this way, since the equation for the spacetime interval

$$s^2 = \Delta t^2 c^2 - \Delta x^2 - \Delta y^2 - \Delta z^2$$

can also be directly derived from the general time travel equation:

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

not only from the equations for time and space transformations in the theory of relativity. However, in Albert Einstein's theory of relativity, the metric equation of the spacetime interval is used for a four-dimensional coordinate system in which there are three space coordinates and one time coordinate. The moment of time is multiplied by the speed of light c to make it the fourth dimension of space, but it is not associated with the physical system of normal space and hyperspace. In relativity, the fourth spatial dimension is necessary to obtain four coordinates (x, y, z and ct) that describe physical phenomena in spacetime, not outside of it.

The metric equation of a space-time interval:

$$c^2 t^2 = \Delta t^2 c^2 - (\Delta x^2 + \Delta y^2 + \Delta z^2)$$

or

$$c^2 t^2 = \Delta t^2 c^2 - l^2$$

shows the distance between two points in time and space in Albert Einstein's special theory of relativity. The equation also describes the interval between the two observed events A and B. However, at the same time, this equation also describes the physical system of ordinary space K and hyperspace K', which is the absolute basis of the physics theory of time travel. Thus, the spacetime interval equation is important both in relativity and in the physical theory of time travel. We will show this briefly in the following. For example, when we divide both sides of the latter equation by the expression $\Delta t^2 c^2$, the result is:

$$\frac{t^2}{\Delta t^2} = 1 - \frac{l^2}{\Delta t^2 c^2} = 1 - \frac{v^2}{c^2}$$

This means that the time dilation equation can be directly derived from the metric equation of the spacetime interval:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

which shows the slowing down of time relative to an outside observer as it approaches the speed of light c. This is the basis of the special theory of relativity. However, at the same time, the spacetime interval equation also describes the system of normal space and hyperspace, which actually causes the phenomenon of time dilation to occur in the universe. For example, we can write the expression derived above in the following form:

$$\frac{t^2}{\Delta t^2} = 1 - \frac{l^2}{\Delta t^2 c^2} = 1 - \frac{l^2}{\Delta l^2}$$

Let's move one term to the other side of the equation:

$$\frac{t^2}{\Delta t^2}+\frac{l^2}{\Delta l^2}=1$$

The expression for the resulting amount can be equal to the following:

$$\frac{1}{2}+\frac{1}{2}=1$$

which means that the following equations may apply:

$$\frac{t^2}{\Delta t^2}=\frac{l^2}{\Delta l^2}$$

$$\frac{t^2}{\Delta t^2}=\frac{1}{2}$$

$$\frac{l^2}{\Delta l^2}=\frac{1}{2}$$

From these we can obtain the connection:

$$\frac{t^2}{2t^2}=\frac{l^2}{2l^2}$$

The latter can result in fractures:

$$\frac{1}{2}=\frac{1}{2}$$

but at the same time the following equality is also seen: $t^2=l^2$ ehk $t=l$. In more detail, its form would be as follows:

$$t=\sqrt{\Delta x^2+\Delta y^2+\Delta z^2}$$

The physical meaning of such an expression would overlap with the nature of hyperspace. The equation shows that the time period is equal to the spatial extent, that is, when moving in space, movement also occurs in time. It must be a space outside of spacetime, because moving in ordinary space does not mean traveling in time, for example to the past. In classical mechanics, such an expression also includes the speed v:

$$vt=l$$

which in turn coincides with the equation for velocity v:

$$v=\frac{l}{t}$$

Since time is "moving" and time t exists in normal space, then space outside spacetime must be "stationary" and normal space must "move" relative to it at speed c. This can be briefly shown as follows. For example, in the equation derived above:

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

we multiply both sides of the equation by c^2:

$$\frac{c^2 t^2}{\Delta t^2} = c^2 - v^2$$

As a result, we get:

$$\frac{l^2}{\Delta t^2} = \Delta v^2 = c^2 - v^2$$

or

$$\Delta v^2 = c^2 - v^2$$

The resulting expression can be interpreted as follows. If v = 0, i.e. the body m is stationary in normal space, then relative to hyperspace it moves at the speed of light c:

$$\Delta v^2 = c^2$$

In this case, time dilation does not occur, i.e. time does not cease to exist:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{0}{c^2}}} = t$$

because in a regular room you are standing still. Time and space exist in ordinary space. However, if v = c, i.e. the body m moves in ordinary space at the speed of light c (for example, the movement of light in vacuum), then in relation to hyperspace it is instead stationary:

$$\Delta v^2 = 0$$

In this case, time dilation equals infinity, i.e. time has ceased to exist:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \infty$$

because one is stationary relative to hyperspace. Time and space do not exist in hyperspace. Such an analysis shows that the system of ordinary space and hyperspace can also be directly derived from the theory of relativity, and that the transformations of time and space described in the theory of relativity derive from the system of ordinary space and hyperspace, and not the other way around. In the theory of relativity, there are connections and hints to the system of normal space and hyperspace, but they are mostly half-hidden or completely hidden, so you have to know how to properly discover and present them.

It follows from the above that two different interpretations can be obtained from the metric equation of the spacetime interval, which are closely related to each other. According to the theory of relativity, a spacetime interval indicates the distance in spacetime between two events or two points in space. This is correct. However, according to the physics theory of time travel, the spacetime interval also shows that ordinary space K moves with respect to hyperspace K' exactly at the speed of light c. This means that the physics theory of time travel shows from the metric equation of the spacetime interval what the theory of relativity does not show. The physical system of ordinary space and hyperspace remains hidden or invisible in the theory of relativity. The physical theory of time travel makes it visible to us.

1.7 Energy equations

The law of conservation of energy is mathematically derived from the homogeneity of time. Since time exists in ordinary space K (due to its "movement" in relation to hyperspace K), the law of conservation of energy also applies to it. Therefore, we will see below that all the subsequent mathematical and physical analysis show that the homogeneity of time resulting from the law of conservation of energy can also be shown through a long analysis of the previously derived general equation of time travel, in which case it is possible to derive from it the basic equation of cosmology, which is actually the law of conservation of energy in essence.

For example, from the previously derived general time travel equation:

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

the following mathematical transformations are possible. In case ct = 0, we get the following equation

$$vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

We divide both sides of the resulting equation by t´:

$$\frac{vt'}{t'} = \frac{\sqrt{1 - \frac{v^2}{c^2}}\, t'c}{t'} = \sqrt{1 - \frac{v^2}{c^2}}\, \frac{ct'}{t'}$$

and hence we finally get the following very important equation:

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

or, as visually better presented:

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

Since the time dilation equation, which can also be derived from the general time travel equation, is in the following form

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

and therefore we can express the kinematic coefficient as:

$$\sqrt{1 - \frac{v^2}{c^2}} = \frac{t}{t'}$$

Therefore, we can transform the equation derived from the general time travel equation

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

into the following mathematical form:

$$v = c\sqrt{1 - \frac{v^2}{c^2}} = \frac{ct}{t'}$$

or

$$v = c\frac{t}{t'}$$

We take t´ to the other side

$$vt' = ct$$

and transform he latter equation into the following form:

$$v \triangle t = ct$$

where $\triangle t = t'$.

Since normal space K moves at speed c relative to hyperspace K', theoretically the universe should also expand at speed c. However, in reality, the rate of expansion of the universe is many times less than the speed of light c. The only way to rationally explain such an apparent dilemma is that the difference in speeds is due to the transformation of time and space throughout the universe. For example, in the previously derived equation

$$v\Delta t = ct$$

it can be seen quite clearly that the difference in speeds can be caused by the fact that time has been altered:

$$\frac{\Delta t}{t} = \frac{c}{v} = y$$

where y is the known kinematic coefficient from the theory of special relativity:

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

or the theory of general relativity

$$y = \frac{1}{\sqrt{1 - \frac{R}{r}}}$$

Since in the relativistic equation for the transformation of velocities derived above

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

the kinematic factor y shows the ratio of different speeds

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

then, according to the equation of time dilation

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

the coefficient y shows the transformation of time:

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

Physically, this means that normal space K "moves" with respect to hyperspace K' at a constant speed c, which causes the transformation of time, i.e. the decrease of the value of y. However, at the same time the decrease in y causes the expansion rate of the universe to increase for the observer inside the expanding universe.

From the previously derived equation

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

it is possible to mathematically derive the basic equation of cosmology, i.e. the Friedmann equation, and also the equation for the static energy of a body $E = mc^2$. For example, the kinetic energy E of a body m is expressed by the equation:

$$E = \frac{mv^2}{2}$$

If the velocities are small compared to the speed of light in vacuum, approximate equations can be used:

$$\frac{1}{y} \approx 1 - \frac{1}{2}\beta^2$$

The expression for the kinematic factor y:

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

can be presented as follows

$$y = \frac{1}{\sqrt{1 - \beta^2}}$$

where β^2 is expressed like this:

$$\beta^2 = \frac{v^2}{c^2}$$

Considering all the above, the kinematic factor y can be replaced with an approximate formula:

$$\sqrt{1 - \frac{v^2}{c^2}} = \sqrt{\left(1 - \frac{1}{2}\frac{v^2}{c^2}\right)^2 - \frac{1}{4}\frac{v^4}{c^4}}$$

since $\left(\frac{v}{c} \ll 1\right)$. Since the member

$$-\frac{1}{4}\frac{v^4}{c^4}$$

is very small, then we can write the latter expression as follows:

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

Consequently, we can express y as follows:

$$y \approx 1 + \frac{v^2}{2c^2}$$

or

$$\frac{1}{y} \approx 1 - \frac{v^2}{2c^2}$$

and perform the following mathematical transformations:

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

If we multiply both sides of the equation by mc, we get the following “analysis of operations”:

$$v \approx c\left(1-\frac{1}{2}\frac{v^2}{c^2}\right)$$

or

$$mcv \approx mc^2\left(1-\frac{1}{2}\frac{v^2}{c^2}\right)$$

in which we eliminate parentheses:

$$mcv \approx mc^2 - \frac{mv^2}{2}$$

and express kinetic energy:

$$\frac{mv^2}{2} = mc^2 - mcv$$

The physical essence of the latter derived expression

$$\left(\frac{mv'^2}{2}\right)' = (\, mc^2 - mcv \,)$$

lies in the following analysis. For example, if the speed of movement of a body m is zero in relation to ordinary space K, i.e. v = 0, then in relation to hyperspace K´, the kinetic energy of the body is equal to the static energy known from the theory of relativity, i.e.

$$\frac{mv^2}{2} = mc^2$$

NOTE: Above we saw that a negative number could appear under the square root of the time dilation equation:

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{t}{\sqrt{1-\frac{2c^2}{c^2}}} = \frac{t}{\sqrt{1-2}} = \frac{t}{\sqrt{-1}} = \frac{t}{i}$$

if the speed is greater than the speed of light: $v^2 = 2c^2$. Now we see that if in the derived equation:

$$\frac{mv^2}{2} = mc^2$$

we cancel out masses:

$$\frac{v^2}{2} = c^2$$

we get the expression for the square of the speed presented above:

$$v^2 = 2c^2$$

It is probably a coincidence, but nevertheless a rather remarkable coincidence, which can show that the mathematical derivations and expressions presented in this work are all connected and harmoniously consistent. In this way, a complex number is created, which contains an imaginary unit: $i = \sqrt{-1}$.

However, if the speed of movement of a body relative to normal space is equal to the speed of light c, i.e. v = c, then relative to hyperspace the kinetic energy of the body is zero, i.e.

$$\frac{mv^2}{2} = mc^2 - mc^2 = 0$$

In all the previous cases, $\frac{mv'^2}{2}$ is the kinetic energy of a body relative to hyperspace, and therefore this expression only acts as a mathematical definition, i.e.

$$\frac{mc^2}{2} \neq mc^2$$

but

$$E'_k = mc^2 - mcv$$

or

$$E'_k = E_k$$

This means that the kinetic energy of a body m relative to hyperspace E'_k

$$E'_k = \frac{mv'^2}{2}$$

depends on what the body's speed of movement v is relative to normal space K:

$$\frac{mv^2}{2} = mc^2 - mcv = mc(c - v)$$

or

$$\frac{mv^2}{2} = mc(c - v)$$

or

$$E'_k = mc(c - v)$$

But at the same time in the expression of total energy of a body

$$E = mc^2 + \frac{mv^2}{2}$$

is a member of the equation $\frac{mv^2}{2}$ only when viewed relative to normal space. It shows that if the body's speed of movement v is zero relative to normal space, i.e. v = 0 (and therefore $\frac{mv^2}{2}$ = 0), then the body's kinetic energy E relative to hyperspace is $E = mc^2$, which we call the "state energy" of a body.

In the previously derived equation

$$\frac{mv^2}{2} = mc^2 - mcv$$

we take the member $-mcv$ to the other side of the equals sign:

$$\frac{mv^2}{2} + mcv = mc^2$$

Next, we consider that if v=0 in the member +mcv, then we get as the equation

$$\frac{mv^2}{2} = mc^2$$

and due to this relation $v^2 = -c^2$:

$$-\frac{mc^2}{2} = mc^2$$

The latter relation $v^2 = -c^2$ derives from the formal geometry of the theory of special relativity, in which the square of the four-dimensional momentum $p_\mu p_\mu$ can be defined together with the potential energy as follows:

$$-m_0{}^2c^2 = p^2 - \frac{E^2}{c^2} = -m_0{}^2c^2\frac{1-\beta^2}{1-\beta^2} = \frac{m_0{}^2(v^2 - c^2)}{1-\beta^2} = p_\mu p_\mu$$

in which the multiplier term

$$\frac{v^2 - c^2}{\sqrt{1-\beta^2}} = v_\mu v_\mu = v^2 = -c^2\frac{1-\beta^2}{1-\beta^2} = -c^2$$

is a time-like vector and is a constant. However, $v_\mu v_\mu$ here is the square of the four-dimensional speed, which actually shows that all bodies in the universe move at the speed of light c. Consequently, the (four-dimensional velocity) vector v_μ can be expressed as follows

$$v_\mu = \frac{dx_\mu}{d\tau}$$

in which the quotient member

$$\tau = t\sqrt{1-\beta^2}$$

is the eigentime of a moving body, and thus we get the final relation of a velocity vector:

$$v_{\mu} = \frac{dx_{\mu}}{t\sqrt{1-\beta^2}}$$

According to the mathematical definition of the four-dimensional velocity vector, the form of the impulse p will be

$$p = m_0 v$$

with different designations as follows

$$p_{\mu} = m_0 v_{\mu}$$

The equation derived above

$$\frac{mv^2}{2} = mc^2 - mcv$$

or

$$\frac{mv^2}{2} + mcv = mc^2$$

is very important, because Einstein's equation can be derived from it. For example, if mcv has v = c and mc^2 = E, we get the expression for the total energy of a body:

$$mc^2 = mcv + \frac{mv^2}{2}$$

or

$$E = mc^2 + \frac{mv^2}{2}$$

where $\frac{mv^2}{2}$ is the kinetic energy of a body and mc^2 is the static energy of a body. From the latter equation we can derive the relationship between mass and energy of a body in relativistic mechanics (Einstein's equation) as follows:

$$E = mc^2 + \frac{mv^2}{2} = mc^2\left(1 + \frac{1}{2}\frac{v^2}{c^2}\right) = mc^2 y = mc^2 \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

and indeed we get that $E = mc^2$ when a body is stationary, i.e. v = 0.

However, in the previously derived equation

$$\frac{mv^2}{2} = mc^2 - mcv$$

we took the member $-mcv$ to the other side of the equal sign as well:

$$\frac{mv^2}{2} + mcv = mc^2$$

and if this member of the equation is equal to zero:

$$mcv = 0$$

i.e. the speed is zero $v = 0$, then we got the following very important expression:

$$\frac{mv^2}{2} = mc^2$$

But now we show that the latter expression is actually equivalent to the following equation:

$$\frac{mv^2}{2} = mcv$$

if in the latter equation the mcv term in the equation has the velocity v = c. But if v = 0, then we get kinetic energy, which equals to zero:

$$\frac{mv^2}{2} = 0$$

According to the law of conservation of mechanical energy, the potential energy of a body must be maximum when its "energy of motion" or kinetic energy equals zero:

$$\frac{mv^2}{2} = -\frac{GMm}{R}$$

Consequently, we get the following relation:

$$-\frac{GMm}{R} = mcv$$

where $v = 0$. We will immediately justify the entire previous reasoning with the following physical analysis. For example, if v = 0 in the mcv term of the equation, it physically means that a body m is stationary with respect to normal space K, but the body m moves at speed c with respect to hyperspace K´. Therefore, the kinetic energy $\frac{mv^2}{2} = E_k$ of the body m is equal to $E = mc^2$ and this is relative to hyperspace K´. In this case, this is the definition of kinetic energy: E_k. Since v = 0 in relation to mcv, which means that the body m is at rest with respect to the normal space K, i.e. the kinetic energy of the body is zero with respect to normal space K, so the rest or potential energy of the body m with respect to normal space K is equal to the gravitational potential energy as follows:

$$mcv = -\frac{GMm}{R}$$

and this potential energy is no longer equal to zero in the equation.

At this point, it should be noted that in the theory of special relativity, the potential energy of a body due to the presence of an external field is not taken into account in the expression of the body's total energy and static energy. The change in the body's potential energy in the external force field is not taken into account. Mass and energy are equivalent quantities. The relativistic mass of a body is also a measure of the body's total energy.

> All bodies exist in ordinary space, in which time (and space) exists. Time as duration is constantly 'moving'. This means that time never "stands still". Moving bodies have kinetic energy. Absolutely all bodies in the universe also move in relation to time (i.e. we all move in time towards the future), but time is not an object of any kind. This is where the static energy E = mc^2 for all bodies in the universe can come from. This means that the energy mc^2 is still the "kinetic energy of the body with respect to time". After all, all bodies move relative to hyperspace K', because ordinary space K moves relative to hyperspace K' at speed c. Consequently, all bodies have kinetic energy and therefore mass. In this way, the energy mc^2 can be kinetic energy "relative to moving hyperspace", i.e. E = mc^2 is the energy of a body relative to time.
>
> It can be seen from the physical system of normal space and hyperspace that all bodies in the universe actually move at the speed of light c. This follows directly from the fact that, according to the physical model, ordinary space moves incessantly with respect to hyperspace at the speed of light c. All bodies and phenomena exist in spacetime, which according to the model is denoted as normal space moving relative to hyperspace. One of the best proofs of this is the expression of static energy, which is possessed by all bodies in the universe (for light it is equal to zero):
>
> $$E = mc^2$$
>
> According to this, the impulse p is manifested as follows:
>
> $$\frac{E}{c} = mc = p$$
>
> Momentum is the product of velocity and mass, and due to rest energy, all bodies with rest mass in the universe possess it. The speed of light c actually shows the speed relative to hyperspace, which is the result of the movement of normal space relative to hyperspace. Bodies "standing" in spacetime also have such momentum and energy. This is one of the most direct manifestations of the physical system of normal space and hyperspace in the entire universe.

Rest energy $E = mc^2$ actually has several meanings in physics. For example, in Albert Einstein's special theory of relativity, it simply means the energy E of a physical body with a rest mass, which does not include the fact that any macroscopic body consists of indivisible particles. In this case, the static energy is a fairly abstract physical quantity. However, nuclear physics shows that the nature of static energy is related to the binding energy of the atomic nucleus, which makes the nature of static energy much more concrete. The binding energy of a nucleus is equal to the work that must be done to move the nucleons of the nucleus to such a distance from each other that they no longer affect each other. The binding energy per nucleon is called the specific binding energy in physics. The binding energy of a nucleus can also be characterized in terms of a mass defect. When a nucleus is completely fissioned, the mass of its component particles, or nucleons, differs from the mass of the nucleus as a whole by a certain amount. This difference is called the mass defect:

$$\Delta m = Zm_p + Nm_n - m$$

where m is the mass of a nucleus, m_p and m_n are the mass of the proton and neutron, respectively, and Z and N are their number in the nucleus. With the help of the mass defect, we can find the energy released during the formation of the nucleus, if we use the famous equation for the rest energy:

$$\Delta E = \Delta mc^2$$

This equation expresses the relationship between the mass defect and the binding energy of the nucleus. Based on the law of conservation of energy, exactly the same amount of energy should also be spent for complete fission of the nucleus. According to the physics theory of time travel, the nature of static energy results from the movement of ordinary space K with respect to hyperspace K', in which case all bodies in the universe move at the speed of light c. In this case, it would be a form of kinetic energy that cannot be derived from classical mechanics. This can only be seen from the physical system of normal space and hyperspace, i.e. the further development of the theory of relativity. In this case, the physical nature of the static energy is even more concrete compared to the previously mentioned ones.

In the theory of special relativity, the potential energy of a body caused by the presence of an external field is not taken into account in the expression for the body's total energy and static energy. However, considering all the previous mathematical relationships, we still get the following very important equation:

$$\frac{mv^2}{2} + mcv = mc^2$$

or

$$\frac{mv^2}{2} - \frac{GMm}{R} = -\frac{mc^2}{2}$$

where

$$+mcv = mc^2 = \frac{mv^2}{2} = -\frac{GMm}{R}$$

and

$$mc^2 = \frac{mv^2}{2} = -\frac{mc^2}{2}$$

All the masses m cancel out:

$$\frac{v^2}{2} - \frac{GM}{R} = -\frac{c^2}{2}$$

The latter derived relation actually directly expresses the law of conservation of mechanical energy:

$$E = E_k + E_p = const$$

where

$$E = E_k + E_p = \frac{v^2}{2} + \left(-\frac{GM}{R}\right) = \frac{v^2}{2} - \frac{GM}{R} = const = -\frac{c^2}{2}$$

The constant $-\frac{c^2}{2}$ in the latter equation does not derive mathematically from the law of conservation of energy known in classical mechanics. The form of such a law of conservation of energy can only be derived by relativistic mechanics as we have done here before. Later we will see that the constant term $-\frac{c^2}{2}$ in the latter equation can also be equal to zero:

$$\frac{v^2}{2} - \frac{GM}{R} = 0$$

from which, in turn, we get the law of conservation of mechanical energy in its classical form:

$$\frac{v^2}{2} = \frac{GM}{R}$$

1.8 Time travel physics and the theory of relativity

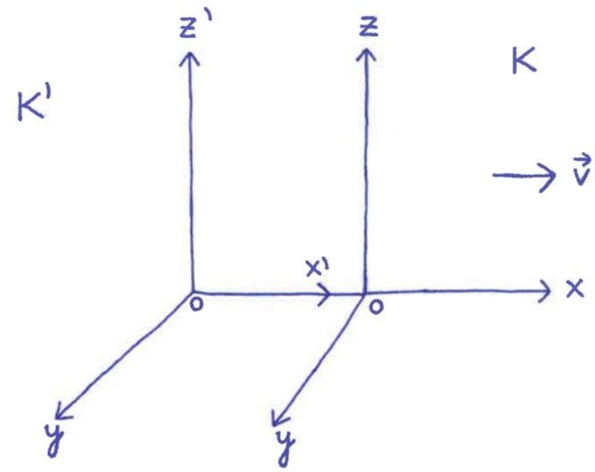
The special theory of relativity does not give an answer to the question: why does the transformation of time and space occur when the speed of movement of a body approaches the speed of light in vacuum? The answer to this fundamental question can actually be found in the physics theory of time travel.

For example, in order to travel in time (that is, to move from one moment in time to another), the body must be "outside" of time (and also space). This is the first physical condition for real time travel. Time does not exist outside of time. Above we proved that a body travels in time when moving in K´, i.e. hyperspace. Therefore, time (and space) no longer exist in hyperspace. Since the normal space K moves relative to the hyperspace K', therefore, in order for a body to reach hyperspace, i.e. K', the speed of movement of the body in normal space K (in which time and space exist) must increase. Since time does not exist in K', i.e. hyperspace (i.e. time has slowed down to infinity, i.e. time has stopped), therefore, when approaching hyperspace (i.e. as the speed of movement of a body increases in normal space K), time slows down.

However, the slowing down of time as the speed of the body increases is known only from the special theory of relativity: for example, the closer the speed of a body gets to the speed of light in vacuum, the more the passage of time slows down and the length of the body shortens. Finally, time and space transform to infinity:

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

In this context, the approach of the body's movement speed to the speed of light in vacuum can be interpreted as an increase in the body's movement speed in ordinary space K, but in relation to hyperspace K', the body starts to stay still. Consequently, K moves with respect to K´ at speed c. Since time and space are inextricably linked, the slowing down of time is also accompanied by a shortening of the length of the body, which is also known from the theory of special relativity. Normal space K moves with respect to hyperspace K' with the speed of light v = c, figure:



The speed of light c is the highest possible speed in the entire universe:

$$c = \frac{l}{t}$$

and this when viewed from any background system:

$$c = \frac{d}{t`} = \frac{\sqrt{l^2 + v^2 t`^2}}{t`} = c$$

If we mathematically transform the later expression as follows:

$$(ct)^2 + (vt`)^2 = c^2 t`^2$$

or

$$(ct)^2 = (c^2 - v^2) t`^2$$

then we see that moving at the speed of light c:

$$t^2 = \frac{c^2 - v^2}{c^2} t`^2 = \left[1 - \left(\frac{v}{c}\right)^2\right] t`^2$$

would "transform" or "slow down" time t' to infinity:

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

Light always travels at speed c in vacuum, i.e. the speed of light is always the same for any observer. This means that a single velocity of finite size does not change as the background system changes. This is only possible if time and space depend on the choice of background system. This means that both time and the coordinate depend on the background system.

NOTE: The shortening of the length of a body described in the theory of special relativity occurs in the direction of movement, i.e. it depends on the direction of movement.

Photons, particles of light, move in vacuum at speed c, where time and space have been transformed to infinity. Therefore, photons can be said to exist "outside" of spacetime, because when moving in vacuum at speed c, time has slowed down to infinity

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

and the length of space also shortened to infinity

$$l = l_0\sqrt{1-\frac{v^2}{c^2}} = l_0\sqrt{1-\frac{c^2}{c^2}} = 0$$

In this case, time and space no longer exist. For example, for an external observer, i.e. relative to an observer existing in spacetime, a body moving at the speed of light has speed c, but a body moving at speed c relative to itself, so-called "in its own time", it reaches any spatial point in the universe in one moment, i.e. its speed is therefore infinitely fast. This means that a body moving at the speed of light has an infinitely fast speed in "its own time", that is, time no longer exists for it, but at the same time, relative to an external observer, i.e. an observer existing in spacetime, the speed of this body is still c, because time and space exist for him.

Some skeptical scientists claim that the transformations of time and space described in the theory of relativity are not the cessation of these existences. This means that time and space do not disappear. That's actually not quite right. For example, the transformation of time, known in relativity as time dilation, is still essentially the cessation of time. This can be proved by the following simple postulate. For example, the closer you get to the speed of light c in vacuum, the slower time gets with respect to an external observer, and the shorter the time it takes for the body to reach its destination in space. For example, a body moving exactly at the speed of light has its own time equal to zero, which is why it reaches any destination in space in just 0 seconds, i.e. in the blink of an eye. In this case, time no longer exists in relation to the body, which is why the dilation of time can be considered as the cessation of time's existence.

Whereas the transformations of time and space are not "apparent", they are completely real. A person does not directly perceive the transformation of spacetime, if he currently exists in the system where the transformation of spacetime is taking place. However, outside this system it is already perceived. A good example of this is the case of the twin paradox. For example, if one of the twin brothers goes on a space trip and later returns to Earth, the brothers are no longer the same age. The space traveler has remained younger than his brother. In theory, the age gap can be increased indefinitely. Let's analyze it a little more mathematically. For example, if a father travels away from Earth for 2 years and back for another 2 years (times measured by the father), then he is 20 years younger than his daughter. However, before the journey began, the father was 20 years older than his daughter. Thus, we obtain the constant velocity parameter β with respect to Earth as follows:

$$40 = 4y$$

where

$$y = 10 = \frac{1}{\sqrt{1-\beta^2}}$$

in which in turn

$$\beta = 0{,}995.$$

However, if an observer traveled in his starship into space at speed approaching the speed of light in vacuum and returned to earth 22 years later, almost 1000 years would have passed on Earth during that time. Thus, the observer traveled in time to the future.

The question still arises that why didn't the person who stayed on Earth stay younger, since we can consider any body to be stationary, and thus it moved along with the Earth relative to the person in the spaceship? This is how it is revealed that the background systems of the two travelers are actually not completely equivalent. In case of a spacecraft returning to the Earth, i.e. returning to the same inertial system (i.e. in case of equalization of velocities), the speed of the spacecraft must be slowed down. The time difference in the common terminal system is caused by the spacecraft staying in non-inertial systems in the meantime.

The transformations of time and space described in the theory of relativity are not "apparent", but are completely real phenomena. A good example of this is the experimental data measured on mesons. For example, particles called μ^+ and μ^- mesons are unstable and spontaneously decay into a positron or electron and two neutrinos. These particles are present in cosmic rays. The average lifetime of a stationary or slow-moving μ-meson is approximately $2 * 10^{-6}\ s$. If the μ-meson were to move at the speed of light c, the distance it would travel would be only 600 m. However, observations convincingly show that μ-mesons are produced in cosmic rays at an altitude of 20-30 km and they even reach the ground. This is explained by the theory of relativity, in which $2 * 10^{-6}$ seconds is the "own time" of the μ-meson, but the time period measured by a clock of the experimenter on Earth is much longer. Real time is the kind of time measured by a clock that moves with the meson. The meson moves at speed v close to the speed of light c. Therefore, the meson path length measured by the experimenter is much larger than 600 m. This means that the distance to the ground is shortened to 600 meters relative to the observer on the meson, and the meson covers the 600-meter distance in $2 * 10^{-6}$ seconds.

In this context, the approach of the body's movement speed to the speed of light in vacuum can be interpreted as an increase in the body's movement speed in ordinary space K, but in relation to hyperspace K', the body starts to stay still. Consequently, K moves with respect to K´ at speed c. For example, from the general time travel equation previously derived

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

it is possible to derive a time dilation equation that is completely identical to the time transformation equation known from the theory of special relativity. For example, if vt´ = 0 in the previously stated general equation, i.e

$$ct = \sqrt{1 - \frac{v^2}{c^2}}\, t'c$$

then we can mathematically transform as follows:

$$t = \sqrt{1 - \frac{v^2}{c^2}}\, t'$$

or

$$t' = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\, t$$

in which the quotient

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

is called the y-factor in the theory of special relativity, or the kinematic factor, which shows the slowing down of time relative to an external observer. In order to understand its physical nature, it is necessary to derive one more equation, which mathematically shows the derivation of the time dilation phenomenon from the physical system of hyperspace and normal space previously derived. To do this, we make, in the previously derived general equation for time travel

$$ct + vt' = \sqrt{1 - \frac{v^2}{c^2}}\; t'c$$

the following mathematical transformations. In case ct = 0, we obtain the equation

$$vt' = \sqrt{1 - \frac{v^2}{c^2}}\; t'c$$

We divide both sides of the resulting equation by t´:

$$\frac{vt'}{t'} = \frac{\sqrt{1-\frac{v^2}{c^2}}\,t'c}{t'} = \sqrt{1-\frac{v^2}{c^2}}\frac{ct'}{t'}$$

and as a result, we finally get the following very important expression, which cannot be derived mathematically in the theory of special relativity:

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

or as visually better presented:

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

Let's denote v by v´:

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

The physical content of the latter equation lies in the following analysis. It is previously known that our normal space K moves at speed c relative to hyperspace K´, and consequently the universe must expand at the speed of light. From this we can see that if the speed of movement of the body m is c relative to normal space, or v = c (for example, the speed of light in our perceived spacetime), then the body is stationary relative to hyperspace, or v' = 0. However, if the speed of movement of the body is zero relative to normal space (the body is stationary), i.e. v = 0, then relative to hyperspace, the speed of movement of the body is equal to c, i.e. v´ = c. This also means that all bodies in the universe move at the speed of light c. The light itself is actually stationary. Since the time dilation equation, which can also be derived from the general time travel equation, is in the form

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$$

and therefore we can express the expression for the square root of the kinematic factor as:

$$\sqrt{1-\frac{v^2}{c^2}} = \frac{t}{t'}$$

We can thus transform an equation derived from the general time travel equation

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

into the following mathematical form:

$$v = c\sqrt{1 - \frac{v^2}{c^2}} = \frac{ct}{t'}$$

or

$$v = c\frac{t}{t'}$$

We'll take t' to the other side

$$vt' = ct$$

and transform the latter equation into the following form:

$$v \triangle t = ct$$

where $\triangle t = t'$. From the latter very important derived equation that eventually leads to the physical understanding of quantum mechanics

$$v \triangle t = ct$$

it can be clearly seen that the movement speed v of the body m depends on the passage of time (for example, the more time changes in relation to an external observer, the less time it takes for the body to move from one point in space to another) or the movement speed of the body itself determines the nature of the passage of time (for example, the faster the body moves, the more time transforms):

$$v = \frac{ct}{\triangle t}$$

The distance ct can be the path length of light relative to normal space K or the path length of a body with static mass relative to hyperspace K':

$$v = \frac{s}{\triangle t}$$

where s = ct. In the following, we analyze the transformation of time

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

as it derives from the physical system of hyperspace K´ and normal space K. For example, if a body with mass m moves with respect to normal space K at speed c, i.e. v = c (This can be, for example, the movement of light in vacuum), then with respect to hyperspace K´, the body is stationary, i.e. v´ = 0. In the previously derived equation

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

in this case v = c:

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

and we get the velocity of hyperspace with respect to K´

$$v' = 0$$

In the real world, this means that if a body moves in vacuum at speed c relative to any observer, then relative to hyperspace K', this body is at rest (i.e. "absolutely at rest"). Since the body m in this case moves with respect to normal space K at speed c, or v = c, time is transformed to infinity in relation to normal space K, or $\triangle t = \infty$:

$$\triangle t = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \frac{t}{0} = \infty$$

and therefore we get the speed of movement of the body with respect to hyperspace K´:

$$v = \frac{s}{\triangle t}$$

or

$$v' = \frac{ct}{\triangle t} = \frac{ct}{\infty} = 0$$

This means that if the body m is moving at speed c, or v = c, relative to normal space K, time has not changed relative to hyperspace K', or $\triangle t = t$:

$$v = \frac{s}{\triangle t} = \frac{ct}{\triangle t} = c$$

However, if the body m is stationary with respect to hyperspace K´, i.e. v´ = 0, then time has transformed to infinity with respect to normal space K, i.e. $\triangle t = \infty$:

$$v' = \frac{s}{\triangle t} = \frac{ct}{\triangle t} = \frac{ct}{\infty} = 0$$

In the real world, this means that if a body is moving at speed c in vacuum, it is a constant speed for any observer existing in vacuum at the time. This follows directly from the fact that the closer we get to the body's speed c, the slower time passes relative to an external observer. When moving at speed c, the time difference $\triangle t$ becomes infinitely large, that is

$$\triangle t = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \frac{t}{0} = \infty$$

and this means that relative to the external observer, time passes infinitely slowly, but relative to the body itself (i.e., the body in its own time), time passes infinitely quickly. This means that the body reaches any point in space in ordinary space K (for example in vacuum) instantly, that is, with an infinitely high speed: $v \longrightarrow \infty$. However, with respect to hyperspace K', the body is "absolutely" stationary, and therefore there is no time transformation with respect to hyperspace K', i.e.:

$$\triangle\, t = \frac{t}{\sqrt{1 - \frac{0^2}{c^2}}} = \frac{t}{1} = t$$

This means that relative to the hyperspace K`, the velocity of the body in its "time" is infinitesimal. If the body with mass m is stationary with respect to normal space K, i.e. v = 0, then with respect to hyperspace K´ it moves at speed v´ = c. For example, if in the equation for speed conversion

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

the speed v is equal to zero, i.e.

$$v' = c\sqrt{1 - \frac{0^2}{c^2}}$$

then we get the velocity c with respect to hyperspace K':

$$v' = c$$

In the real world, this means that absolutely all bodies in the universe, which have a static mass m_0 and thus static energy $E_0 = m_0c^2$, move at the speed of light c relative to hyperspace K´, but at the same time they can be stationary in our ordinary space K. All bodies also move at speed c relative to light. Since the body m is stationary with respect to normal space K, i.e. v = 0, time has not changed with respect to normal space K, i.e. $\triangle t = t$:

$$\triangle\, t = \frac{t}{\sqrt{1 - \frac{0^2}{c^2}}} = \frac{t}{1} = t$$

and therefore we get the speed of movement of the body with respect to hyperspace K´:

$$v = \frac{s}{\triangle\, t}$$

or

$$v' = \frac{ct}{\triangle\, t} = c$$

This means that if the body m is stationary relative to normal space K, i.e. v = 0, then time has transformed to infinity in relation to hyperspace K´, i.e. $\triangle t = \infty$:

$$v = \frac{s}{\triangle t} = \frac{s}{\infty} = 0$$

If body m moves with respect to hyperspace K´ at speed c, i.e. v´ = c, then time has not changed with respect to normal space K, i.e. △t = t:

$$v' = \frac{s}{\triangle t} = \frac{ct}{\triangle t} = c$$

This means that if, in case of light, the case was moving in vacuum, i.e. in normal space K at speed c and therefore in its own time, the light reached any spatial point in normal space in an instant, but in this case the situation is the opposite. For example, bodies with static mass move at speed c relative to hyperspace K', and as a result, the time difference between hyperspace and normal space is infinitely large. This means that when viewed from hyperspace K', time in normal space, i.e. in our universe as a whole, runs infinitely fast, but when in normal space, time runs at a normal pace for the observer and the flow of time never seems to be interrupted, i.e. its existence seems to be eternal. Since all bodies move at speed c with respect to hyperspace K', therefore "own time" in relation to hyperspace includes the entire universe, i.e. the entire normal space K. In this sense, all bodies in the universe that have static mass and static energy, and which move at speed c relative to hyperspace, move at an infinitely high speed as viewed from the hyperspace perspective (ie. hyperspace in its own time), i.e. $v \longrightarrow \infty$, because time runs at an infinitely high speed.

In order to better understand this, we present a "thought experiment" below. For example, our entire expanding universe is like one giant background system in which there is a general or global transformation of time and space. In this huge background system (which is the size of the universe), there exist an infinite number of smaller background systems, such as moving or inertial background systems (in which the laws of the theory of special relativity are manifested) and non-inertial background systems or gravitational fields (In which the laws of the theory of general relativity are manifested). Suppose we have two observers, one inside our expanding universe and the other hypothetical observer outside it. To an observer inside the expanding universe, the events in the universe seem to proceed in a normal sequence, except for the time courses occurring in different background systems, the differences of which can be caused by different ratios of the movement speeds of bodies or the force of gravity. However, to another observer outside the expanding universe, time in the universe seems to run infinitely fast.

> NOTE: It should be noted here that the two-observer experiment presented above is only valid for "illustrating" the previous mathematical analysis. This means that to a hypothetical observer outside the expanding universe, time does not actually pass infinitely fast in the universe.
>
> > The physics theory of time travel is described in the Cosmology of the Universe section, which describes the cosmological expansion of the universe, which takes place at an accelerating pace, i.e. there is a general acceleration of time across the entire universe, which cannot be directly perceived. For example, a person does not perceive time slowing down, nor time speeding up, if it occurs in the system where the person is currently located. The acceleration of time manifests itself as an acceleration in the rate of expansion of the universe, because the increase in the lifetime of the universe and the rate of expansion of the universe (speed depends on time) are related. This is how we get the accelerating expansion of the universe.

> To an observer inside the expanding universe, the events in the universe seem to proceed in a normal sequence, except for the time courses occurring in different background systems, the differences of which can be caused by different ratios of the movement speeds of bodies or the force of gravity. However, to another observer outside the expanding universe, time in the universe appears to flow much faster and at a slower pace. The slowing down of the passage of time in the universe is betrayed to the observer inside the universe by the increase in the rate of expansion of the universe, which is already expressed in the change of the Hubble constant over time.
>
> "*Of course, it must be taken into account that time is not an absolute in the theory of relativity. What we are talking about now is the "time of the accompanying observer", i.e. time perceived by an observer in some galaxy of the expanding universe and moving with it. God, who looks at things from the side, may have a completely different time estimate.*" (9)

However, all the previous mathematical analysis showed quite convincingly that if normal space K moves in relation to hyperspace K', then in order for a body to reach the hyperspace, i.e. K', the speed of the body in normal space K (in which time and space exist) must increase. Since time does not exist in K', i.e. hyperspace (i.e. time has slowed down to infinity, i.e. time has stopped), therefore, when approaching hyperspace (i.e. as the speed of movement of the body increases in normal space K), time slows down. However, the slowing down of time as the speed of the body increases is known only from the theory of special relativity: for example, the closer the speed of the body gets to the speed of light in vacuum, the more the passage of time slows down and the length of the body shortens. In this context, the approach of the body's speed to the speed of light in vacuum can be interpreted as an increase in the body's speed in ordinary space K, but in relation to hyperspace K', the body starts to stay still. Consequently, K moves with respect to K´ at speed c.

> Above we stated that time and space do not exist in hyperspace, although we use the term "hyperspace" which includes the concept of space. The non-existence of time and space in hyperspace is due to the fact that, according to the physics theory of time travel, it is possible to teleport in space and time in hyperspace. This means that teleportation in our perceived time and space takes place through hyperspace, where physical bodies exist with static mass m in hyperspace for 0 seconds, but can move from one point in time to another or from one point in space to another "during this time". Teleportation is a form of body movement that no longer takes time. This is made possible by the external dimension of hyperspace, or spacetime, which can nevertheless be imagined in various physical models as a three-dimensional coordinate system.
>
> If light moves at the speed of light c relative to normal space K, it is stationary relative to hyperspace K'. Above we stated that the light wave exists in normal space in this case, but it does not exist in hyperspace. At this point, such a statement needs to be explained in more detail. Since normal space moves at speed c relative to hyperspace and hyperspace and normal space are parallel dimensions of each other, therefore physical bodies and phenomena that exist in normal space actually exist in hyperspace as well. However, bodies that exist in hyperspace may not always exist in normal space.

If a light wave is stationary with respect to hyperspace K', then the question arises: stationary in which sense? How can light be stationary relative to hyperspace if it moves relative to normal space, i.e. the space we experience daily (for example in vacuum), at the speed of light c? It is actually very easy to understand. Since light does indeed travel at speed c in vacuum, this results in an infinite time transformation for light:

$$t^{'} = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}} = \infty$$

As a result, the own time of light is equal to zero t = 0, which allows light to reach any point in space in the universe in just 0 seconds, i.e. in an instant. In this sense, light is stationary, and that is relative to hyperspace, not relative to normal space.

Since time and space are inextricably linked, the slowing down of time is also accompanied by shortening of the length of the body, which is also known from the theory of special relativity.

The transformations of time and space described in the theory of special relativity are derived from the Lorentz transformation equations, which in turn are derived from Galilei Galileo’s transformation equation:

$$\begin{cases} x = x' + vt' = x' + vt \\ y = y' \\ z = z' \\ t = t' \end{cases}$$

These transformation equations must not change when the starting point of the coordinates is moved, i.e. the coordinate x must not be replaced by the quantity x + a. This follows from the homogeneity of space, and only linear transformations satisfy this condition. For this, the linear transformation equation must have the following form:

$$x = y(x' + vt') = \frac{x' + vt'}{\sqrt{1-\frac{v^2}{c^2}}}$$

or

$$x' = y(x - vt) = \frac{x - vt}{\sqrt{1-\frac{v^2}{c^2}}}$$

in which the multiplier term y

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

is a kinematic factor that we already knew and derived mathematically. From these coordinate conversion equations, we can actually find the time conversion equation as well.

The coordinate transformation equations for background systems moving in normal space K are described by Lorentz transformations:

$$x` = y(x - vt)$$

and

$$x = y(x` + vt`)$$

From the transformation equation for the length, or space, of the body, i.e. $x' = y(x - vt)$, we can also find the transformation equation for time t as follows:

$$\frac{x'}{y} = x - vt$$

or

$$vt = x - \frac{x'}{y}$$

in which x can be expressed as a coordinate transformation equation and then mathematically further transformed as follows to find the transformation equation for time t:

$$vt = [y(x' + vt')] - \frac{x'}{y}$$

or

$$vt = yx' + yvt' - \frac{x'}{y}$$

If we take speed v to the other side of the equal sign of the equation:

$$t = \frac{yx' + yvt' - \frac{x'}{y}}{v}$$

then we can transform mathematically as follows:

$$t = y\frac{x'}{v} + y\frac{vt'}{v} - \frac{x'}{v}\frac{1}{y}$$

or

$$t = y\left[t' + \frac{x'}{v} - \frac{x'}{v}\frac{1}{y^2}\right]$$

or

$$t = y\left[t' + \frac{x'}{v}\left(1 - \frac{1}{y^2}\right)\right]$$

In the latter equation, we express the kinetic coefficient y:

$$t = y\left[t' + \frac{x'}{v}\left(1 - \frac{1}{\left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2}\right)\right]$$

as a result of which we get:

$$t = y\left[t' + \frac{x'}{v}\frac{v^2}{c^2}\right]$$

Finally, we get the mathematically derived time conversion equation for t:

$$t = y\left(t' + \frac{v}{c^2}x'\right) = \frac{\left(t' + \frac{v}{c^2}x'\right)}{\sqrt{1-\frac{v^2}{c^2}}}$$

or

$$t' = y\left(t - \frac{v}{c^2}x\right) = \frac{\left(t - \frac{v}{c^2}x\right)}{\sqrt{1-\frac{v^2}{c^2}}}$$

These equations are called Lorentz transformation equations in the official theory of special relativity, in which it is clearly seen that time t and space coordinate x can change at once:

$$x' = \frac{(x+vt)}{\sqrt{1-\frac{v^2}{c^2}}}$$

and

$$t' = \frac{\left(t + \frac{v}{c^2}x\right)}{\sqrt{1-\frac{v^2}{c^2}}}$$

Time t and coordinate x are in our system, but time t\` and coordinate x\` are in a system that is moving relative to us. Both time and coordinate conversion equations depend on each other. These equations are called Lorentz transformation equations. Time dilation can be derived from these equations

$$t' = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}}$$

and shortening of body length, or contraction

$$l' = l\sqrt{1 - \frac{v^2}{c^2}}$$

For example, if we, in the transformation equation of the Lorentz coordinate x,

$$x = \frac{x' + vt'}{\sqrt{1 - \frac{v^2}{c^2}}}$$

take v = 0 or t´ = 0, then we will get the equation for contraction of length of a body:

$$x = \frac{x'}{\sqrt{1 - \frac{v^2}{c^2}}}$$

or

$$x' = x\sqrt{1 - \frac{v^2}{c^2}}$$

However, if we, in the Lorentz time transformation equation

$$t' = \frac{\left(t - \frac{v}{c^2}x\right)}{\sqrt{1 - \frac{v^2}{c^2}}}$$

take v = 0 or x = 0, then we get the time deceleration, or dilation, equation:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The gravitational field also consists of time dilation and space contraction. This means that when approaching the center of gravity, time slows down and the distances between points in space decrease (space contracts) relative to an outside observer. Body mass affects the passage of time and the metric of 3-dimensional Euclidean space. The metric examines the distance ds between two points in space. At the center of gravity, time and space are warped to infinity. This means that time and space cease to exist at a certain distance R from the center of gravity:

$$t` = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{t}{\sqrt{1 - \frac{2GM}{c^2 r}}} = \frac{t}{\sqrt{1 - \frac{R}{r}}} = \frac{t}{\sqrt{1 - \frac{R}{R}}} = \infty$$

The theory of special relativity only deals with inertial background systems in which the law of inertia applies. The law of inertia states that a body moves uniformly and in a straight line as long as nothing changes this state. The question arises that if time and space transformations (i.e. time dilation and body length contraction) occur in inertial background systems, can they also occur in non-inertial background systems? In inertial background systems, time and space transformations appear as the speed of motion approaches the speed of light c, but non-inertial background systems are gravitational fields. Gravitational force, and with it the force field, is related to the mass of the body. Inertial background systems deal primarily with inertial mass. According to Newton's second law

$$F = ma$$

or

$$a = \frac{F}{m}$$

the inertia of a body with an inert mass is characterized, i.e. the resistance to change in the state of motion. For example, the larger the mass a body is, the more force must be applied to make the body move or stay still. However, in non-inertial background systems, i.e. gravitational fields, the concept of heavy mass is used, which says that the greater the mass of a body, the greater the gravitational force it produces.

Inert mass and heavy mass are equivalent to each other, which means that it is not possible to determine whether the observed body is located in a gravitational field or in an accelerating background system.

> For example, in a weightless state in a falling elevator or in a spaceship orbiting the Earth, it is not possible to determine the existence of acceleration or gravitational field.

Mathematically, this is expressed in curved space. For example, the orbit of a spacecraft in flat or Euclidean space is equivalent to a straight line in curved space. A straight line in curved space is called a geodesic line. A trajectory with sufficient curvature can be straight in curved space. A straight line is the shortest path between two points in space.

> With a negative curvature, the so-called geometry of hyperbolic spaces was developed in 1826 by N. Lobachevsky, and the geometry of spaces with arbitrary curvature was created in 1854 by B. Riemann.

Albert Einstein linked the curvature of space to the physical quantities that describe mass and motion. When solving Einstein's equation, a world line of the observed body is obtained in a curved space, which is determined by the masses of other bodies. The world line is the movement path of the body in four spaces. In case of a four-dimensional coordinate system (or curved spacetime), three spatial axes and one time axis are used. The moment of time is multiplied by the speed of light c to make it the fourth dimension of space. This results in four coordinates: x, y, z and ct.

The equality of heavy and inert mass is called the weak equivalence principle, but the bending of a light beam by gravity follows from the strong equivalence principle.

It is clear that the mass of bodies bends time and space, but the theory of general relativity does not give an answer to the question: why does mass bend spacetime? Mass warps the surrounding spacetime, but why is that? The physical theory of time travel gives us the answer to this fundamental question.

The concept of "mass" is strongly related to human empirical experience. For example, if you take an apple in one hand and a flower vase filled with water in the other hand, a person "feels" that the vase filled with water is much "heavier" than the apple. This is what the empirical understanding of the nature of mass is all about. However, "weight" is a vectorial physical quantity that shows the force with which gravity acts on a body.

According to the theory of general relativity, inert mass and heavy mass are equal or equivalent. Mass is a measure of the body's inertia, i.e. it describes the body's inertia with respect to changes in speed. This means that the greater the body's mass, the more time it takes to change the body's velocity.

> For example, breaking a heavy train takes significantly longer than, for example, breaking a baby carriage. The lengths of the braking distances of these two bodies are very different for the same numerical value of speed.
>
> > From the latter, it can in turn be concluded that, for example, if a train travels evenly and in a straight line along the road and the mass of some body inside the train increases enormously over time, then the greater the mass of the body, the slower the train moves and with it the body in the train. The velocity of the body will eventually remain in place relative to the ground.

From the last examples, it is possible to conclude that if the mass of a body increases, then it must exert a greater "resistance" to the dimension of time, since all bodies "move" in time towards the future. This is described by a physical model in which the mass of a body in normal space K increases, but not the speed relative to normal space K. In this case, the body's speed of movement relative to hyperspace K' becomes slower, but the speed of normal space K's own movement relative to hyperspace K' always remains the same. However, in case of a change in the body's speed relative to hyperspace K', time and space transformations must already occur, as was shown above. This shows that the greater the body's mass, the more it must bend the surrounding time and space.

The physical system of ordinary space K and hyperspace K` manifests itself in nature as the cosmological expansion of the universe. Mass warps the surrounding spacetime and thus mass resists the expansion of the universe. This means that gravity as a curvature of spacetime resists the expansion of the universe, which is a good example of how mass as a measure of body inertia is related to the physical system of ordinary space K and hyperspace K`.

1.9 Relativity, quantum mechanics and classical mechanics

Since all bodies in the universe move in time towards the future and all phenomena in the universe take place in time and space, then the physical theory of time travel is the fundamental basis for the existence of the entire universe. The physics theory of time travel must explain practically all physical phenomena in the universe: from the Big Bang of the universe to its "death", from black holes to atomic physics, from various interactions to extra dimensions of spacetime, etc. In the form of the physical theory of time travel, it is a "theory of everything", that is, an interpretation of the universe that explains the functioning of the entire world. The physics theory of time travel does a relatively good and believable job of explaining the general aspects of the universe.

It can be said that the physics theory of time travel is a further development of relativity and quantum mechanics, or a "connection" of these two great physical theories. It is also worth noting that, for example, classical mechanics turned out to be a part of relativistic mechanics, or a special case. Similarly, it is possible to show that relativity and quantum mechanics actually turn out to be a part of the physics theory of time travel, or a special case.

Classical mechanics is a special branch of relativistic mechanics. This can be shown quite simply as follows. For example, the basic equation of classical mechanics is Newton's second law, which manifests itself in the most general form as a differential equation:

$$\vec{F} = \frac{d\vec{p}}{dt}$$

This is the law of change of momentum or impulse. In classical mechanics, the relationship between momentum p and velocity v is linear, but not in special relativity. In the theory of relativity, the "principle of relativity" applies, which states that the force F must be invariant, i.e. the same in all inertial systems. Therefore, we can write the impulse p as:

$$\vec{p} = \frac{m\vec{v}}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{m\vec{v}}{\sqrt{1 - \beta^2}} = my\vec{v}$$

where

$$\vec{\beta} = \frac{\vec{v}}{c}$$

and

$$y = \frac{1}{\sqrt{1 - \beta^2}}$$

Acceleration a is expressed as a quotient of speed v and time t:

$$\vec{a} = \frac{d\vec{v}}{dt}$$

Based on the above, we can write Newton's second law in relativistic form:

$$my\vec{a} + my^3\left(\vec{\beta}\vec{a}\right)\vec{\beta} = \vec{F}$$

in which $(\vec{\beta}\vec{a})$ denotes the scalar product of vectors β and a . It should be noted here that at low speeds:

$$\vec{\beta} \to 0$$

$$y \to 1$$

we get the classical equation from the relativistic equation of Newton's second law:

$$\vec{F} = m\vec{a}$$

Such a result convincingly shows that at small velocities compared to the speed of light in vacuum, classical mechanics turns out to be a special case of relativistic mechanics. At high speeds, force and acceleration are no longer proportional. If the velocity and force vectors are "in the same direction", then the relativistic equation of Newton's second law can be written as:

$$mya(1 + y^2\beta^2) = F$$

From the latter, it can be seen that at high speeds the acceleration a starts to depend not only on the force F but also on the speed v of the body. The consequence of this is that much greater force must be applied to give the same acceleration at high speeds than at low speeds. This means that the accelerating force begins to increase without limit as it approaches the speed of light. Consequently, no body (with static mass) can reach the speed of light.

In special relativity, the energy of a body is described by Einstein's equation:

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

If the velocity v of a body is stationary relative to "normal space", i.e. v = 0, then we get the expression for the static energy of a body:

$$E = mc^2$$

Einstein's previously derived equation is rewritten in special relativity as follows. For example, if the velocities of a free body are much lower than the speed of light in vacuum, then an approximate expression is used:

$$y \approx \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \approx \frac{1}{1 - \frac{1}{2}\frac{v^2}{c^2}} \approx 1 + \frac{1}{2}\frac{v^2}{c^2}$$

Accordingly, we now write Einstein's equation in the form of the equation of classical mechanics:

$$E = mc^2\left(1 + \frac{1}{2}\frac{v^2}{c^2}\right) \approx mc^2 + \frac{mv^2}{2}$$

in which classical energy is manifested:

$$E = \frac{mv^2}{2}$$

This shows that classical mechanics derives from relativistic mechanics, i.e. classical mechanics is a part or a special case of relativistic mechanics.

General relativity is related to gravitational field. A gravitational field is a curvature of spacetime caused by very large masses. The more mass a body has, the more it warps spacetime, and through this, the gravitational force is also greater. The curvature of spacetime consists of gravitational time dilation and gravitational length contraction. Gravitational time dilation is related to gravitational force, which most directly demonstrates the relationship between the curvature of spacetime and gravitational force. Newton's gravitation law can be derived from the curvature of spacetime, i.e. the classical equation can be derived from the general relativity equation. The following mathematical derivation and analysis is a classic example of how it is possible to derive Newton's gravitation law from the curvature of spacetime without directly using tensor mathematics and Riemannian geometry. To do this, we make some of the following mathematical transformations in the gravitational time dilation equation:

$$t' = \frac{t}{\sqrt{1 - \frac{\alpha}{r}}}$$

or

$$\sqrt{1 - \frac{\alpha}{r}} = \frac{t}{t'}$$

We square both sides of the latter equation:

$$\left(1 - \frac{\alpha}{r}\right) = \frac{t^2}{t'^2}$$

Since according to Newton's second law

$$a = \frac{F}{m}$$

gravitational acceleration a is equal to gravitational force

$$a = g = \frac{GM}{r^2}$$

then, therefore, the gravitational acceleration a must also be proportional to the time relation, which was previously derived from the gravitational time dilation:

$$a = \left(1 - \frac{\alpha}{r}\right)$$

First, we differentiate the expression in parentheses with respect to r:

$$\frac{\partial\left(1 - \frac{\alpha}{r}\right)}{\partial r} = \frac{\alpha}{r^2} = \frac{2GM}{c^2 r^2}$$

where the member

$$\alpha = \frac{2GM}{c^2}$$

Is known as the Schwarzschild radius. After such differentiation, we see that the gravitational acceleration a is related to the Schwarzschild radius as follows:

$$a = \frac{2GM}{c^2 r^2}$$

It is known from differential mathematics that

$$\frac{dx^0}{ds} = \frac{dt}{ds} \approx 1$$

and the acceleration a is actually the second derivative with respect to time

$$\frac{d^2x^i}{ds^2} = \frac{dt^2}{ds^2} = \frac{d^2r}{ds^2} = a$$

or

$$v = \frac{dr}{ds} \ \ and \ \ a = \frac{d^2r}{ds^2}$$

Therefore, we can express the gravitational acceleration as a differential expression:

$$\frac{d^2r}{ds^2} = \frac{2GM}{c^2r^2}$$

Instead of the spacetime interval ds, we can write the product of own time and the speed of light c

$$ds = cd\tau$$

because in the metric equation of the spacetime interval they are related as follows:

$$ds^2 = c^2d\tau^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$$

We can also note this in the expression for gravitational acceleration, or in this case Newton's second law in case of gravity:

$$\frac{d^2r}{c^2d\tau^2} = \frac{2GM}{c^2r^2}$$

or

$$\frac{d^2r}{d\tau^2} = \frac{2GM}{r^2}$$

or

$$\frac{d^2r}{d\tau^2 2} = \frac{GM}{r^2}$$

Since the acceleration a manifests itself as a differential relation:

$$\frac{d^2r}{d\tau^2} = a$$

then thus we get the following relationship, in which the acceleration divided by two equals gravity:

$$\frac{a}{2} = \frac{GM}{r^2}$$

According to the general equivalence principle of general relativity, gravity can be replaced by inertial force, i.e. we can treat acceleration as centripetal acceleration:

$$a = \frac{v^2}{r}$$

and hence we get the following relation:

$$\frac{v^2}{2r} = \frac{GM}{r^2}$$

or

$$\frac{v^2}{2} = \frac{GM}{r}$$

If we multiply both sides by the mass M in the latter expression

$$\frac{Mv^2}{2} = \frac{GMm}{r}$$

then we see a relationship called the law of conservation of energy in classical mechanics, which has kinetic energy on one side and gravitational potential energy, or simply gravitational potential, on the other side:

$$\frac{mv^2}{2} = \frac{GMm}{r}$$

From the law of conservation of energy derived from the gravitational time dilation equation, it is possible to mathematically derive Newton's second law in case of gravitational force:

$$a = g = \frac{GM}{r^2}$$

First, the gravitational potential φ is actually derived from Newton's gravitational force F when we integrate Newton's law of gravity over the radius r as follows:

$$\frac{GMm}{r} = \int_r^{+\infty} \frac{GMm}{r^2} d\vec{r} = U$$

where F is Newton's universal law of gravitation:

$$F = \frac{GMm}{r^2}$$

Second, kinetic energy E is proportional to the work done:

$$Fs = ma = mg = m\frac{dv}{dt}\frac{ds}{ds} = mv\frac{dv}{ds}$$

or

$$Fs = mv\frac{dv}{ds}$$

It can be seen from the latter relation that by differentiating the expression for work A, we get the equation for kinetic energy as follows:

$$dA = Fsds = mvdv = d\left(\frac{1}{2}mv^2\right)$$

Integrating the latter expression:

$$A = \int_{s_1}^{s_2} \vec{F}sd\vec{s}$$

we get the mathematical expression for kinetic energy:

$$A = \int dA = \int_0^{\frac{mv^2}{2}} d\left(\frac{1}{2}mv^2\right) = \frac{1}{2}mv^2 = \frac{mv^2}{2}$$

By differentiating and integrating the two sides of the equation separately in this way (as is the case in differential and integral calculus), we finally arrive, indirectly or directly, at the form of Newton's second law:

$$a = \frac{F}{m}$$

or in case of gravity

$$\frac{d^2r}{d\tau^2} = \frac{GM}{r^2}$$

Newton's second law is sometimes presented in a form in which mass is simply multiplied by acceleration:

$$F = ma$$

and it is completely identical to Newton's gravitational force F:

$$F = \frac{GMm}{r^2}$$

Since the spacetime metric is affected by both mass of the body M and electric charge q:

$$ds^2 = \left(1 - \frac{R_M}{r}\right)dt^2 - \frac{1}{1 - \frac{R_M}{r}}dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2) =$$

$$= \left(1 - \frac{R_q}{r}\right)dt^2 - \frac{1}{1 - \frac{R_q}{r}}dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

where

$$R_M = \frac{2GM}{c^2} = R_q = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

then, therefore, the gravitational force F should appear even if spacetime is curved only by the electric charge q:

$$ds^2 = \left(1 - \frac{R_q}{r}\right) dt^2 - \frac{1}{1 - \frac{R_q}{r}} dr^2 - r^2 (d\theta^2 + sin^2\theta d\varphi^2)$$

In both cases, the “surface of a hole in spacetime” or “Schwarzschild surface”:

$$t` = \frac{t}{\sqrt{1 - \frac{2GM}{rc^2}}} = \frac{t}{\sqrt{1 - \frac{R}{r}}} = \frac{t}{\sqrt{1 - \frac{R}{R}}} = \frac{t}{\sqrt{1 - 1}} = \frac{t}{0} = \infty$$

has the largest possible potential U in the universe:

$$U = \frac{GM}{r} = \frac{c^2}{2}$$

and through it also the "Planck force" F:

$$\frac{2Mc^2}{r} = 2\frac{E}{r} = 2F = \frac{c^4}{G}$$

or

$$F_p = \frac{c^4}{G}$$

Newton's second law is also used to describe the cosmological expansion of the universe, in which the expansion of the universe creates an inertial force on all bodies in the universe. This means that the inertial force F_{in} due to the cosmological expansion of the universe is derived from Newton's II law and also from Hubble's law. For example, the well-known Hubble's law is expressed as follows:

$$v = HR$$

or

$$v = Hl$$

where $l = R$. If we multiply both sides of the latter equation by mass m, we get the definition of momentum p:

$$mv = p = mlH$$

Next, we divide both sides of the obtained equation by time t, and as a result we get the inertial force F_{in}, which is caused by the expansion of the universe:

$$\frac{p}{t} = \frac{mv}{t} = m\frac{v}{t} = ma = F_{in} = \frac{mlH}{t} = ml\frac{H}{t}$$

In cosmology, a relation is proved that describes the dependence of the Hubble constant H on time:

$$\frac{H}{t} = \dot{H} = \frac{d}{dt}\left(\frac{\dot{a}}{a}\right) = \frac{\ddot{a}a - \ddot{a}\dot{a}}{a^2} = \frac{\ddot{a}a}{a^2} - \frac{\dot{a}^2}{a^2} = \frac{\ddot{a}}{a} - \left(\frac{\dot{a}}{a}\right)^2 = \frac{\ddot{a}}{a} - H^2$$

and therefore we get as the form of the inertial force equation:

$$F_{in} = ml\dot{H}$$

or

$$F_{in} = ml\left(\frac{\ddot{a}}{a} - H^2\right)$$

The following relation is also proven in cosmology:

$$\frac{\ddot{a}}{a} = \frac{H^2}{2}$$

and therefore we can also write the equation for the inertial force F_{in} as follows:

$$F_{in} = ml\left(\frac{H^2}{2} - H^2\right)$$

In the latter equation, H is the expansion rate of the universe, m is the mass of a body or galaxy, and l is the distance between the bodies or galaxies. The physical output of the expansion of the universe is the expansion of the world space, i.e. its increase, which is seen as masses moving away from each other, or "pushing". That is why the inertial force F_{in} acts on the bodies of the universe:

$$F_{in} = ml\dot{H} = ml\left(\frac{\ddot{a}}{a} - H^2\right)$$

where

$$\frac{\ddot{a}}{a} = \frac{H^2}{2}$$

l is the distance of the observer from some structure (which has a mass of m) and H is the Hubble’s constant. It begins on a very large spatial scale, because then gravity is very weak, i.e. the curvature of spacetime is very small. Over time, such pushing approaches the centers of gravity of all bodies in the universe. Until now, we have understood this phenomenon as "dark energy".

The speed of light c is of decisive importance in the theory of relativity. Likewise, Planck's constant h is a very important parameter in quantum mechanics, because without it no mathematical calculation can be made in quantum mechanics. In quantum mechanics, there is a relationship between a particle and a wave: the higher the frequency of a particle, the higher its mass. However, the greater the mass or energy, the shorter the wavelength. This is expressed in Planck's quantum energy equation: E = hf, which also contains Planck's constant h. The greater the mass, the greater the energy according to the relation $E = mc^2$. If we did not know the numerical value of Planck's constant, almost no quantum mechanical calculations could be performed. Apparently, it plays the same role in quantum mechanics as the constancy of the speed of light (in vacuum) in the theory of relativity. The following value for the Planck constant has been obtained from experimental data:

$$h = 1{,}054 * 10^{-34}\ J*s = 1{,}054 * 10^{-27}\ erg*s.$$

A quantity whose dimension is ENERGY * TIME is called an effect in mechanics, that is why Planck's constant is also an effect quantum. The h dimension also matches the angular momentum dimension. However, very often Planck's constant h is divided by 2π, so the actual numerical value of h is:

$$\bar{h} = 6{,}62 * 10^{-34}\ J*s = 6{,}62 * 10^{-27}\ erg*s.$$

The "reduced" Planck constant $\bar{h}$ used in quantum mechanics is related to the speed of light c as follows:

$$\frac{1}{c^4} \approx \frac{h}{2\pi} = \bar{h}$$

This shows that relativity and quantum mechanics are related or stem from a single "source".

The uncertainty relations described in quantum mechanics are general, so they should also apply in the macro world, not just in the quantum world. In fact it is, but in the classical world, or the macro world, these uncertainties are extremely small and therefore do not need to be considered. For example, when measuring the exact position of a small ball with a microscope (with the wavelength of visible light), we would get the coordinate uncertainty:

$$\Delta x \approx 10^{-7}\ m$$

Consequently, the uncertainty of the momentum of the small ball would be as follows:

$$\Delta p_x \approx 10^{-27}\ kgm/s$$

Let’s suppose the mass of the small ball were equal to:

$$1\ mg = 10^{-6}\ kg$$

This would give as an uncertainty of the ball velocity:

$$\Delta v_x = \frac{\Delta p_x}{m} \approx 10^{-21}\ m/s$$

Compared to the magnitudes of the macro world, such an uncertainty would be extremely small, and therefore we can consider it as zero. Therefore, we can describe the path of the ball's movement as a fixed trajectory.

1.10 The third theory of relativity, or the physical foundations of cosmorelativity

The theory of special relativity dealt with inertial or moving background systems, in which time and space change in relation to an external observer in moving background systems. In inertial background systems, the law of inertia applies, which is known from classical mechanics. General relativity deals with non-inertial background systems in which time and space transform in gravitational fields. Non-inertial background systems are known as gravitational fields. According to general relativity, gravity is the curvature of spacetime caused by the mass of a body. These two theories of relativity were formulated by Albert Einstein at the beginning of the 20th century. They describe transformations of time and space in different background systems.

For example, in the theory of special relativity, the phenomenon of kinematic time dilation applies:

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

This means that the closer the speed of movement of any physical body in the universe gets to the speed of light c in a vacuum, the slower time passes. However, this is relative. For example, in relation to an external observer who observes the accelerating movement of the body from the side (i.e. standing still), time slows down. In this case, the phenomenon of time dilation manifests itself. However, with respect to the accelerating body itself, time proceeds in a normal sequence. In this case, it is own-time, which does not change under any kinematic conditions, except in the case of teleportation.

Let's take for example the movement of a train. Suppose that the speed of the train approaches the speed of light c in vacuum. In this case, to an observer inside the train, time in the train appears to pass in a normal sequence, but when looking out of the window of the train, the passage of time in the world seems to be speeding up instead. To a stationary observer outside the moving train, the passage of time in the train and also the movement of the train itself seem to slow down, but relative to oneself, i.e. outside the train, time proceeds in a normal sequence. At first glance, such statements seem to contradict the theory of relativity, which tells us that the one who is standing and the one who is moving is relative. This is why it is believed that it must seem to every observer that time has just slowed down in all other systems. This would mean that in special relativity, time could only slow down, in which case there would be no acceleration of time in the universe. However, this cannot be quite correct, because, for example, in a train traveling at the speed of light c, to an observer looking out of the window of the train, the passage of time in the world would seem infinitely fast. For example, light itself travels at speed c in vacuum, and thus the light reaches any point in space in the universe in 0 seconds "in its own time". In this case, a hypothetical observer moving along with the light cannot see the passage of time in the surrounding world as infinitely slow. In this case, time in the world can only run infinitely fast. But in relation to oneself, time still proceeds in a normal sequence.

If the observer exists in a system in which time and space transformations occur, then this is not directly perceptible to the observer. The transformation of time and space can be directly perceived only if the observer is outside this system and observes from the side the system in which the transformations of time and space occur. In this sense, the observer's own time and own length always remain the same, regardless of what the transformations of time and space are at the moment. The observer's own time and own length are actually an illusion that may not show the actual passage of time and the actual dimensions of the bodies to the observer in the system.

In general relativity, time and space transform in gravitational fields. This means that gravity is the curvature of spacetime caused by the very large mass of a body. The curvature of spacetime, in turn, consists in the transformation of time and space around a massive body, i.e. in its vicinity. According to this, gravitational length contraction and gravitational time dilation exist.

Let's take for example the movement of a spaceship. Let's say that the motion of a spacecraft is approaching a black hole, say, the size of the Moon. In this case, to the observer inside the spaceship, time in the spaceship appears to be running in a normal sequence again, but looking out the window of the spaceship, the passage of time in the world now appears to be speeding up instead. To a stationary observer outside the moving spaceship, who observes the spaceship's movement towards the black hole from a great distance, the passage of time in the spaceship and also his movement towards the black hole seem to slow down, but relative to himself, i.e. outside the spaceship, time passes in a normal sequence. However, before and in the future, we will rather take the transformations of time and space in the theory of special relativity as examples.

In the theory of special relativity, light always moves at speed c in vacuum, i.e. the speed of light is always the same for any observer. This means that a single velocity of finite size does not change as the background system changes. This is only possible if time and space depend on the choice of background system. This means that both time and the coordinate depend on the background system.

According to special relativity, the speed of light c is the same for all observers. As a result, shortening of bodies, or contraction, occurs "for any targeted length of movement", i.e. shortening of body length occurs in the direction of movement. However, time dilation, or time slowing down, does not occur in the direction of movement, but it manifests itself regardless of the direction of movement of the body. This means that in the case of time dilation only the speed of movement is important, but in the case of length contraction, the direction of movement is also important, in addition to the speed of movement.

In the theory of special relativity, it is said that, for example, time slows down relative to an external observer (or a stationary observer). Such an expression gives the impression that the transformation of time is just an illusion that does not really exist.

However, the transformations of time and space in the theory of relativity are not "apparent", but are completely real phenomena. For example, if one of the twin brothers goes on a space trip and later returns to Earth, the brothers are no longer the same age. The space traveler has become younger than his brother. In theory, the age gap can be increased indefinitely. In the theory of special relativity, this is referred to as the “twin paradox,” even though there is no paradox. The twin paradox is the effect of time dilation, or time slowing down. For example, if a father travels away from Earth for 2 years and back for another 2 years (the time periods measured by the father), he may be 20 years younger than his daughter. However, before the start of the journey, the father could have been 20 years older than his daughter.

However, if an observer traveled in his starship into space at a speed approaching the speed of light in vacuum and returned to earth 22 years later, almost 1000 years could have passed on Earth during that time. Thus, the observer can travel in real time into the future.

However, besides special and general relativity, there is also a third type of relativity. The third theory of relativity also describes the transformations of time and space in the same way as the first two theories of relativity, but the only difference is that instead of background systems, the entire universe is now considered, i.e. the universe is considered as one whole. According to this, our entire expanding universe is like one giant background system that contains an infinite number of smaller background systems. It is possible to treat and describe the universe as a whole, i.e. as a single background system or absolute space. Such an approach is justified by the astronomical fact that, for example, we can see the redshift of galaxies in any other galaxy. Since the expanding universe is described and treated as one whole, this third type of relativity theory (the so-called "theory of cosmorelativity") is the basic teaching of modern universe cosmology in the physics theory of time travel (3).

For example, the expansion of the universe follows from Hubble's law, in which the distances of galaxy clusters increase from each other:

$$\vec{v} = H\vec{r}$$

The Hubble constant H(t) depends only on time. An observer in galaxy A would see that, according to Hubble's law, galaxies B and C would move as follows:

$$\vec{v}_{AB} = H\vec{r}_{AB}$$

$$\vec{v}_{AC} = H\vec{r}_{AC}$$

The speed of movement of galaxy C would appear to an observer in galaxy B:

$$\vec{v}_{BC} = \vec{v}_{AC} - \vec{v}_{AB}$$

Based on the above, we get:

$$\vec{v}_{BC} = H\vec{r}_{AC} - H\vec{r}_{AB} = H(\vec{r}_{AC} - \vec{r}_{AB})$$

Relative to an observer in galaxy B, the vector

$$\vec{r}_{AC} - \vec{r}_{AB} = \vec{r}_{BC}$$

Is the space vector of galaxy C. According to this, it can be said that galaxy C is moving away from galaxy B according to Hubble's law. It follows that Hubble's law is valid for any observer in any galaxy.

Our entire expanding universe is like one giant background system in which there is an overall transformation of time and space. In this huge background system (which is the size of the universe), there exist an infinite number of smaller background systems, such as moving or inertial background systems (in which the laws of special relativity are manifested) and non-inertial background systems or gravitational fields (in which the laws of general relativity are manifested).

In the theory of relativity, time and space are relative or relative phenomena. But in cosmology, time and space are rather absolute phenomena. For example, the age of the universe or lifetime is a concept of absolute time, and the volume of the universe or its diameter (i.e. size) is a concept of absolute space. In the third theory of relativity, "relativity" is replaced by an absolute term, because, for example, we would see the redshift of galaxies in any other galaxy. The expansion of the universe is no longer relative, but rather absolute, to which all bodies and phenomena in the universe are subject to.

In the third theory of relativity, the transformations of time and space in specific background systems (which are described by the equations of special and general relativity, respectively), in which a real observer can exist or observe from a distance, are not taken into account. This means that instead the focus is on the universe as a whole, in which an almost infinite number of different background systems, events and processes are taking place. In the following, we present two basic concepts that are the basis of the third theory of relativity:

> To a real observer "inside" the universe, events and processes throughout our universe proceed in a normal sequence, and the rate of expansion of the universe is many times slower than the speed of light in vacuum, which accelerates in "time" (the rate of expansion of the universe is 73.2 km/s per megaparsec, or 3,26 million light-years).
>
> However, to a "hypothetical" observer "outside" the universe, it seems that the events and processes taking place in the universe are actually going many times faster (as well as the expansion of the universe), as if the movie was put on a fast-forward button, but at the same time its progress is slowing down. This now means that the real observer "inside" the universe actually exists in such a time, the course of which is many times slower than reality, that is, existence in the entire universe takes place as if in slow motion. Such a fact is betrayed to us as real observers existing inside the universe by the cosmological expansion rate of the universe, which is many times slower than the speed of light in vacuum and which accelerates in "time".
>
>> The time of co-moving observer is the kind of time perceived by an observer moving along with the expanding universe while being in some kind of arbitrary galaxy. However, someone watching from the sidelines may have a completely different time estimate. In the third theory of relativity, time in the universe seems to flow much faster to the viewer from the side, and it runs at a slower pace.
>>
>> To better understand this, the analogy of the movement of a train, which was already described above, can be pointed out. For example, if the speed of the train approaches

> the speed of light c, then to an observer inside the train, time in the train appears to pass in a normal sequence, but to a stationary observer outside the moving train, time in the train appears to actually slow down.

In the theory of special relativity, the matter is simple: transformations of time and space take place in different inertial background systems, in which case it is possible to detect the transformations by measuring time intervals in different inertial background systems. However, in the third theory of relativity, such a transformation of time and space is much more abstract, since the transformation of time and space takes place in the entire universe at the same time, in which case it is, in an abstract sense (figuratively speaking), one background system. It is actually not possible to fully reduce such a model, or rather a mental construction, to the so-called black-and-white understanding that we are used to using when describing the laws of nature, for example in classical mechanics. To understand this in the only possible way, one must create such an abstract model in which there are two observers: one is a real observer who observes events and processes "inside" the universe, and the second observer is a hypothetical (that is, not actually existing) observer who observes events and processes from “outside” of the universe. Naturally, it is not possible to imagine anything that is outside the universe, but in order to understand this model, such an abstract possibility must still be used. For example, the expansion of the universe is modeled in many physics theories as the expansion of a sphere, which is the closest match to ordinary human experience for understanding the expansion of the universe. Concepts like "inside" and "outside" are also based on common human experience and can thus be understood in case of any models.

> Modeling is indispensable for describing the laws of physics. A model translates the laws of physics into human language, i.e. the common understanding of a person. For example, people can translate different texts from Japanese to English. The role of the model in physical science is the role of a so-called "translator", the task of which is to translate physical reality, i.e. the laws of physics, into ordinary human understanding, i.e. human language. The model doesn't actually have to be 100% accurate with the law of physics being translated, but it has to be comprehensible to common human sense.
>
> For example, the physical model of the cosmological expansion of the universe is usually the expansion of a sphere (for example, a balloon) in space. But in fact, the expansion of the universe and the expansion of a sphere are completely different phenomena from each other in physical sense. There are both similarities and completely different traits between the two. The model of the expansion of a sphere and the real expansion of the universe are very different physical phenomena compared to each other, and looking for and finding an analogy between them can often lead you astray. This is further explained and described in the chapter: "Expansion of the universe to a real observer inside the universe".

At this point, the question arises: why have time and space transformed all over the universe? The justification for this is that from the theory of relativity it follows that ordinary space K moves with respect to hyperspace K' at a constant speed of light c. Since the private system of normal space and hyperspace manifests itself in reality as the cosmological expansion of the universe, then the universe should expand at a constant speed of light. But in reality, the universe is expanding at a speed that is shown to us by the Hubble constant H. This is why we get the false impression that the universe is not expanding at the speed of light. But in reality it is not so.

The universe is actually expanding at the speed of light c, but we perceive this speed to be much lower, because time has changed or slowed down by a factor of y all over the universe:

$$H = \frac{c}{y}$$

Figuratively speaking, we all live in slow motion (the speed of which is accelerating), and therefore we see the expansion of the universe much slower than the speed of light. But in fact, the universe is constantly expanding at the speed of light c.

1.10.1 The rate of expansion of the universe and dark energy

One of the fundamental foundations of the physical theory of time travel is the statement that at different moments in time there are also different points in space, i.e. in order to travel in time, a person must move in the spatial dimension. This also means that the further away in time (for example in the past or future) an event takes place, the further away it takes place in space. Such regularity manifests itself in nature as the expansion of the universe. For example, if the universe expands (i.e. the volume of the universe increases over time), then at different moments in time the volume of the universe (and thus the spatial coordinates of all bodies in the universe) is different. This is obviously related to one of the basic statements of the time travel theory, which says that there are also different points in space at different moments in time.

> The physical system of normal space K and hyperspace K' manifests itself in nature as the cosmological expansion of the universe.

The cosmological expansion of the universe is often imagined as the expansion of a sphere or a balloon, and in this case it can be very clearly seen that the spherical coordinates of the body on the surface of the sphere (i.e. points in space) are different at different moments of time. The same is true for the length of the radius of the sphere. The more the universe expands (that is, the greater the imaginary radius r of the universe), the more the distance between two points in space increases (that is, ds increases).

The expansion of the universe manifests as galactic systems moving away from each other. Therefore, the observer at any location in the universe can see the redshift of the galaxies, which is interpreted physically as the cosmological expansion of the universe. For example, the wavelength λ of the spectral lines of distant galaxies is slightly higher compared to nearby ones. This redshift, or wavelength difference, is proportional to the distance between the galaxies. From redshift z

$$z = \frac{\Delta\lambda}{\lambda}$$

it is possible to calculate the speed v of galaxies moving away and also their distance s:

$$v = cz = c\frac{\Delta\lambda}{\lambda}$$

and

$$s = \frac{v}{H_0} = \frac{c}{H_0}\frac{\Delta\lambda}{\lambda}$$

in which H_0 is the Hubble constant. The cosmological expansion of the universe "counteracts" the bending of spacetime caused by the masses. Its physical output is the movement of masses away from each other, i.e. "pushing". Therefore, an observer in any location in the universe is affected by an inertial force F_{in}:

$$F_{in} = ml\dot{H} = ml\left(\frac{\ddot{a}}{a} - H^2\right)$$

in which

$$\frac{\ddot{a}}{a} = -\frac{H^2}{2}$$

l is the distance of the observer from some structure (which has a mass m) and H is the Hubble constant. It begins on a very large spatial scale, because then gravity is very weak, i.e. the curvature of spacetime is very small. The above inertial force F_{in} is caused by the cosmological expansion of the universe. The formula that describes this is briefly derived in cosmology as follows. For example, the well-known Hubble's law is expressed as follows:

$$v = HR$$

or

$$v = Hl$$

in which $l = R$. If we multiply both sides of the latter equation by the mass m, we get the definition of momentum p:

$$mv = p = mlH$$

Next, we divide both sides of the resulting equation by time t, and as a result we get the inertial force F_{in}, which is caused by the expansion of the universe:

$$\frac{p}{t} = \frac{mv}{t} = m\frac{v}{t} = ma = F_{in} = \frac{mlH}{t} = ml\frac{H}{t}$$

In cosmology, a relation is proved that describes the dependence of the Hubble constant H on time:

$$\frac{H}{t} = \dot{H} = \frac{\ddot{a}}{a} - H^2$$

and therefore we get the formula for the inertial force in the following form:

$$F_{in} = ml\dot{H}$$

or

$$F_{in} = ml\left(\frac{\ddot{a}}{a} - H^2\right)$$

The following connection is also proven in cosmology:

$$\frac{\ddot{a}}{a} = -\frac{H^2}{2}$$

and therefore we can also write the formula for the inertial force F_{in} as follows:

$$F_{in} = ml\left(-\frac{H^2}{2} - H^2\right)$$

In the latter equation, H is the rate of expansion of the universe, m is the mass of the body or galaxy, and l is the distance between the bodies or galaxies.

The (metric) expansion of the universe manifests itself in the increase of the distance between two points in space. However, it must be taken into account that the increase in ds occurs only on a very large spatial scale - for example, at the level of galaxy clusters and superclusters.

The expansion of the universe manifests itself only on a very large spatial scale - for example, on the scale of galaxy clusters and superclusters. This means that the greater the distance between two points in space (i.e. the further away the clusters of galaxies are from each other), the faster they are moving away from each other. The speed of points in the universe moving away from each other approach zero on a very small spatial scale (for example, on the scale of planets and stars), but on a very, very large spatial scale (for example, even on a larger spatial scale than superclusters of galaxies) they already approach the speed of light in a vacuum.

> For example, if the distance between two points in space is 1 Mpc, or 3.2 million light-years, then their speed of recession is about 50...80 km/s. But if the distance between them is one meter, then their speed of recession is $2 * 10^{-18}$ m/s, because the value of the Hubble constant at 50...80 (km/s) Mpc is $2 * 10^{-18}$ m/s in the SI system per meter. This is roughly like the planet Earth increasing by one micrometre per year.
>
> The expansion of the universe manifests itself on a very large spatial scale: in the space between galaxy clusters and superclusters. The further away galaxies are from each other, the faster they are moving away from each other. But in fact, the expansion of the universe, i.e. the increase of the distance between two points in time, also occurs on the scale of human space. For example, two people are moving away from each other in space, and the further they are from each other, the faster they are moving away from each other. However, this effect is extremely small, but still mathematically calculable. It is not possible to perceive it, because this effect is extremely small. For example, two nearby people will attract each other with the force of gravity, but this effect is also extremely small. Nevertheless, it is mathematically calculable.
>
> As the universe expands, clusters and superclusters of galaxies move away from each other. At this point it seems that we cannot use a concept like "point in space", since

galaxies and their clusters cannot be considered as "points". Actually, you can. The expansion of the universe can be thought of as an increase in the distance between two points in space over time, but from when the distance between two points in space reaches the sizes between clusters of galaxies. Whereas it would be more correct to consider the distances between spatial points, not only the distance between two spatial points. Such insights are applied in new models that describe the cosmological expansion of the universe.

For example, the expansion rate of the universe is currently measured at: $74\frac{km}{s}*(Mpc)$, which is expressed in the SI system, i.e. in SI units, as follows:

$$H=\frac{x}{y}=\frac{74\ 000\left(\frac{m}{s}\right)}{3{,}086*10^{22}(m)}=2{,}3(979)*10^{-18}\frac{m}{s}\ per\ one\ meter$$

Such is the rate of expansion of the universe "per meter", in which the rate at which galaxies are moving away

$$x=74\frac{km}{s}=74\ 000\frac{m}{s}$$

the distance in intergalactic space

$$y=1\ Mpc=3{,}086*10^{16}\ m*miljon=3{,}086*10^{22}\ m$$

and the numerical value of the speed of light in a vacuum

$$c=300\ 000\frac{km}{s}=3*10^{8}\frac{m}{s}$$

According to this, we get the expansion rate of the universe "per Planck length" as follows:

$$H=2{,}3(979)*10^{-18}\frac{m}{s}\ (per\ one\ meter)*1{,}616\ 229(38)*10^{-35}\ m=$$
$$=3{,}875556*10^{-53}\frac{m}{s}\ per\ one\ Planck\ length$$

in which the Planck length l is expressed:

$$l=1{,}616\ 229(38)*10^{-35}\ m$$

This means physically that at the current age of the universe t:

$$t=13{,}7*10^{9}\ year$$

the expansion rate of the universe H per one Planck length l is as follows:

$$H=3{,}875556*10^{-53}\frac{m}{s}\ per\ one\ Planck\ length$$

The result is not actually physically real, since the smallest length in space can only be the Planck length:

$$l = 1{,}616\ 229(38) * 10^{-35}\ m$$

which is many times larger than the distance s derived above:

$$s = 3{,}875556 * 10^{-53}\ m$$

Since the expansion rate of the universe H per one Planck length l was calculable from the equation:

$$H = 2{,}3(979) * 10^{-18}\frac{m}{s}\ (per\ one\ meter) * 1{,}616\ 229(38) * 10^{-35}\ m =$$
$$= 3{,}875556 * 10^{-53}\frac{m}{s}\ per\ one\ Plancki\ length$$

then according to this the Planck length l is expressed as follows:

$$l = \frac{H}{v} = \frac{3{,}875556 * 10^{-53}\frac{m}{s}\ per\ one\ Planck\ length}{2{,}3(979) * 10^{-18}\frac{m}{s}\ (per\ one\ meter)} = 1{,}616\ 229(38) * 10^{-35}\ m$$

From the latter, in turn, we get the time period t (in seconds):

$$t = \frac{1}{2{,}3(979) * 10^{-18}\frac{m}{s}\ (per\ one\ meter)} = 4{,}17031 * 10^{17}\ s$$

which means that if the expansion rate H of the universe per one Planck length l is:

$$H = 3{,}875556 * 10^{-53}\frac{m}{s}\ per\ one\ Planck\ length$$

then the real physical content is that the distance in space corresponding to the Planck length l:

$$l = 1{,}616\ 229(38) * 10^{-35}\ m$$

„doubles“ during time period t:

$$t = 4{,}17031 * 10^{17}\ s$$

The resultant time period t:

$$t = \frac{4{,}17031 * 10^{17}\ s}{31536000\ s} = 13{,}223 * 10^{9}\ year$$

“almost” coincides with the current age of the universe t:

$$t = 13{,}7 * 10^{9}\ year$$

However, it took the universe about 13.7 billion years to reach this rate of expansion:

$$t \to 0 \ldots 13{,}7 * 10^9\ year$$

On a very, very large spatial scale (for example, even on a larger spatial scale than galaxy superclusters), the expansion rate v of the universe approaches the speed of light in vacuum. If
z > 1 in the formula $v_r = cz$, then the speed vr of galaxies moving away from each other is greater than the speed of light in vacuum. In this case, the theory of relativity is used to find the change in wavelength, i.e. the shift of the spectral line at speeds relatively close to the speed of light. For example, the frequency of a wave decreases, i.e. the wavelength increases, when the light source moves away from us, i.e. the observer:

$$\frac{v}{c} = \frac{(z+1)^2 - 1}{(z+1)^2 + 1}$$

and

$$z = \sqrt{\frac{c+v}{c-v}} - 1$$

In it, the redshift z depends on the recessional velocity v in the relativistic form, i.e. in the case of $z = \frac{\triangle\lambda}{\lambda} > 1$, which is derived and analyzed in more detail in the cosmology section of the physical theory of time travel.

> At this point, it must be noted that if the rate of expansion of the universe v in the Hubble's law:
>
> $$v = HR$$
>
> is exactly equal to the speed of light c:
>
> $$c = HR$$
>
> therefore, the volume of the universe must be infinitely large, since only at infinity can the expansion rate v of the universe be exactly equal to the speed of light c. For example, if the volume of the universe is infinite, there are an infinite number of galaxies.

It follows from the theory of relativity that normal space K moves with respect to hyperspace K' constantly at the speed of light c. Since the system between normal space and hyperspace manifests itself in reality as the cosmological expansion of the universe, then the universe should expand constantly at the speed of light. But in reality, the universe is expanding at a rate that is shown to us by the Hubble constant H. This is why we get the false impression that the universe is not expanding at the speed of light. But in fact it is not so.

The universe does not expand in space or time, but space and time "emerge" continuously (from the initial moment of expansion of the universe). This means that the expansion of the universe is metric in nature, which we understand as the transformations of time and space described in the theory of relativity. According to the principle of inseparability of time and space, the transformation of space is accompanied by the transformation of time. It follows that the time of the universe (that is, the lifetime and with it the rate of expansion of the universe) is not absolute, but is relative. For example, to an observer in the universe, time appears to "flow" in the universe in a normal sequence, but to an observer outside the universe, time in the universe appears to be moving much faster, with its course slowing down. From this follows the fact that the universe is actually constantly expanding at the speed of light c, but a real observer in the universe cannot perceive it directly, because the expansion of the universe (i.e. at the speed of light) is accompanied by the transformation of time in the universe.

For example, the larger the universe, the shorter the time intervals. This has been the case since the beginning of the expansion of the universe. Figuratively speaking, we all live in slow motion (the speed of which is accelerating), and therefore we see the expansion of the universe as much slower than the speed of light. But in fact the universe is constantly expanding at the speed of light c.

> This now means that the Universe is actually expanding at the speed of light c, but we perceive this speed to be much lower because time has been transformed, or slowed down, by a factor of y across the universe:

$$H = \frac{c}{y}$$

To a real observer inside the universe, events and processes throughout our Universe follow a normal sequence, and the rate of expansion of the universe is many times slower than the speed of light in vacuum, which accelerates in "time" (the rate of expansion of the universe is 73.2 km/s Mpc, i.e. per 3.26 million light years). Here we ignore the transformations of time and space in specific background systems (which are described by the equations of special and general relativity, respectively), in which a real observer can exist or observed from a distance. Instead, we focus on the universe as a whole, in which an almost infinite number of different events and processes take place. But to a "hypothetical" observer outside the universe, it seems that the events and processes taking place in the universe are actually going many times faster (as well as the expansion of the Universe), as if the movie was put on a fast-forward, but at the same time its progress is slowing down. This now means that the real observer inside the universe actually exists in time, the course of which is many times slower than reality, that is, existence in the entire universe takes place in slow motion. Such a fact is betrayed to us as real observers existing inside the universe by the expansion rate of the universe, which is many times slower than the speed of light in vacuum and which accelerates in "time".

All of the above can figuratively be expressed much more easily. For example, it may appear to us that the universe is 13.7 billion years old, but in reality it may be only one second old. This means that the entire time period of our universe's existence (which is currently 13.7 billion years) has actually been "stretched out" from the one second time period that would be the actual age of the universe at this point in time.

It is important to note that if the observer exists in a system in which time transformation occurs, it is not directly perceptible to the observer. The transformation of time can be directly perceived only if the observer is outside this system and observes from outside of the system in which the transformation of time occurs. In this sense, the observer's "own time" always remains the same, regardless of what the current transformation of time is. The observer's own time is actually an illusion that may not show the actual passage of time to the observer in the system.

The value of Y indicates how many times time has slowed down for a real observer inside the universe, or how many times time has sped up for a hypothetical observer outside the universe. The cosmological evolution of the universe shows that the further back in time, the larger the value of y was, and the further forward in time, the smaller the value of y. The value of Y becomes smaller over time, as a result of which the expansion rate of the universe increases for a real observer inside the universe. At the initial instant of the expansion of the universe, the value of y was infinitely large, but in the very, very distant future, the value of y will approach one.

1.10.2 Time moved 5 times slower in the early universe

Scientists have discovered that time moved 5 times slower in the early universe (4). This was first demonstrated by quasars, which were used as "clocks" in the study. Geraint Lewis, an astrophysicist at the University of Sydney, was the leading author of the study. He explained that we should see the slow motion of a distant universe due to the expansion of space. It follows directly from Albert Einstein's theory of relativity. Previous studies have shown that time moved two times slower in the universe when it was half as old as presently. In this case, observational data of exploding stars, or supernovae, were used as cosmic clocks.

However, quasars are such cosmic objects that are much brighter than supernovae. Therefore, their observational data can be used in studies concerning the history of the universe. The universe is known to be 13.8 billion years old. More recent studies show that about 1 billion years after the Big Bang of the universe, time in the universe moved 5 times slower. It must be noted that if someone could have recorded or measured the passage of time for an observer at such a time, one second would still have been one second. To an observer inside the system, time still proceeds in a normal sequence.

Such a measurement of the slowing down of cosmological time was made possible by the analysis of data from 190 quasars collected over a period of 20 years. The analysis was carried out by the aforementioned Lewis and University of Auckland statistician Brendon Brewer. Quasars are regions that are extremely compressed and surround supermassive black holes. They are mostly located in the centers of galaxies and are believed to be the brightest and most powerful cosmic objects in the entire universe. Scientists use them as "*beacons*" when mapping the universe.

Despite this, quasars were more difficult to use as "*cosmic clocks*" than supernovae. When black holes absorb matter, turbulent explosions occur. This makes it possible to use quasars as cosmic clocks, the ticking of which can be measured. Lewis has compared it to watching fireworks, in which case big sparkly flashes seem random, but different elements brighten and fade on their own timeline.

> Lewis: "*We unraveled this fireworks spectacle and showed that quasars can also be used as a standard time marker in the early Universe*".

Such studies prove that time in the universe billions of years ago ran much slower compared to the current time in the universe. Since time passed more slowly in the past than it does now, therefore time has accelerated during the lifetime of the universe. Since the cosmological expansion of the universe is also accelerating in time, it can therefore be concluded that the acceleration of the expansion of the universe occurs due to the acceleration of the time of the universe. Studies confirms that time in the universe is indeed accelerating, but critics still have the opportunity to doubt whether it can somehow be related to the acceleration of the expansion of the universe, i.e. the dark energy of the universe.

Marek-Lars Kruusen's physics theory of time travel predicts this. The acceleration of the passage of time in the universe was predicted by the physics theory of time travel long before any studies. However, it can still be said that such studies are at least indirect evidence for the connection between the acceleration of the passage of time in the universe and the increase in the rate of expansion of the universe. The dark energy of the universe, or its connection with the acceleration of the passage of time in the universe, is extremely important for the calculation of the physical and mathematical parameters of tunnels in spacetime.

1.10.3 Transformations of time and space

Transformations of time and space are manifested when moving at the speed of light. For example, the closer we get to a body's movement speed c in normal space, the slower time runs, i.e. the movement approaches the timeless and spaceless dimension, which is hyperspace. When moving in ordinary space at the speed of light c, the time difference t' becomes infinitely large, since in this case it is equal to being stationary in hyperspace:

$$t' = \frac{t}{\sqrt{1 - \frac{c^2}{c^2}}} = \infty$$

Physically, this means that when a body is stationary in hyperspace, infinite transformations of time and space occur, for example, time has slowed down to infinity. However, when moving at the speed of light in hyperspace, the transformations of time and space are no longer manifested, since in this case the body is stationary relative to normal space. Time and space exist in ordinary space. Therefore, time and space exist (without any transformation) also for those bodies that move along with normal space at speed c.

If a body is stationary in hyperspace, then, for example, time has slowed down to infinity, so time does not exist. However, if a body moves in hyperspace at the speed of light c, then in this case time runs in normal sequence, i.e. time has not slowed down. In ordinary space, such phenomena (transformations of time and space) occur in exactly the opposite way. For example, if a body is stationary in vacuum, time has not slowed down. However, if a body moves in vacuum at the speed of light c, then time has slowed down to infinity, i.e. time has ceased to exist.

Since the transformations of time and space are manifested differently in normal space and hyperspace, this proves that in normal space, "existence in time" or the progression from the past to the future occurs. Normal space "moves" in relation to hyperspace in only one direction, and this causes the existence of a "time arrow" in normal space, which manifests itself as the existence of physical phenomena from the past to the future. This can be proven through the transformations of time and space. For example, if a body is stationary in hyperspace, then time has slowed down to infinity, so time does not exist. Hyperspace is an outer dimension of spacetime in which neither time nor space exists. However, if a body moves in hyperspace at the speed of light c, then in this case time runs in normal sequence, i.e. time has not slowed down. In this case, existence in time occurs. In normal space, such phenomena occur in exactly the opposite way. For example, if a body is stationary in vacuum (it moves at the speed of light c relative to hyperspace), then time has not slowed down. However, if a body moves in vacuum at the speed of light c (stationary relative to hyperspace), then time has slowed down to infinity, i.e. time has ceased to exist.

Transformations of time and space in different dimensions (i.e. normal space and hyperspace) are the reason for the transformations of time and space described in special relativity. The special theory of relativity says that in the case of a body moving in vacuum at speed c, time passes infinitely slowly, i.e. time dilation equals infinity. Such a circumstance is due to the fact that the body is stationary in relation to hyperspace in this case, so time must have slowed down to infinity. In this case, time no longer exists. It shows the interrelationship between the causes and effects of the transformations of time and space. For example, the transformations of time and space in hyperspace and ordinary space do not result from the transformations of time and space described in the theory of special relativity, but the transformations of time and space described in the theory of special relativity themselves result from the transformations of time and space of different dimensions, i.e. the physical system of hyperspace and ordinary space. It can also be said that the theory of relativity can be derived from the physical theory of time travel, since the physical theory of time travel is based on the physical system of hyperspace and ordinary space, which is actually the basis of the transformations of time and space described in the theory of relativity.

> It should be noted that all bodies in the universe also move at speed c relative to light. This may give the false impression that the physical system of hyperspace and normal space is not really needed. It is enough only if we take into account such physics, in which all bodies in the universe move with respect to light at the speed c. In fact, this is not correct. The reason is that the physical system of hyperspace and normal space, which is the basis of the entire physics theory of time travel, is much deeper physics and a physical model with much more far-reaching consequences, with which a great many physical phenomena can be explained. If we only considered the movements of bodies with respect to light, we would not get very far. Some simple physical phenomena could be explained, but many others would remain unexplained.

In Albert Einstein's special theory of relativity, transformations of time and space are manifested when a body moves at or nears the speed of light c. For example, the closer the body's speed gets to the speed of light c in vacuum, the slower time "moves" relative to an external observer. However, time and space transformations can also occur in different dimensions. For example, if a body is stationary in hyperspace, time has slowed down to infinity, so time does not exist. Since hyperspace is an external dimension of spacetime, the non-existence of time in hyperspace is therefore completely understandable. However, if the body moves in hyperspace at the speed of light c, then the transformation of time no longer takes place, i.e. time runs in normal sequence. In this case, it is already ordinary space in which time exists. In special relativity, the transformations of time and space are manifested in different background systems in which they occur in relation to something or someone. In this case, relativity must be taken into account. However, the transformations of time and space can also manifest themselves in different dimensions, in which case they do not occur in relation to anything or anyone, but are of absolute nature. In this case, relativity is no longer taken into account.

> Since hyperspace and ordinary space are not background systems and the speed of light c is constant with respect to any observer or background system, i.e. absolute in the

whole ordinary space, therefore, the transformations of time and space in different dimensions are absolute, not relative. Normal space is a dimension that encompasses the entire known universe at the same time. The principle of the constancy of the speed of light c applies everywhere in ordinary space, for example to any observer or background system. It can also be said that ordinary space is a dimension in which the principle of the constancy of the speed of light c is manifested. Hyperspace is a dimension outside of spacetime, i.e. outside of normal space.

1.11 Hyperspace and a hole in spacetime

In order for a person to be able to travel in time (that is, "move" from one point in time to another), the first thing he needs is so-called to "exit" from the current moment ("exit time"). Physically, this means that a person must enter a region of spacetime where time t' has slowed down to infinity

$$t' = \frac{t}{\sqrt{1-\frac{R}{r}}} = \frac{t}{\sqrt{1-\frac{R}{R}}} = \infty$$

or time t has ceased to exist:

$$\sqrt{1-\frac{R}{R}}t' = t = 0$$

After all, it sounds logical that in the case of "exiting time", time no longer exists. This manifests itself, for example, when the speed of light in vacuum is exceeded, because the closer the body's speed gets to the speed of light in a vacuum, the more time slows down

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$$

and the length of a body decreases:

$$l' = l\sqrt{1-\frac{v^2}{c^2}}$$

However, such a region of spacetime also exists, for example, in the centres of black holes. Being in such a spacetime region, a person is no longer subject to the cosmological expansion of the universe (i.e. Hubble's law):

$$v = HR$$

because the expansion of the universe manifests itself with an increase in the distance between two points in space (this means that galaxies move away from each other the faster the further they are from each other). Movement in time turns out to be possible, which is essentially movement in space, because time and space cannot exist separately from each other:

$$t' = l$$

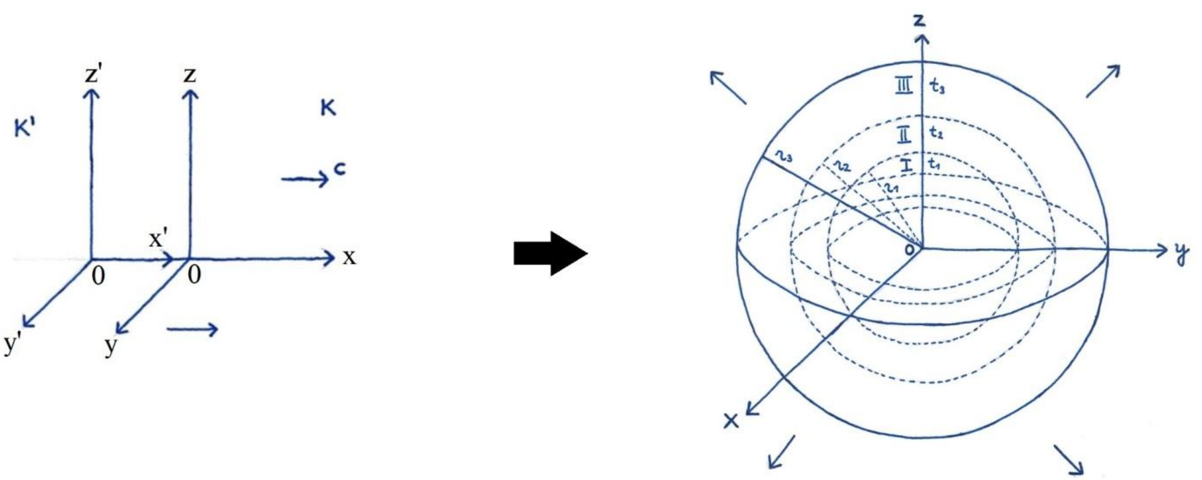
A person travels in time only and again only if he gets into hyperspace, i.e. outside of spacetime. "There", according to the theory of general relativity, spacetime is curved to infinity (that is, time has slowed down to infinity and the distance between two points in space has also shortened to infinity). Such a region of spacetime (where spacetime ceases to exist) exists, for example, in the centres of black holes (Schwarzschild radius R):

$$R = \frac{2GM}{c^2}$$

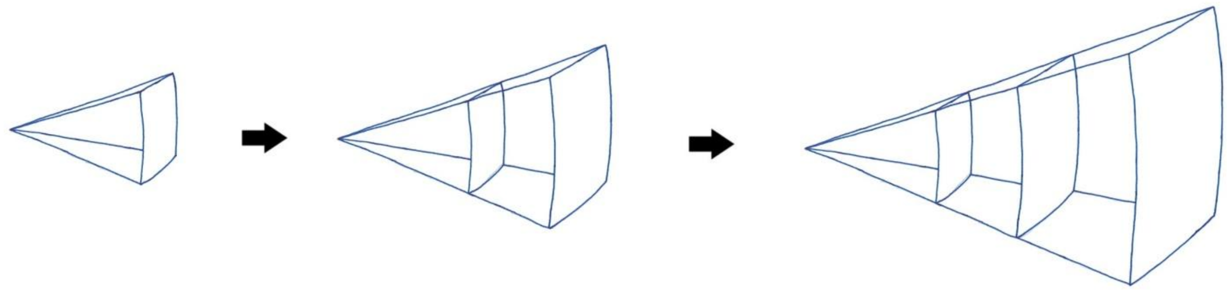
and therefore black holes can act as “gates” through which it is possible to enter hyperspace.

A hole in spacetime can be seen as an opening or "door" or "window" through which you can "enter" hyperspace. Through the hole in spacetime you can get to hyperspace, i.e. outside of spacetime. This means that if a person has entered into a hole in spacetime, then the person has also entered through it into the hyperspace dimension. The same principle applies to the artificial creation of a hole in spacetime.

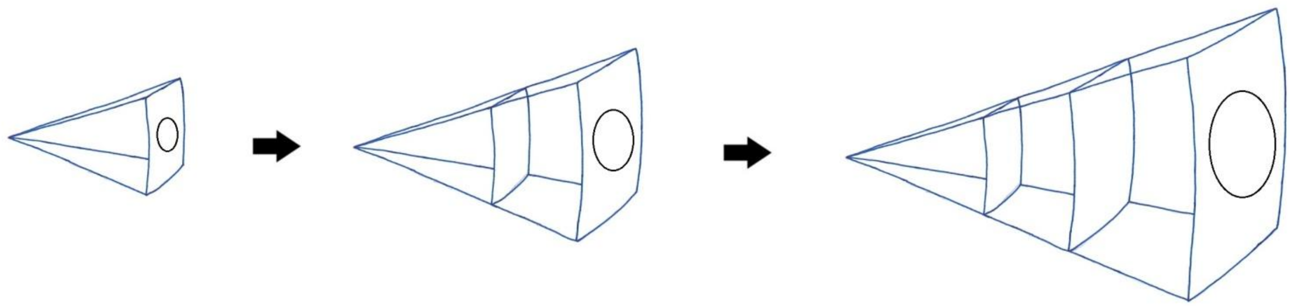
The physical system of normal space K and hyperspace K' manifests itself in nature as the cosmological expansion of the universe, figure:



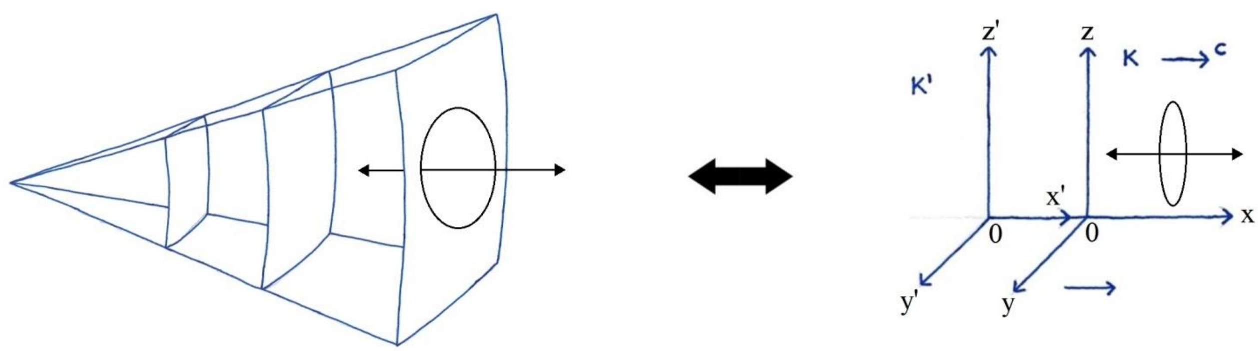
As the universe expands, galaxies move away from each other faster the further away they are from each other. In this case, space "moves", not directly the galaxies themselves, figure:



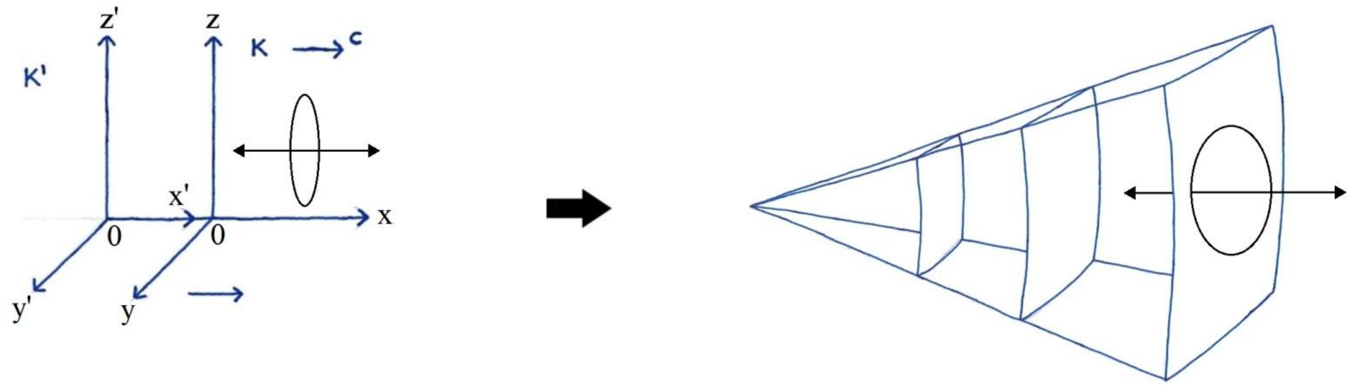
The hole in spacetime that exists in spacetime "moves" along with the expansion of the universe, figure:



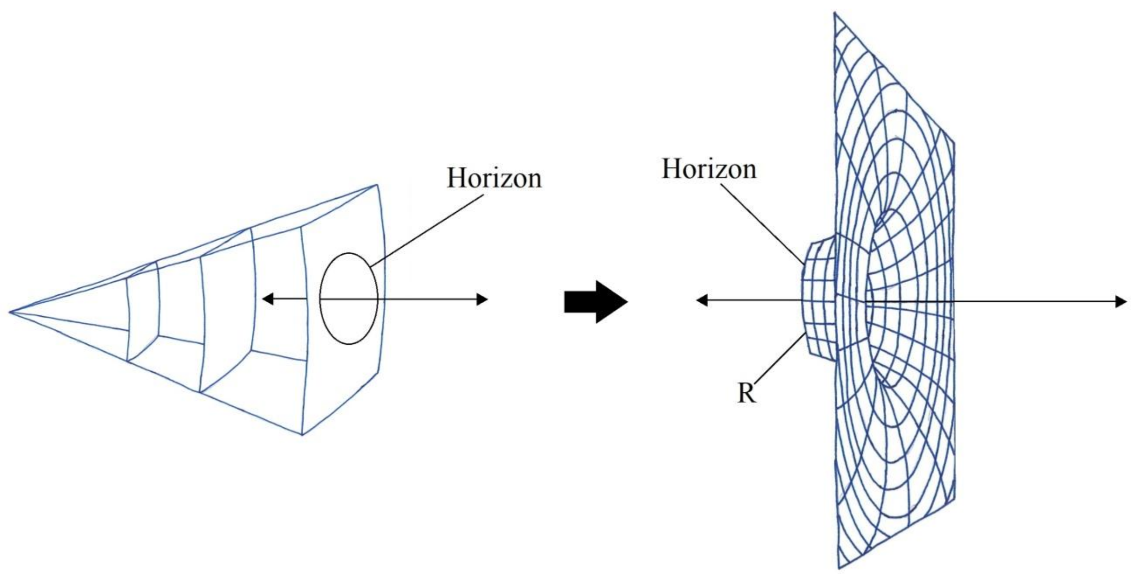
A hole in spacetime can be considered as an opening or "door" or "window" through which you can "enter" hyperspace. Figure:



Through the hole in spacetime you can get to hyperspace, i.e. outside of spacetime. This means that if a person has entered a hole in spacetime, then the person has also entered through it into the hyperspace dimension. The same principle applies to the artificial creation of a space-time hole. Figure:



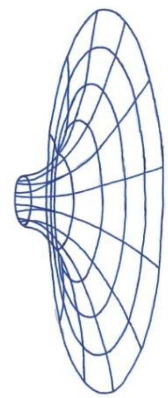
For example, a black hole (its Schwarzschild surface ("Horizon") with Schwarzschild radius r) is a hole in spacetime through which it is possible to "enter" hyperspace, figure:



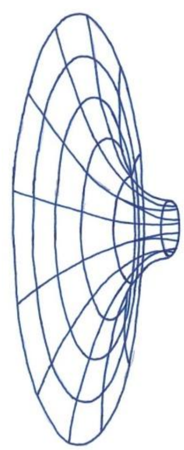
It can be clearly seen from the latter figure that the hole in spacetime (with radius r) can be physically interpreted as a "window" or a "gate", through which it is possible to reach hyperspace, i.e. outside of spacetime. The hole in spacetime is real, not imaginary. Through the hole in spacetime, you can move from normal space to hyperspace and from hyperspace to normal space.

> In this case, the physics of holes in spacetime has two different interpretations. For example, the real part of a hole in spacetime is what we understand as a black hole, whose gravitational force would pull everything into itself. However, the imaginary part of a hole in spacetime can be interpreted as a "white hole" that would "spit out" anything that entered the hole. A black hole and a white hole would be two different sides of the same phenomenon, like for example a coin has two sides. Black holes have been detected in space, but white holes have not yet been observed.

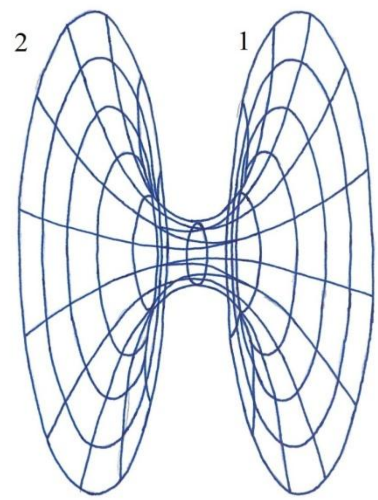
The latter figure clearly shows the correctness of the analysis presented above and its interpretation, in which the real l indicates the "exit from normal space":



and imaginary l would show "entering hyperspace":

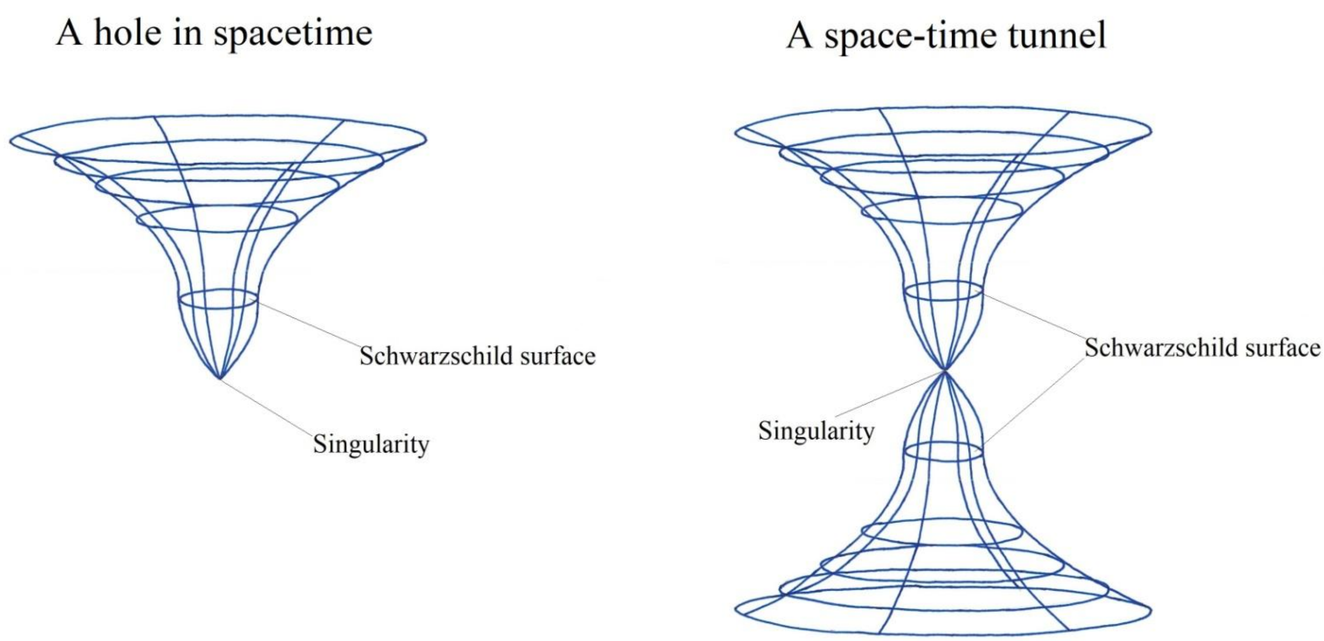


This would be the most accurate interpretation of the physical nature of a tunnel in spacetime or wormhole. This follows directly from the fact that the solution of the wormhole metric equation connects two flat regions of spacetime, in which case one of them is positive and the other negative, i.e. one is real and the other imaginary. Figure:

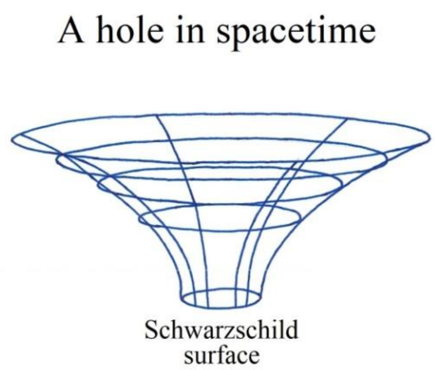


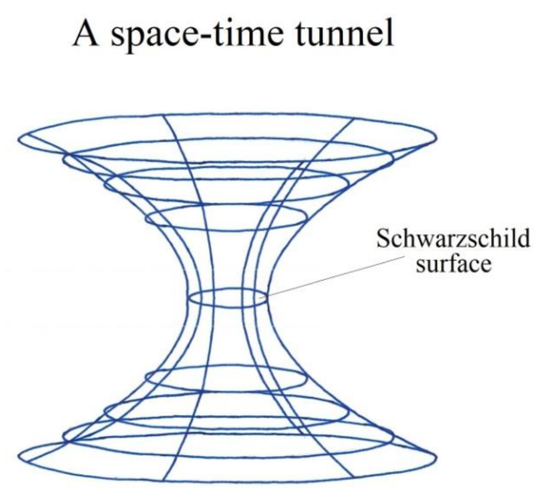
In this case, tunnels in spacetime, or wormholes, are no longer fictions belonging to science fiction, but actually real physical phenomena, since holes in spacetime are actually existing phenomena in the universe.

Some scientific sources claim that since the centre of a hole in spacetime (for example, a black hole) is said to have a point singularity ("singularity"), then a tunnel in spacetime is created precisely through this singularity. A descriptive diagram of this would be:



However, singularity doesn't really exist, and so we can only consider the size of the hole in spacetime in time and space or, therefore, the radius R of its event horizon. Figure:



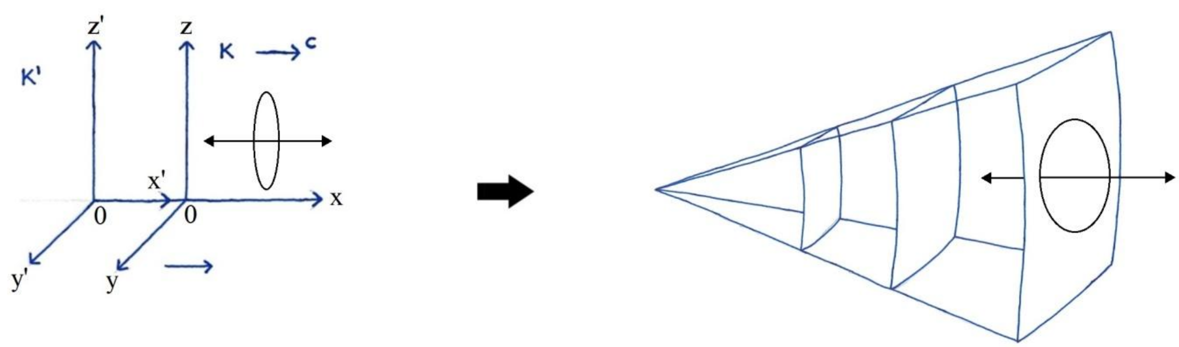


1.12 The length of the space-time tunnel

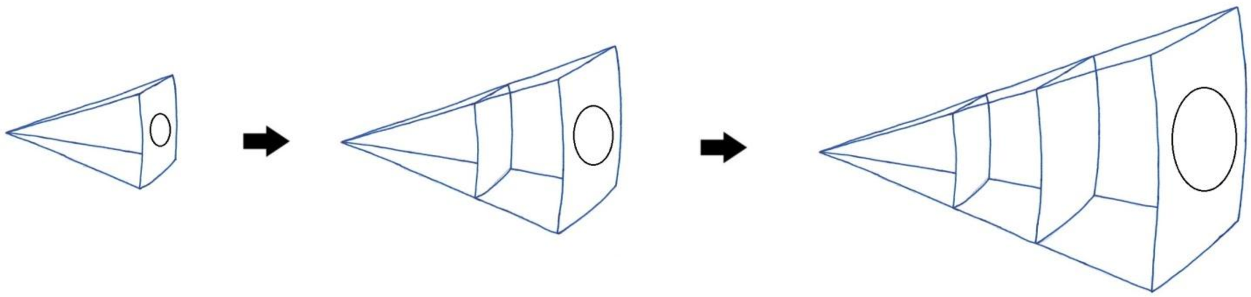
Since the trapped surface of spacetime as a hole in spacetime exists in time, i.e. it "moves" relative to hyperspace by a certain distance x, it creates a tunnel, the length of which can be calculated using mathematical equations.

A spherical hole in spacetime formed by the trapped surface of spacetime (for example, a black hole) can also move in the space we experience on a daily basis, i.e. normal space. However, if it exists in time, the hole in spacetime moves with respect to hyperspace by a certain distance x, which can be interpreted as a "tunnel in spacetime". How far you move in time depends on the "length" of this tunnel.

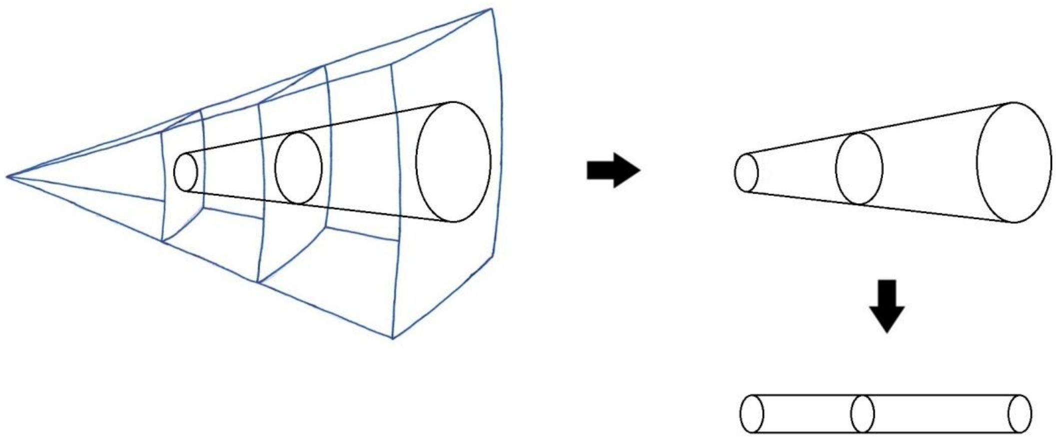
The physical system of normal space K and hyperspace K' manifests itself in nature as the cosmological expansion of the Universe, figure:



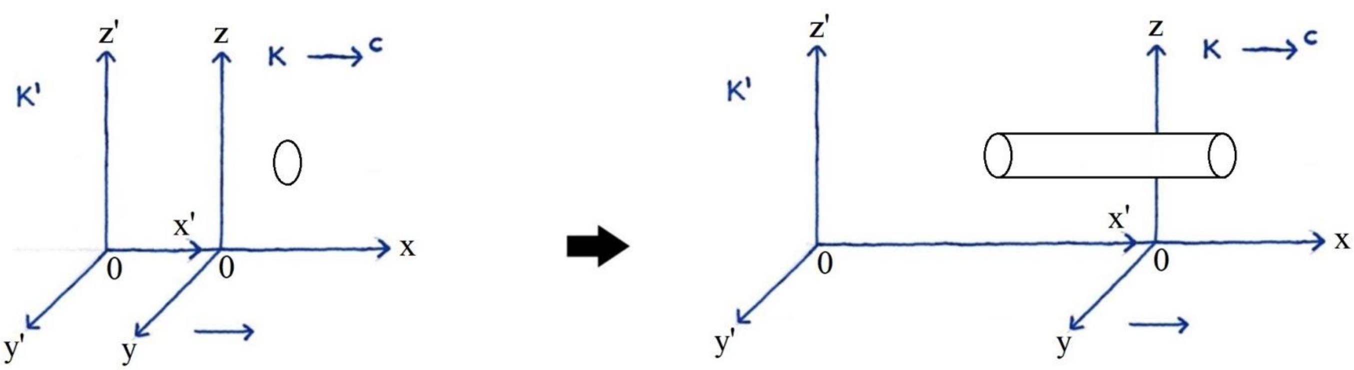
The hole in spacetime that exists in spacetime "moves" along with the expansion of the Universe, figure:



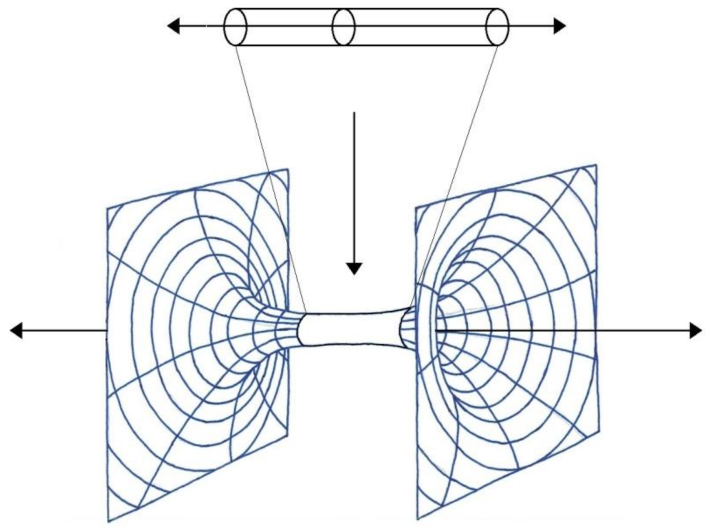
Consequently, the hole in spacetime creates a tunnel effect, figure:



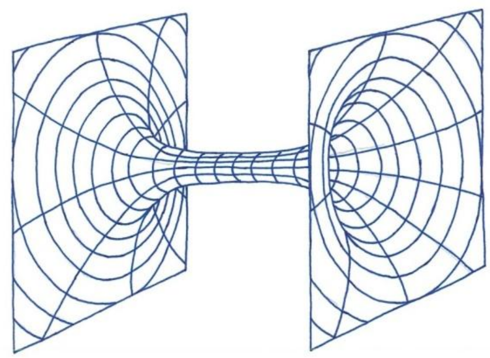
This means that the "movement" of the hole in spacetime with respect to hyperspace (not with respect to normal space) creates a tunnel effect, and this precisely with respect to hyperspace, figure:



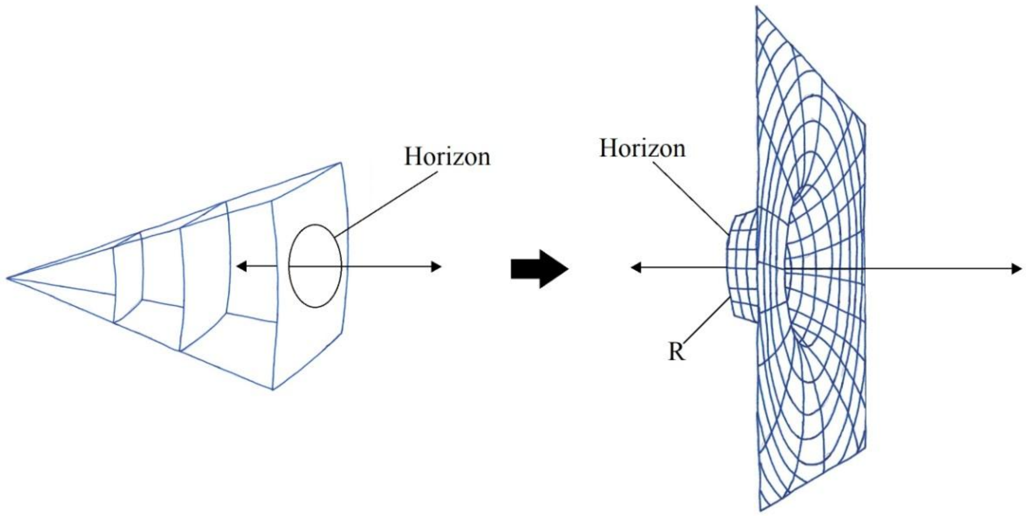
This resulting tunnel can be physically interpreted as a tunnel in spacetime tunnel, figure:



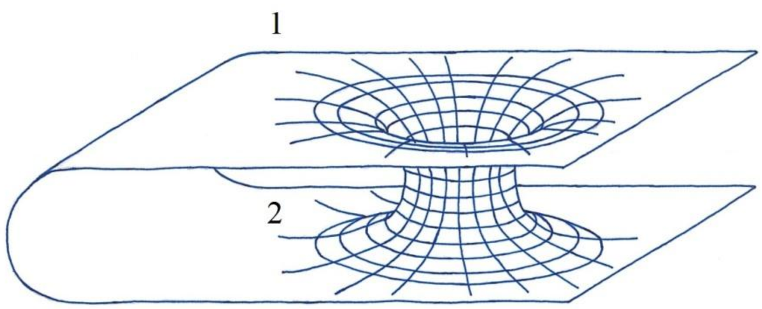
The tunnel in spacetime allows you to "move" in hyperspace, which in turn allows you to travel in time and teleport in space. The longer the tunnel in spacetime, the longer the distance we can travel in hyperspace, and thus the further in time or space we can teleport. Figure:



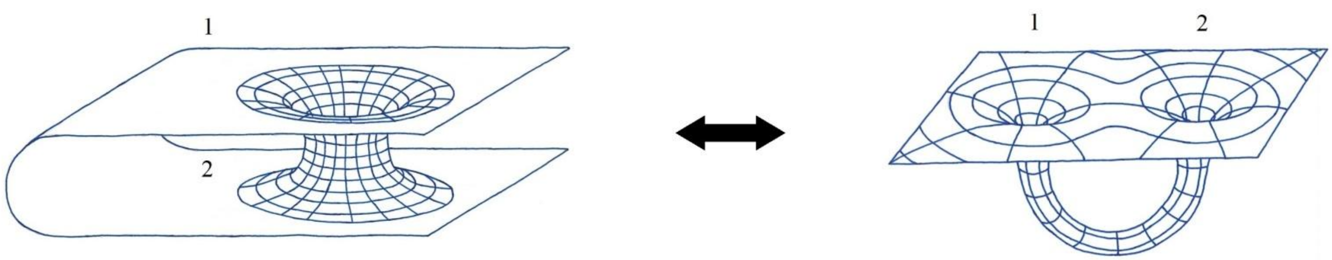
A tunnel in spacetime can be considered as two different physical objects. First, a tunnel in spacetime created by a hole in spacetime allows travel from normal space to hyperspace and from hyperspace to normal space:



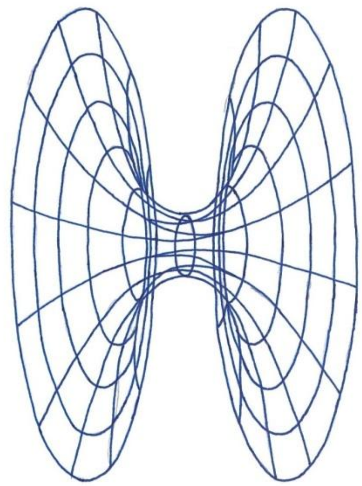
Second, a tunnel in spacetime allows, for example, a person to teleport (i.e. move) in time and space. This is represented in the models so that the tunnel allows a person to travel via a shortcut from area 1 to area 2 and vice versa:



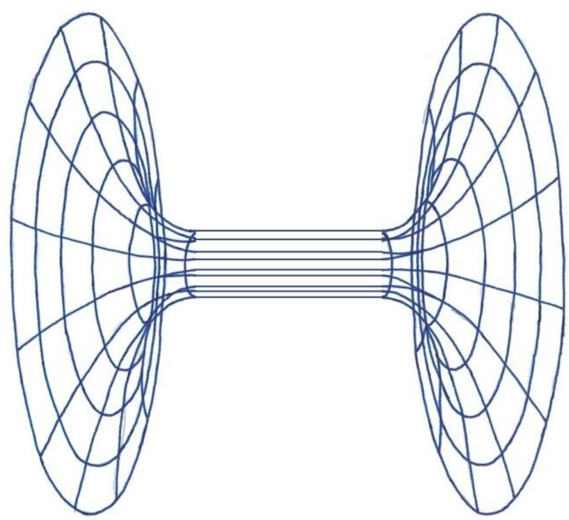
The latter can also be visualized with two different drawings showing region 1 and region 2:



All these different figures (previously and also in the future) are actually different possible ways of representing the same object. Since the hole in spacetime allows moving from normal space to hyperspace and from hyperspace to normal space, we can imagine it in relation to normal space as in the following figure, with a hole in spacetime in the middle:

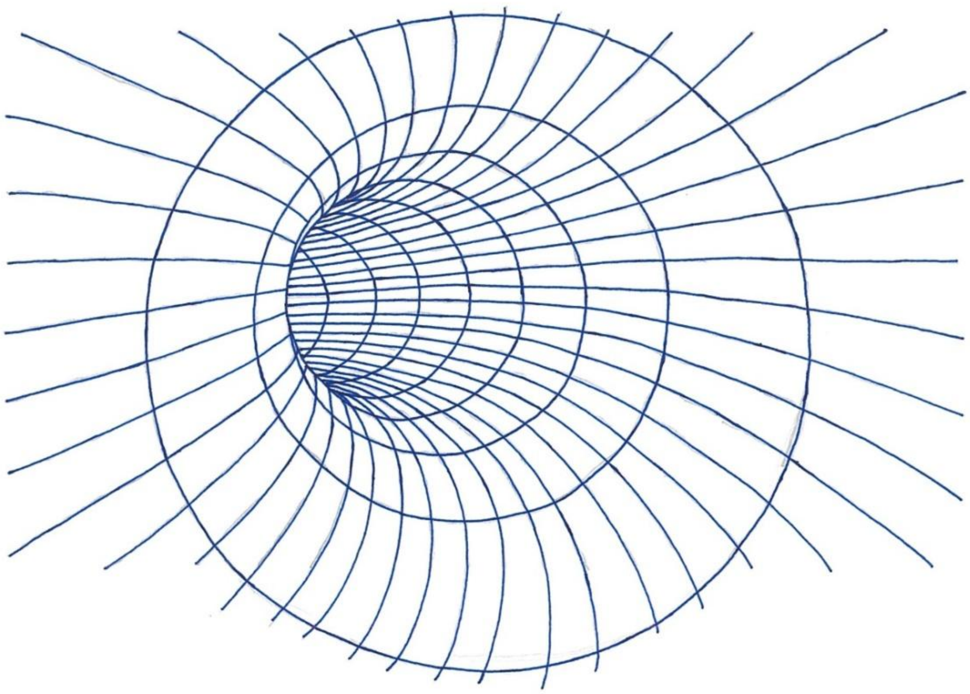


Since the hole in spacetime exists in time, due to which it moves a certain distance relative to hyperspace, we can therefore imagine the hole in spacetime as a tunnel in spacetime or a wormhole in relation to hyperspace:



> COMMENT: Holes in spacetime can move in normal space, for example, black holes move from one location to another in outer space. But the motion of a hole in spacetime in normal space does not create the effect of a tunnel in spacetime in our perceived space. A tunnel in spacetime can only form when viewed in relation to hyperspace, that is, a tunnel in spacetime can only form from the existence of hole in space-time in time. This means that the tunnel in spacetime is a physical phenomenon caused by time.

Tunnels in spacetime are mostly imagined as straight lines in various physical models, but the movement of a hole in spacetime in normal space can create a non-linear tunnel effect with respect to hyperspace. In this case, for example, the mouth of the tunnel in spacetime might look like this:



1.13 Introduction to mathematical analysis

In the case of any change in an energy field, a "trapped surface in space-time" also appears for a short time, on which time and space have been transformed or curved to infinity according to the theory of special relativity. For example, if a magnetic field occurs in empty space at the speed of light c, then the temporary "boundary" between the empty space and the energy field can be conceptually interpreted as a two-dimensional "surface" with time and space transformed to infinity, as it "moves" ("propagates") in space at the speed of light c.

> On the Schwarzschild surface at the center of the black hole, or the "horizon" of the black hole, time and space are also transformed, or curved, to infinity. The Schwarzschild radius r of the black hole determines the size of the Schwarzschild surface S.

The propagation of a changing electric field takes place via magnetic field. For example, a change in electric field at one point firstly creates a changing magnetic field, and a change in that magnetic field causes (through electromagnetic induction) a change in the electric field at a neighboring point. This means that any change in the electric or magnetic field propagates through space as a wave. This resulting wave is an electromagnetic wave, i.e. an electromagnetic field. In turn, it follows from this that, for example, when the electric charge changes, an electromagnetic wave or electromagnetic field surrounding the electric charge is created for a "short time", which moves away from the charged body, i.e. as if it "expands" away from the body, and which can be interpreted based on the above analysis as a photon probability wave, or a probability field, on the "surface" of which time and space are transformed to infinity due to the speed of light.

An electromagnetic wave is the propagation of changes in electric field and magnetic field in space. A change in an electric field creates a magnetic field, and a change in the magnetic field in turn creates an electric field. This transformation of electric and magnetic fields into each other occurs at the speed of light c, and the speed of electromagnetic wave in vacuum is also the speed of light c. An electromagnetic wave can also be seen as the motion of a photon of a quantum particle in vacuum, with zero mass m and energy E expressed as the well-known formula of Max Planck's quantum energy E.

The speed and length of an electromagnetic wave and the (group) speed and length of a probability wave of a photon are equal to each other:

$$\lambda = \frac{h}{p}$$

Since the electric field turns into magnetic field, and the magnetic field turns into an electric field precisely at the speed of light c, the "period of existence" of a trapped surface in space-time created in this process would be extremely short. This, in turn, indicates the fact that the emerging trapped surface in space-time must have "quantum mechanical properties".

Any change in the electric or magnetic field propagates through space as a wave. This resulting wave is an electromagnetic wave, or an electromagnetic field, whose time period of existence is extremely small. Therefore, the "period of existence" of a trapped surface in spacetime created in this process must also be extremely small. This suggests that the emerging trapped surface in spacetime must have "quantum mechanical properties". For example, if the time period of the existence of an electromagnetic wave can be calculated with the uncertainty relation between energy and time known from quantum mechanics:

$$\Delta E \Delta t = \bar{h}$$

or

$$\Delta t = \frac{\bar{h}}{\Delta E}$$

therefore, it should also be possible to use such an equation to calculate the time period of existence of the emerging trapped surface in spacetime. If the time period of the existence of a physical phenomenon is extremely small, then the uncertainty relation between energy and time known in quantum mechanics must be used to calculate this field. This is a well-known approach in such circumstances.

At this point, a distinction must be made between the time period of existence of an electromagnetic wave and an electromagnetic field. For example, an electromagnetic wave propagating in vacuum may take 10^{-9} seconds to make one complete oscillation, but at the same time, the same electromagnetic field may propagate in vacuum (for example, space) for thousands of years before being absorbed by something. Over the thousands of years that it travels through space, an electromagnetic wave can complete trillions of trillions of full oscillations. In the case of the generation of a wave due to changes in electric charge fields and the creation of an accompanying trapped surface in spacetime, we must take into account the time period of existence of the electromagnetic field, not the time period required for one complete oscillation of an electromagnetic wave. In this case, both time periods are extremely small: in nanoseconds.

It is worth noting that an electromagnetic wave is a part of an electromagnetic field.

An electromagnetic wave can be viewed as the motion of a photon of a quantum particle in vacuum with zero mass m and energy E expressed as the well-known Max Planck quantum energy E equation:

$$E = hf$$

The speed v and length λ of an electromagnetic wave and the (group) speed v and length λ of a photon probability wave are equal to each other:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

This means that, according to quantum mechanics, an electromagnetic wave is equal to a photon probability wave. They are one and the same.

The time period of the existence of the trapped surface in spacetime is related to the time period of the existence of the wave caused by the changes in the fields of electric charges. This also means that the equation for the uncertainty relation between energy and time can be applied over the entire trapped surface in spacetime regardless of the geometric shape. For example, if the trapped surface in spacetime were spherical, then the time period of existence of this spherical trapped surface in spacetime could be calculated from the equation for the uncertainty relation between energy and time.

> The time period of existence of a trapped surface in spacetime also indicates the time period of existence of the tunnel in spacetime or wormhole. The trapped surface in spacetime forms a tunnel in spacetime.

In the equation for the uncertainty relation, energy E is the energy of the field and time t is the time period of existence of the electromagnetic wave, through which the time period of existence of a trapped surface in spacetime can be determined. For example, in quantum field theory, the time periods of existence of field particles, i.e. virtual particles, are also determined by the uncertainty relation between the particle's energy and time:

$$\Delta E \Delta t = \bar{h}$$

A similar principle also applies in this case in the case of existence of a trapped surface in spacetime (i.e. a tunnel in spacetime).

It is known from quantum mechanics that the equation for the uncertainty relation between energy and time is also related to momentum p. Such a relation is called the Heisenberg uncertainty relation between the momentum p and the coordinate x:

$$\Delta p \Delta x = \bar{h}$$

Consequently, it must also be valid for trapped surface in spacetime. But in this case, it means that the trapped surface in spacetime, or Schwarzschild surface, has momentum p, because it exists in normal space for a certain period of time, so it "moves" relative to hyperspace at speed c along a path length x.

Since the trapped surface in spacetime as a hole in spacetime exists in time, i.e. it "moves" relative to hyperspace by a certain path length x, it creates a tunnel, the length of which can be calculated mathematically. For example, any movement of a hole in space creates the illusion of a tunnel. For example, the ultra-fast linear movement of a ring in space creates the illusion of a tunnel.

> Existence in time means movement relative to hyperspace. A certain path length x is moved relative to hyperspace at the speed of light c.

The trapped surface in spacetime can be physically interpreted as a spherical hole in spacetime (in case of gravitational field, it would be a black hole), which can also move in the space we experience on a daily basis, i.e. in ordinary space, a certain distance x. However, if it exists in time, the hole in spacetime also moves some kind of distance x relative to hyperspace, which can be interpreted as a "tunnel in spacetime". How far you move in time depends on the "length" of this tunnel. The distances traveled by a hole in spacetime in normal space and hyperspace are not equal. The distance traveled in hyperspace is many times greater than in normal space.

Impulse is accompanied by various interpretation possibilities. This means that since in quantum mechanics, from the equation for the uncertainty relation between energy and time:

$$\Delta E \Delta t = \bar{h}$$

uncertainty relation between momentum and coordinate:

$$\Delta p \Delta x = \bar{h}$$

therefore, in case of a trapped surface in spacetime, it can mean different aspects at the same time. For example, a trapped surface in spacetime can have momentum p because it can travel a distance x in normal space. However, at the same time, the momentum of the trapped surface in spacetime can also result from motion relative to hyperspace, since it exists in time. In this case, x represents the distance relative to hyperspace. The momentum p can also indicate, for example, the momentum of the trapped surface of a spherical spacetime in normal space, in which case it does not move relative to normal space. Such an interpretation is also possible, because due to the electromagnetic wave, the surface area S of a closed trap in spacetime must continuously increase in time, therefore it must have momentum p, even though the closed surface as a whole may not move at all in ordinary space. An analogue of this is, for example, the expansion of a balloon in space. In relation to hyperspace, motion always occurs because it means existence in time.

It is known from the physics theory of time travel that if a body moves in normal space at the speed of light c, then this body must be "stationary" in relation to hyperspace. Exactly the same regularity actually applies to an expanding surface. For example, if some kind of closed surface increases at the speed of light c in ordinary space, then such an increase would not occur in relation to hyperspace. However, due to existence in time, this increasing surface would move relative to hyperspace at speed c.

1.14 Mathematical analysis

Gravitational field as a curvature of space-time is described centrosymmetrically by the Schwarzschild metrics:

$$ds^2 = c^2\left(1-\frac{R}{r}\right)dt^2 - \frac{1}{1-\frac{R}{r}}dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

and so far it has been assumed that this same metrics also mathematically describes the length of a tunnel in space-time. This is actually not the case. The Schwarzschild metrics describes a gravitational field, or the curvature in space-time, in the center of which exists the so-called Schwarzschild surface:

$$R = \frac{2GM}{c^2}$$

On the Schwarzschild surface, time and space are curved or transformed to infinity. It is this surface that can be physically interpreted as the entrance and exit of a tunnel in space-time. According to the special theory of relativity, mass and energy are equivalent quantities:

$$E = mc^2$$

that is, we can express mass through energy:

$$m = \frac{E}{c^2}$$

Consequently, we get the formula for the radius of the Schwarzschild surface:

$$R = \frac{2GE}{c^4}$$

and if it were the electric field energy E, then we get the equation for radius of the Reissner-Nordström surface:

$$R = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

Above we proved that the equations for potential energy and quantum energy are "co-derivable" and therefore they are also equal to each other:

$$E = mc^2 = hf$$

Consequently, the trapped surface in spacetime, or the Schwarzschild surface, must also have quantum mechanical properties:

$$E = \frac{Rc^4}{2G} = mc^2 = hf$$

according to which it would be possible to calculate the length of a tunnel in space-time and thus also how far in time or space one teleports.

We prove the quantum mechanical properties of a trapped surface in space-time through the following mathematical analysis. For example, in the previously derived equation for radius R:

$$R = \frac{2GE}{c^4}$$

it is the energy of the field E, which in this case is the energy of the electric field E:

$$E = \frac{q^2}{2C}$$

We previously proved that the equation for Planck's constant h holds:

$$\frac{1}{c^4} \approx \frac{h}{2\pi} = h$$

and hence we get the equation for radius R in the following form:

$$R = 2GEh$$

When written out, it comes out as follows:

$$R = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

that is, by squaring both sides of the latter equation:

$$R^2 = \frac{q^2 G}{4\pi\varepsilon_0 c^4} = \frac{q^2 G}{4\pi\varepsilon_0}\frac{1}{c^4}$$

in which we see that the trapped surface in spacetime S is related to Planck's constant h:

$$4\pi R^2 = S = \frac{q^2 G}{\varepsilon_0} h$$

The radius R indicates the size of the trapped surface in spacetime:

$$R = x = 2GEh$$

We can mathematically transform the latter equation as follows:

$$\frac{x}{2GE} = \frac{1}{2GE}x = h$$

Since the uncertainty relation between the position x and the momentum p of an energy quantum is known from quantum mechanics:

$$px = h$$

then, therefore, the x member of the equation must be equal to the impulse p:

$$\frac{1}{2GE} = p$$

The result is the well-known uncertainty relation:

$$px = h$$

in which the impulse p of trapped surface in spacetime equals:

$$\frac{E}{c} = mc = p$$

In this context, this means that the energy field creates a trapped surface in space-time and as a result, the trapped surface in space-time has mass and impulse. The location x of the trapped surface in space-time created by the energy field in our three-dimensional space coincides with the energy quantum uncertainty relation between position and impulse

$$x = \frac{h}{p}$$

and thus the trapped surface in spacetime indeed has quantum mechanical properties.

> NOTE: It is possible to prove the validity of the approximate value of Planck's constant h in relation to impulse p through the relation
>
> $$\frac{1}{2GE} = p = mc$$
>
> For example, the following mathematical transformation is performed for this purpose:
>
> $$\frac{1}{2Gm} = Ec$$
>
> and both sides of the last equation are multiplied by c^2:
>
> $$\frac{c^2}{2Gm} = \frac{1}{R} = Ec^3$$

From the latter equation, we get:

$$\frac{1}{c^3} = ER$$

and if we divide both sides of the resulting equation by the speed of light c:

$$\frac{1}{c^4} = E\frac{R}{c} = Et$$

in which we considered the definition of velocity v from classical mechanics:

$$v = c = \frac{s}{t}$$

then we get the uncertainty relation between energy E and time t:

$$h = Et$$

which coincides with the dimension of Planck's constant h: "energy times time".

The quantum mechanical properties of a trapped surface in spacetime are as follows. For example, in Max Planck's equation for quantum energy

$$E = hf$$

frequency f is related to the time period t as follows:

$$f = \frac{1}{t}$$

Consequently, we get the equation:

$$Et = h$$

Which, in quantum mechanics, is called the Heisenberg uncertainty relation between a particle's energy and time:

$$\Delta E \Delta t = h$$

However, in case of a trapped surface in space-time, this equation means that the energy E of the electric field, which is the creator of the trapped surface in space-time, also determines the time period of the existence of the trapped surface in space-time.

In quantum field theory, the time periods of the existence of field particles, i.e. virtual particles, are determined by the uncertainty relation between the particle's energy and time:

$$\Delta E \Delta t = h$$

A similar principle also applies in this case if trapped surfaces in space-time (tunnels in space-time) exist.

This same formula also relates to impulse. For example, the energy of an electric field E is equal to the equation for potential energy:

$$mc^2t = h$$

The latter equation can also be presented mathematically as follows:

$$mcct = h$$

in which impulse p

$$mc = mv = p$$

and coordinate x

$$ct = x$$

Form the equation

$$px = h$$

which in quantum mechanics is called the Heisenberg uncertainty relation between a particle's impulse and its coordinate:

$$\Delta p \Delta x = h$$

However, in case of a trapped surface in space-time, this means that the trapped surface in space-time, or Schwarzschild surface, has an impulse p, because it exists in ordinary space for a certain period of time, i.e. it "moves" relative to hyperspace at a speed c along the distance x:

$$ct = x$$

In this case, we can also write out the last equation like this:

$$c\tau = x$$

and if we square both sides of the latter equation, we see that this equation equals the equation derived in the part concerning cosmology:

$$ds^2 = c^2\tau^2 = c^2\frac{dt^2}{y^2} - y^2dl^2$$

which describes the expansion of the space-time of the universe, i.e. the movement of normal space in relation to hyperspace. Normal space moves with respect to hyperspace at the speed of light c. The latter equation can also be presented in spherical coordinates:

$$dl^2 = dx^2 + dy^2 + dz^2 = dr^2 - r^2(d\theta^2 + sin^2\theta d\varphi^2)$$

and the multiplier y^2 is related to the speed of light c and the Hubble constant H as follows:

$$y^2 = \frac{c^2}{v^2} = \frac{c^2}{H^2}$$

In the part concerning cosmology, we proved that the universe is actually expanding at the speed of light c:

$$v = H = c$$

Since a trapped surface in space-time as a hole in space-time exists in time, i.e. it "moves" relative to hyperspace by a certain distance x, it creates a tunnel, the length of which can be calculated based on the previous mathematical analysis.

> A spherical hole in space-time formed by the trapped surface in space-time (for example, a black hole) can also move in space we experience on a daily basis, i.e. in ordinary space. However, if it exists in time, the hole in space-time moves with respect to hyperspace by a certain distance x, which can be interpreted as a "tunnel in space-time". How far you move in time depends on the "length" of this tunnel.

We will analyze all the previously presented mathematical derivations in much more detail immediately below.

1.15 Quantum mechanical properties of a trapped surface in spacetime and the consequent calculations

The time of existence of the emerging trapped surface in space-time is extremely small, but its surface area S, on the other hand, is very large - it can even be the size of a person. As a result, such a trapped surface in space-time can have quantum mechanical properties similar to, for example, microparticles.

At this point, it should be noted that quantum mechanical properties occur on such a trapped surface in space-time, which is created precisely with an electromagnetic wave (variable field), i.e. a probability wave, with a length:

$$\lambda = \frac{h}{p}$$

This is due to the speed of light c. The trapped surface in space-time is also created by the body's mass M and electric charge q:

$$R = \frac{2GM}{c^2} = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

but we will not consider such cases here in this case. An electromagnetic wave exists in “two different physical environments”:

> First, the propagation of the changing electric field takes place through the magnetic field. For example, a "change in the electric field of a charge" at one point firstly causes a

changing magnetic field, and a change in that magnetic field induces (through electromagnetic induction) a change in the electric field at a neighboring point. This means that any change in an electric or magnetic field (including the change in the field of a charge) propagates in space as a wave. This resulting wave is an electromagnetic wave and therefore an electromagnetic field.

Secondly, the propagation of an electromagnetic wave, i.e. the change of an electric field and a magnetic field, can also occur in vacuum and in matter without the presence of an electric charge. A change in an electric field creates a magnetic field, and a change in a magnetic field in turn creates an electric field. This transformation of electric and magnetic fields into each other occurs at the speed of light c, and the speed of movement of an electromagnetic wave in vacuum is also the speed of light c. An electromagnetic wave can also be seen as the motion of a photon of a quantum particle in vacuum, with zero mass m and energy E expressed using the well-known equation for Max Planck's quantum energy E:

$$E = hf$$

The length of an electromagnetic wave and the length of a probability wave of a photon are equal to each other:

$$\lambda = \frac{h}{p}$$

Although in this case we only deal with trapped surfaces in space-time accompanying electromagnetic waves, mathematically they can also be described by such equations that also describe trapped surfaces in space-time created by mass/electric charge:

$$t` = \frac{t}{\sqrt{1 - \frac{R}{R}}} = \infty$$

For example, the equation for the trapped surface in space-time, which describes the creation of the trapped surface in space-time created by an electric charge, is mathematically derived from the well-known Schwarzschild radius R equation:

$$R = \frac{2GM}{c^2}$$

which describes the size of a trapped surface in space-time R created by the mass of the body M. In the latter formula, instead of the mass M

$$\frac{c^2 R}{2G} = M$$

energy E is used according to the according to the principle of equivalence of mass and energy:

$$E = mc^2$$

or

$$\frac{E}{c^2} = m$$

Thus, the equation is obtained

$$\frac{c^2 R}{2G} = \frac{E}{c^2}$$

according to which a trapped surface in space-time R is created only due to the energy E:

$$\frac{c^4 R}{2G} = E$$

Since the electric field "has" energy E (i.e. it is intrinsically an "energy field"):

$$E = \frac{q^2}{2C} = \frac{1}{8\pi\varepsilon_0}\frac{q^2}{r}$$

then the electric field can affect spacetime metrics and thus create a trapped surface in spacetime R:

$$\frac{c^4 R}{2G} = \frac{1}{8\pi\varepsilon_0}\frac{q^2}{r}$$

The creator of a trapped surface in space-time is the energy of an electric field E, which was derived from the well-known principle of equivalence of mass and energy:

$$E = mc^2$$

Due to the theory of time travel, the potential energy E is always related to the quantum energy as follows:

$$E = mc^2 = hf$$

This is purely because these formulas are "co-derivable" in time travel theory.

In 1900, the famous physicist Max Planck presented the equation for quantum energy:

$$E = hf$$

in which he connected the energy of a particle E to the wave frequency f. The frequency is related to the time period t:

$$E = h\frac{1}{t}$$

and this gives us an equation from which we can in turn "derive" the uncertainty relation between the particle's energy and time:

$$Et = h$$

Since any energy E can be presented as an equation for potential energy:

$$mc^2t = h$$

then the equation of de Broglie's wavelength λ can be derived from the obtained relationship:

$$mc * ct = h$$

or

$$x = \lambda = \frac{h}{p}$$

Such a possibility and rigor of mathematical derivation actually confirms the connection between the potential energy of any body and the quantum energy, i.e. the "convergence" of the two, i.e. the inseparability from each other.

This means that if the equation for the trapped surface in spacetime was derived using the equivalence principle of mass and energy, then this trapped surface in spacetime is also related to the quantum energy E:

$$E = hf$$

that is, the emerging trapped surface in space-time must have quantum mechanical properties. In the latter equation for energy, the wave frequency f is related to the time period t as follows:

$$f = \frac{1}{t}$$

Consequently, we get the equation in the form

$$E = h\frac{1}{t}$$

that is, we get the "energy times time" dimension:

$$Et = h$$

The last relation obtained is essentially the uncertainty relation between the energy E and the time period t known in quantum mechanics:

$$\Delta E \Delta t \geqslant h$$

or

$$\Delta E \Delta t \geqslant \frac{h}{2\pi}$$

However, in this case the last relationship can be interpreted such that the energy of an electric field E, which is the creator of the trapped surface in space-time, also determines the time period Δt of the existence of a trapped surface in space-time (i.e. a space-time tunnel).

For example, from the equations for radius R presented and used repeatedly above:

$$R = \frac{2GM}{c^2} = \frac{2GE}{c^4}$$

an expression containing Planck's constant h is obtained:

$$R = 2GEh$$

or

$$\frac{1}{2GE}R = h$$

in which there is also a relation for the impulse p:

$$\frac{1}{2GE} = p$$

Therefore, the Swarzschild radius R is related to the length λ of the electromagnetic wave, or probability wave:

$$pR = h$$

or

$$R = \frac{h}{p} = \lambda$$

The Swarzschild radius R forms a spherical trapped surface in space-time with surface area S

$$S = 4\pi R^2$$

and the electromagnetic wave length λ is in this case related to the distance the light travels ct:

$$\lambda = ct = \sqrt{\frac{S}{4\pi}}$$

In the resulting equation, time t is the time period of existence of spherical trapped surface in space-time S:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

the square of which the distance of time travel depends on:

$$t^2 = \frac{1}{c^2}\frac{S}{4\pi}$$

At this point, of course, one could ask why we did not use the equation V for the volume of the sphere beforehand:

$$V = \frac{4\pi R^3}{3}$$

from which the equation for the time period t could also be derived:

$$t = \frac{1}{c}\sqrt[3]{\frac{3V}{4\pi}}$$

or

$$t^3 = \frac{1}{c^3}\frac{3V}{4\pi}$$

However, it is not practical to use the equation for volume, because, for example, in the equation for the Nordström radius R:

$$R = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

only the expression for area S is "visible":

$$4\pi R^2 = S = \frac{q^2 G}{\varepsilon_0 c^4}$$

If we put the expression for the latter area S into the equation for the time period t derived above:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

we will get the following equation:

$$t = \frac{1}{c}\sqrt{\frac{1}{4\pi}\frac{q^2 G}{\varepsilon_0 c^4}}$$

which is equal to the equation for Nordström radius R:

$$ct = R = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

Such an analysis would not come out with equation for the volume of a sphere V, that is, there is no possibility of deriving the equation for the volume of a sphere in Nordström's equation. The formula for the volume of a sphere cannot be derived from Nordström's equation "from within", i.e. it cannot be derived from within the system.

1.16 Calculations

Next, we will calculate what the time period t and surface S of a trapped surface in space-time must be in order to teleport 100 years into the past or the future.

In the special theory of relativity, the phenomenon of time dilation consisted in the fact that the closer the body's speed v gets to the speed of light c in vacuum, the slower time passes in relation to an external observer:

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

A good example of this is the case of the twin paradox.

> For example, if one of twin brothers goes on a space trip and later returns to Earth, the brothers are no longer the same age. The space traveler has remained younger than his brother. In theory, the age gap can be increased indefinitely. For example, if a father travels away from Earth for 2 years and back for another 2 years (times measured by the father), then he is 20 years younger than his daughter. However, before the journey began, the father was 20 years older than his daughter. Thus, we obtain the constant velocity parameter β with respect to Earth as follows:
>
> $$41 = 4y$$
>
> in which
>
> $$y = 10 = \frac{1}{\sqrt{1 - \beta^2}}$$
>
> in which
>
> $$\beta = 0{,}995.$$
>
> However, if an observer traveled in his starship into space at a speed approaching the speed of light in vacuum and returned to earth 22 years later, almost 1,000 years would have passed on earth during that time. Thus, the observer traveled in time to the future.

But in the part of the theory of time travel concerning cosmology, it is proven that the speed of expansion H of the universe is many times smaller than the speed of light c precisely because time has changed, or slowed down, throughout the entire universe. The quotient of the speed of light c and the expansion rate H of the universe indicates the size of the multiplier y:

$$y = \frac{c}{v} = \frac{c}{H}$$

in which $v = H$ is the rate of expansion of the universe at the present time and as expressed in the SI system. As a result, time in the universe has transformed

$$\frac{t`}{t} = y \approx 1{,}25 * 10^{26}$$

times.

Normal space K moves with respect to hyperspace K' at the speed of light c, or 300,000 km/s. This means that if one second has passed in our space-time (i.e. normal space K), a distance of approximately 300,000 kilometers would have been traveled in hyperspace during this time. This also means that if we were to time travel one second into past or future, we would have to travel a distance of approximately 300,000 kilometers in hyperspace. This is true if the rate of expansion of the universe is equal to the speed of light in vacuum. However, the actual rate of expansion of the universe at the present time is 74 km/s * (Mpc). However, such speed is as follows in the SI system (i.e. in units):

$$\frac{x}{y} = \frac{74\ 000\left(\frac{m}{s}\right)}{3{,}086 * 10^{22}(m)} = 2{,}3(979) * 10^{-18}\frac{m}{s}\ per\ one\ meter,$$

where the speed of retreating of the galaxies is x = 74 km/s = 74,000 m/s, the distance in space is y = 1 Mpc = 3.086 * 1016 m * million = 3.086 * 1022 m, and the numerical value of the speed of light in vacuum is c = 300,000 km/s = 3 * 108 m/s. Since the speed of expansion of the universe is many times smaller than the speed of light, time in the universe actually runs much, much faster than it seems to us

$$t^{\prime} = yt,$$

therefore, we need to find the value of y (i.e. gamma):

$$y = \frac{t'}{t}$$

which shows us how many times the rate of expansion of the universe is slower than the actual rate of expansion, i.e. how many times the passage of time in the universe has slowed down or sped up (y is a multiplier that has no unit):

$$y = \frac{t'}{t} = \frac{3 * 10^{8}\left(\frac{m}{s}\right)}{2{,}3979 * 10^{-18}\left(\frac{m}{s}\right)} = 1{,}25109 * 10^{26} \approx 1{,}25 * 10^{26}$$

It is important to note here that we used the rate of expansion of the universe, which is 74 km/s per megaparsec. In fact, the value of Hubble's constant H, or the rate of expansion of the universe, is known to be between 72.6 and 75.4 km/s per Mpc. The work of Adam Riess, the American Nobel laureate and Johns Hopkins University professor, and Sherry Suyu from the Max Planck Institute for Astrophysics in Germany give us such a result. However, results from ESA's Planck space telescope give the Hubble constant H as 67.4 km/s (+/- 0.5 km/s) per Mpc instead, which is much smaller than the value of H presented above. Such a value gives the lifetime of the universe to be about 13.8 billion years, but in the calculations above we considered a 13.7 billion year old universe. However, there is not a very big difference between these two different lifetimes of the universe.

According to observations of the Cosmic Microwave Background using the Cosmology Telescope in the Atacama Desert in Chile, the rate of expansion of the universe is 67.9 kilometers per second per megaparsec. But according to studies of supernova departure rates, the rate of expansion of the universe is instead 74 kilometers per second per megaparsec. Whereas one parsec equals 3.26 light years, or:

$$1pc \approx 3 * 10^{16}\ m$$

Physically, this means that if, for example, one second has passed in our "everyday-perceived space-time" or ordinary space K:

$$t` = 1\ sek$$

then in fact (i.e. viewed from a hypothetical observer outside the Universe, i.e. in relation to hyperspace K`) "only" the following has passed

$$t = \frac{t`}{y} = 8 * 10^{-27}\ sec$$

In the latter equation, t` is apparent time (i.e. time passing to a real observer inside the universe) and t is real time (i.e. time passing to a hypothetical observer outside the universe). It follows that if one second of time has actually passed in the universe, it has apparently passed:

$$t` = ty = y \approx 1{,}25 * 10^{26}\ sek \approx 3{,}963 * 10^{18}\ a \approx 4\ billion\ billion\ years$$

in which t = 1 sec. It has been previously considered that there are 31,536,000 seconds in one year, if it is not a leap year. From these simple relationships, it is possible to directly calculate how far it is possible to teleport in time. The calculation of this field depends purely on how long is the existence time of the trapped surface in space-time (or a tunnel in space-time) in the universe. The further you travel in time, the longer the tunnel in space-time must be. It is possible to travel in time only in hyperspace, i.e. outside of space-time, and this means that the greater the distance we travel in hyperspace, the further we travel in time. It follows that the length of a tunnel in space-time depends on the time period of existence of a hole in space-time. This is because the longer the hole in space-time exists in time (that is, the longer the time interval between the creation and disappearance of the hole in space-time), the longer the distance that has been traveled in hyperspace.

In fact, the physical body passes through a tunnel in space-time in only one moment, i.e. the body exists in hyperspace for zero seconds. The length of the tunnel in space-time, i.e. the distance of the movement in hyperspace, is determined by the time of the existence of the hole in space-time, i.e. the time period between the creation and disappearance of the hole in space-time. This means that the time of existence of a hole in space-time would also indicate the time of existence of a time-traveling body in hyperspace, on the basis of which it would be possible to calculate the distance traveled or to be traveled in hyperspace. The longer the journey of the body's "movement" in hyperspace, the further it travels in time. For example, if a trapped surface in spacetime exists in our time

$$\frac{t`}{y} = t = 2{,}522 * 10^{-17}\ sec$$

then we can teleport to the past or future in time t` = 3 153 600 000 seconds or 100 years (leap years have not been taken into account). Since the body already exists "inside" a closed trapped surface in space-time in hyperspace, i.e. outside the space-time of the universe, in this case the time period t

$$t = 2{,}522 * 10^{-17}\ sec$$

represents also the time of existence of a closed trapped surface in space-time t` in the space-time of the universe. As a result, it is possible to calculate how long time travel is performed, i.e. to calculate the value of t`. All calculations are done in the SI system.

If in the equation for the time period t of the existence of the trapped surface in space-time derived above:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

Then the value of the surface area S would be as follows:

$$S = 28{,}26\ m^2$$

then we would get the time period of existence of a trapped surface S in space-time as follows:

$$t = 5 * 10^{-9}\ sec$$

which coincides very well with the period of the electromagnetic wave if the wavelength were 1.5 m. The square of this time period:

$$t^2 = 2{,}5 * 10^{-17}\ sec^2$$

in turn coincides with the value of the time period of the existence of the recently obtained trapped surface in space-time:

$$\frac{t`}{y} = t = 2{,}522 * 10^{-17}\ sec$$

in which case we can teleport to the past or the future in time t` = 3,153,600,000 seconds, or 100 years (leap years are not taken into account).

For comparison, it can be pointed out here that, for example, in quantum field theory, a virtual electron-positron pair can exist in vacuum for a maximum of:

$$t` = 1 * 10^{-22}\ sec$$

Such a time period is even smaller than the time period of existence of a tunnel in space-time. The time period of the existence of a trapped surface in space-time or a tunnel in space-time is extremely small. However, there are also other phenomena in nature, the period of existence of which is very short. For example, the normal duration of lightning is about 0.2 seconds, and in this time the spark can move up and down between the cloud and the ground dozens of times. However, the duration of lightning is billions of times longer than the period of existence of a tunnel in spacetime. Pixabay photo of lightning between cloud and ground (free image by “*neja5*” from Pixabay):

Seemingly, it seems that thunder is a powerful natural phenomenon. However, actually the energy of lightning is very small. Even chocolate can have much more energy than lightning that occurs between a rain cloud and the ground. However, the power of lightning is very high. In physics, power equals the speed of doing work, i.e. the amount of work done in a unit of time, and the duration of lightning in one unit of time is very small, which is why its power is very high.

It is worth noting here that in this case we do not simply consider the time period t in the mathematical calculations:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

instead, we consider its square:

$$t^2 = \frac{1}{c^2}\frac{S}{4\pi}$$

or, therefore:

$$\frac{t`}{y} = t = t^2 = \frac{1}{c^2}\frac{S}{4\pi}$$

This is because the area S is related to the square of the radius R^2:

$$S = 4\pi R^2 = 4\pi c^2 t^2$$

which in turn can describe the distance of travel of light l, in which the square of the time period t^2 occurs:

$$c^2 = \frac{R^2}{t^2} = \frac{l^2}{t^2}$$

The above calculations show that the resulting equation:

$$\frac{t'}{y} = t = t^2 = \frac{1}{c^2}\frac{S}{4\pi}$$

indicates that also the y-factor of the universe

$$\frac{t'}{t} = y$$

must be an inherently squared expression. How is it possible? The solution is that the law of variation of the y-factor of the universe must be expressed without the square root:

$$\frac{1}{1 - \frac{R}{r}} = y$$

not with a square root:

$$\frac{1}{\sqrt{1 - \frac{R}{r}}} = y$$

The same principle applies to such an expression:

$$\frac{1}{1 - \frac{t'}{t}} = y$$

For example, in the theory of general relativity, a similar equation appears without the square root:

$$\frac{t'^2}{t^2} = \frac{1}{1 - \frac{R}{r}} = y^2$$

in which can be seen: t^2. We discussed the law of change of the y-factor of the universe in much more detail in the cosmology section above.

4π appears in the equation because it is a formula for the surface area of a sphere. All calculations can be done with the surface area of a sphere. For example, it is possible to "convert" the entire surface area of the human body into the surface area of a sphere and make the necessary calculations accordingly.

The formula for the total surface area of human body S can be expressed as follows:

$$S = 0{,}2 * M^{0{,}425} + H^{0{,}725} \ \ (m^2) \, ,$$

where M is the human body mass (kg) and H is the human body height (m). But the last equation is sometimes also written like this:

$$S = (1000 * M)^{\frac{35{,}75 - logM}{53{,}2}} \frac{H^{0{,}3}}{3118{,}2} \, ,$$

where M is the human body mass (kg) and H is the human body height (m). The ideal weight of a person (kg) can be expressed as follows:

$$M_m = (3 * H - 450 + t) \ 0{,}25 + 45 \, ,$$

where M_m is man's weight, H is the height and t is the age, and

$$M_n = (3 * H - 450 + t) \ 0{,}225 + 40{,}5 \, ,$$

where M_n is the woman's weight, H is her height, and t is her age. The shape of the area S of a trapped surface in space-time can be the shape of a human body, and therefore it can also be calculated using the formula for the area of a human body:

$$S = 0{,}2 * M^{0{,}425} + H^{0{,}725} \ \ (m^2)$$

or with another equation

$$S = (1000 * M)^{\frac{35{,}75 - logM}{53{,}2}} \frac{H^{0{,}3}}{3118{,}2} \quad (m^2).$$

The last two equations are actually roughly equal to each other, because both equations describe the surface area of a human body:

$$S = 0{,}2 * M^{0{,}425} + H^{0{,}725} \approx (1000 * M)^{\frac{35{,}75 - logM}{53{,}2}} \frac{H^{0{,}3}}{3118{,}2} \quad (m^2).$$

The surface area S of a human body is on average 1.8 m^2, or approximately 2 m^2.

Since, according to the physical theory of time travel, ordinary space K moves with respect to hyperspace K` at the speed of light c, i.e. the universe expands in time at the speed of light c:

$$Hy = c = \frac{l}{t} = \frac{3 * 10^8 (m)}{1(s)} = 3 * 10^8 \frac{m}{s}$$

then it can be concluded that in one second in normal space a distance of 300 thousand kilometers passes in hyperspace:

$$t = l$$

or

$$\frac{t`}{y} = l`y$$

or

$$1(s) = 3 * 10^8 (m)$$

However, time has transformed y times throughout the universe, and the square of the time period of the existence of a trapped surface in spacetime is:

$$\frac{t`}{y} = t = 2{,}522 * 10^{-17}\ sec$$

therefore, as a result of the transformation of time, space must also have transformed throughout the universe:

$$l = l`y = 3 * 10^8 * 1{,}25 * 10^{26} = 3{,}75 * 10^{34} (m)$$

Consequently, we get:

$$t * l = 9{,}4575 * 10^{17} (m) \approx 9{,}5 * 10^{17} (m) \approx 100(ly)$$

which means that, for example, when traveling into the past a hundred years ago, we travel a distance of approximately one hundred light years in hyperspace. Exactly the same principle applies to teleportation in space, where one does not travel in time to the past or the future, but only in the "present" time, as a result of which one only teleports in space. Years will simply be replaced by light years. For example, if a trapped surface in spacetime exists in time

$$\frac{t`}{y} = t = t^2 = 2{,}522 * 10^{-17}\ sec$$

then we can teleport approximately 100 light years in time in the present, or in space.

Here it is worth noting that, for example, if 1 second passes in hyperspace, then the next time period corresponding to it in normal space:

$$t` = ty = y \approx 1{,}25 * 10^{26}\ sec \approx 3{,}963 * 10^{18}\ a \approx 4\ billion\ billions\ years$$

However, if we compare the time interval and the length of space (no longer time intervals), we get the following value as a result:

$$1\ sec = 3 * 10^8\ m$$

which refers to the speed of light c. Normal space K moves with respect to hyperspace K' at the speed of light c, or 300,000 km/s. This means that if one second has passed in our space-time (i.e. normal space K), a distance of approximately 300,000 kilometers would have been traveled in hyperspace during this time. This also means that if we were to time travel one second into the past or the future, we would have to travel a distance of approximately 300,000 kilometers in hyperspace. This would be true if the speed of light was equal to the real rate of expansion of the universe, not the apparent rate of expansion of the universe.

Since the "real" time period of existence of a spherical trapped surface in spacetime is:

$$t = 5 * 10^{-9}\ sec$$

and its radius r is 1.5 m, we can, according to the equation for the electric field strength E_T:

$$E_T = k\frac{q}{r^2}$$

calculate the magnitude of the electric charge q:

$$\frac{E_T r^2}{k} = q = 7{,}5 * 10^{-4}\ C$$

The result obtained is the largest possible electric charge for a sphere with a radius of 1.5 meters, since the "electrical breakdown" of air as vacuum is at the field strength:

$$E_T = 3 * 10^6\frac{V}{m}$$

If the electric field strength has the value:

$$E_T = 3 * 10^6\frac{V}{m}$$

then the air loses the properties of the insulator under normal conditions and a spark discharge occurs. The dielectric permittivity of air (for 0.9 MHz under normal conditions) is:

ε = 1,00058986 ± 0,00000050

and the average pressure of the Earth's atmosphere at sea level (under normal conditions) is

P = 101 325 Pa = 101,325 kPa = 1 013,25 hPa or 1 bar or 760 mm Hg.

The magnitude of the electric charge q can also be ten times smaller, or:

$$q = 7{,}5 * 10^{-5}\ C$$

We can calculate the field energy E of an electrically charged sphere from the magnitude of the electric charge q:

$$E = \frac{CU^2}{2} = \frac{q^2}{2C} = \frac{5{,}625 * 10^{-7}C}{3{,}3 * 10^{-10}F} = 1704{,}545\ J$$

in which the electric capacitance is:

$$C = 4\pi\varepsilon_0 r$$

and the electric charge q is expressed as:

$$q = CU$$

However, we can calculate the energy E of an electromagnetic wave directly from the equation for the energy of a quantum:

$$E = mc^2 = \frac{h}{t} = 1{,}324 * 10^{-25}\, J$$

in which the time period of existence of an electromagnetic wave and the accompanying trapped surface in space-time is:

$$t = 5 * 10^{-9}\, sec$$

Since one electron volt equals:

$$1eV = 1{,}60 * 10^{-19}\, J$$

then the extremely small energy thus obtained manifests itself in electron volts as follows:

$$E = \frac{1{,}324 * 10^{-25}\,(J)}{1{,}60 * 10^{-19}\,(J)} = 8{,}275 * 10^{-7}\, eV$$

If such a value of energy E were the field energy E of an electrically charged sphere, then the electric charge q of the sphere would have the following magnitude:

$$\sqrt{E2C} = q = 6{,}609 * 10^{-18}\, C$$

which would be "slightly" greater than the elementary charge e:

$$e = 1{,}6 * 10^{-19}\, C$$

This means that the resulting charge would be approximately equal to 41 elementary charges:

$$\frac{6{,}609 * 10^{-18}\,(C)}{1{,}6 * 10^{-19}\,(C)} = 41{,}30$$

At this point, it is interesting to note that if, for example, in quantum mechanics the wavelength of a particle depends on the mass of the particle (and through it also on its energy), in the physics of time travel the distance of time travel does not depend on the mass of the time traveler's own body. It only depends on the energy of the field, just as we described it above.

1.17 Determining the direction of time travel

In the uncertainty relation equation, energy E is the energy of a field and time t is the time period of existence of an electromagnetic wave, through which the time period of existence of a trapped surface in spacetime can also be determined, which also determines the length of the tunnel in spacetime. This uncertainty relation is also simultaneously related to momentum p, which actually shows the relationship between energy E and time t. It follows that a trapped surface in spacetime, or Schwarzschild surface, must have momentum p, since it exists in normal space for a certain period of time, which is why it "moves" with respect to hyperspace at speed c along a path length x.

The uncertainty relations show that the field, the electromagnetic wave, and the trapped surface in spacetime are all related to momentum p, which is a vectorial (direction-indicating) quantity. The direction of a field pulse can appear, for example, as the direction of the E-vector. From this it can be concluded that if momentum of a trapped surface in spacetime and the field are related, this suggests that the vectorial qualities of the field can indicate the direction of movement in time. This can manifest as follows. For example, if electric charge q were "inside" the trapped surface S of closed spacetime, and therefore in hyperspace, no longer in ordinary space, then in this case the directions of the E-vectors or B-vectors originating from the electric charge would coincide with the directions of movement in time, since hyperspace as "timespace" is such an external spacetime dimension in which it is possible to move (i.e. teleport) only in time.

The trapped surfaces in spacetime, which arise from changes in energy fields or from their creation/ceasing, surround the sources of energy fields. For example, electric charges in case of electromagnetic interaction. This means that if an electric charge is briefly surrounded by a closed trapped surface in spacetime, it can be understood as the electric charge existing in a hole in spacetime, through which it also exists in hyperspace. Since the E-vectors can point towards or away from the electric charge, it can therefore determine the direction of movement in time, since hyperspace is not ordinary space. Hyperspace is a dimension of space in which movement would cause movement in time.

For example, according to the Nordström metric, an electric charge q of a spherical trapped surface in spacetime creates:

$$R_q = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

It can be seen from the equation that the greater the electric charge q of the body, the greater the radius R_q of the trapped surface in spacetime and thus the area:

$$R_q{}^2 \sim q^2$$

The size of the trapped surface in spacetime can exceed the size of a body with an electric charge:

$$S_R > S_q$$

In this case, the charged body remains "inside" the closed trapped surface in spacetime. It should be emphasized that a spherical surface is a closed surface. If a body with an electric charge is surrounded by a closed trapped surface in spacetime, then the body with an electric charge exists in a hole in spacetime, through which it also exists in hyperspace. Since E-vectors can point towards or away from an electric charge, it therefore matches the dimension of hyperspace. There is only one dimension of hyperspace (i.e. you can only move forward or backward), but hyperspace is represented in various models as three-dimensional, more precisely as spherical coordinates, because the physical system of hyperspace and normal space manifests itself in nature as the cosmological expansion of the universe. In this case, the coincidence of E-vectors and hyperspace directions can be clearly seen.

If in case of a positive charge the E-vector is directed away from the charge, then in hyperspace it would coincide with the direction into the future, because in the future the volume of the universe will be larger due to expansion. In this case, the movement in time would be directed to the future. If the E-vector points towards the charge for a negative charge, then in hyperspace it would match the direction into the past, because in the past the volume of the universe was smaller due to constant expansion. In this case, there would be movement in time to the past.

From the dependence of the direction of movement in time on the direction of E-vector, it follows that if instead of the E-vector there was a B-vector, then in hyperspace its direction would not coincide with either the past or the future, since the lines of force of the B-vector are closed curves. The B vector is neither directed away from nor toward the charge. In this case, it can be said that the force is directed "in the direction of the present", which would mean that the teleportation would take place in the space we experience on a daily basis, i.e. ordinary space, and not in time to the past or future. This would indicate that teleporting in normal space would be a special case of time travel.

The direction of the magnetic field line coincides with the direction of the B vector. The direction of the flow and the direction of the B-vector are always perpendicular to each other. The direction of the electric current dictates the direction of the magnetic field lines clockwise or counterclockwise. The direction of magnetic induction as the direction of a vector quantity is indicated by the north pole of a magnetic needle oriented in the magnetic field. But in this case, the direction of the B-vector (i.e. clockwise or counter-clockwise) is not important, as it would have no relevance to hyperspace. It is important that the B vector is not directed away from the charge or towards the charge, as is the case with the E vector, for example. This is relevant to hyperspace.

In turn, it follows from the above that the direction of teleportation in normal space (no longer in hyperspace) must depend on the direction of the teleporting body's impulse, and no longer on the direction of the lines of force originating from the body's charge. This means that the body teleports in normal space in the direction in which its normal movement in spacetime would also take place. This means teleporting in a direction that would be caused by some external force. It can also be an inner strength. It is known from classical mechanics that the movements of bodies take place under the influence of forces. Forces also determine the trajectories of movements of bodies in spacetime. The same seems to be the case with teleportation through spacetime.

In this case, we are only interested in the directions of the impulses, not so much their numerical values.

1.17.1 Mathematical analysis

The time period t of existence of a spherical trapped surface in space-time S:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

is also simultaneously related to the impulse p:

$$ct = \lambda = R = \sqrt{\frac{S}{4\pi}} = \frac{h}{\vec{p}} = \frac{h}{mc}$$

which also shows the relationship between energy E and time t:

$$t = \frac{h}{E} = \frac{h}{mc^2}$$

One could initially think that the obtained impulse (mc) could be the emerging electromagnetic wave and therefore also the impulse p of the trapped surface in space-time. For example, if a magnetic field with the speed of light c is created in empty space or vacuum, then the temporary "boundary" between empty space and the energy field can be conceptually interpreted as a two-dimensional "(trapped) surface" with time and space transformed to infinity, because it "moves" ("spreads “) in space at the speed of light c. However, the electromagnetic wave and thus the trapped surface in space-time does not actually move relative to hyperspace, i.e. in this case it does not expand as a whole (i.e. the area S does not increase). Consequently, impulse describes something else with respect to hyperspace.

In this case, we are not dealing here with the momentum of the body (a hole in space-time) or its direction due to motion in ordinary space.

Immobility relative to hyperspace is the direct result of the general mechanical system of hyperspace and normal space. For example, if a body with mass m moves with respect to ordinary space K at speed c, or v = c (this can be, for example, the movement of light in vacuum), then with respect to hyperspace K´, the body is stationary, i.e. v´ = 0. In the equation for speed derived above

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

in this case, v = c:

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

and we get the speed in relation to hyperspace K'

$$v' = 0\,.$$

In the real world, this means that if a body moves in vacuum at speed c relative to any observer, then relative to hyperspace K', this body is at rest (i.e. "absolutely at rest"). Since the body m in this case moves with respect to normal space K at speed c, or v = c, time is transformed to infinity in relation to normal space K, or $\triangle t = \infty$:

$$\triangle t = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}} = \frac{t}{0} = \infty$$

and therefore we get the speed of movement of the body with respect to hyperspace K´:

$$v = \frac{s}{\triangle t}$$

or

$$v' = \frac{ct}{\triangle t} = \frac{ct}{\infty} = 0\,.$$

If the body with mass m is stationary with respect to normal space K, i.e. v = 0, then with respect to hyperspace K´ it moves at speed v´ = c. For example, if in the speed conversion formula

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

the speed v is equal to zero, that is

$$v' = c\sqrt{1-\frac{0^2}{c^2}}$$

then we get the velocity c with respect to hyperspace K´:

$$v' = c\,.$$

In the real world, this means that absolutely all bodies in the universe that have static mass

m_0 and therefore potential energy $E_0 = m_0c^2$ move at the speed of light c relative to hyperspace K´, but at the same time they can be stationary in our normal space K. All bodies also move at speed c relative to light. Since the body m is stationary with respect to normal space K, i.e. v = 0, time has not changed with respect to normal space K, i.e. △t = t:

$$\triangle t = \frac{t}{\sqrt{1-\frac{0^2}{c^2}}} = \frac{t}{1} = t$$

and therefore we get the speed of movement of the body with respect to hyperspace K´ as follows:

$$v = \frac{s}{\triangle t}$$

or

$$v' = \frac{ct}{\triangle t} = c\ .$$

Any energy (including the energy of the electric field of a charge):

$$E = mc^2$$

must also have an impulse p:

$$\frac{E}{c} = mc = \vec{p}$$

which has a magnitude with a direction, i.e. it is a "vector". For example, the potential energy of the electric field of a charge can be expressed as:

$$E_p = k\frac{q^2}{r} = q\vec{E}_T r$$

and the energy of an electric field:

$$E = \frac{q^2}{2C}$$

in which case we can also use the equation for potential energy E_p as an example:

$$E_p = q\vec{E}_T r = mc^2$$

From the latter, the expression for impulse p can be seen:

$$\frac{q\vec{E}_T r}{c} = mc = \vec{p}$$

or

$$q\vec{E}_T t = \vec{p}$$

from which, in turn, the definition for the electric force F can be derived:

$$q\vec{E}_T = \frac{\vec{p}}{t} = \frac{mc}{t} = \frac{m\vec{v}}{t} = m\vec{a} = \vec{F}$$

The force F is also present on the trapped surface S of space-time, in which, for example, time t' has transformed to infinity:

$$t` = \frac{t}{\sqrt{1-\frac{\vec{v}^2}{c^2}}} = \frac{t}{\sqrt{1-\frac{c^2}{c^2}}} = \frac{t}{\sqrt{1-\frac{2GM}{c^2 r}}} = \frac{t}{\sqrt{1-\frac{R}{r}}} = \frac{t}{\sqrt{1-\frac{R}{R}}} = \infty$$

and it is created by an electric charge q:

$$R = \sqrt{\frac{q^2 G}{4\pi\varepsilon_0 c^4}}$$

or

$$R^2 = \frac{q^2 G}{4\pi\varepsilon_0 c^4}$$

From the latter, we get the expression for electric force F:

$$\frac{c^4}{G} = \frac{q^2}{4\pi\varepsilon_0 R^2} = \frac{q^2}{\varepsilon_0 S} = \vec{F}$$

from which the equation for the strength of an electric field can be seen:

$$\frac{q}{\varepsilon_0 S} = \frac{\vec{F}}{q} = \vec{E}_T$$

and the potential of an electric field:

$$\frac{q}{4\pi\varepsilon_0 R} = \varphi$$

This refers to the fact that regardless of the creator of the trapped surface in space-time (i.e. the creation of the trapped surface in space-time caused by velocity or charge), its impulse p must be somehow related to the electric charge q itself.

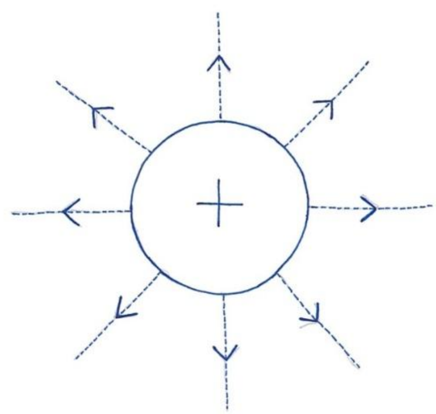
Since the time period of the existence of a spherical trapped surface in space-time is also related to the impulse, which is a vectorial quantity, therefore the impulse should also be related to the electric charge itself, since the impulse, the strength of the electric field, and the electric force are all physically related and mathematically derivable. In this case, we are only interested in the directions of these quantities, not so much their numerical values.

> I REPEAT: In this case, we are only interested in the "directions" of these quantities, not so much their "numerical values".

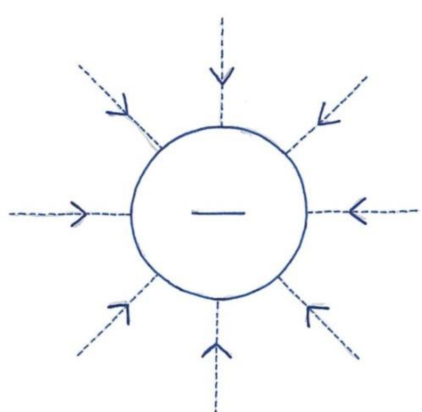
Impulse, electric field strength and electric force are all directional quantities, i.e. they are vectors. Since the strength of an electric field is vectorial, i.e. quantity having a direction, the strength of the electric field is also called the E-vector. The direction of the E-vector also determines the direction of the line of force, which is an imaginary line, at each point of which the E-vector is directed along the tangent of this line. The E vector of a positive charge is directed away from the charge, but the E vector of a negative charge is directed toward the charge. The direction of the E-vector matches the direction of the force acting on the charged sample, but in case of a magnetic field, i.e. in case of a moving charge, the B-vector is perpendicular to the direction of the force acting on the sample wire. The B-vector is the magnetic induction, which shows the force acting on a piece of wire with unit current and unit length in a magnetic field intersecting this wire.

The electric charge q is "inside" the trapped surface S of a spherical closed space-time, and therefore in hyperspace, no longer in ordinary space. In this case, the directions of the E-vectors and B-vectors originating from the electric charge coincide with the directions of movement in time (we move under the influence of force), since hyperspace as "time space" is such a space dimension in which it is possible to move (or teleport) in time:

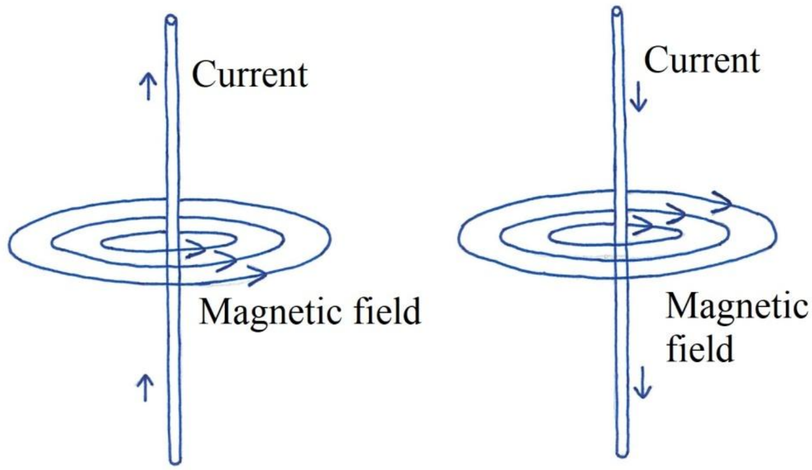
1. For example, if in case of a positive charge, the E-vector is directed away from the charge, then in hyperspace it coincides with the direction into the future, because in the future the volume of the universe will be larger due to expansion. In this case, time travel is directed to the future. Figure:



2. If the E-vector is directed towards the charge in the case of a negative charge, in hyperspace it matches with the direction into the past, because in the past the volume of the universe was smaller due to constant expansion. In this case, time travel to the past would take place. Figure:



3. If instead of the E-vector there was a B-vector, then in hyperspace its direction would not coincide with either the past or the future. In this case, the force is directed "towards the present" and therefore teleportation would take place in the space we experience on a daily basis, i.e. ordinary space. Figure:



The magnetic force acting on a current-carrying wire is always directed perpendicular to the direction of both the current and the magnetic field, but in this case we only care about the line of force of the magnetic field, which emanates from the charge and shows the direction of the magnetic field. It is an imaginary line, at each point of which the B vector is directed along the tangent of this line. The direction of the line of force coincides with the direction of the B vector at the given point. The direction of the flow and the direction of the B-vector are always perpendicular to each other. The B-vector represents magnetic induction, which shows the force acting on a piece of wire with unit current and unit length in a magnetic field intersecting this wire. The direction of magnetic induction as the direction of a vector quantity is indicated by the north pole of a magnetic needle oriented in the magnetic field. In this case, the direction of the B-vector (clockwise or counter-clockwise) is not important, but the fact that there is a B-vector instead of an E-vector is important.

> The direction of electric current dictates the direction of the magnetic field lines clockwise or counterclockwise. However, in the case of a ring machine, it is a circular current, and due to the insignificance of the direction of the lines of force of the magnetic field, the direction of the current is not important either.
>
> At this point, it must also be mentioned that the direction of teleportation in normal space (not in hyperspace) depends on the direction of the body's impulse, and no longer on the direction of the line of force originating from the body's charge. This means that the body teleports in normal space in the direction in which its normal movement would take place. This means that in this case teleportation is done "at the moment of movement".

The uncertainty relation known from quantum mechanics between the impulse p and the coordinate x was expressed as follows:

$$\Delta p \Delta x \geqslant \frac{h}{2\pi}$$

or

$$\Delta p \Delta x = h$$

The question arises, what is the physical content of the last obtained equation in case of a trapped surface in space-time. For example, the wavy nature of the trapped surface in space-time is a bit difficult to imagine, and space-time and its curvature have no energy and therefore no impulse. For example, the gravitational field, or the curvature of space-time, has no energy - i.e. it is not an energy field in nature, like an electric field is, for example. Since the last equation obtained

$$\Delta p \Delta x = h$$

is directly derived from the equation

$$\Delta E \Delta t = h$$

therefore, the physical meaning and content of the equation $\Delta p \Delta x = h$ in the case of a trapped surface in space-time consists in the following comparative analysis. Since in the equation derived above

$$Et = mc^2 t = h$$

energy E represents the energy of the electric field, which determined the time period t of the existence of the emerging trapped surface in space-time in the space-time of the universe, so the impulse p in the equation

$$Et = mc^2 t = mcct = px = h$$

or

$$\Delta p \Delta x \geqslant \frac{h}{2\pi}$$

shows that an electric field with energy (and consequently also the trapped surface in space-time) has impulse p, because it exists for a certain period of time t in the space-time of the universe, i.e. it "moves" relative to hyperspace at the speed c. As a result, the electric field (and therefore also the trapped surface in space-time) has an impulse p:

$$\frac{E}{c} = \frac{mc^2}{c} = mc = mv = p$$

and due to the existence of the universe in space-time, also the distance x in hyperspace:

$$ct = x$$

Potential energy $E = mc^2$ also resulted from the existence of the body or field in the space-time of the universe, i.e. from the movement with respect to hyperspace at speed c. If the time period t is $t = 2{,}522 * 10^{-17}\ sec$ and the speed of light c is $c = 3 * 10^8\ m/s$, then we get the distance x as follows:

$$x = (3 * 10^8) * (2{,}522 * 10^{-17}) = 7{,}56 * 10^{-9}\ m$$

The energy of an electric field E determines the magnitude of the impulse p, i.e. its numerical value in the equation:

$$\frac{E}{c} = p$$

If the energy of an electric field E is $E = 4{,}181 * 10^{-18}\, J$ and the speed of light c is $c = 3 * 10^{8}\, \frac{m}{s}$, we get the impulse as follows:

$$p = \frac{E}{c} = \frac{mc^2}{c} = mc = \frac{4{,}181 * 10^{-18}}{3 * 10^{8}} = 1{,}3936 * 10^{-26}\ \frac{J}{\left(\frac{m}{s}\right)}$$

and hence we can calculate the mass m in it as follows:

$$m = \frac{p}{c} = \frac{mc}{c} = \frac{1{,}3936 * 10^{-26}}{3 * 10^{8}} = 4{,}6453 * 10^{-35}\ kg$$

For comparison, the mass of a photon of green light can be mentioned here, for example, which is $4{,}4 * 10^{-36}$ kg (the frequency of green light is, for example, $f = 6 * 10^{14}$ Hz). However, in this case, we are not interested in the numerical value of the impulse, but its vectorial value, i.e. its direction with respect to the charged body existing inside the closed trapped surface in space-time (that is, in hyperspace). This means that if the energy of an electric field E determined the existence of the trapped surface in space-time for the time period t in the space-time of the universe:

$$t = \frac{h}{E}$$

then in case of impulse p, its size is also determined by the energy E of an electric field:

$$\frac{E}{c} = p$$

and consequently, the direction of this (i.e. the impulse) must be determined by the E-vector of the electric field, which is the quantity describing the vectorial nature of the strength of the electric field. The strength of the electric field indicates how strong electric force acts on a body with a unit positive charge in this field. Since the time t indicated the time period of the existence of the trapped surface in spacetime in hyperspace, therefore, x indicates

$$x = ct$$

the length of the path traveled by the trapped surface in space-time in hyperspace ("visually expressing" the length of the tunnel in space-time). This means that the direction of movement of a physical body in time in hyperspace depends on the direction in which the impulse p of the trapped surface in space-time is directed in relation to the electric field (and therefore also the body generating the electric field) existing inside the trapped surface in the same space-time (that is, in hyperspace). The direction of the impulse p of the trapped surface in space-time is in turn determined by the direction of the E-vector of the electric field existing inside it relative to the trapped surface in space-time. The physical justification is that, for example, the vectors of the impulse of a moving body and the force acting on it must be unidirectional in space, because the movement of a body takes place under the influence of force. For example, a stone always falls towards the center of the Earth under the influence of gravity, and therefore the vectors of the stone's motion and the Earth's gravity are unidirectional. Even in the case of movement of a light wave, the direction of this impulse coincides with the direction of propagation of the light wave.

1.18 The law of constancy between dimensions

From the point of view of classical mechanics, the possibility of time travel would be accompanied by a violation of the law of conservation of energy. For example, if you travel in time to the past, as a result, the time traveler "disappears" from one point in time and appears afterwards in another point in time. At that point in time, when the time traveler "disappears", for example, according to classical mechanics, the law of conservation of energy would be violated, since the time traveler as a mass of energy has ceased to exist. The law of conservation of energy states that energy is neither created nor lost, but changes from one form to another. In this case, time travel does indeed violate the law of conservation of energy. But even so, there is still one way that time travel would not violate the law of constancy. This can be called the "law of conservation between dimensions", which would probably be the only way to avoid violating the law of conservation of energy.

According to this, the time traveler has disappeared at one point in time, but has appeared at another point in time. Such a fact suggests that the disappearance and reappearance of energy neutralize each other in the same way that positive and negative electric charges ultimately result in zero. But this would only apply to hyperspace, not normal space. For example, with respect to normal space, energy may disappear and appear, but with respect to hyperspace, it can be seen that the time traveler moves from one "location" to another, rather than his disappearance or appearance. Hyperspace is a spatial dimension outside of spacetime in which "motion" causes time travel. This means that there would be a violation of the law of conservation for normal space, but there would be no violation for hyperspace. Such a fact also suggests that the laws of conservation known from classical mechanics (especially the law of conservation of energy) may actually be a part of the law of conservation between dimensions or its sub-branch. This means that the law of conservation of energy can be derived from the law of conservation between dimensions.

At first glance, the law of constancy between dimensions seems unrealistic, but it is worth drawing parallels with, for example, the law of inertia about the possibility of this belief. The law of inertia, known from classical mechanics, tells us that bodies move uniformly and in a straight line as long as nothing prevents this movement. For example, if a moving train suddenly stopped, this would cause the ball inside the train to move along the floor of the train. Seen from the background system of the train, the ball would suddenly start moving as if by magic, which should clearly be impossible. But relative to the background system associated with the earth, it would be quite logical for the ball to start moving. The sudden braking of the train causes the ball to move relative to the train as the ball moves forward from inertia. This is the essence of the law of inertia, with which parallels can also be drawn with the law of constancy between dimensions. For example, time travel seems to contradict the law of conservation of energy, but only with respect to ordinary space. The contradiction disappears if we look at it in relation to hyperspace. This means that the contradiction with the law of conservation of energy disappears when viewed in relation to a larger system.

The law of constancy between dimensions is a relatively new theory. Before that, it was believed that you could only travel through time for a certain period of time. For example, if a person traveled back in time, he could only be there for a certain period of time, for example 5 minutes. After that, he would automatically return to the time he left. It was thought that the violation of the law of conservation of energy could be solved in this way. This means that the law of permanence is violated, but only for a certain period of time. For example, in the world of elementary particles, violations of the law of constancy also occur, but for a very small period of time. The time period is so small that it cannot be detected experimentally. However, time travel only for a certain period of time to avoid violating the law of constancy is no longer widely accepted as a hypothesis. Today, this "place" is occupied by the law of constancy between dimensions.

1.19 Time paradoxes

One might get the wrong impression that the physics theory and technology of time travel is not presented in such a way as to avoid the famous paradoxes associated with time travel. This means that whether the time travel technology described in this work would avoid the time paradox or not has yet to be analyzed.

Would this physics theory ensure with its equations that a person who gets into the past with a time machine would be paralyzed at the moment when he tries to murder his father in the past before he meets his mother? After that, the question of what will happen to him in the present also needs to be resolved. For example, if someone travels to the past with a time machine, will they disappear from the present by then, remaining unaccounted for? If he were to become paralyzed in the past, as a result of which he would not be able to stop himself from procreating, would he be able to return to the present, or would he still return to the present, but in a comatose state?

Solving time paradoxes is only possible through real time travel. But you can also travel in time in such a way that the time paradox does not arise at all. This means that any time travel does not automatically create catastrophic time paradoxes. It all depends on what has been done in the past. For example, it makes a big difference whether you kill Adolf Hitler, the famous leader of Nazi Germany, or "kick" a mosquito that is currently roaming around in nature. Killing Adolf Hitler (for example, at the age of a teenager) would of course lead to a big turn in recent history, but killing one small random mosquito in nature would not do much (if anything) in the history of mankind. These time paradoxes are a bit overblown topics in the field of time travel science. They are actually not as important as most people think.

The solution to the mystery of the time paradox would probably be to first invent time travel technology and then start doing experiments. Of course, experiments are not performed on humans, but only on animals (for example, on insects). For example, a person travels to the past with his time machine and decides to kill, for example, the great-great-grandmother of a particular fly. Then we look at the present in time in the case of a migration that happened to his third or fourth generation descendant. This is the safest and most objective way we can learn about possible solutions to time paradoxes.

Philosophers try to prove the impossibility of time travel through time paradoxes. But in fact nature itself shows the opposite. The fundamental physics of the universe does not deny the possibility of time travel, but on the contrary: physical science shows the possibility of time travel (for example, phenomena in quantum mechanics). Solving the famous time paradoxes would be the next step after the creation of time machine technology. It's that simple.

The most well-known time paradox is related to the "grandmother/grandfather paradox", which briefly consists of the following. A man invents a time machine and travels back in time. What happens to the time traveler himself if he, for example, kills his own grandmother? Since the cause always precedes the effect, in such a case the time traveler could no longer exist and the time machine could not be invented either. This is the mystery of the world's most famous time paradox, which is also considered a classic time paradox.

> However, there is another type of time paradox that is much less well known than the latter famous grandmother paradox. It consists briefly in the following. One day, a random boy receives a phone call from someone unknown telling him how to create a time machine. After this phone call, the boy invents the time machine. It turns out that the information on the phone was actually given by the same person, i.e. himself, but from the future. In case of such a time paradox, we know how the boy found out about the creation of the time machine. But still, the question arises, how did the one who called the boy know about the creation of the time machine? It turns out that in both cases, the boy finds out about the time machine through a phone call. How is such a thing possible? Where is the end and the beginning in this story? This is the mystery of such a time paradox. Unfortunately, it must be mentioned that such a described type of time paradox does not exist in reality. This is just a philosophical figment of the human mind, widely described in time travel literature, but in reality such a time paradox can never materialize.

In the following, we will familiarize ourselves with the possible solutions of the classical time paradox, which have been proposed by various scientists over time and which seem to be real and consistent with the existing physics theories of time and space:

1. Let's say that a person travels back in time and kills, for example, his own grandmother. So what happens to the time traveler's own life? When a person travels back in time, the world around them becomes exactly as it was in the past. However, when traveling in time to the past, a person does not become younger, from which it is possible to conclude that time travel does not affect the time traveler himself. In this case, the time traveler is not affected by the killing of the grandmother in the past.

2. Cause and effect relationships only apply if time and space exist. This is a fact of physical science. But at the "moment" of time travel, the time traveler himself exists "outside of spacetime". In hyperspace, or outside of spacetime, time and space no longer exist. Existing outside of spacetime, influences in spacetime no longer affect the time traveler.

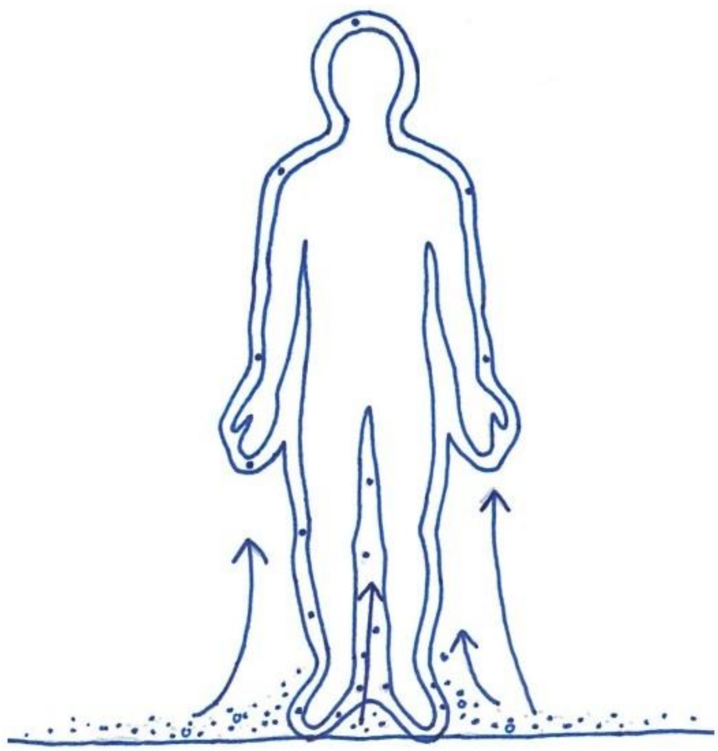
    > For example, if a car were to hit a concrete wall at high speed, the person inside the car would die instantly. But if there was no person inside the car at the time, in which case he would observe the car ramming into the concrete wall from a

distance, then in this case the person himself will not die. In this case, the person exists outside the moving car. Analogously, it can be the same with a time traveler. For example, if a person kills his grandmother in the past, nothing actually happens to the time traveler himself, because the time traveler existed in the meantime (at the "moment" of time travel) outside of spacetime. As a result, simply the world around him changes. For example, in such a case, upon returning to the future, no one would recognize the time traveler and the state's information systems would not have any personal data about him (not even a birth certificate).

3. If a person travels back in time and kills his own grandmother, there is also a version where nothing happens: the time traveler and his own grandmother both survive. The explanation for this lies in the cinematic effect of the universe, in which the entire physical existence of the universe resembles a movie. For example, on a cinema screen we see static images that quickly follow each other in time. A film can tell any story to the viewer. If a person kills his own grandmother in the past, it is possible that nothing really happens after that. This can be directly derived from the regularity of the cinematic effect of the universe. For example, if we cut out one frame from the film, i.e. we cut off one image from the film strip, the other frames or images on the film strip will still remain. Exactly the same can actually be the case with the solution to the grandmother's paradox, in which case the grandmother and the time traveler themselves do not actually die if they kill their own grandmother in the past.

4. If you kill your own grandmother in the past, and for some unknown reason, the time traveler should also die (for example, vanish in an instant), then the question arises, does the law of conservation of energy not apply in such a case? The time traveler himself is, in a physical sense, a large amount of energy and mass, which simply "evaporates into the air" when he kills his own grandmother. After all, energy cannot be lost or created according to the well-known law of conservation of energy. In this case, this energy must simply change into something else.

It should also be noted here that if we can go back in time, changing the past does not necessarily change the future. For example, if you travel to the past, it becomes the future for the time traveler. This means that the time traveler's former present becomes the past, which cannot be changed by the new future.



Real cases of human time travel

2 Real cases of human time travel: paranormal phenomena

2.1 Introduction

The question inevitably arises that if, for example, the electric field of a charge around the human body is sufficient for time travel, why are there no known cases in the world in which case human time travel has manifested itself. Since people somewhere in the world receive an electrostatic charge every day, why haven't we heard that someone has indeed traveled in time. The formation of an electrostatic charge on the surface of the human body is actually a fairly common and even everyday phenomenon all over the world. Such a question is logical and directly follows from previous knowledge, in which a person would travel in time if the electric field of his charge changed in the entire space around him.

However, in fact there are many known cases in the world in which case people have traveled through time. This means that throughout history there have been documented and researched cases of human time travel. These cases are not very well known in the world and they are not very common either. Nevertheless, their frequency is much higher than cases of spontaneous combustion of the human body. According to statistics, there are actually far more cases than we actually know about. One reason is considered to be that people who have traveled through time do not dare to talk about it publicly for fear of getting a reputation of being crazy. However, the most extraordinary thing is that these cases can be explained by the theories mentioned before, in which a person would travel in time if the electric field of his charge changed throughout the space around him. These cases of time travel can be explained very precisely with the conclusions derived from this theory of time travel, which has been written down and presented in the entire preceding 300+ pages of material (3). Therefore, it is extremely important to study and analyze these cases very thoroughly. These cases provide fairly objective evidence of the validity of the theory of time travel, or at least theoretical proof/plausibility. These cases have been studied for centuries and are well documented throughout history. One of the best-known investigative experts was Jenny Randles, who documented hundreds of cases of human time travel.

2.2 Real cases of human time travel

Millions of people around the world get an electrostatic charge, but not every one of them instantly travels through time. It is actually exactly the same with exiting the human body. For example, not all people who are clinically dead experience near-death experiences, or exit their bodies. A person's time travel and exit from the body can only take place in one specific spatial configuration of changes in the fields of electric charges, which sometimes manifests and sometimes does not manifest. This still makes these phenomena quite rare.

> When time travel occurs, a changing field is created around the human body everywhere at once. This means that the energy field must change everywhere around the human body at the same time, not so that the field changes at one end of the body earlier and a little later at the other end of the body. This is a very, very important condition. In this sense, the time travel of a person takes place only in one specific spatial configuration of changes in electric fields of charges, which sometimes manifests and sometimes does not manifest itself.

The following are quotes from these real cases, which are presented and described in a very good book "*Encyclopedia of the unexplained*", p. 99-110.

> Source: "*Encyclopedia of the unexplained*", Peter Hough and Jenny Randles, publisher: Sinisukk, Tallinn 1998, ISBN: 9985730380. (5)

Only the most well-known and researched cases are presented in this work:

> There are many known cases when people have seen places as they might have been in former times. Ruth Manning Saunders describes one such case in her 1951 book "*The River Dart*". Three girls were on a hunting trip with their father in Hayford, near Buckfastleigh. In the middle of the evening, the girls limped away on their own and got lost in the falling darkness. To their joy, they saw a light ahead and reached a house by the side of the road. A reddish glimmer of fire seemed to be coming from the uncovered windows, which kindly warmed the night. The three girls looked in the window and saw an old man and an old woman sitting hunched by the fire. Suddenly, lo and behold, the fire, the old man, and nothing, and the whole house were gone, and in their place night descended like a blackening sack.
>
> > *"There are many known cases where people have seen places as they might have been in the past."* This means that cases of time displacement are actually quite common on a global scale, but only a very small proportion of them reach the public. The known cases are only a very small part of the total cases in the world. This is probably because people are mostly afraid to talk about their experiences to others, fearing for their social reputation and sanity. Time travel is generally considered impossible, and there is no way to empirically prove what you have experienced to others. Therefore, a large part

of the cases remain unreported in any form in the world.

> *"Three girls looked in the window and saw an old man and an old woman sitting hunched by the fire. Suddenly, lo and behold, the fire, the old man and the old woman and the whole house were gone, and in their place night descended like a blackening sack."* It follows from this that time travel to the past or the future is essentially time teleportation, and it is in good agreement with the physical theory of time travel. Teleportation in time is manifested in the fact that one travels in time to the past in a moment (i.e. in 0 seconds), and therefore the world surrounding the time traveler changes in a single moment to what the world was like at the moment in time to which one "moves" in time.

Evidently, American biologist and paranormal investigator Ivan T. Sanderson has also seen buildings from another era. He was driving with his wife and an assistant somewhere in Haiti when their car got stuck in a ditch. They abandoned the vehicle and continued on foot until fatigue overtook them. In his book, “*More Things*”, Sanderson wrote: "*Suddenly looking up from the dusty ground, I saw in the bright moonlight on either side of the road three-story houses of various sizes and shapes, casting just such shadows as they were supposed to cast.*" The scene continued, the ground became muddier, and it was paved with cobblestones. The woman stretched her hand forward and described in shock what the man saw. Sanderson was convinced that he could see the houses of Paris in front of him. After staring at them for a while, both of them felt very dizzy. Sanderson shouted to an assistant who had reached a little way ahead of them. The man came back and the biologist asked him for a cigarette. As soon as the flame of the assistant's lighter went out, so did the vision of fifteenth-century France. What's more, the assistant didn't see it and didn't notice anything else out of the ordinary.

> *"Evidently, American biologist and paranormal investigator Ivan T. Sanderson has also seen buildings from another era. He was traveling with his wife and an assistant somewhere in the middle of Haiti when their car got stuck in a ditch."* It is noteworthy that time has been traveled by car, by bicycle, by foot, traveled alone or even in a group, outdoors or inside buildings, in different weather conditions. etc. It is indeed remarkable that in different situations and in different environments there has been a displacement in time. In this case, three people have traveled in time at the same time, and all three people have had the same experience. There are also many such cases where a person has traveled through time while being alone. In terms of weather conditions, cases of displacement in time have mostly occurred when there is a thunderstorm coming and there is therefore much more electrical energy in the atmosphere than usual.

> *“As soon as the flame of the assistant's lighter went out, so did the vision of fifteenth-century France. What's more, the assistant did not see it and did not notice anything else unusual."* Again, another fact that points to the nature of teleportation in time. Time is "traveled" in an instant, or teleported, not as we are used to seeing in science fiction movies. The world around the time traveler changes in an instant, not by transitioning (i.e. evolving) from one year to another. All cases of time travel involve teleportation through time, and this common characteristic adds to the plausibility that these cases have actually occurred. The trait of time teleportation is completely consistent with the

physics theory of time travel.

"When they had looked at them for a while, both were overcome with severe vertigo." People have indeed very often felt psychological aspects of time shift phenomena - dizziness, depression, changes in the perception of reality, etc. Unfortunately, science cannot yet say what exactly they come from. All that is known for sure is that similar psychological manifestations occur in humans when they are directly exposed to electromagnetic fields. Such circumstances emerge from the researches of experimental physics, for example the researches of Tarmo Koppel. This means that the psychological manifestations of time shift phenomena and the effects of electromagnetic fields on the human body and brain are extremely similar, which suggests a common origin. Feelings of depression and other characteristic things related to perception have also appeared in the case of other time shift phenomena based on the descriptions. People who have experienced a time shift often mention the feeling as if two time zones exist at the same time, one of which partially overlaps with the other.

Joan Forman, author of *"The Mask of Time",* also experienced a time shift while sourcing material for the work. He visited Haddon Hall in Derbyshire during a week-long holiday. Standing outside, she saw four children playing on some stairs. The oldest, a girl of about nine, had her back to Joan. Miss Forman described the child as wearing a white Dutch hat, a long greenish-gray dress with a lace collar, and blond hair falling to her shoulders. She heard the children's laughter, although she realized that physically she could not see the children with her own eyes. Suddenly the girl turned her face towards her. Joan Forman had imagined the child to be very beautiful, but in fact he turned out to be quite plain. Shocked, Miss Forman took a step forward, and all the children suddenly disappeared. She entered Haddon Hall and began looking for the portrait of the girl she had met. Finally she noticed it. The child depicted in the painting was younger, but she unmistakably recognized its thick jawline and stubby nose. Joan Forman had apparently met Lady Grace Manners - many years after her death - as a child playing.

"Amazed, Miss Forman took a step forward and all the children suddenly disappeared." This is another manifestation of teleportation in time, and there is no doubt about it. According to the physics theory of time travel, time can be traveled in the dimension of hyperspace, i.e. outside of spacetime. This is made possible by a tunnel in spacetime, or wormhole, which can arise from electromagnetic interaction. The principle is that if a person has teleported in time, then according to the physics theory of time travel, the person has passed through a wormhole, or a tunnel in spacetime. It is not possible to visually observe the tunnel in spacetime, because the time of its existence is extremely small. The tunnel in spacetime (i.e. hyperspace dimension) is traversed in an instant and we understand this physically as teleportation.

"Someone remembered Joan Forman, who had lost sight of these four playing children while moving away. Did he "have" to stop at the exact point that, under certain conditions, the spectacle of the past could begin to unfold before his eyes again?' At a certain point, he saw Lady Grace Manners playing as a child - years after her death." A tunnel in spacetime allows you to travel (i.e. teleport) through time. A tunnel in

spacetime is created as a result of electromagnetic interaction, more precisely, changes in the fields of electric charges. This means that if human body is surrounded by a changing field, a trapped surface in spacetime near an electrically charged surface can form. In this case, this trapped surface is shaped like a human body, and the trapped surface in spacetime can be interpreted as the entrance and exit of a tunnel in spacetime. By going through the tunnel in spacetime (which allows you to move in hyperspace, i.e. outside spacetime), you are teleported in time. The occurrence of a variable field near the surface of the human body depends on the ratio of human and environmental influences. It seems to require some sort of trigger for the time shift to appear. A sudden flash of light or an unusual amount of electrical energy in the atmosphere seems to fit the role, because they can interact with the human brain under the right conditions.

> In case of any change in the energy field, a "trapped surface in spacetime" also appears for a short time, on which time and space have been transformed or curved to infinity according to the theory of special relativity. For example, if a magnetic field occurs in empty space at the speed of light c, then the temporary "boundary" between the empty space and the energy field can be conceptually interpreted as a two-dimensional "surface" with time and space transformed to infinity, as it "moves" ("propagates") in space at the speed of light c. On the Schwarzschild surface at the center of a black hole, or the "horizon" of a black hole, time and space are also transformed, or warped, to infinity. The Schwarzschild radius r of a black hole determines the size of the Schwarzschild surface S.

Pensioner Miss Charlotte Warburton, who lived with her husband near Tunbridge, Kent, was taken back in time on Tuesday, June 18, 1968. The married couple had gone to the city to do some shopping, and then each of them went about their business, having agreed to meet later in the same cafe as always. With the usual shopping done, Miss Warburton went to a few more shops, looking for tinned biscuits. That's how he ended up in an unknown small self-service store. There was no cake there, but a senior citizen looking around the shop noticed a passage in the left wall, and curiosity forced him to take a closer look. The passage led to a large rectangular room with mahogany panels, the design of which was sharply different from the modern chrome and plastic decorations of the store. Miss Warburton described it: "*I did not notice any windows, but the room was lighted by a number of small electric bulbs with ice-glass domes. I saw two couples wearing mid-century clothing, and one woman's outfit stood out to me. She was wearing a beige felt hat, which had a tuft of dark fur attached to the left brim, which was set half askew on her head. The woman's coat was also beige, and a couple of decades ago it might have been considered very fashionable.*" Everyone was drinking coffee and chatting with each other, which didn't seem like anything out of the ordinary considering it was mid-morning. However, the pensioner found it strange that he had never heard of this cafe before, and later remembered that he had not smelled the aroma of coffee at all. Having met her husband, Miss Warburton told him of her discovery, and they decided to visit this new cafe the following Tuesday. A week later, shopping was done as usual; after that they went to that small shop and walked towards where the cafe door had been. However, now there was a cold food counter by the wall in the same place. Mr. Warburton was adamant that his wife was not mistaken, and went with her to two more similar shops, but there too he could not find what he was looking for. Miss Warburton saw what she had experienced so clearly that she began to feel as if her perception had drifted back to a time when the mahogany-paneled coffee-house still existed. Charlotte Warburton decided to find out what happened herself. He got in touch with a woman there who was interested in psychic phenomena and asked if she remembered any such coffee shop. She was told that a few years ago there had been a cinema next to the shop, with the Tunbridge Wells Constitutional Club to the left. She remembered that when she went to the club during World War II, she saw small snack tables and mahogany paneled walls. Still not satisfied, Miss Warburton searched for the said club in its new location and also found the club's chief financial officer, who had held the position since 1919. He stated that the old club rooms were accessed from the street side door next to the store, and then you had to go up the stairs. There had also been a dining room upstairs, the furnishings of which exactly matched Miss Warburton's description.

> Mrs. Warburton also noticed several men wearing blazers and the adjacent glass booth where the cashier was sitting. Everyone was drinking coffee and talking to each other, which seemed nothing out of the ordinary, considering it was mid-morning. Miss Warburton saw what she had experienced so clearly that she began to feel as if her perception had drifted back to the time when the mahogany-paneled coffee-house still existed. Time shifts are not imaginary phenomena. It often turns out that the information received through them fully corresponds to reality.

The most famous case of time displacement occurred with two English tourists who visited the Palace of Versailles, the residence of the French royal family in the seventeenth and eighteenth centuries. The parties involved - as in the case of Dieppe half a century later - were two women: Miss Anne Moberley and Miss Eleanor Jourdain. These middle-aged ladies could be considered educated people. Miss Moberley was an headmistress of Oxford St. Hugh College and Miss Jourdain was headmistress of Watford School for Girls. Both were interested in history and not inclined to fantasize. On a warm afternoon on August 10, 1901, these single ladies left the Galeries des Glaces and decided to walk to the Petit Trianon. They were not quite sure of the way, and turned into a quiet street, where Miss Moberley saw a woman flapping some cloth out of a window. She later learned that her friend hadn't seen it, and the building didn't even exist. They crossed the path where they noticed two men wearing long grey-green robes and a triangular hat. They seemed to be working there because a wheelbarrow and shovel were within reach. The men guided them in the right direction and the ladies continued their walk. Then Miss Jourdain noticed a woman and a teenage girl standing in the doorway, both wearing vintage dresses. From that moment on, the landscape seemed to transform nightmarishly; it became flat, almost two-dimensional, and both women sensed a wave of depression towering over them. At that moment they approached a round garden house where a man was sitting. There seemed to be something ominous and repulsive about him, and they could not pass him. Suddenly footsteps were heard from behind, but the women looked around and saw no one. Miss Moberley now noticed another person standing near them, a man in a coat and hat, who smiled warmly at them. He led them to the house. On the way, Miss Moberley noticed a woman drawing on the lawn. She wore a dress with a deep cut and a white hat with a wide brim. The woman turned around and looked after the passing strangers. Miss Moberley only later learned that her friend had never seen a person who bore a striking resemblance to Marie-Antoinette, Queen of France in the eighteenth century. As they went on, the women noticed a young man "*who looked like a lackey*" coming out of the house. He closed the door behind him and led them towards the entrance of the Petit Trianon. The atmosphere of depression and unreality that possessed the women began to dissipate in the building.

> Had they gone back in time and seen buildings and people from before the French Revolution, or was there a much more prosaic explanation? Their book “*An Adventure*“ was published ten years later. Since then, the described case has been investigated very thoroughly. Critics found inconsistencies in the descriptions of the women. Later it became clear that an aristocrat named Comte Robert de Montesquiou-Fezenzac, who was fond of the eighteenth century, used to dress up in the costumes of that era and walk around the gardens of Versailles with some friends. Someone knew to add that in her childhood she knew a woman who dressed herself as Marie-Antoinette in summer and used to sit in the garden of the Petit Trianon. Had the two English women just met actors wearing period clothing? Considering this explanation to be correct, however, other peculiar aspects of the phenomenon must be dismissed. If they were indeed actors, how could it happen that in many cases only one witness saw them? The ladies described buildings and paths that no longer existed in the twentieth century. Indeed, if they had followed the indicated path, they would have had to walk through several brick walls. Feelings of depression and other characteristic things related to perception have also appeared in other time shift phenomena based on the descriptions.
>
> From that moment the landscape seemed to transform nightmarishly; it became flat, almost two-dimensional, and both women perceived a wave of depression gushing from them. The atmosphere of depression and unreality that possessed the women began to dissipate in the building. The feeling of depression and other characteristic aspects related to perception have also appeared in other time shift phenomena, based on the descriptions.

Near the Petit Trianon, Marie Antoinette's small Versailles palace, our contemporaries sometimes find themselves at a party from 200 years ago, where people in 18th-century court clothes walk in groups and chat, and the wind carries minuet tunes in the distance. A young woman paints something on a canvas mounted on an easel. Two ladies are looking at her, the younger of whom is a light-headed woman in a silver dress and a beauty wearing a straw hat, holding a small dog in her arms. These people pay no attention to guests from the future. Two English women, Miss Moberly and Miss Jordan, were the first to attend this party on August 10, 1901. For a while, the ladies did not tell anyone about the matter, and only in 1911 did they decide to make the incident public. Toda's visit to the past had been accompanied by a peculiar feeling of unreality and heavy fatigue, but the girls, who were completely normal mentally, confirmed that it was not a mirage or a vision. They had indeed been to the park of Versailles, asked twice for directions to the Petit Trianon, and received a polite answer from cavaliers who appeared to be actors in a historical theater performance. At irregular intervals, sometimes quite often, once after many years, this scene has revealed itself to individual eyewitnesses. Their narratives have always been the same. Everything takes place within a few minutes, then the music fades, the voices die down, and the alley takes on a modern look again. The Versaille party has been seen by people of different nationalities, social positions and ages, who are united by only one thing: they went to Versaille for the first time and had never heard anything about this "*show of the past*" before. (Paradox 10 - 1999, TV 1999) (6)

Another vivid time shift phenomenon - and again English tourists arriving in France were involved - took place in October 1979. Len and Cynthia Gisby and their friends Geoff and Pauline Simpson planned to travel to Spain from their home in Kent. After crossing the English Channel, they drove to Montélimar. When it got dark, they stopped in front of a hotel called "Ibis", but in the reception room, a man in a plum-colored uniform informed them that there were no rooms available, but if they continued along a side road, they would reach a small inn, where they would surely find shelter. They noticed the end of the road and drove to find the hotel, although the road was very dilapidated. The women noticed the advertising posters of the circus with a surprisingly old-fashioned design on the side of the road. Finally they reached an inn, where they had to stop on the side of the road because there was no parking lot. Next to it stood another building that resembled a police station. Although the owner of the inn could not speak English, and they spoke French with difficulty, they managed to make themselves understood and got free rooms. It was ten o'clock in the evening. The two-story ranch-style building was very old-fashioned inside. The windows in the bedroom had no glass, only shutters, the bed sheets were made of thick calico, and instead of pillows, headrests lay on the bed. The bathroom furnishings would be more suited to Queen Victoria's time. The soap was stuck on the rod. After emptying their suitcases, they went downstairs, ate a hearty dinner - the dish was heated on metal plates - and washed it down with beer. Several scantily clad men sat at the bar. After a good night's sleep, the four of us went downstairs for breakfast. Just as they were eating, a lady walked in with a dog under her arm. The lady was wearing button boots and a long prom dress. Then two gendarmes entered, wearing a high-brimmed uniform cap, a dark blue cape, and ankle boots. By this time, the Gisbys and the Simpsons were already convinced that they were staying in a working museum built for the entertainment of tourists. They agreed to photograph it. Each man photographed a woman leaning out of a bedroom window. It was necessary to continue the journey. First Len and then Geoff tried to find out from the gendarmes which way to get to the main road, but despite their best efforts, they didn't seem to understand a word of what they were saying. When Spain finally happened to be mentioned, they were led down the old Avignon road. While paying the bill, they were again surprised. The total came to less than £2. Len's misunderstanding only caused smirks from the host and the gendarmes. Finally they left. Instead of turning on the road to Avignon, they studied the map and easily reached the main road. They traveled to Spain, where they stayed for two weeks. It was only natural that on the way back we wanted to stay again in that old-fashioned, quaint and cheap inn near Montélimar. They found the end of the road and even saw circus advertisements, but there was no inn. Looking around the neighborhood turned out to be completely useless. Stunned, they drove to the "Ibis" and wanted to talk to the man wearing the plum-haired uniform. They were told that there is no such person working at Ibis. No one from the hotel staff could answer inquiries about where the inn we were looking for could be located. In England, they had films of their holiday trip released. Friends were surprised that there were no photos taken in the inn among the photos they received. Surprise turned to disbelief when, upon examination of the numbered negatives, it turned out that the frames sought did not exist at all. One camera had left a mechanical mark, as if a failed attempt had been made to advance the film, but that was all. There was no trace of the mentioned footage on the film in either camera. In 1983, both married couples returned to France in order to thoroughly clarify what had happened with the help of the French Tourist Board. Philippe Despeysses, a representative of tourism organizations, had found a place that somewhat resembled the location of the mysterious inn. The Gisbys and the Simpsons were taken there. Although they had to admit that everything was very much like what they had seen before, a conversation with the owners convinced them that it was not the same place they had stayed in 1979. Jenny Randles tried to find out from both couples what they had experienced. He found other questions besides the missing film footage. “*If there really was a time shift to the past, why didn't anyone at the inn wonder your car or your clothes?*” he asked. “*Why did the master accept payment in coins that could not have had any value in the olden days?*” The Simpsons answered with sincerity and conviction, “*You'll have to find the answer yourself. We only know what happened to us.*”

In the latter case, it is quite extraordinary that a documentary was eventually made based on this case and therefore it is found in old documentary series (for example "*Strange But True?*") that were wound in the nineties of the 20th century (7):

https://www.youtube.com/watch?v=8aB2uuiuK0g

The described cases can be interpreted in many ways based on the time shift theory. Did the people who experienced it slip back in time and see events that had yet to happen, or did they perceive a visual recording that randomly turned on before their eyes? Parapsychologists created the rock recording theory to explain a certain type of clairvoyance – instances in which people see figures, buildings, and landscapes from the past and hear the sounds of those times. For example, Joan Forman, who had lost sight of these four playing children while moving away. Did she have to stop at a certain point so that, under certain conditions, the performance of the past could begin to play out again before his eyes? The theory of stone records is based on the assumption that certain events, especially those that generate a certain amount of emotional energy, are recorded in some way in the environment, for example, in the stone walls of buildings, in the soil or in the atmosphere. This can be true in cases where ghosts are seen years later in the same place. Only under certain conditions, such as the concentration of electromagnetic energy in the atmosphere, or the arrival of a person with special psychic powers, something seems to press a button, and what was recorded becomes perceptible again. This seems to negate the idea that a person with hypersensitive perception could travel back in time, but I guess this theory can only be applied to cases where the wanderings seem to go unnoticed by observers. And what is experienced when the observer and the observed come into contact with each other? In this case, we are not dealing with a record of past events, but perhaps with the past itself.

Our psychic selves operate only in three-dimensional space, but consciousness moves back and forth in time. People who have experienced jet lag often report feeling as if two time zones exist at the same time, one partially overlapping the other. The absence of natural sounds accompanying the time shift, such as birdsong or traffic noise, has also been observed by people who have experienced other phenomena - for example, a close encounter with a UFO. A

> time shift appears to require some sort of trigger. A sudden flash of light or an unusual amount of electrical energy in the atmosphere seems to fit the role, as they can interact with the human brain under the right conditions. Time shifts are not imaginary phenomena. It often turns out that the information received through them fully corresponds to reality. A branch of physics known as quantum mechanics can help us understand the nature of time correctly. In his book "*Man and Time*", J. B. Priestly divided time into three components: the first is the present time, the second is the time of the possible future, and the third is the time of the imagination.

Based on the time shift theory, the described cases can only be interpreted as the people who experienced it slipping back through time and seeing events that had yet to happen. For example, Joan Forman had lost sight of these four playing children while moving away. Did she have to stop at a certain point so that, under certain conditions, the performance of the past could begin to play out again before his eyes? Only under certain conditions, such as the concentration of electromagnetic energy in the atmosphere or the arrival of a person with special psychic powers, something seems to click, and the past becomes perceptible again. This clearly points to the fact that a person could still travel back in time. Since the observer and the observed also make contact with each other, in this case we are not dealing with hallucinations, but rather with the past itself.

Only a tunnel in spacetime would allow moving (i.e. teleporting) in time. A tunnel in spacetime is created as a result of electromagnetic interaction, more precisely changes in the fields of electric charges. In turn, it follows from such a theory that if, for example, the body of an electrically charged person were to be surrounded by a changing field, then a trapped surface in spacetime could be created near the electrically charged surface. In this case, this trapped surface is shaped like a human body, and the trapped surface in spacetime can be interpreted as the entrance and exit of a tunnel in spacetime. By going through the tunnel in spacetime (which allows you to move in hyperspace, i.e. outside spacetime), you are teleported in time. The occurrence of a variable field near the surface of an electrically charged human body depends on the ratio of human and environmental influences.

> In the event of a change in the energy field, a "*trapped surface in spacetime*" also appears for a short time, on which time and space have been transformed, i.e., curved to infinity according to the theory of special relativity. For example, if a magnetic field is created in empty space at the speed of light c, then the temporary "boundary" between the empty space and the energy field can be conceptually interpreted as a two-dimensional "surface" with time and space transformed to infinity, as it "moves" ("propagates") in space at the speed of light c. On the Schwarzschild surface at the center of a black hole, or the "horizon" of a black hole, time and space are also transformed, or warped, to infinity. The Schwarzschild radius R of a black hole determines the size of the Schwarzschild surface S.

Static electricity can be transferred to any body. Electric charge can be positive, negative or neutral. With a positive charge, there are more protons than electrons. With a negative charge, there are more electrons than protons. The charge is neutral when there are equal numbers of protons and electrons. Positive and negative charges usually occur when two objects are separated or placed against each other because protons and electrons are not transferred equally. When an object has a charge, it is called static electricity. Static refers to a state of rest. We can say that the charge is simply on the object, waiting for an opportunity to move. When two electrically conductive objects with different levels or polarities of charge come close to each other or come into contact, the charge quickly transfers from one object to the other. The rapid movement of charge turns everything from static electricity to ESD.

The abbreviation "ESD" stands for the transfer of static electricity from one object to another. With each lightning strike, a large amount of static electricity is released towards the ground below the lightning cloud. A person hears crackling and sees sparks when taking clothes out of the dryer. A person gets shocked when he crosses the carpet and then touches the door handle. These examples of ESD that we see and feel last for a fraction of a second and range from 2000 V, the smallest level that humans can feel, to even over 25,000 V. However, even below 2000 V, there is still enough static electricity that the charge would be transferred and, for example, damage electronics, even if we don't even feel it. But ESD is generated continuously. Many common objects around us also contain static electricity. Static electrical charges less than 20V can damage or destroy the sensitive electronic components we come into contact with every day. Static charge transfer, whether visible or not, is the transfer of an electrostatic charge, called “ESD” for short.

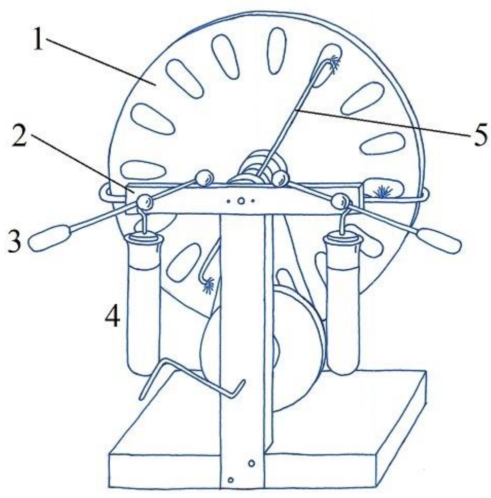
It is important to understand how certain materials behave with electrostatic charges. They are usually divided into three categories. The first material is, for example, a conductor, which is usually some type of metal, such as a wire. A conductor means that this material is electrically conductive, which means that it allows electrons to move freely through it. This allows grounding to be used to remove charges. Grounding means the possibility that additional charges move to the ground and a neutral charge moves along the material. Another material is an insulator that prevents electricity from moving. Like conductors, these materials can become charged, but grounding techniques do not work well to neutralize the charges. The third material is partially electrically conductive, which can be considered an intermediate material between conductors and insulators. These are conductors that do not conduct electricity well. The human body, most electronic components and static charge dissipating materials are partly electrically conductive. They allow grounding techniques to be used, but in this case electrical charges move slowly.

Humans are one of the biggest sources of ESDs, because static electricity builds up in our bodies quite easily. Our skin can contain quite a large amount of such charges. We are only familiar with charges above 2000 V, but some ESD-sensitive electronic components can be damaged even if the charge is less than 20 V. When the static charge comes into contact with a partially conductive surface, the charge is safely directed away from the ESD-sensitive device. The charge is neutralized to the ground through grounding. ESD problems become much more serious when humidity levels drop to 30 percent or even below. Some protective equipment also becomes ineffective when the humidity level is very low.

The physical body receives an electrical charge in two different ways. This means that electric charges move through space for two different reasons. For example, an electrostatic charge is created on the body by friction, i.e. electric charges move in space under the influence of frictional force. Another possibility is that electric charges move only under the influence of an electric field. An example of this is the electric current in a wire or the charging of a capacitor (accumulator), in which the electric charges move under the influence of the pulling and pushing forces of an electric field, and no longer due to the force of friction. This means that the movement of electric charges in space (and consequently also the electric charges of bodies) is caused by the manifestations of frictional forces or under the influence of electric forces (i.e. the pulling and pushing forces of an electric field). There are no other options.

In case of electrostatic charge, the charges move under the influence of frictional force, but in the case of “electrodynamic charge”, the charges move under the influence of attractive and repulsive forces, or electric fields. This means that the physical body receives an electric charge through friction or under the influence of an electric field, i.e. through pulling and repelling forces. For example, an accumulator used in electrical engineering, or simply a battery, can be charged by an electric current, in which the charges move under the influence of pulling and pushing forces. Electrostatic charge is created on the body by friction.

It must also be noted that the mechanical frictional force is actually electrical in nature. This means that the frictional force is also an electrical force in its deep nature. Nevertheless, in this case, for the sake of simplicity, we still broadly classify the causes of the movement of electric charges into two, as we did before. For example, in an Wimshurst machine, electric charges move due to the frictional force caused by the rotating motion of the discs of the Wimshurst machine. But at the same time, the electric current in the wire is already caused by the effect of the pulling and pushing forces of the electric field, i.e. electrical forces. Figure of an Wimshurst machine:



1 Transparent acrylic discs with tin-foil segments

2 Insulating bar

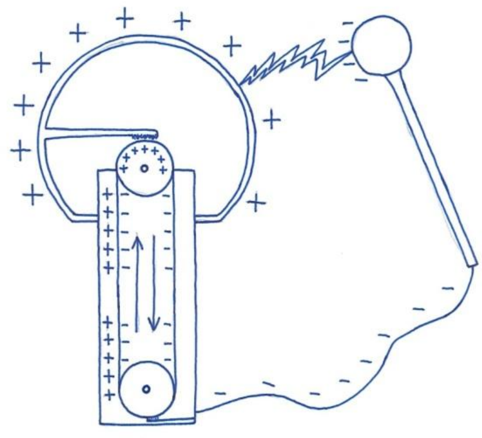
3 Electrode rods

4 Leyden jars

5 Diagonal rod with metal brushes

Electrostatics is the study of electric charges that are stationary relative to each other. Electrokinematics studies the various patterns of motion of electric charges in time and space. But electrodynamics tries to find out what causes charges to move in space.

A person can receive an electrostatic charge naturally or may have to use different technologies (such as a Van de Graaff generator or Wimshurst machine). In this case, we are investigating the generation of electrostatic charge on human body obtained in an organic (natural) way and its effect on human health. Figure of a Van de Graaff generator:



The electric charges generated on human body depend on several factors. For example, there are materials that promote the creation of an electrostatic charge, but also its loss (i.e. which conduct or dissipate the charge). Electrical devices can directly convert electrical energy into electrostatic charge. However, this can be transferred to human body. In most cases, people are connected to the earth (i.e. grounded).

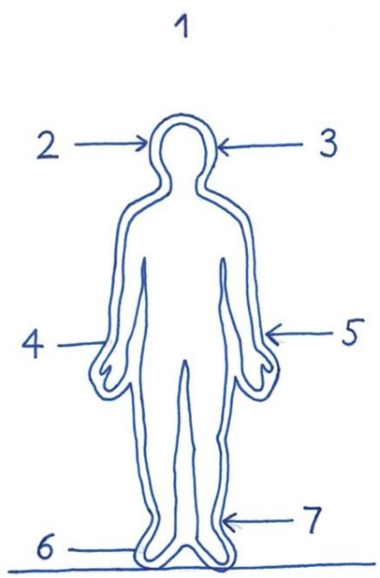


Figure: Charges can be created on human body.

1. Factors influencing the creation of an electric charge in human body
2. ELECTRONICS: collecting charge
   no charge
3. WALL MATERIAL: collecting charge
   dissipating charge
4. CLOTHING: synthetic
   free of charge
5. FURNITURE: collecting charge
   dissipating charge

6. FOOTWEAR: isolating sole
   conducting sole
7. FLOOR COVERING: collecting charge
   dissipating charge

The floor covering may have an electrostatic charge that can be transferred to a person. However, an electrostatic field can also occur on the floor covering when a person walks on it (this means friction). Even in this case, this electrostatic charge is transferred to the human body. This is evidenced by electric sparks that appear, for example, when people come into contact with each other or when they touch metal surfaces. For example, synthetic floor coverings can have an electrostatic field (and therefore a charge), but not all synthetic carpets. For example, if a person walks on a lacquered floor, an electrostatic field can also be generated. And even more so when legs are dragged.

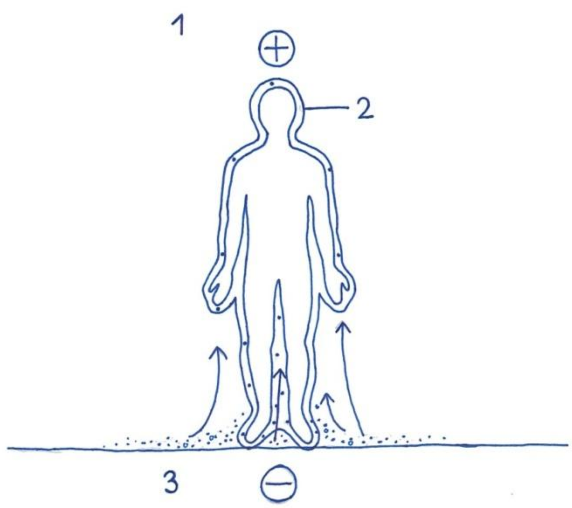


Figure: Electrifying human body.

1. a human collects a charge from the material of the floor covering
2. electrostatic field
3. floor covering with a strong electrostatic charge

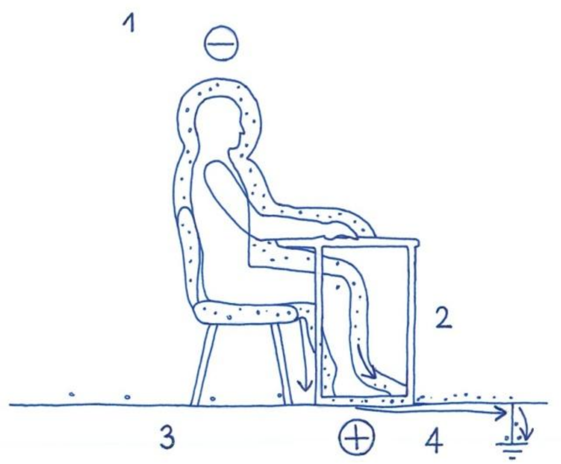


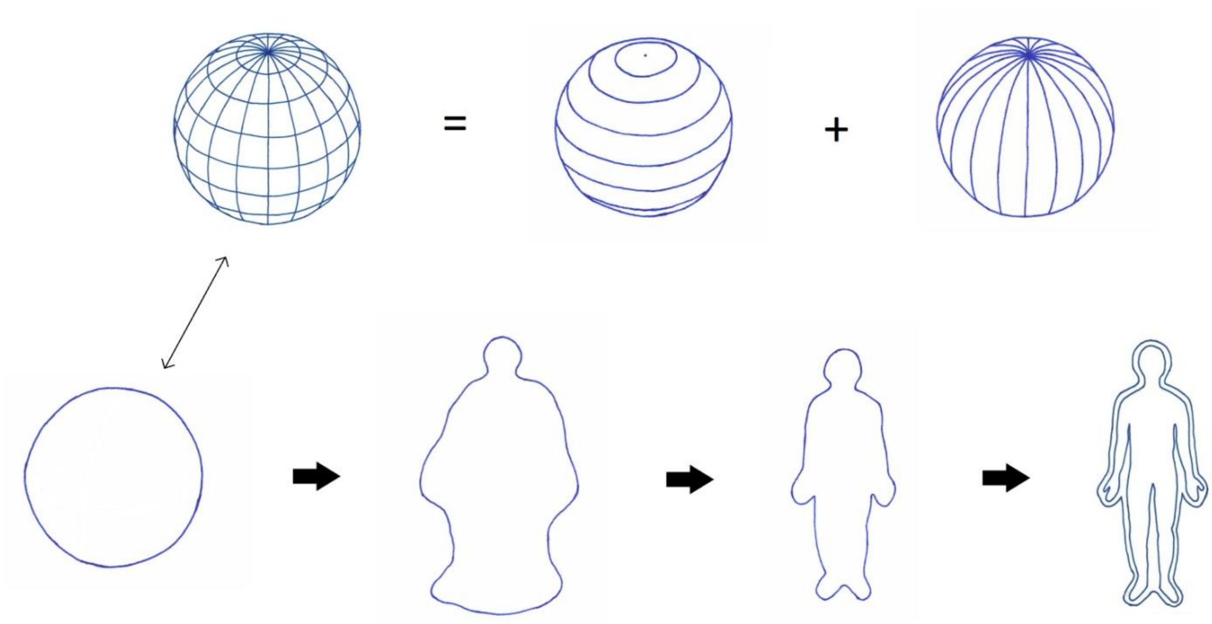
Figure: Collecting of grounding a charge takes place.

1. a person carrying an electrostatic charge
2. an electrostatic charge is unloaded from the body
3. a floor covering dissipating or grounding electrostatic charge
4. connection to earth

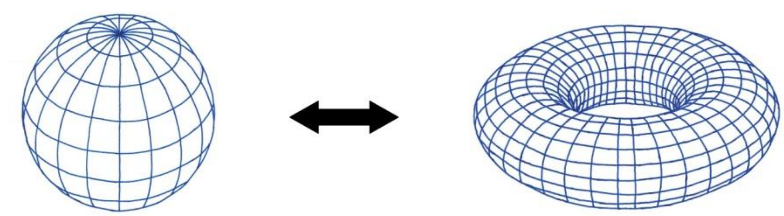
There are also floor coverings called antistatic floor coverings. In this case, it conducts electrostatic charge accumulated on a human body into the ground or disperses it into the floor covering. But only the dissipative floor covering collects the charge. But with a sufficiently large accumulated charge, the floor covering will begin to send the accumulated charge back to people. All electrostatic products do not discharge humans. (8)

Real cases of time travel can be explained by the previously mentioned theories, in which a person would travel in time if the electric field of their charge changed throughout the space around them. These cases of time travel can be explained very precisely with the conclusions derived from the physics theory of time travel, which has been written down and presented in the entire preceding 100+ pages of material. From the physics theory of time travel, we can calculate how far in time it is possible to travel and how strong electric charge is needed for this, if the trapped surface in spacetime trapping surface had the shape and size of human body. These calculations provide fairly objective evidence of the validity of the given time travel theory, at least its theoretical evidence/plausibility.

The calculations concerning a trapped surface in spacetime with the shape and size of a person would be approximately valid even if we considered the same quantities for a purely spherical trapped surface in spacetime. Therefore, 4π remains in the equations. Figure:



The geometric shape of the trapped surface in spacetime can also be in the shape of a loop or donut:



For example, if the time period t of the existence of a trapped surface in spacetime S in the equation derived above:

$$t = \frac{1}{c}\sqrt{\frac{S}{4\pi}}$$

the value of the area S would be equal to the area of a human body:

$$S = 1{,}9\, m^2$$

then we would get the period of existence of a trapped surface in spacetime S as follows:

$$t = 1{,}29 * 10^{-9}\, sec$$

which coincides very well with the period of an electromagnetic wave if the wavelength were 0.38893 m. Since the physical data of the people described in various cases are not known, for the sake of simplicity we use the surface area S (1,9 m^2) of a male person's body in these calculations, in which case the person is 20 years old, 180 cm tall and weighs 70 kg. Let's analyze the magnitude of the results of the calculations. However, for the square of the resulting time period:

$$t^2 = 1{,}6641 * 10^{-18}\, sec^2$$

or

$$\frac{t`}{y} = t = t^2 = 1{,}6641 * 10^{-18}\, sec$$

we can teleport into the past for t` = 208,012,500 seconds or 6.596 years (leap years are not taken into account). We got 6.5 years as a result, which is a much smaller number of years compared to the above-described time travel cases, in which, for example, 26, 50, 150 and even up to 300-500 years have been traveled into the past. Here are some of the most important examples:

> “…As soon as the flame of the assistant's lighter went out, so did the vision of fifteenth-century France. …”

> “…Joan Forman had apparently met Lady Grace Manners - many years after her death - as a child playing. …”

> “…Pensioner Miss Charlotte Warburton, who lived with her husband near Tunbridge, Kent, was taken back in time on Tuesday, June 18, 1968. …I saw two couples wearing mid-century clothing, and one woman's outfit stood out in my mind. She was wearing a beige felt hat, which had a tuft of dark fur attached to the left brim, which was set half askew on her head. The woman's coat was also beige, and twenty years ago it could have been considered very fashionable. …She was told that a few years ago there had been a cinema next to the shop, and to the left was the Tunbridge Wells Constitutional Club. She remembered that when she went to the club during World War II, she saw small snack tables and mahogany paneled walls. Still not satisfied, Miss Warburton searched for the said club in its new location and also found the club's chief financial officer, who had held the position since 1919. He stated that the old club rooms were accessed from the street side door next to the store, and then you had to go up the stairs. There had also been a dining room upstairs, the furnishings of which exactly matched Miss Warburton's description. …”

> “…The most famous case of time displacement occurred with two English tourists who visited the Palace of Versailles, the residence of the French royal family in the seventeenth and eighteenth centuries. ...1901. on the warm afternoon of August 10, these single ladies left the Galeries des Glaces and decided to walk to the Petit Trianon. …Miss Moberley learned only later that her friend had never seen a person who bore a striking resemblance to Marie-Antoinette, Queen of France in the eighteenth century. …”

> "...near Petit Trianon, Marie Antoinette's small Versailles palace, our contemporaries sometimes find themselves at a party from 200 years ago, where people in 18th century court clothes walk in groups and chat, and the wind carries minuet tunes in the distance. A young woman paints something on a canvas mounted on an easel. ...The first to come to this party were two English women, Miss Moberly and Miss Jordan on August 10, 1901. For a while, the ladies did not tell anyone about the matter, and only in 1911 did they

decide to make the incident public. …At irregular intervals, sometimes quite often, once after many years, this scene has revealed itself to individual eyewitnesses. Their narratives have always been the same. Everything takes place within a few minutes, then the music fades, the voices die down, and the alley takes on a modern look again. The Versailles party has seen people of different nationalities, social positions and ages, united by only one thing: they went to Versailles for the first time and had never heard anything about this "show of the past" before. …"

"...Another vivid time shift phenomenon - and again English tourists arriving in France were involved - took place in October 1979. Len and Cynthia Gisby and their friends Geoff and Pauline Simpson planned to travel to Spain from their home in Kent. …Bathroom furnishings would be more suited to Queen Victoria's time. …"

Seemingly, it's just that we calculated a value of 1.9 m^2 with surface area, which is basically the "minimum" surface area value for a normal adult human body. Since a person also wears different clothes and as a result, the surface of human body becomes much more "folded", so the surface area S of a person can actually reach up to 30 m^2. If, as a result, the area of the trapped surface in spacetime is, for example, 28.26 m^2, then a person can travel back in time for about 100 years, which is obviously within the limits of the magnitude of the time travel cases described above.

For example, if the value of the area S of the trapped surface in spacetime was 28.26 m^2, then the period of its existence would be $5 * 10^{-9}$ seconds. However, if its area were 1.9 m^2, then the period of its existence would be $1{,}29 * 10^{-9}$ seconds. These two obtained values of the period of existence are not very different from each other in terms of magnitude.

Since the human small intestine is 7 m long and 2.5 cm wide, it could therefore be assumed that its surface area S would be about 0.6 m^2. However, in fact, it is not so. Since the surface of the small intestine is also quite "folded", as a result, its surface area S reaches to as much as 250 m^2.

Since the "real" period of existence of a trapped surface in spacetime is:

$$t = 1{,}29 * 10^{-9}\ sec$$

and its radius r would be 0.38893 m in case of a spherical trapped surface in spacetime, we can, based on the strength of an electric field E_T according to the equation:

$$E_T = k\frac{q}{r^2}$$

calculate the approximate electric charge q for a human body as well:

$$\frac{E_T r^2}{k} = q = 5{,}042 * 10^{-5}\ C$$

The obtained result is the largest possible electric charge for a sphere with a radius of 0.38893 meters, since the "electrical breakdown" of air as vacuum is at the field strength:

$$E_T = 3 * 10^6 \frac{V}{m}$$

Such electric charges, in which electric breakdowns would occur in the air, would already be felt by a person (for example, a person's hair would stand on end). However, people usually do not perceive charges that are about 10-100 times smaller than this, and in cases of time travel, people themselves have not felt electric charges on their bodies. Therefore, the magnitude of the electric charge q can actually be ten times smaller, or:

$$q = 5{,}042 * 10^{-6}\ C$$

For the same area, however, the charge densities can vary quite a lot.

Since, according to the cases described above, time travel has mostly taken place to the past, and therefore, people must have received a negative electric charge. The E-vector of the field is directed towards the charge in case of a negative charge, and therefore in hyperspace it matches the direction into the past, because in the past the volume of the Universe was smaller due to constant expansion. Therefore, time travel mostly took place to the past.

It is also worth noting here that time travel has mostly occurred to the past, but far less often to the future, and teleportation in space has hardly occurred at all.

The real cases of people traveling in time described above can be explained by the physics theory of time travel, in which case a person would travel in time to the past or the future if his electric charge field changed for a while in the entire space around him at once. The cases of time travel described above can be explained very precisely with the conclusions derived from the present physics theory of time travel, which have been written down and presented in the form of the entire previous more than 300 pages of material. From the physics theory of time travel, it is possible to calculate how far one can travel in time and how much electric charge would be needed for this, if the trapped surface in spacetime were the shape and size of the human body. It turns out that these calculations are consistent in an order of magnitude for the explanation needed for real-world cases of time travel, which provides fairly objective evidence of the validity of the current physics theory of time travel, or at least its theoretical proof or plausibility.

Nevertheless, it must be noted that in the real cases of time travel of people described above, there are also aspects that the physics theory of time travel cannot solve, unfortunately. This means that the real teleportation of a person in time to the past or future can be successfully explained and described by the physics theory of time travel, but unfortunately not yet the other aspects involved. For example, if a person teleports back in time and comes into contact with people from the past, why aren't those same people surprised by the different clothing, new technical equipment, or even the existence of a car from the people from the future? Also, teleporting happens only for a certain period of time, where after a certain amount of time in the past you are automatically teleported back to your own time. If something is brought from the past into the present world, such as money or other larger/smaller items, after a while they just start to break or fall apart. Being in another time, dizziness, depression, emotional stress or other manifestations related to perception are also perceived. Unfortunately, the physics theory of time travel cannot yet explain these aspects, so further research in this area is needed. This means that in the following parts, the specificity and data volume of the physics theory of time travel will expand further, in which case the previously mentioned aspects will also be explained.

WEBSITE:

www.technologyandscience.eu

Author's declaration

The author have declared him have no conflict of interest with regard to this content and ethics committee/IRB approval is not relevant to this content.

Methods

This work sets out a science of physics that would enable a person to move in real time into the past and into the future. Developing this specific science and technology will create new opportunities to explore human history and also to move in space. The overall method of study of all work is purely theoretical physics. For example, the hypothesis that is largely erected in this work is derived in theory. But at the same time, all these hypotheses are entirely in line with the generally accepted physics theories that exist.

In this work, the presented mathematical derivations and equations are not numbered. This is because there is no direct need and this work is constantly updated over time (in the form of new versions).

Data availability statement: data sharing not applicable to this content as no datasets were generated or analysed during the current study.

About the company

"*MLK Technology and Science Ltd*" is a startup company primarily engaged in scientific research on wormholes and technology development. The official data of the company can be seen on the websites:

1) https://ariregister.rik.ee/eng/company/17008425/

2) https://orcid.org/0000-0002-3223-6099

3) Company homepage: https://www.technologyandscience.eu

4) See more here: https://zenodo.org/communities/time_travel/

Area of activity: scientific research and development, research and experimental development on natural sciences and engineering, other research and experimental development on natural sciences and engineering. The company is registered in the Republic of Estonia (EE), which is a member state of the European Union (EU).

References

1. Kruusen, Marek-Lars. 2024. “*Quantum gravity and the creation of wormholes NEW VERSION*” OSF Preprints. July 4. doi: https://doi.org/10.31219/osf.io/yjefd.

   Kruusen, Marek-Lars. 2024. “*First generation technology for creating a tunnel in space-time*” OSF Preprints. February 29. doi: https://doi.org/10.31219/osf.io/cypu3.

   Kruusen, Marek-Lars. 2024. “*An introduction to the physics of time travel and the mini-standard model of particle physics*” OSF Preprints. February 29. doi: https://doi.org/10.31219/osf.io/8kmju.

2. 3D Wormhole in Blender II (YouTube video): https://www.youtube.com/watch?v=zmK41NtJiE8

3. Marek-Lars Kruusen (2024). „*The physics theory of time travel*“, National Library of Estonia: https://www.digar.ee/arhiiv/en/nlib-digar:1012983.

   Marek-Lars Kruusen (2023). *The physics theory of time travel*. Zenodo (European Organization for Nuclear Research, CERN). Source: https://doi.org/10.5281/zenodo.8392591.

   Marek-Lars Kruusen (2024). *Development of the physics theory and technology of time travel*. Zenodo (European Organization for Nuclear Research, CERN). Source: https://doi.org/10.5281/zenodo.10813949.

4. Lewis, G.F., Brewer, B.J., „*Detection of the cosmological time dilation of high-redshift quasars*“, Nat Astron (2023), source: https://doi.org/10.1038/s41550-023-02029-2.

5. "*Encyclopedia of the unexplained*", Peter Hough and Jenny Randles, publisher: Sinisukk, Tallinn 1998, ISBN: 9985730380. Original: Jenny Randles; Peter A. Hough (1993), *Encyclopedia of the Unexplained*, Blitz Editions.

6. Magazine „*Paradoks*“, no. 10, 1999, Estonia, editor: Jaanus Aua, publishing house: Sünnimaa.

7. ITV Central, „*Strange But True?*“ episode and continuity, 15th September 1995. Source: https://www.youtube.com/watch?v=8aB2uuiuK0g. On the network drive, these files are as follows: “*Strange but true.mp4*“.

8. Tarmo Koppel, *Electrostatic charge on the body causes stress*, source: http://tarmo.koppel.ee/?p=531. Chevalier, G., Mori, K., Oschman, J.L. (2006), “*The effect of earthing (grounding) on human physiology.*” European Biology and Bioelectromagnetics, Jan 31, 2006, 600-621. Ober, A. (2003), “*Does grounding the*

human body to earth reduce chronic inflammation and related chronic pain?”, European Bioelectromagnetics Association annual meeting.

9. “*Füüsika XII klassile, Kosmoloogia*” (in English: „*Physics for Class XII, Cosmology*“), Jaak Jaaniste, Publishing house: “Koolibri”, 1999, page: 107.

10. „*Breaking the Time Barrier – The Race to Build the First Time Machine*“, p. 125-126, Jenny Randles, Paraview Pocket Books, ISBN: 0-7434-9259-5, copyright 2005 by Jenny Randles.

Marek-Lars Kruusen's

technology and science