The biggest Misunderstanding of the 20th Century Science is that Time is a 4th Dimension of Space

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Time t is a numerical order of change in a 4D space

Today's physics understands space and time as being coupled in “space-time”; a fundamental arena in which universe takes place. Einstein himself has never considered time as being part of space; he was talking about a “four-dimensional continuum” in which physical events occur. In his Special Theory of Relativity Einstein used Minkowski's 4-dimensional space that has four coordinates: X1, X2, X3, X4 where X4 = ict. X4 is not a “temporal coordinate”, X4 is not the time t that is measured with clocks. In the formula X4 = ict, time t is only a component. Out of this mathematical formalism one can conclude that in the Special Theory of Relativity time t is not part of space. Minkowski space is not 3D+T, it is 4D (1).

Space-time is 4D

Physicist G. 't Hooft is defining space-time being four dimensional space where forth coordinate X4 = ict (2). X4 is formulated as a product of an imaginary number i ($i = \sqrt{-1}$), light speed c, and time t: X4 = ict. In this formula, time t represents the numerical order of a physical event which is measured with clocks. Comparing the formula X4 = ict with fundamental physical formula which expresses the relation between distance, velocity, and time d = vt (distance is velocity multiplied by time) we see that X4 is a spatial distance. Considering time as being the fourth dimension of space does not look appropriate.

Historical overview of space-time as the fundamental arena of the universe

Let us see how the idea of “space-time” as the fundamental arena of the universe has entered into physics. Experiments with light carried out in the last decades of the 19th century confirmed that for an observer, light has the same speed regardless of whether the source of light is coming closer to the observer or is moving away from the observer. The Galilean transformation which has served physicists for centuries to describe the position of two inertial systems proved unfit to describe this unusual property of light. Let us suppose that one observer is standing on a train station (observer O), and another observer is on the train itself (observer O’). At the moment the train passes the station, we start measuring the numerical order of train's motion with a clock. At any distance from the station we can describe the position between these two observers in terms of Galilean transformation.

In Galilean transformation the clock on the train-station and the clock on the train run with the same speed: t’ = t. This works just fine when the velocity of train is such as we are used to, i.e. between 100 and 200 kilometers per hour. If we imagine a train with a speed close to that of an airplane or higher, we can no more describe the position of observers O and O’ with a Galilean transformation because light still has the same speed for both observers.

To solve this puzzle of the constancy of light speed, Einstein in his Special Theory of Relativity used the Lorentz transformation which exactly describes the position of observers O and O’ also when O’ on the train moves with a speed v which is close to the light speed c. According to the Lorentz transformation, the clock on the super fast train runs slower than the clock on the train station.

The higher the speed of the train, the slower is the speed of the clock on it in comparison to the speed of the clock on the train-station. Different clock speeds have been proved experimentally, clocks do run slower on the surface of the Earth than on a fast airplane.

Our observers O and O’ are linked by means of two cameras and two displays. The first camera is monitoring the clock on the station and is sending the image of it to the second display on the train. The second camera, which is monitoring the clock in the train, is sending the image to the first display on the station. Both observers O and O’ see exactly the same image on their displays. For both observers, the clocks run with the same speed. In inertial systems there is no “local time”. The train moves in space only, not in time. On a super-fast train the clock runs with a lower speed than the clock on the train station. This difference in the clock speed is true for both observers.

We can see that the Galilean and the Lorentz transformations both describe the relation between three coordinates X, Y, Z and the speed of clock t of two inertial systems. In both transformations, time t is considered as time measured with clocks. And with clocks we measure the numerical order of physical events. There is no time existing behind numerical order of material change i.e. motion. Time is not a part of the space-time as a fundamental arena of the universe, time is merely a numerical order of material change that run in cosmic space and numerical order of material change of cosmic space itself.

Planck time is a fundamental unit of numerical order

Let us take a look at light. A photon moves in a timeless quantum space. We observe a photon moving from the point A to the point B in the quantum space. The smallest distance a photon can move on the distance from A to B d_{AB} is the Planck distance d_p: $d_{AB} = \sum d_{p1} + d_{p2} .... + d_{pn}$. Each motion on the distance d_{px} corresponds exactly to one Planck time t_{px}. Planck time t_p is here considered to be the fundamental unit for measuring the numerical order of photon motion. The velocity of a photon is calculated by dividing the distance d_{AB} with the numerical order of photon motion t_n: $c = \frac{d_{AB}}{t_n}$ (3).

Time in Quantum Space

According to the quantum gravity theory, the cosmic space in which stellar objects exist is made of fundamental packets of energy that build the cosmic space, called the “quanta of space” (QS) (4).

In this quantum 4D space, time t is only the numerical order of physical events. Material change, i.e. motion occurs in a timeless quantum space. Quantum space is a medium of immediate information transfer by quantum information events where two particles communicate between themselves instantly without a clock “ticking” even once. The numerical order of these immediate events as for example Einstein-Rosen-Podolski experiment is zero: $t_n = 0$ (5). At Planck scale, physical events happen instantly, at the scale of photons, physical events happen in a “short time”, the numerical order t_n of these events is generally small. The numerical order t_n of physical events at the atom scale is already bigger, and it is even bigger at the scale of massive objects.

Semantics analysis of terms space, time and space-time

In physics term "space" is well defined. With "space" we mean a medium in which material objects exist from the galaxy to the photon. Term "space" is a meaningful term in sense that it corresponds to the concrete observable thing in a physical world.

Term "time" is not well defined yet. For Newton time is running independently with the same speed in the whole universe. Newton did not define exactly what time is. Einstein definition of time is based on its measurement: "Time has no independent existence apart from the order of events by which we measure it". He did not say what time exactly is. Out of his definition follows that time is numerical order of events, more precisely "time is numerical order of material change i.e. motion that we measure with clocks. This definition of time corresponds exactly to the measurement in a physical world. With clocks we do not measure time in which material change run, we measure its numerical order. In physics term "time" is a meaningful term in a sense that it corresponds to the numerical order of material change.

Term "space-time" was created by the German mathematician Herman Minkowski. He developed the formalism for four dimensional space where fourth dimension is X4= ict. Equivalently as Euclid space is 3D Minkowski space is 4D. From the point of mathematical formalism term "space-time" is inadequate.

According to the semantics analysis term "space-time" is an "empty" term in the sense that it does not corresponds any physical reality and also does not correspond any mathematical reality. Correct term for Minkowski space is a "four dimensional space" instead "space-time".

Right understanding of Space-time excludes Time Travel

This un-correct naming of Minkowski 4D space has caused more than 100 years conviction namely that "space-time" is a fundamental arena of the universe. As one can travel in both direction of fourth dimension X4 = ict some of physicists discuss about hypothetical time travel into past. They do not understand that moving back along the X4 doles not mean moving in time. X4 is spatial coordinate equivalently as are X1, X2, X3. One can move and travel in space only. Time is a numerical order of its motion (6).

The proposal here is that in physics term "Minkowski space-time" is replaced with the term "Minkowski 4D space". This will help next generations of physicists to have a right understanding of time as a numerical order of change running in a 4D space. 99.999 percent of today physicists are convinced time is a 4^{th} dimension of space although mathematical formalism X4 = ict shows 4^{th} dimension is spatial too. Language has an immense power over the human mind. That's why it is important to use meaningful terms especially in exact science as physics.

Conclusions

According to the mathematical formalism of Special Theory of Relativity, X4 = ict time is a numerical order of photon motion in 4D space. For us, human beings, this means: the universe is timeless phenomena wherein time measured with clocks is merely a numerical order of change. In a timeless universe, the past and the future exist only as numerical orders of physical events. The universe does not take place in the time; on the contrary, time is the numerical order of universal change. Travels into time are not possible. We can travel in space only. Time is numerical order of our motion in space.

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