Real time, own time and causality in infinite Universe

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ABSTRACT: *It follows of the Expansive Nondecelerative Universe (ENU) model that the Universe is infinite both in time and space due to changes in some constants. We are able to determine the causal future, i.e. the maximum time which can be influenced at present. An analogous result is obtained introducing the real logarithmic time. Putting the curve of logarithmic time and the Universe worldline identical, an illusive acceleration of our universe expansion appears. This acceleration may, however, be related just to the observed past of the Universe.*

1. Causality and change of constants

The Universe development is illustrated in Figure 1. The axes *x* and *y* represent the cosmological time and the Universe dimensions, respectively. The beginning of the expansion lies in the point 0. Our current position is represented by the point P. The universe boundaries form a causal horizon in the form of a light cone.

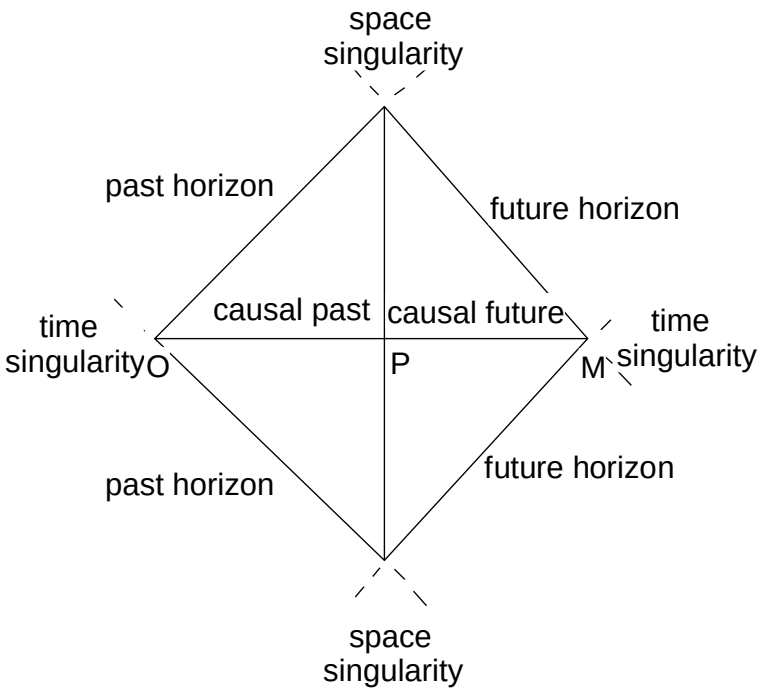

Fig. 1: A chart of the Universe evolution

The future causal horizon can be understood as follows. At the time being, we are able to influence our nearest future. We may take a decision what to do tomorrow and fulfill the decision. The further is the scheduled future, the less possibility is to affect it. If the current Universe is governed by a single wish, it can be planned and influenced only up to the point M, which is a maximum cosmological time t_{max} for us. There is no meaning to evaluate the future beyond this limit. The angle of a future causal horizon and the time axis is β. It must hold

$$\beta = \frac{a_{pres}}{c\, t_{max}} \tag{1}$$

We know that in the ENU, the scale factor is identical with the Universe effective range. It means that gravitational force does not affect scale factor or, in other words, its gravitational impact must be minimal.
The extent of a minimal gravitational effect can be determined. The lightest object able to exert a gravitational effect on its environment is the particle bearing Planck mass (~10^{-8} kg). If such a particle exerts its effect in a maximum possible distance (a_{pres}) we have a guaranteed minimum gravitational influence on the Universe as a whole. This minimum effect may curve the worldline of photons and focus them into a single point. This point represents a future singularity, *i.e*. the end of the time (maximum cosmological time). The angle of the curving is of course β and relativistic solution of its calculation is

$$\beta = \frac{l_{Pc}}{a_{pres}} \tag{2}$$

Equations (1) and (2) lead to the maximum cosmological time of the value about 10^{71} years.

The most interesting idea is that at the time being, 13.8 billion years we are just in the geometric center between the beginning of the expansion of our Universe and the maximum cosmological time. It might seem that we are living in a privileged time. We are, however, in a strong opposition to such privilege and in no case we believe in such an unbelievable coincidence. It seems that any observer in any time will perceive it in the same way. Any observer in the past and in the future will perceive identically as we do now. Any of them will seem to live just in the geometric center between the Universe beginning and its end. It should be pointed out that for all observers the same physical laws are in force. If, however, the physical laws are unchangeable, certain physical constants are to be changed or evolved in time. This idea has unimaginable consequences for our Universe and a deeper understanding of the physical reality.

The physical laws do not involve the time direction and thus, what is valid for the Universe end must be valid also for its beginning. Going back in time, the initial point of the Universe creation would evade into infinitely small dimensions and we could never see the Big Bang.

The Universe beginning is thus nothing but an illusion. The Universe has no beginning and will have no end. It is an eternal and objective reality. It is not possible to determine either the reason or the mechanism and initial conditions of its beginning. From the viewpoint of the ENU model, the question of the Universe origin does not represent an issue to be solved. [1]

2. Logarithmic – real and own time of the Universe

At first, we will manifest an advantage of introducing the real logarithmic time. Such approach was many years ago discussed also by Milne [2]. It holds:

$$\tau = \ln t \tag{3}$$

where τ is real logarithmic time and t is own cosmological time of the Universe.

At present, real time equals zero, it was negative in the past and will be positive in the future. Cosmological time at present is normalized to 1 and is proportional to the Universe gauge factor *a*. For any observer his/her present real time is zero at any moment (see Fig. 2).

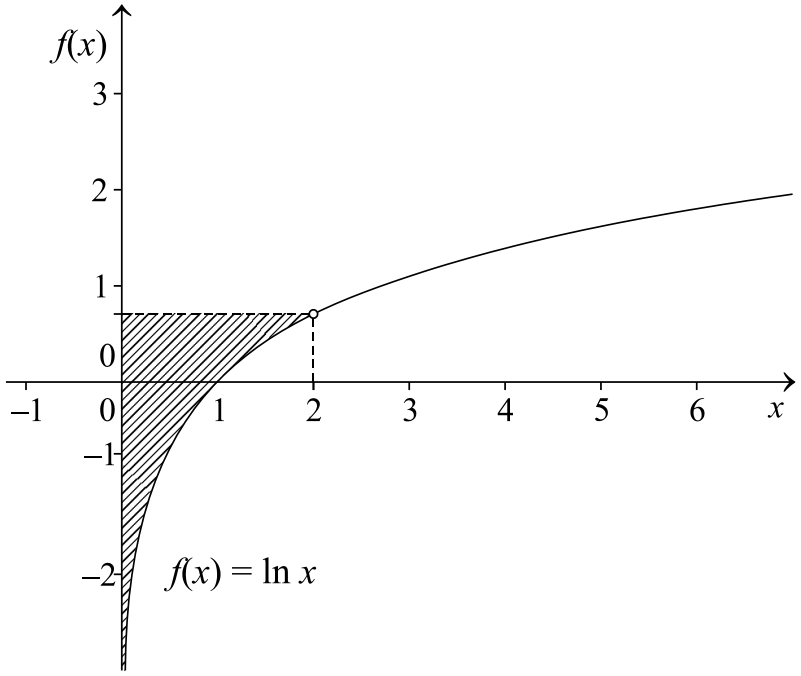

Fig. 2. Plot of logarithmic function

Three moments documenting advantage of logarithmic time introducing deserve attention.

1: If $t \to 0$, $\tau \to -\infty$

It means that the Universe if infinite, it has no beginning and no end. If cosmological time approaches zero, due to changes in some constants the units of Planck time and Planck length are proportionally reduced. This is why no Big Bang could exist. The corresponding changes in constants have no impact on the change in fundamental physical interactions and natural physical laws.

2: Any influence of real time could be observed only in the past. Due to the logarithmic function it seems that the Universe started to accelerate its expansion in the past. What is perceived as accelerated expansion of the Universe is in fact the

gradual increase of space and time units. At the same time, any observer will have the real time equals zero at any cosmological time. Everybody will find that in a given time the Universe characteristics correspond the constant velocity of expansion equals the speed of light.

3: The area delineated by the curve (3) in the range from $t = 0$ to $t = 1$ has negative value and represents the past universe. The area for $t \geq 1$, is positive and represents the future of the universe. To sum the negative and positive parts reaching zero value, it must hold for $t \geq 1$:

$$t \ln t - \int_1^t \ln t \, dt = 1 \tag{4}$$

Solution of (4) leads to t = 2, which is exactly in agreement with Fig. 1. One must only realize that cosmological time is dimensionless and expressed in logarithmic scale. Causality is thus preserved just up to a limit predicted by another, independent mode. An increase of t from 1 to 2 represents 61 order of magnitude and this is in accord with the ENU as for causality in the universe. For cosmological time it is 10^{71} years. The question of why the area over the curve of function is taken into account can be answered as follows. As regard to the observation of the universe past, the curve (3) may be understood as a worldline of the universe expanding in direction of the τ-axis (real time) i.e. bottom-up. This is why we compare the areas delineated by the curve (3), τ-axis and the coordinate of real time over and under the *t*-axis.

3. Conclusions

In the paper, advantages of introducing real logarithmic time are documented. By means of a modified function (3), Feigenbam limit showing the moment in which the order is transformed to the chaos can be derived [1, 3].

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