The accelerated expansion of the universe is explained by quantum field theory.

Abstract.

Formulas describing interactions, in fact, use the limiting speed of information transfer, and not the speed of light. This speed depends, both on the speed of light itself and on the expansion of the universe by Hubble. This leads to the fact that the limiting speed of information transfer varies depending on the distance and depending on the local site in question. This gives a different interaction when the particles are repelled from each other and when they are attracted. This leads to the appearance of a nonzero residual interaction. And this leads to an explanation of the accelerated expansion.

Keywords.

Speed of light, limiting speed, data transmission speed, electrical interaction, inertia, gravitational interaction.

01. Limiting speed.

It is known that the association of the Special Theory of Relativity and Quantum Mechanics gives good results in theoretical physics. An interesting result can be got, if to examine eventual small areas. But General Theory of relativity examines areas the size of that aspires to the zero. From the axiomatic theory of the field we know that the size of area, where the axioms of our physical space are executed, makes $5 * 10^{-18}$ m [1]. We will consider that within the limits of this area maximum speed of information transfer does not change. As is generally known, she is designated by the letter of "c" in the special theory of relativity.

Since it is known from the General Relativity Theory that there is a change in the metric with time and, accordingly, with the distance, in fact all our small areas cannot be considered as Inertial Systems of Counting, even if they had reference bodies. That is, it turns out that these are independent noninertial regions in which the existence of different limiting velocities is not forbidden. It is also clear that, depending on the distance from the observer, the change in the metric is different, according to the Hubble law, recalculated for a short distance instead of a megaparsec. Therefore, in the local areas located at different distances from the observer, the light (or similar to the light) signal will travel a different distance at the same time. The increase in distance due to the Hubble expansion is not inertial and occurs in the same frame of reference as the motion of the light signal. Therefore, we add velocities according to Galileo's formula, according to the Special Theory of Relativity. In addition, we remember that the visible part of the universe is considered to be practically flat, so that our small areas are all the more described by Euclidean geometry.

In fact, we have obtained that in different local areas independent of each other, information transfer occurs at different rates, that is, the value of the constant "c" for each local area is different. It is clear that the area located farther from the observer has a larger metric change, so the information transfer rate is greater there.

02. Interactions in the areas.

We now recall that the de Broglie wave (for an electron and a photon) is approximately $l_e = 2{,}4 * 10^{-12}$ m, which is 6 orders of magnitude larger than the size of the region under consideration, so we can not speak of a field in this area. For example, an electron is smaller than the considered area by more than 4 orders of magnitude. Consequently, in this area one can speak of a free charged particle, on which an extraneous "force" acts. By force is meant the time derivative of the momentum. This force is the usual Coulomb interaction. In general, the formula is complex. Therefore, let us consider a simplified special case of this formula for a force acting along the line of motion of a particle. The formula is simple and is described in the literature [2]:

$$\frac{dp}{dt} = \frac{m}{(1-\frac{v^2}{c^2})^{\frac{3}{2}}} \frac{dv}{dt} \qquad (1)$$

Now consider a simplified thought experiment. One charged particle A attracts by formula (1) another free charged particle T that moves along the straight line connecting A and T. If next to A is placed another particle B, with the same charge as A, but with another sign, then B will repel the particle T.

It is clear that the shift in some direction of the particle must be at least a smaller of the distances, or by the value of the local area. Therefore, the motion of the particle towards the observer will be in one local area. Removal will be in the more distant local area, relative to the observer. That is, they obtained that when the particle is removed, the information transfer rate should be considered more than when the particle is approached. We also remember the superposition of all interactions, and hence the possibility of considering each interaction separately.

03. The residual interaction formula.

We obtain formulas for certain residual interactions because of the difference in the limiting rates of information transfer in different local areas.

The additional speed is - u, because of the Hubble expansion, v - is the velocity of the particle T, c - is the velocity of the light signal. It should be clarified that here v is the particle velocity, which consists of the particle's own velocity and the velocity of the Hubble expansion at this distance. And the speed u is the extra speed due to the Hubble expansion, which appears due to the transition from one local area to another.

For simplicity of calculations, we shall assume in the local area where the attraction is considered, the influence of the Hubble expansion = 0. And in the region where repulsion is considered, the influence of the Hubble expansion gives an additional velocity u. We only need these two areas and the difference in them is the influence of the Hubble expansion on the speed of information transfer. The intrinsic particle velocities in v are certain mean-square velocities of such particles. Repulsive force f_1, other attraction force f_2.

$$f_1 = \frac{m}{\left(1-\frac{v^2}{(c+u)^2}\right)^{\frac{3}{2}}} \frac{dv}{dt} \tag{2}$$

$$f_2 = \frac{m}{\left(1-\frac{v^2}{c^2}\right)^{\frac{3}{2}}} \frac{dv}{dt} \tag{3}$$

03.01 Attraction.

Consider $v << c, u << c$. Then:

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

Our calculation is approximate. Acceleration we take in absolute value. A possible sign will be taken into account in the case of force. Positive direction is chosen - repulsion:

$$\Delta f = -f_2 + f_1 = m\frac{dv}{dt}\left(-\left(1 + \frac{3}{2}\frac{v^2}{c^2}\right) + \left(1 + \frac{3}{2}\left(\frac{v}{c}\right)^2\left(1 - 2\frac{u}{c}\right)\right)\right)$$

Or

$$\Delta f = -3m\left(\frac{v}{c}\right)^2 \frac{u}{c}\frac{dv}{dt} \tag{4}$$

That is, we have not a zero residual interaction.

03.02 Repulsion.

Now consider the case where $v \sim c, u << c$.

In this case, we are interested in particles that are aimed at removal, which is associated with the expansion of the universe. Therefore, the correction (in different local areas) to the particle velocity will be the same as for the information transfer rate.

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

Or in this case (symbol d), the forces will be:

$$f_1^d=\left(1-\frac{3}{2}\left(\frac{v}{c}\right)^2\left(1+2\frac{u(c-v)}{cv}\right)\right)m\frac{dv}{dt}$$

$$f_2^d=\left(1-\frac{3}{2}\left(\frac{v}{c}\right)^2\right)m\frac{dv}{dt}$$

Then

$$\Delta f^d=-3\left(\frac{v}{c}\right)^2\frac{u(c-v)}{cv}\ m\frac{dv}{dt} \qquad (5)$$

It is easy to see that at speed

$$v > c \qquad (6)$$

the force of attraction changes sign and becomes the force of repulsion.

It should be noted that we have a very rough estimate and the speed v is taken as the total velocity of the Universe runaway and the particle's own velocity for a given area.

If we take into account all possible particles, their finest fragmentation and superposition, then there will be a significant effect on the universe. Or to the Hubble expansion will be added and repulsion due to interaction (5).

In addition, it is very important to note that the farther from the observer, the greater the number of particles satisfying the value (6), since the expansion rate increases. In addition, the velocity component due to the Hubble expansion grows linearly with distance. This all should completely compensate for the decrease in the electrical interaction with the distance. Since the speed in the numerator in the second degree increases the interaction (5), and in the denominator the distance proportionally decreases the electrical interaction in the same formula.

04. Conclusion.

Have received a formula that explains the appearance of a force that accelerates the expansion of the universe. This force remains constant with increasing distance. This was discovered when investigating the expansion of the universe.

References:

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