

REAL TIME

Time is an elusive and yet ubiquitous phenomenon of our world, a movement which cannot be overlooked. It is hardly possible to find an even more fundamental phenomenon, so which affects our whole life.

As an independent physical phenomenon, having certain physical properties, time began to be considered from the beginning of the twentieth century. It is a question of the theory of relativity. In this creation of Einstein, time turned out to be cramped with other physical phenomena in nature, and could no longer be considered only as a passive background for the general picture of the world. The theory of relativity predicted a number of striking effects, later confirmed experimentally, related to the course of time. Time was turned out to be in the center of serious physical and mathematical analysis. At the same time, in this theory, the passage of time remains, as it were, "incorporeal," not having physical properties of motion, similar to the properties of motion of bodies in space.

In 1908, the teacher of Einstein, Hermann Minkowski, put forward the idea space-time continuum (unity), according to which time and space are a single entity, and all events take place in such a 4-dimensional space-time. Each material particle with which various events are happening, in the course of time describes in this space-time, a certain trajectory, which Minkowski called the world line of the particles. The approach he proposed allowing building an effective mathematical. The apparatus of the special theory of relativity, perfectly reflecting its effects. The unusual four-dimensional world in which we live Perhaps the most striking result of the special theory of relativity (STR) was the conclusion that all material bodies exist in the 4-dimensional world. At the same time in immediate sensations we are given only three spatial dimensions continuum. A three-dimensional world familiar to us, perceived by our body's feelings, was incomplete, but the geometry of the 4-dimensional world is very different from the geometry of the 3-D dimensional, and according to our ideas is very unusual.

Imagine the three dimensional cube. To each verge of cube possible to construct a perpendicular. All the perpendiculars constructed in this way, if they do not rely on the opposite the faces of the cube are perpendicular to each other. It is obvious. Now we move this cube to the 4-dimensional world. It turns out that now it is possible to all sides of the cube constructing perpendiculars, which in this case will be parallel to each other.

At the same time, it is possible to draw a continuous line entering our a cube from outside that will pass through some point inside the cube and come out and with this will never cross the surface of the cube; does not touch any of its faces! Another, almost a very important example. Take a rotating wheel, such as cycling or automobile, all the same. We introduce a system coordinates relative to which the center of the wheel will be fixed, it will rotate "in place". All points of the wheel, except the point of its center, will move in process of rotation; will change their coordinates. A point of the center of rotation in Rotational motion will not participate - its coordinates do not change when rotation. Through this point, you can draw an axis of rotation perpendicular to the wheel. The axis of rotation are characterized by the fact that all its points also do not change their coordinates in the process of turning the wheel. Let us now pose the question - how many axes rotation can have such a rotating wheel. Our common sense will tell us that any wheel has only one axis of rotation and he will be mistaken. In the four-dimensional world, in which, according to the special theory of relativity, we exist, any the rotating wheel always has not one, but two, and mutually perpendicular axis of rotation!

This fact is clearly manifested in the repeatedly verified famous Lorentz transformations, underlying the special theory of Relativity - the coordinates and dimensions of a moving body along two coordinate axes, orthogonal to its spatial displacement, with these transformations always remain unchanged. The natural question arises - if we live in a 4-dimensional world, then why do we do not notice this? The answer is that one of the measurements always goes to an area we do not perceive is a time domain.

For our consciousness, it is not represented in its entire extent, but its only moment - the moment of the present. In addition, the phenomena of the special theory of relativity become noticeable only at velocities close to the speed of light and observe them in ordinary life are almost impossible. So, the transition to a 4-dimensional space-time continuum, which implemented in the special theory of relativity, inevitably leads us to the detection of completely unusual for us properties of the world and those around us physical bodies and these unusual properties are associated, first of all, with accounted for by measurement - temporary. Our world in fact may not be the same as we used to see.

Time is a physical process or a convenient abstraction?

The flow of time is a real physical process or simply some convenient abstraction? If this is a physical process, then it could not fail to manifest itself in the theory of relativity - the most complete modern theory, reflecting the properties space and time, and reliably verified experimentally. Then, if the movement of time is a full-fledged physical process, then there must necessarily be possibility to reveal in relativistic relations the parameters characterizing directing the physical process of time movement, or, in other words, to identify the process of time movement in the relationships of (STR). If it is not, this fact will be an argument in favor of the opposite point of view. We seek to value and phenomena immersed in the fourth, temporal dimension, but as it was already above, ordinary things in the 4-dimensional world behave unusually, and have completely unusual properties for us. And it is these properties and quantities It is necessary to search in the theory of relativity, if we want to get to the mysterious process in the universe - the flow of time, carrying all of us through life. Indeed, the special theory of relativity includes disparate quite real physical quantities that are completely incomprehensible properties, and the behavior of which does not fit into our familiar framework. Let's take, for example, the speed of light in an empty space. This is a strange speed, not obeying to any laws to which any space velocity or the energy of rest, quite unexpectedly manifested in the relations of the special theory of relativity. Why is any inert, completely immobile and not participating in any processes of the body, as it turned out, in itself has tremendous energy? Physicists say that physical bodies possess this energy already by virtue of its very existence. But why? So, if we isolate and analyze all such strange physical values in the special theory of relativity, then it is revealed completely an amazing result. These quantities in their totality are strikingly arranged in an ordered series of physical quantities, characterizing a real in nature, the process of motion - speed, energy, inertia, momentum! The analysis allows us to conclude that a particular process identified, combining all the unusual values of (STR), is a physical process non-spatial motion of resting bodies, manifested in a special theory relativity in its inertial phase.

One of the basic provisions of (STR) is the assertion that all phenomena of our world are carried out within the framework of the four-dimensional space-time continuum. The detected process is a process spatial motion, therefore, it can occur only in remaining, time dimension, i.e. Reflects the movement of material bodies in time (or, in other words, the process of time movement). Even being completely motionless, any existing body, nevertheless, always continues its movement in the time dimension. Such a movement carries within itself the colossal energy of the flow of time, a small part of which humanity has already experienced itself in the form of nuclear explosions. It is this energy movement in time and manifested itself in the special theory of relativity as mentioned above mysterious rest energy. All material bodies are involved in this continuously The ongoing process, which

we perceive as the movement of time. So, the phenomenon manifested as a result of the (STR) analysis is not that other, as a real process of movement in time, possessing the properties of physical process. And if so, then it can be described and examined already from the physical point of view.

It is possible to determine a certain quantity that is taken as the speed of motion of physical bodies along the time dimension (Speed of Time), and which can otherwise be called the speed of movement time. Let us dwell on this most important characteristic of the process of motion time.

What is this - the speed of time?

How can it seem at first glance, the concept of the speed of time is paradoxical. Indeed, speed in the ordinary sense is the ratio of the distance traveled in space to the time of such movement. A speed of movement in time - it turns out that this is the ratio of time to yourself?

On the other hand, what is the speed of time it is easy to imagine the following simple example. Let there be a VCR connected to the TV. After turning on the playback, we will see on the screen recorded on videotape the plot. The most surprising thing in this process is that everyone The richest variety of life that we can see on the screen is reduced to VCR to a single monotonous motion of the videotape through reproducing the VCR unit at a certain speed. Suppose that in the corner of the frame on the videotape will be recorded the readings of the clock, corresponding to the recorded plot. We now turn on the accelerated playback. Video film will move faster read head of the recorder - and on the screen we will see that the pace of development of the plots accelerated, and the hours displayed on the screen will go forward in comparison with our own watch. If we turn on the slow-motion mode, The pace of events on the screen will slow down, the hours on the screen will start to lag behind our hours. At both cases of changing the course of events that we see on the screen are related to changes in a single value - the speed of motion of the videotape with respect to the reading head. It is this key quantity determines the rate of events that we can observe on the screen.

What is time like?

In our example, this value is determined by the ratio of the distance between, sections of the film, on which two certain events are recorded, by the time of our own hours, for which these sections will pass through the reproducing device. It turns out that in this case the speed is the ratio of the distance (at film) between events by the time it takes to rewind the film With respect to the read head from writing one event to recording another, and there is no paradox here. Its changes change the pace of realization of the events that we see on the screen, and we can quite naturally take this value as a certain speed the movement of time in the world that we see on the screen. In this interpretation all future events are collected on a reel with which the film is rolled, all past remain on the reel on which the film is rewound after playback recorded events on it, and the place of touch of the reproducing head of the tape recorder and The moving film determines the moment of the present, which we observe on the TV screen. Note that the time in this case is determined by the testimony of our own hours, which go at the usual (normal) pace. In relation to their and determines the accelerated and delayed the course of events on the TV screen. This example illustrates the concept of the speed of time. However, how can represent this value in the real world? The theory of relativity, which introduced the notion of the unity of space and time, believes that all elements of this construction - continuum - should be expressed in the same units of measurement - otherwise it will be difficult to compare them. Therefore, all four dimensions of space- It is convenient to define time in unified - spatial units of length. Any the material particle moves in this 4-dimensional world along a certain trajectory - world line - and, consequently, it is possible to distinguish the component of this movement along time measurement, expressed in spatial units.

Our world, which we directly observe, is a three-dimensional region of space. Through it passes the axis of time. Moreover, no matter how we choose this axis, it always crosses the "present" only at one point. We perceive this point as the moment of the "present", the moment fulfillment of the events in our world. The flow of time is determined by the passage of a moving region-space, in which we exist, along the axis of time, which we assume to be fixed. If the axis time in spatial units, it is possible to define exactly the "shift" region of the "present" as a certain interval, expressed in units of length. This interval is correlated with the readings of the clock, which are normal, normal for us tempo. This is the only rate of time that we experience in reality, and in relation to it, we will determine the shift of the "present" region along the axis time. If the speed of time in our world has increased, it will mean, that for the same interval of the normal course of time, the "real" realm advanced further than usual.

The ratio of such a shift, expressed in spatial units, to the corresponding interval of the "normal" course of time and determines the value that we will refer to as the speed of time (ST). Such a representation of the ST well illustrated by an example with a VCR and similar to the speed motion video during playback of recorded scenes. Where in the ST is expressed in the usual dimension, like any speed body movement in space. This allows you to compare them among themselves. It is show that it is impossible to overtake time in our universe. No processes in our world can develop faster than the current time in it. That is why the speed of time is the limit for speed of fulfillment of any events in space. The value of the time velocity (ST) invariant, that is, its value does not depend on any spatial displacements physical bodies and from forces acting in outer space, which in the orthogonality of the time dimension is spatial. Comparing the properties of time and space velocities, it is immediately evident that their main difference is the invariance of the time velocity of motion in time and the non invariance of the velocity of motion in space. Hence the most important the feature of the speed of light in a vacuum - its invariance - makes it closer to speed of time, rather than the usual spatial velocity. Investigation of the properties of T velocity allows us to prove that the velocity the motion of light with a true ST. Thus, the speed of light in a vacuum - the definition of the non-space velocity ST, and in this connection it takes on itself all the properties of T velocity, including its invariance and independence from any movements of physical bodies in space. Because the T process is in its inertial phase, T speed is not changing its value, which leads to a constant with it the speed of light in vacuum. In other words, the velocity C reflects in the space of the extraterrestrial temporal speed, which is responsible for its unusual properties.

This situation can be illustrated with the help of the same example with VCR. The rate of events that we see on the screen depends on the overall case not only from the speed of the film rewinding relative to the reproducing head. Let's say that we somehow "stretched" the videotape. As a result the distance between the sections of the film on which the records of two neighboring events, will be more than usual. Let us now reproduce such a "stretched" section with the usual speed. It is obvious that the events that are reproduced from this "Stretched" section of the film, will appear on the screen slowed - although the speed of the motion of the videotape, as we noted earlier, has remained the same. Thus, the The pace of events on the screen is affected by two factors - the speed of film rewind (analog of T speed) and its "stretching", i.e. Change the scale of the film (analog of the effect of relativistic time dilation with spatial movements of bodies). The spatial motions of material bodies with a non-zero rest mass are always included the T process, outside of which they cannot develop. Matter cannot move beyond time. This result follows directly from the fact that in relations of relativistic mechanics that describe the motion of such bodies in space, it is always possible to isolate T values - the rest mass, the value the speed of light in a vacuum (equal to T speed), T pulse and rest energy. And stopping the movement of physical bodies in space does not affects the values of these quantities in the relativistic description of the state of these bodies, on their movement in time. The manifestation in the relativistic relations of the parameters T of the process in form of fundamental physical constants proves that the motion of time is a fundamental process that is not connected with any movements in

space or the manifestation of any spatial forces. Movement in time encompasses not only resting, but also moving in space physical bodies. Therefore, the definition of T process, associated with resting bodies, remains valid even when moving in space, allowing to allocate a share of T properties of the motion of matter in their general motion in the space-time continuum. T phenomena - these are the observed manifestations of the mysterious and a powerful physical process that is continuously (and inexorably) going in our world and which we know as the process of "the movement of time."

These phenomena include an orderly change of events in our world. The experimentally confirmed unusual properties of the speed of light in a vacuum, the real possession of each physical body with a nonzero rest mass tremendous rest energy, and the manifestation of other unusual properties of physical quantities, described in (STR), you can confidently attributed to T phenomena, i.e. observed manifestations of physical process of time. The presence in the physical reality of T phenomena of doubt does not cause and has reliable experimental confirmation. The motion of a material body in space with such an approach is natural generalizes and its movement in time. Time is as real as real space, and movement in time is as real as real movement in space. We do not have doubts in the reality of space, although it can not be touched or placed anywhere. So is time, being as elusive as space, nevertheless this is inevitable reality, the movement of which is impossible to evade.

Why is time moving?

The movement of time is not easy to understand, but it cannot be overlooked. Extremely the interesting question is why each material particle moves continuously along its world line, in particular in the time dimension. Taking into account the properties of the T process, it can be argued that, according to at least for the time being, a significant role in this is played by the property T inertia of the substance. In other words, the basis of modern movement physical bodies along their world lines is the motion of physical bodies by inertia in time, which is perceived by us as the universal flow of time. Having received at the time of the origin of the universe - in the fiery whirlwind of the Big Bang, powerful release of T energy, material particles further moved and move now in time by inertia, just as the material bodies move by inertia in space.

Why do different things exist in our world?

We ourselves, like the rest of the world around us, are of a different kind spatial forms, structures, i.e. The union of elementary particles in space. Such unification is possible because the particles that make up different objects, interact with each other. Their interaction leads to the emergence of spatial forms, sometimes very exotic. Atomic nuclei themselves atoms, molecules, planets, stars, galaxies, everything that has a form in space – everything this is generated by the interaction of particles, the forces of communication between them. The energy of such interaction is the binding energy of parts that form a single whole, some piece consisting of such parts. (STR) has defined the concept of binding energy, which is expressed by the product the quantity called the mass defect, the square of the speed of light (C). In physics, the energy communication is used mainly to assess the interaction of parts of the atomic nucleus. It is natural to generalize this relation to any spatial structure, parts which are united by some interaction. It is possible to obtain an equivalent temporal expression for the binding energy, which is equal to the product of the same mass defect, but already by the square of the temporal velocity TS. We will assume that no real physical quantity, including a mass defect, is can take infinitely large values. Then we get amazing result - no spatial structure can in principle exist outside the movement of time. => $E=M*TS^2$

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