The greatest mistakes of modern cosmology

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Abstract

Currently we have two theories describing the world: general theory of relativity describing the macroworld and quantum mechanics describing the microworld. Both theories are drastically different and do not match each other. In this article, I will try to show the greatest mistakes of modern cosmology and possible solutions that bring both theories together.

1 Introduction

I am a mathematician by education (I graduated in mathematics from Charles University in Prague). Most of the time, I worked as a computer scientist. I wrote a book on artificial intelligence in which I wondered, among other things, what image of the Universe could intelligent computers create on the basis of publicly available knowledge about the cosmos. Then I came to the conclusion that our image of the Universe (that is the image presented in popular science publications and on the Internet which I have read so far, for example [1]) is wrong.

I have become seriously interested in cosmology. In addition to the scientific books recommended to me by professor Irina Dymnikova, I learned from the lectures of professor Petr Kulhánek posted on the aldebaran.cz website and from articles on arXiw.org. I have been dealing with problems related to cosmology intensively for over ten years and I am still convinced that modern cosmology has gone to the wrong direction. The problem is that the wrong assumptions were made at the beginning. They were taken for granted without realizing it may be otherwise.

For example, in my opinion, it is not possible to arrange two inertial systems which are drifting apart from each other in such a way that the corresponding spatial axes are parallel to each other (in spacetime each system has a different division into space and time and their spaces do not coincide). On the other hand, some assumptions that I consider essential are overlooked. For example time and space cannot be treated separately because they are tightly coupled. From such an assumption (which was already postulated by Minkowski) it follows that the Universe must expand (time is extending, so space must do so as well) but also that neither inflation nor acceleration of expansion can take place. I believe that dark energy is also unnecessary because time flows independently of energy.

A large part of the problems of modern cosmology are due to the misassumption that what we observe around us is three-dimensional space. In fact, each observed object is distant from us not only in space but also in time. What we see around us is not a three-dimensional space but a certain, quite complicated fragment of spacetime which we imagine as space. This leads to misinterpretation of the observed data and incorrect conclusions, for example regarding dark matter.

Moreover, our idea of spacetime is also wrong. Due to the difficulty of visualizing four-dimensional objects, we resort to mathematical equations and not always realize what they mean in a geometric and physical sense. The fact that number line geometrically means Euclidean line implicitly introduces Euclidean space (without our awareness) into our mathematical models. Newton's laws were formulated for the Euclidean space and Einstein's equations were formulated so that they coincide with Newton's equations in boundary conditions.

If space is not Euclidean space, then Newton's and Einstein's equations apply only locally and in the case of long distances there must be discrepancies. In this case, the application of Einstein's equations to the entire Universe is unjustified.

The next problem is the interpretation of complex numbers which appear in calculations. For example, Minkowski added the imaginary unit "i" to the temporal dimension in his model of spacetime, which was a brilliant idea but has not been completed. Later, because the imaginary unit in the definition of the spacetime interval is squared, the imaginary unit was completely omitted and the square of it was replaced by -1. Despite the fact that complex numbers often appear in calculations, their physical interpretation is avoided. While the introduction of the imaginary time component can explain not only why we can confuse distances in spacetime with distances in space but also explain where some quantum phenomena come from in spacetime.

2 The visible part of the Universe

It is wrong to assume that the visible part of the Universe is a huge sphere of three-dimensional space which is expanding. One should realize that every object we see is distant from us not only in space but also in time. What we see around us is not a three-dimensional space but some part of spacetime. In other words, the visible part of the Universe is a four-dimensional object in which one of the dimensions is time.

Since the time shift for the distances we deal with on Earth is so small that it can be omitted, in the course of evolution there was no need to develop the imagination of four-dimensional objects. However, such imagination is possible and it can be learned. It is not only possible but even necessary if we want to fully understand the geometry of the Universe.[1]

[1] The left hemisphere of the brain deals with calculations and the right hemisphere with geometric imagination. To fully understand something, you need not only to calculate it but also be able to imagine it.

We can imagine the entire visible part of the Universe as if it is composed from spheres around us, wherein the larger the radius, the older the sphere (Figure 1).

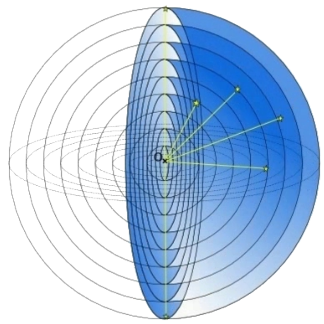

Figure 1:

Figure 1 shows the spheres around the observer as we imagine them, that is without the shift in time and as if they formed a huge ball in three-dimensional space. Such a misconception leads to several wrong conclusions. First, it seems to us that the oldest sphere is huge and creates a horizon behind which there is something that we cannot see at the moment but we will see in the future [2]. Moreover, we are convinced that two very distant objects which we see at large angle must be far apart [5]. Finally, we think that space is flat because this is how we imagine straightened four-dimensional surface containing visible objects.

In order to account for the time shift, we need to add a time dimension. Each sphere will be on the timeline at the distance equal to the time it took for the light to come from objects on the sphere to the observer. Distribution of the nearest spheres for which the expansion of the Universe can be omitted, we can imagine more or less as shown in Figure 2.

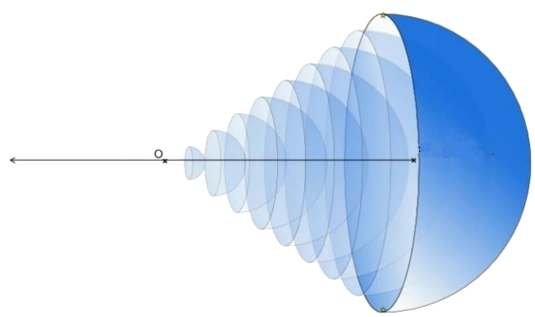

Figure 2:

However, if the Universe is expanding, it must be progressively smaller at some point on the older spheres (according [3]). We are going to get something similar to what Figure 3 shows.

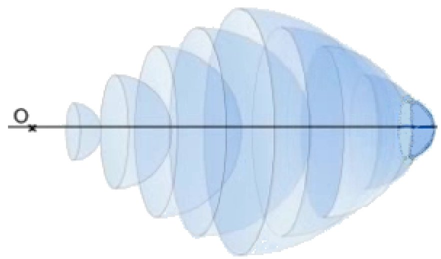

Figure 3:

Figure 4 shows the spheres simultaneously as imagined by the observer and arranged in spacetime. Here you can see how objects that seem to us very distant from each other can be close to one another in spacetime.

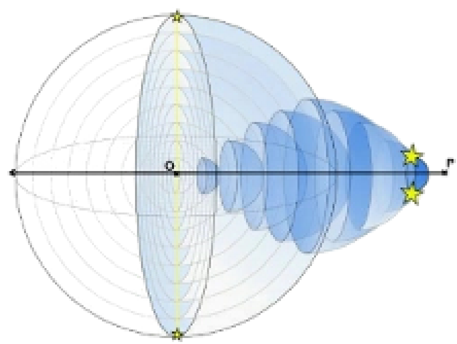

Figure 4:

The homogeneity of the background radiation will no longer be a problem if we realize that although the background radiation is reaching us from all sides from a very long distance, it comes from a small area of spacetime (Fig. 5).

It is also worth realizing that what we are watching is the past and the past cannot change. The oldest sphere we see, and which seems huge to us, will be as small in the future as it is now. Simply, we will move away from it, the path of light to us will be longer and after straightening it in our mind, the sphere will appear larger to us. In the future, we will not see anything new at the greatest distance from us. We will see what we see now (the young Universe), only with a greater redshift (because the light will travel to us longer in the expanding space).

It should also be noted that the spheres, as imagined by the observer and ordered in spacetime, look practically the same regardless of the actual curvature of space (according to [3] p. 440). A sphere cut out from flat space looks the same as a sphere cut out from curved space. For this reason, the curvature of space in the observed Universe cannot be directly detected.

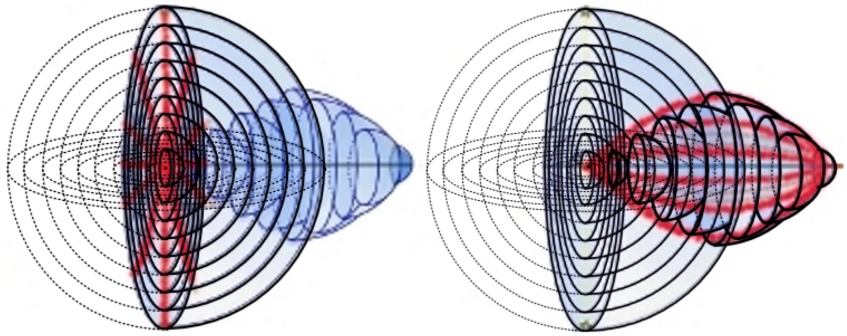

Figure 5:

3 Spacetime diagrams

What we showed in the previous chapter from the point of view of the observer looking around them, we will now show using the spacetime diagram. A very simple spacetime diagram (with one spatial and one temporal dimension) is pictured in Figure 6.

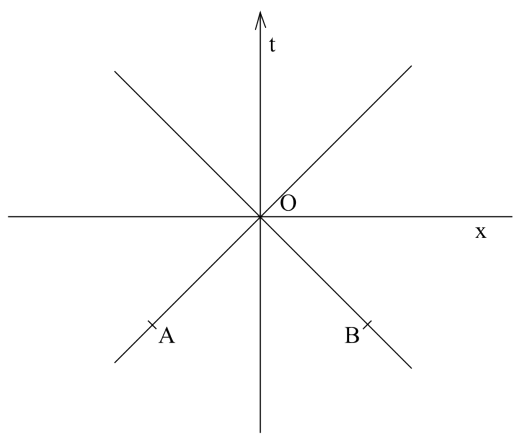

Figure 6:

The observer is at point $\boldsymbol{O}$ and everything he can see at any given moment is on the half-lines $\boldsymbol{OA}$ and $\boldsymbol{OB}$. Let us consider how the observer will imagine the order of objects $\boldsymbol{A}$ and $\boldsymbol{B}$. The observer cannot look towards time. The space of observer $\boldsymbol{O}$ in the diagram is line $\boldsymbol{x}$. The observer from this space can see only the point they are at but they imagines everything they can see ordered in space, that is on the line $\boldsymbol{x}$. Objects $\boldsymbol{A}$ and $\boldsymbol{B}$ will be imagined by the observer in positions A_1 and B_1 which are shown in Figure 7.

The spacetime diagrams in Figures 6 and 7 show the part of spacetime in the vicinity of the observer $\boldsymbol{O}$. One has to realize that the observer cannot examine what the space looks like at greater distance from him. On the basis of experiences from the immediate area, they imagine the space as an non-curved line and imagine the objects they can see in such

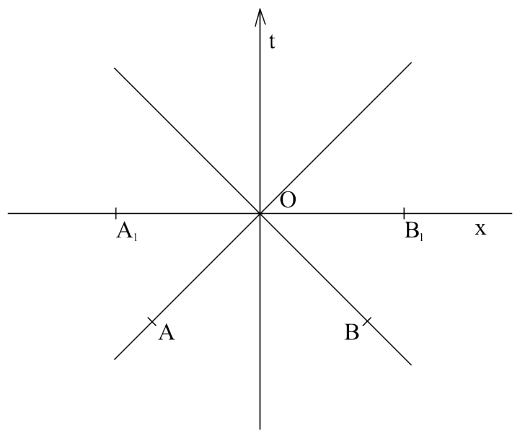

Figure 7:

non-curved space. The real space can be curved and it can increasingly move away from the line along with the distance.

If we go back in time, we also have to take into account the expansion of the Universe. The closer to the beginning of the Universe, the more space shrinks. If we take into account the entire period since the creation of the Universe, the diagram may look more or less as shown in Figure 8. Points $\boldsymbol{A}$ and $\boldsymbol{B}$ herein correspond to the most distant objects seen on the left and right sides.

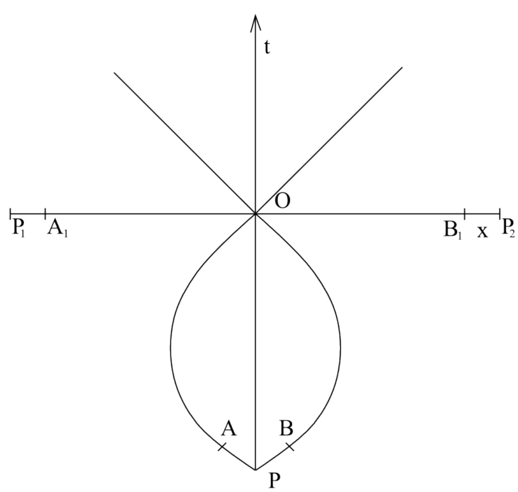

Figure 8:

The observer cannot see the beginning $\boldsymbol{P}$ but in the diagram, the points P_1 (a bit further to the left than point A_1) and P_2 (a bit further to the right than point B_1) would correspond to them.

The visible part of the spacetime will be imagined by observer $\boldsymbol{O}$ as a line segment

A_1B_1, even when the real space is curved and does not coincide with the line $\boldsymbol{x}$. Regardless of whether the real space is curved or flat, the space that the observer imagines has only one point in common with the real space and they are compatible with each other only in the immediate area of the observer.

Figure 9 shows how the observer $\boldsymbol{O}$ will imagine the order of objects $\boldsymbol{A}$ and $\boldsymbol{B}$ after some time. The position of objects $\boldsymbol{A}$ and $\boldsymbol{B}$ in spacetime will not change, only the observer $\boldsymbol{O}$ will move away from them. The length of the light path from them to the observer will be extended and the observer will have the impression that objects $\boldsymbol{A}$ and $\boldsymbol{B}$ have moved away from them and they will imagine them in positions A_2 and B_2.

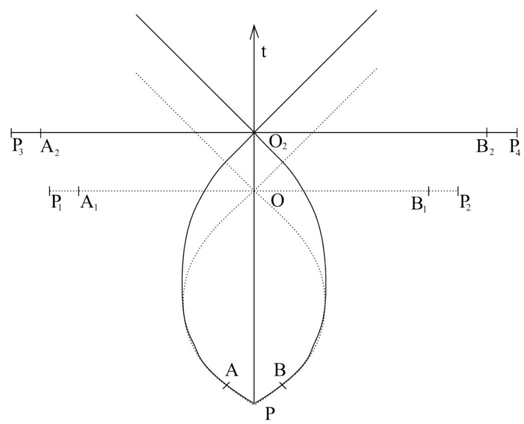

Figure 9:

Also, greater redshift in more distant objects does not mean that they move away from us faster but that we move away from them longer and that space has extended more during this time.

Let us also consider the differences in perception of the Universe of two observers who move in relation to each other with uniform rectilinear motion (Fig. 10).

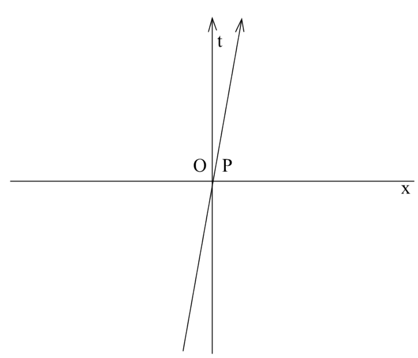

Figure 10:

The observer $\boldsymbol{O}$ believes that he does not move in space and in spacetime he only moves in the direction of time (in the direction of line $\boldsymbol{t}$ in the figure). $\boldsymbol{P}$ moves in relation to him in uniform linear motion and his path in spacetime will be inclined at a certain angle, depending on the speed of its movement.

However, it follows from the principle of relativity that the observer ***P*** may think that he is still standing and that the observer ***O*** is moving. Then, it seems to him that time flows in the direction ***t'*** and that his space does not coincide with the space ***x*** (Fig. 11).

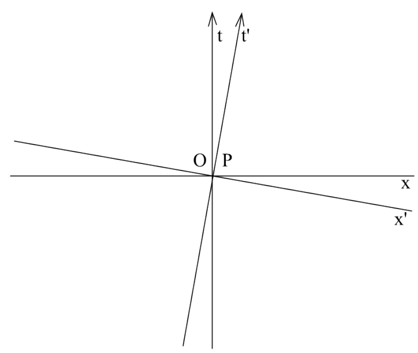

Figure 11:

It can be seen from this that two inertial systems that move relatively to each other cannot be positioned in such a way that the corresponding spatial axes are parallel to each other.

Spacetime diagrams give us some idea of spacetime, except that it is the image that is inconsistent with how spacetime distances are calculated. When looking at the picture, we imagine distances as if the Euclidean metric was valid in spacetime but one should use the spacetime interval. However, the spacetime interval does not allow us to determine the arrangement of visible objects in spacetime because it shall be zero for all objects visible at that moment. We have to find some other way to figure out the distance in spacetime. This will be dealt with in the next section.

4 How to determine the position of the observed objects in spacetime

If we observe an object in the sky, we imagine that it sits in space in the direction from which light comes from it to us and at the distance that the light has travelled from the object to us. Except that if the light from the object has travelled towards us for 10 years, the observed object is not only 10 light years away in space but also 10 years distant in time. As shown above, the observable part of the Universe is not a sphere of three-dimensional space but a specific part of spacetime. In order to get a correct image of the Universe, we need to determine the arrangement of objects in spacetime. Here, however, the problem arises. Distances in spacetime must be established in a different way than in space. For this purpose, we use the spacetime interval, which, however, shall be zero for all the objects that we can see at the moment. If we think about it, we will understand that we see only the light that has reached our eye at a given moment and that is at a distance of zero from us. Due to the importance of this statement, let's repeat it again in other words: the whole visible part of the Universe, everything we see around us, is the image formed by our brain on the basic of the light that is at distance of zero from us. Brain creates a certain flat three-dimensional space projection which works well in practice for small distances. However, if we want to determine the arrangement of objects in spacetime, we must find a way to determine the distance other than the spacetime interval which for all observed objects shall be zero.

Let us begin our considerations by recalling how distances in Euclidean space are defined. Suppose that we want to find the distance of the point with coordinates $\boldsymbol{x}$, $\boldsymbol{y}$, $\boldsymbol{z}$ from the origin of coordinates. We will calculate the distance using the Pythagorean theorem (generalized to more dimensions):

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

If we want to add time as additional dimension and then measure distances in the resulting spacetime, we must ensure that all dimensions are in the same units. This can be achieved by multiplying time by the speed of light. However, the time dimension is different from the spatial dimension. Simple adding $\boldsymbol{ct}$ as the fourth dimension and calculating the distance using the Pythagorean theorem lead to the problems with causality. Minkowski solved the problem by multiplying time by the imaginary unit $\boldsymbol{i}$ and he obtained the formula:

$$\delta = \sqrt{x^2 + y^2 + z^2 + i^2c^2t^2}$$

which due to the fact that

$$i^2 = -1$$

finally gives the result

$$\delta = \sqrt{x^2 + y^2 + z^2 - c^2t^2}$$

where the imaginary unit is no longer needed.

The distance defined in such a way is invariant, that is, it is the same for every observer and does not lead to problems with causality. Besides, there seemed to be no other way of defining a distance in spacetime. Except that, the distance defined in this way shall be zero for all currently observed objects and does not make it possible to determine the arrangement of visible objects in spacetime. There has to be some other way to define distance in spacetime.

The way to solve the problem is to reflect on the nature of time. On the one hand, time can be different for different observers and it can mix with space, and on the other hand, for everyone time must flow in one direction as time and not as space. The solution may be to add another component to the time and describe the time not with an imaginary number but with a complex number. Then we will get the formula for distance in spacetime

$$\delta = \sqrt{x^2 + y^2 + z^2 + c^2t^2 + i^2c^2t^2}$$

which is

$$\delta = \sqrt{x^2 + y^2 + z^2 + c^2t^2 - c^2t^2}$$

and we will get the result algebraically

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

From this we can see why distances in spacetime (if we do not see time dimensions) can be confused by us with the distances in space.

At the same time, it can be seen that in the previously used spacetime diagrams, you can safely use the Euclidean metric (and not worry about the spacetime interval), you just need to be aware that it is about projecting spacetime into a plane and that the time must still have the imaginary part that is not visible on the diagram.

One more very important point: if we only look at the results of the calculations, we lose the information about complex time. However, in geometric interpretation, we get additional time dimension with the real component and the imaginary component. Herein, it is clear that the calculations themselves (without appropriate geometric representation) can lead to misinterpretation of the calculation results.

5 Is the Universe flat?

If we assume that time and space together form the spacetime in which they are interconnected, there are reasons to assume that at the beginning, space was small and that it grows with time.

In that case, why is the Universe considered flat? Three issues contributed to this.

First of all, in everyday life we do not notice the curvature of space and our geometric education is based on Euclid's geometry, therefore, non-curved space seems natural to us. Also, all Newtonian physics is formulated for the Euclidean space and it works in practice, which gives the impression that the Euclidean space is a good approximation of real space.

Secondly, the Einstein equation, which determines the relationship between the curvature of spacetime and the distribution of mass, was misapplied for the entire Universe. Due to the fact that the energy-momentum tensor on the right side of the equation is a two-index tensor, on the left side of the equation the Ricci tensor was used, which is also two-index, not the Riemann tensor, which describes the complete curvature but is a four-index tensor. As a consequence, Einstein's equation[2] describes the relationship between the curvature of spacetime and the distribution of mass only locally, and spacetime may also have a curvature independent of mass. It follows that the Universe can be spherical regardless of the density of matter (artificially added later cosmological constant does not explain anything but adds confusion because no one knows exactly how to interpret it).

Thirdly, what we see around us is not space but a cross-section of spacetime with a light cone. In addition, our brain straightens this cross-section and creates the image of non-curved three-dimensional space. This creates the illusion that there is non-curved three-dimensional space around us. Being subjected to such an illusion leads to apparent problems that either one doesn't know at all how to solve them, or creates absurd hypotheses such

[2] $R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = (\frac{-8\pi G}{c^2})T_{\mu\nu}$, where $R_{\mu\nu}$ is the Ricci tensor, $g_{\mu\nu}$ is the metric tensor, R is the scalar curvature, G is the Newtonian constant of gravitation, c is the speed of light and $T_{\mu\nu}$ is the stress-energy tensor.

as cosmic inflation or dark matter. If we realize that the most distant objects in the visible Universe are close to each other (regardless of whether the space is flat or curved - according to [3]), the problem of homogeneity of background radiation disappears immediately because despite the fact that it comes from all directions from great distances, it comes from a small region of spacetime. It also follows from this that there are no causally disconnected regions in the observed Universe.

There is no convincing evidence that space is flat. It might as well be curved. Which assumptions to adopt and which to reject must be ultimately decided by some observations. What observations might these be if we have just stated above that "the observed part of the Universe looks practically the same regardless of the curvature of space"? Well, the differences are imperceptible up to a certain distance, while for very distant objects the differences may be significant.

It is necessary to consider what these differences may be and what are the possible interpretations of the observed phenomena. In order to compare the two models, first we need to define what our model of finite Universe should look like. We assume that space and time are related to spacetime in such a way that Planck's time t_P corresponds to Planck's length l_P, i.e. in the Planck's time 1 t_P, the Universe is a sphere with a radius of 1 l_P Planck's length and with each successive Planck's time t_P, the radius grows larger by the Planck's length l_P.

Fig. 12 exemplifies, what it will look like propagation of light on the surface of such a sphere, which shows a cross-section through such a Universe after 4 t_P (light is understood here as a signal spreading at the speed of 1 l_P for 1 t_P).

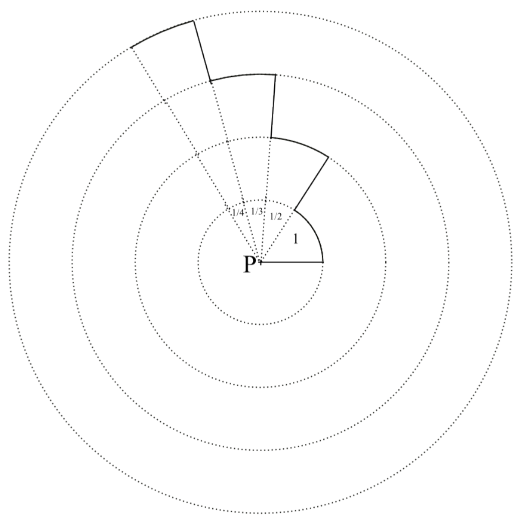

Figure 12:

At 1 t_P, spacetime has a radius of 1 l_P and the light will travel a distance of 1 l_P, that is, it will travel circumferential distance corresponding to an angle of 1 radian. During the second t_P, the light will travel a distance of 1 l_P along the circumference of a circle with a radius of 2 l_P, that is, corresponding to an angle $\frac{1}{2}$ radian. During the third t_P, the light will travel a distance of 1 l_P along the circumference of a circle with a radius of 3 l_P, that is, corresponding to an angle $\frac{1}{3}$ radian. During the fourth t_P, the light will travel a distance of 1 l_P along the circumference of a circle with a radius of 4 l_P, that is, corresponding to an angle of $\frac{1}{4}$ radian.

It can be seen that the angles corresponding to the distances that the light will travel along the circumference of the expanding circle at particular stages form a harmonic series (which is divergent to infinity), that is, the light will have time to reach any point in the finite time from any point. We can also calculate how long the light will go around the whole circle.

For this purpose, it is necessary to check how many first components of the harmonic series need to be summed to obtain a number greater than 2π. We will receive[3] the time of 301 t_P. The second lap will finish in 160,996 t_P. If we take $t_P \approx 5.391 * 10^{-44}$ s, then 1 s$\approx$1.855 * 10^{43} t_P and the sum of the first 1.855 * 10^{43} components of the harmonic series shall be approximately 100, that is, the light will go around the circle 15 times in the first second ($30\pi \approx 94.247$). In the first year (31,557,600 s$\approx$5.854 * $10^{50} t_P$), the light will go around the circle 18 times and in the first 400,000 years - 20 times. If the background radiation comes from this time, it took about 200 million years to go around the entire circle and by the time of 13.8 billion years (which roughly corresponds to 8.078 * 10^{60} t_P) it has had time to go around even more than half of the next circle. We see that there is neither any horizon nor any causally disconnected areas here. The expansion of the Universe here is the consequence of linking space and time into spacetime in such a way that along with the waxing of time, space also waxes (we do not explain here why time passes but explaining that the Universe is expanding because of some dark energy does not explain anything). There are no accelerations nor slowdowns in expansion here and so we can calculate the Hubble constant for any moment in the Universe:

If we mark
 d1 - the distance by which radius extends in 1 second
 dr - the distance by which radius extends in 1 year
 o1 - the distance by which the circumference of a circle extends in 1 second
 k - distance 1 Mpc in km
and if we adopt values
 d1 = 299792,458 km
 dr = 31557600*d1
 o1 = 1,8836515673088531*106 ($\approx 2\pi \times d1$)
 k = 3*1019 km
then for
 H - the Hubble constant
 W - the age of the Universe in years
we will obtain dependencies
 $H = \frac{k*o1}{2\pi*dr*W}$ from which we will calculate the Hubble constant ***H*** for a given age of the Universe ***W***, or
 $W = \frac{k*o1}{2\pi*dr*H}$ to calculate the age of the Universe ***W*** for a given Hubble constant ***H***.

For example, for W=13.8 billion years, we will get H$\approx$68.9 km/s/Mpc, for H=72 km/s/Mpc we will get W$\approx$13.2 billion years.

[3]For the calculations I used WolframAlpha (https://www.wolframalpha.com/)

Calculations are made for the actual space that is available to the observer only up to the Planck length and not for the space that the observer imagines based on the light that has just reached him.

Figure 13 shows what the path of light looks like in spacetime with curved and non-curved space and how the observer imagines what he can see.

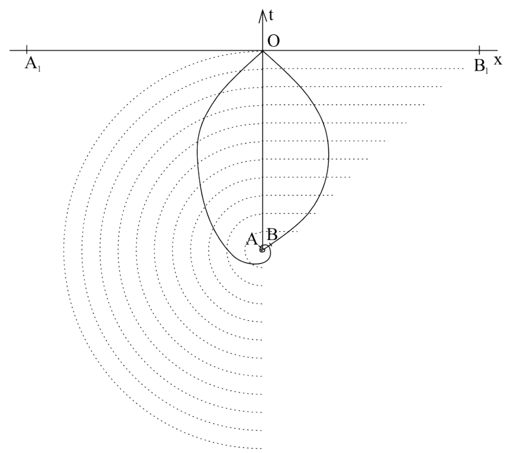

Figure 13:

For observer $\boldsymbol{O}$, space is the line $\boldsymbol{x}$. Everything the observer sees, he imagines on this straight line, regardless of whether the real space is curved (left half of the figure) or non-curved (right half of the figure). In both cases, he sees the real space only up to Planck length and what he ”sees” in a greater distance is the straightened curve of the path of light in spacetime.

The path of light in both cases is very similar over the last 11 billion years. More significant differences will appear only for greater distances, but how to detect them, if we see only the light that has a distance of zero from us and if we imagine straightened path of light?

If we considered only the photon path in spacetime, the differences were minimal. We will get greater differences, if we examine the propagation of light as a wave. For non-curved space the light intensity will decrease along with distance, while for the wave of light propagating on the surface of a sphere, the light intensity first will decrease, but then, on the inverted half of a sphere, it will increase, then it will decrease again and so on.

On the surface of the expanding sphere calculations may be more difficult, but it can be expected that the calculation results for the background radiation will be different on the understanding that space is curved space than for a flat space. The fact that, on the assumption of flat space, calculating the Hubble constant from the background radiation gives different results than the calculations based on Cepheids, gives grounds for assuming that space is not flat (especially since there is no other explanation for the divergent results in the calculations of the Hubble constant from Cepheids and from the background radiation [4]).

During the calculations, one more thing may turn out to be important. To simplify the calculations, one makes assumptions about the homogeneity and isotropy of the distribution of matter in space. It seems that such assumptions can be made for a large scale. However, if we assume that the Universe is finite, we cannot choose liberally large scales and the assumptions about homogeneity can lead to erroneous calculation results. The fact that time does not pass everywhere the same leads to spacetime deformation and if we want to get correct picture of the Universe, we must take these deformations into account, not only in the cosmological scale but even around atomic nuclei.

6 Quantum phenomena as the property of spacetime

Let's try to analyze the spacetime diagrams again, but now assuming that we describe time with a complex number. On the diagram, we need to add one more dimension to the imaginary part of time. For that reason the diagrams will be a little less clear.

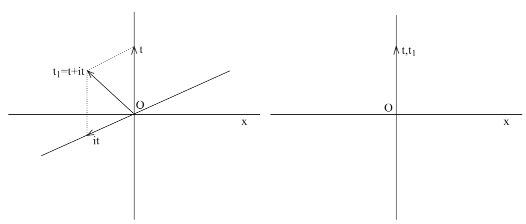

Figure 14:

In figure 14 on the left: for observer ***O***, line ***x*** represents space, line ***t*** represents the real component of time (in our model ***it*** corresponds to cosmic time), line ***it*** is perpendicular to ***x*** and ***t*** lines. Time of observer ***O*** flows in the direction of t_1, that is, in the plane defined by lines ***t*** and ***it*** at an angle of 45 degrees.

Figure 14 on the right shows an orthogonal projection to the ***x,t*** plane. Line ***it*** will be visible only as the point identical to point ***O*** and line t_1 will coincide with line ***t***, only you have to imagine it coming out of the paper at point ***O*** at a 45 degree.

Now we will add observer ***P***, who moves relatively to observer ***O*** in a uniform linear motion and now passes him. Figure 15 on the left shows what the situation looks like in a two-dimensional diagram, whereas on the right, there is a diagram including the imaginary component of time.

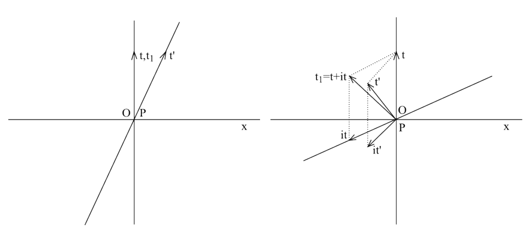

Figure 15:

If the observer $\boldsymbol{P}$ moves relatively to the observer $\boldsymbol{O}$ and they are now next to each other, the real part of the time of both observers will be identical while the imaginary parts of their own times will form an angle dependent on their mutual speed. It can also be imagined that, for a moving observer, the entire spacetime rotates around axis $\boldsymbol{t}$ by an angle dependent on the speed.

Now let's consider what the situation will look like in the case of accelerated motion. As the speed changes, the angle will change, i.e. the rotation of spacetime around the line $\boldsymbol{t}$ will occur.

If we adopt the principle of equivalence between gravity and accelerated motion, then it must be assumed that the rotation of spacetime is also related to gravity. This means that the spacetime rotation (i.e. mixing of space and time) takes place around each particle and hence, amongst other things, the impossibility of determining the exact location of the particle comes from.

If we additionally take into account the fact that gravity is also related to the slowing down of time, we will get near each particle a spinning hole, i.e. a spacetime vortex. If we think about it, it turns out that the particle is not needed here. Simply a spacetime vortex can be considered a particle. This gives the possibility to imagine where the wave character of particles and other previously difficult to understand quantum phenomena come from.

7 Summary

Spacetime modeled as differential manifold in addition with assumptions about homogeneity and isotropy of matter distribution in space gives a very simplified model of spacetime which cannot include quantum phenomena. It also does not contain the most important quality of time, which is that time passes and that one can distinguish between past, present, and future.

In this respect, an interesting idea is to use the ideas of the British physicist Stephen Wolfram, i.e. modelling the Universe as a cellular automaton[6][4]. In such a model, we immediately have the shortest period of time and the time that flows in one direction. We have also the shortest distance - the distance of neighboring cells - and the constant speed of signal propagation. Cellular automata also show how simple rules can lead to complex structures and complex operation. However, it may be difficult to construct a grid on a four-dimensional expanding sphere, additionally with the imaginary part of time.

My goal was not to create some new complete model that explains everything. I have only tried to detect potential flaws in current theories and cosmological models that may arise from unconscious adopting certain assumptions (which seem obvious but do not have to be true) and show that there may be other solutions. Gradually, I have been coming to more and more interesting conclusions. My model is evolving and improving.

At this stage, in my view, the entire Universe is reduced only to spacetime which is constantly undulating, spinning and expanding. Time plays a major role here. The fact that it flows, that is, it waxes, causes that space also waxes, which means that the Universe

[4]A cellular automaton is a mathematical model that describes a system of cells that can assume a finite number of states, and whose states change synchronously according to specific rules depending on their present state and the state of their neighbours.

is expanding. The fact that it does not flow uniformly everywhere causes distortions of spacetime which appear as gravity, and consequently, as matter. In addition, it does not flow straight, it is tilted in the imaginary direction and causes rotation at every point in spacetime (multiplication with a complex number geometrically means rotation), which gives the basis for quantum phenomena and continuous motion as well as various interactions.

My adventure with cosmology began with imagining how intelligent computers could imagine the Universe. I think that today is the time to use real artificial intelligence to model the Universe.

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