Neutrino oscillations, Compton effect and dynamic model of a stationary Universe.

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Abstract: The mechanism of neutrino oscillations, which are the result of the Compton effect, that is, the scattering of CMB photons by neutrinos, is investigated. The scattering of high-energy photons by neutrinos leads to the formation of neutrons, which opens the way to the synthesis of baryonic matter in the Universe and restores the dynamic model of the stationary Universe. Confirmation of the stationary model of the Universe is the fact of the scattering of galaxies, which in fact is a consequence of the chaotic motion of galaxies in a limited volume. On an unlimited Universe scale, galaxies move randomly and therefore there are no Universe extensions.

Keywords: Neutrino oscillations, Compton effect, neutrino mass, dynamical model of the stationary Universe, scattering of galaxies, chaotic motion of galaxies.

INTRODUCTION.

The neutrino mass remains one of the main problems of modern physics. In this paper, we will try to predict the mass of neutrinos based on purely theoretical assumptions. For this we need to remember a little chemistry. For further explanation, we quote.

“It is more interesting to consider what happens to an electron in a region with linear dimensions smaller than the Compton wavelength of an electron. According to Heisenberg uncertainty in this area, we have a quantum mechanical uncertainty in the momentum of at least m*c and a quantum mechanical uncertainty in the energy of at least me*c^2:

$$\Delta p \geq me*c \text{ and } \Delta E \geq me*c^2$$

which is sufficient for the production of virtual electron-positron pairs. Therefore, in such a region the electron can no longer be regarded as a "point object", since it (an electron) spends part of its time in the state "electron + pair (positron + electron)". As a result of the above, an electron at distances smaller than the Compton length is a system with an infinite number of degrees of freedom and its interaction should be described within the framework of quantum field theory. Most importantly, the transition to the intermediate state "electron + pair (positron + electron)" carried per time ~ λc.e./c

$$\Delta t = \lambda c.e./c = 2.4263*10^{(-12)}/(3*10^8) = 8.1*10^{(-20)} \text{ s}$$

Now we will try to use all the above-mentioned to describe the chemical bond using Einstein's theory of relativity and Heisenberg's uncertainty principle. To do this, let's make one assumption: suppose that the wavelength of an electron on a Bohr orbit (the hydrogen atom) is the same Compton wavelength of an electron, but in another frame of reference, and as a result there is a 137-times greater Compton wavelength (due to the effects of relativity theory):

λc.e. = h/(me*c) = 2.4263*10^(-12) m

λb. = h/(me*v) = 2*π*R = 3.324 Å

λb./λc.e. = 137

where R = 0.529 Å, the Bohr radius.

Since the de Broglie wavelength in a hydrogen atom (according to Bohr) is 137 times larger than the Compton wavelength of an electron, it is quite logical to assume that the energy interactions will be 137 times weaker (the longer the photon wavelength, the lower the frequency, and hence the energy). We note that 1/137.036 is a fine structure constant, the fundamental physical constant characterizing the force of electromagnetic interaction was introduced into science in 1916 year by the German physicist Arnold Sommerfeld as a measure of relativistic corrections in describing atomic spectra within the framework of the model of the N. Bohr atom (therefore it is also called the constant of Sommerfeld) [78, 79]" [1].

And now let us recall such a wonderful discovery as cosmic microwave background (CMB). But suppose that the CMB is simply the spectrum of our Universe, and not the "echo" of the Big Bang. CMB is just the spectrum of our Universe, that is, it is the "macro-imprint" of the fundamental quantum world of the entire Universe. The fact that the CMB is the spectrum of our Universe strictly follows from the Interfering Model of the Universe, that is, the model in which each elementary particle fills the entire Universe in the literal sense [1, pp. 51 – 53].

Naturally, if we present the Universe as an interferential picture of all elementary particles, then such a Universe will have a certain spectrum. Moreover, in such a spectrum, the maximum will be determined by elementary particles, of which there will be more. It is clear that in our Universe most of all is neutrinos, let us recall the well-known fact that in a few seconds 10^14 neutrinos fly through our body without obstacles.

The maximum of the CMB is 1.8725*10^(-3) meters. "The CMB has a thermal black body spectrum at a temperature of 2.72548±0.00057 K.[4] The spectral radiance dEν/dν peaks at 160.23 GHz, in the microwave range of frequencies, corresponding to a photon energy of about

6.626×10^{-4} eV" [2, 3].

$$E = 6.626 \times 10^{-4}\ \text{eV} \quad \text{from this follows} \quad \lambda max = 1.8725 * 10^{-3}\ \text{m}.$$

$$E = mc^2, \ \lambda = h/(mc), \ h = 6{,}626 * 10^{-34}\ \text{J*s}$$

Therefore, if we again assume that this is the Compton wavelength of the neutrino (since the maximum), but only 137 times more due to the effects of the theory of relativity, as in the case of the de Broglie wave in the N. Bohr model, see above. The determination of the neutrino mass is not difficult:

$$\lambda max = \lambda c.n. * 137 = (h*137)/(m*c)= 1.8725 * 10^{-3}\ \text{m}$$

$$m(n) = (h * 137)/(\lambda max * c) = (h * 137)/(1.8725 * 10^{-3} * 3 * 10^{8}) = 1.616 * 10^{-37}\ \text{kg}.$$

$$m(n) = 1.616 * 10^{-37}\ \text{kg, or } 9.065 * 10^{-2}\ \text{eV}$$

where λc.n. - Compton wavelength neutrino,

λmax - maximum cosmic microwave background wavelength,

m(n) - neutrino mass, c - the speed of light.

Thus, we obtained a theoretical neutrino mass value of $1.616*10^{-37}$ kg or 0.09065 eV, which is consistent with the earlier made boundary predictions. This predicted neutrino mass should be considered as the average mass (arithmetic mean), since, due to oscillations, different types of neutrinos pass into each other.

$$\nu_e \leftrightarrow \nu_\mu,\ \nu_e \leftrightarrow \nu_\tau,\ \nu_\mu \leftrightarrow \nu_\tau$$

Mass m = $1.616*10^{-37}$ kg this is an average neutrino, that is, muon neutrino.

In terms of mass difference, there will be approximately the following alignment:

$m(1) = m(\nu_e) = 1.516*10^{-37}$ kg, this is the mass of the electron neutrino (0.08516 eV),

$m(2) = m(\nu_\mu) = 1.616*10^{-37}$ kg, this is the mass of the muon neutrino (0.09065 eV),

$m(3) = m(\nu_\tau) = 1.716*10^{-37}$ kg, this is the mass of the taon neutrino (0.09639 eV).

The sum of the masses of all three types of neutrinos is 0.2722 eV.

Our predictions are confirmed by calculations on the Grace supercomputer made by a group of scientists based on cosmological observations [4]: the mass of the electron neutrino is 0.086 eV, the sum of the masses of all three types of neutrinos is 0,26 eV.

The question of why the Compton wave in both the electron and the neutrino in the "world of chemical bonds" is 137 times larger than its normal value needs further research. But, now we can definitely say that this is due to the passage of time in various reference systems. More precisely, it can be said that this is due to the lack of time at the quantum level (in the Compton wavelength region), and with a certain dependence of the formation of the "arrow of time" in the "world of chemical bonds" and in our world [5].

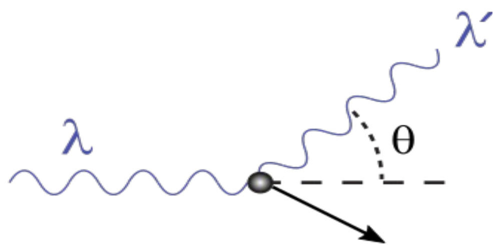
The fact that the neutrino has mass was shown by Takaaki Kajita (Japanese 梶 田 隆 章) and Arthur Bruce McDonald, for which they received the 2015 Nobel Prize in Physics "for the discovery of neutrino oscillations showing that neutrinos have mass" [6]. The idea of neutrino oscillations was first put forward by the Soviet-Italian physicist B. M. Pontecorvo in 1957 [7].

RESULTS AND DISCUSSION.

The cause of the neutrino oscillations is the Compton effect. Yes, yes, it is precisely the Compton effect (scattering of CMB photons on different types of neutrinos) that causes the neutrino oscillations, both the direct and the reverse. Moreover, developing these arguments, it is easy to come up with an explanation of baryonic asymmetry. But, to begin with, we will analyze the Compton effect and its cause, after this neutrino oscillations can be easily explained.

The Compton effect is the scattering of high-energy photons (X-ray photons) by free electrons [8]. Photons before and after scattering do not interfere, that is, they are incoherent. The effect is accompanied by a change in the frequency of photons (the frequency decreases), part of the energy of which, after scattering, is transferred to electrons (and therefore electrons increase their speed). Note that the energy of photons is greater than the energy of electrons, so photons give energy to electrons. If the electron energy is greater (relativistic electron velocities), then the electrons transfer part of the energy to photons (photons will increase the frequency), and this is called the inverse Compton effect.

We proceed to consider the effect in more detail. Let's look at the picture [9].



When a photon is scattered by a free electron, the photon wavelength λ and λ '(before and after scattering, respectively) are related by the relation:

$$\lambda' - \lambda = \lambda c.e. (1 — \cos \theta)$$

where λ - is the initial wavelength,

λ' - is the wavelength after scattering,

$\lambda c.e.$ - is the Compton wavelength of the electron, called the Compton shift:

$$\lambda c.e. = h/(me*c) = 2.4263 * 10^{(-12)} m$$

θ - is the scattering angle, i.e., the angle between the directions of photon propagation before and after scattering,

me — is the electron rest mass,

c — is the speed of light,

h – is the Planck constant.

The Compton effect is one of the proofs of the existence of wave-particle duality of microparticles and confirms the existence of photons (corpuscles). That is, the Compton effect is essentially a confirmation of the existence of quanta (an energy quantum is transferred from a photon to an electron). It can be argued that the Compton effect conveys the essence of quantum effects. Consider this in more detail.

In the Compton effect, a quantum of energy is transferred from one particle to another. And simplified, this process can be represented as a collision of billiard balls (a collision of two corpuscles), see figure [10].

But, is this analogy true that conveys the meaning of the Compton effect? At first glance, it seems that it is true: in billiards we have two balls before the collision (in general, with different speeds), and after the collision we have the same two balls, but with different kinetic energies. In the Compton effect, we also have an electron and a photon before the collision, then we have a quantum interaction, and after the interaction we again have a photon and an electron. That is, the collision of billiard balls correctly conveys the meaning of the Compton effect? No, there is a fundamental difference: during the collision of billiard balls, the particles themselves (balls) do not change, but only their kinetic energy changes (the balls remain the same).

In the Compton effect, after interaction, we already have a different photon (with a different frequency), that is, we already have a different particle (but the same electron). Thus, with the Compton effect, not only the transfer of a quantum of energy occurs (as in the collision of billiard balls), but also the transformation of one elementary particle into another: one photon turns into another. I think there is no need to explain that a photon with a frequency ν, and a photon with a frequency ν', are various elementary particles that without quantum interaction do not turn into each other. And each of these photons can live forever (under certain conditions). It is unforgettable that a photon is a fundamental particle.

Thus, with the Compton effect, one particle is transformed into another (in this case, photons). And therefore, we can write it in general form:

photon 1 + electron (speed v1) = photon 2 + electron (speed v2)

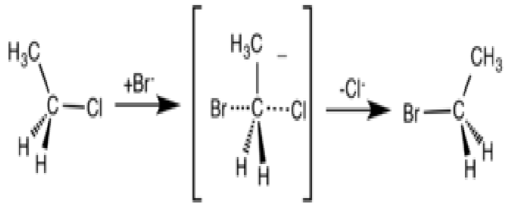
But it's important that one particle (photon 1) turns into another particle (photon2). Therefore (since a photon is an ordinary fundamental particle), this means only one thing: other elementary particles (except photons) in the Compton effect (in the general case) can also turn into other elementary particles. Let us now add another condition under which quantum interaction occurs between particles: the distance between elementary particles should not exceed the de Broglie wavelength for each particle. Now we have a complete picture of quantum interactions.

It is easy to pass from the Compton effect to the general picture of quantum interactions if we recall the scientific feat of Louis de Broglie, who generalized the particle-wave nature of the photon to all elementary particles. We will do this and we will generalize the Compton effect to all quantum interactions between elementary particles.

In quantum interactions of two elementary particles, not only does a quantum of energy transfer from one particle to another, but one micro-particle transforms into another micro-particle, that is, the internal structure of the particles changes. This transformation of particles obeys the law of conservation of energy and the law of conservation of charge. Now we can write down the Compton effect in the general case:

photon 1 + micro-particle 1 = photon 2 + micro-particle 2

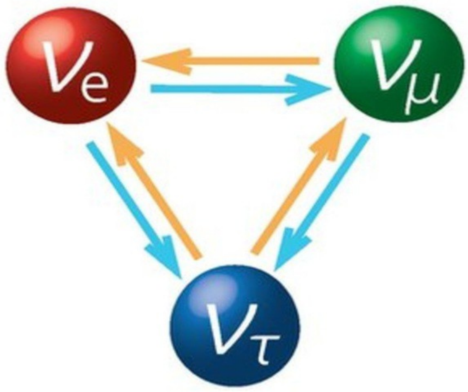
We will not analyze the energy balance of the Compton effect, since this is a well-known and obvious fact. We draw attention to the fact that the quantum interaction of two micro-particles is very similar to the transition state in organic chemical reactions, for example, in the SN2 reaction. In chemical reactions, some chemical bonds are destroyed, while other chemical bonds are formed. This is the meaning of chemical transformations. In the SN2 reaction (and many other organic reactions), in the transition state, the “old” chemical bonds have not yet been destroyed, and the “new” chemical bonds have not yet formed. This is the meaning of the transition state in chemistry. And this is a complete analogy of quantum interaction. Let's look at the picture of the transition state [11].



In parentheses, the transition state of the SN2 chemical reaction (second order nucleophilic substitution): the C-Cl bond has not yet broken (this is the “old” chemical bond), and C-Br has not yet formed (this is the “new” chemical bond). Note: the nucleophile (bromine anion) attacks the molecule, and the nucleophile (chlorine anion) is also released as a result of the reaction. Nucleophilicity is the “ability” of anion (in the general case of a particle) to donate its lone pair of electrons to the formation of a new chemical bond.

Quantum interaction occurs at a certain distance between particles, and this distance should be less than the de Broglie wavelength for these particles. A quantum interaction, like a chemical reaction, must pass through its “transition state”. In the "quantum transition state", the energy quantum is already absorbed (there are no "old" particles), but the "new" ones have not yet formed, therefore the "transition quantum state". This is followed by the "birth" from this "energy mixture" of already "new" particles. The "birth" of new particles occurs with the conservation of the law of conservation of energy and the law of conservation of charge.

In the classical Compton effect, an electron cannot turn into another particle, since the total energy of the transition state does not allow the formation of other particles. And if, under the conditions of the Compton effect, new particles can theoretically form, then they will form! An example is the neutrino oscillation! Look at the picture [12].



Given the general Compton effect, it is easy to explain neutrino oscillations as the scattering of CMB photons on neutrinos (the total energy of the CMB photon and neutrino allows this transformation):

$$h\nu 1 + \text{neutrino } 1 = h\nu 2 + \text{neutrino } 2$$

where hν1 - is the CMB photon, hν2 — photon after radiation.

With the direct Compton effect (when CMB photons give off a quantum of neutrino energy), light neutrinos will transform into heavier ones: electron to muon, electron to tau, muon to tau. In the opposite Compton effect (when relativistic neutrinos transfer an energy quantum to CMB photons), heavy neutrinos will be converted into lighter ones: muon to electron, tau to muon, and tau to electronic. Since the CMB uniformly fills the entire Universe the percentage of conversion of one type of neutrino into another type of neutrino will correlate with the lifetime of the neutrino, and after a certain time, equilibrium will be established. when all three types of neutrinos will be 1/3. Note that for this we need to accept the fact that all three neutrinos (electron, muon and tau) are ordinary elementary particles. This is enough to explain the neutrino oscillations as the Compton effect of neutrinos on CMB photons.

Given the overall Compton effect:

photon 1 + microparticle 1 = photon 2 + microparticle 2

baryonic asymmetry can be easily explained (the predominance of matter in the universe over antimatter). To do this, we need to accept the fact that a very high-energy γ-quantum interacts with a neutrino, and as a result of the reaction, a neutron and a low-energy photon are formed:

high-energy γ-quantum (photon 1) + neutrino = photon 2 + neutron

We write this equation in the form:

$$\gamma + \nu_e = n + h\nu$$

where γ — is a high-energy gamma quantum,

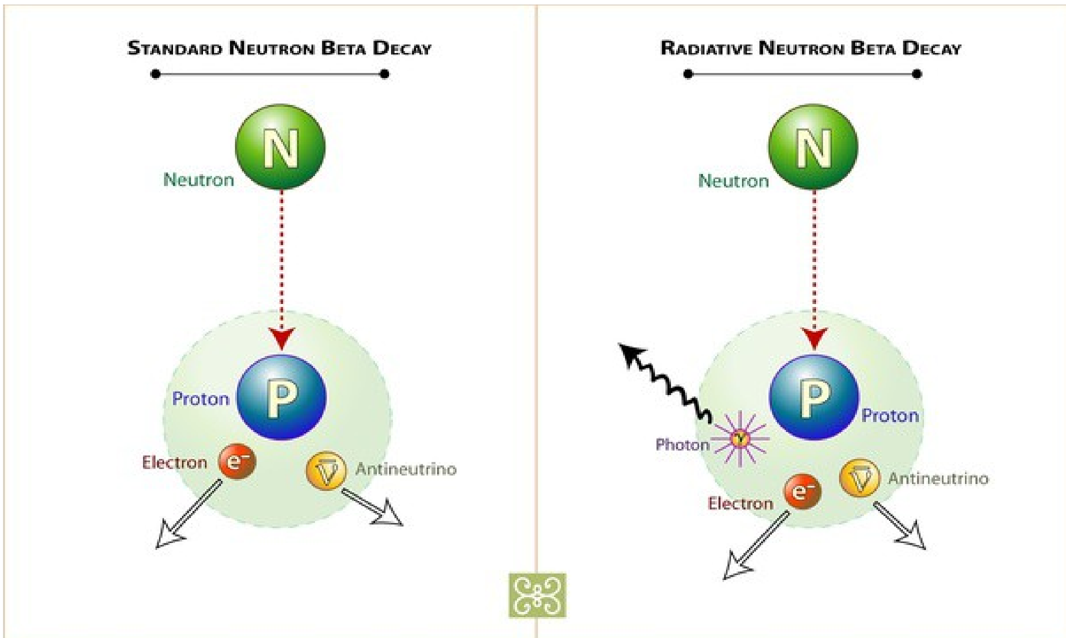
ν_e — is a neutrino (let it be electronic, but any can),

n - is a neutron,

hν — is a low-energy photon (compared to a γ - photon), since the energy of a γ - photon was used to form a neutron.

Surprisingly, the neutrino confirmed its name: a neutrino, that is, a small neutron, in quantum interaction with a high-energy γ - quantum transforms into a neutron. The name "neutrino" (Italian, neutrino), that is, diminutive of neutron, was given to the particle by the Italian theoretical physicist Enrico Fermi [13].

Thus, when a gamma quantum interacts with a neutrino, the neutrino turns into a neutron (this is the “ordinary”, generalized Compton effect), and a low-energy photon is emitted. It is clear that in this transformation it is impossible to obtain quarks in a “pure” form (as elementary particles), since this prohibits the law of conservation of charge. Next, the formed neutron decays into a proton, electron and antineutrino [14]:



A neutron has a mass m = 1.675*10^(-27) kg, or 939.565 MeV, therefore the energy of the γ-photon should be similar, that is, approximately 1 GeV. In cosmic rays such photons abound. The energies of gamma rays that are observed in cosmic rays can exceed hundreds of GeV. Considering that there are photons of necessary energy in cosmic rays, the formation of neutrons will occur continuously (scattering of photons on neutrinos, neutrinos in space are in huge numbers).

After neutron decay, we have all the particles to build matter: a neutron, a proton, and an electron. The "assembly" of a hydrogen atom is obvious. But, if anti-neutrino is formed during neutron decay, then the process of antimatter formation is completely analogous, and therefore the amount of matter production will exactly correspond to the amount of antimatter. Here, the process of oscillating an anti-neutrino into a neutrino will help us. It will also be the general Compton effect, that is, the scattering of CMB photons on anti-neutrinos:

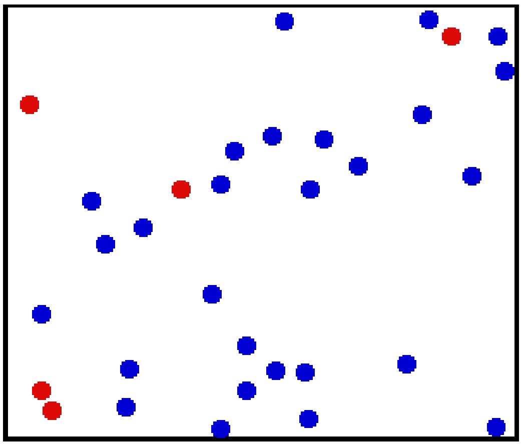
anti-neutrino + photon1 = neutrino + photon 2

Namely, the oscillations of anti-neutrinos in neutrinos (and vice versa) "guarantee" that "excess" of baryonic matter will always be formed. If there were no anti-neutrino oscillations in the neutrino (and vice versa), then the formation of baryonic matter would be impossible.

The neutrino in the process of the formation of baryonic matter from gamma rays acts as a "catalyst". Since it is a neutrino that initiates the conversion of a gamma quantum into a neutron, next the neutron decays into an anti-neutrino (as well as a proton and an electron), and next the anti-neutrino turns again into a neutrino (anti-neutrino oscillations into neutrinos). This is a very good analogy to a catalyst in chemical reactions. Compare with the definition of a catalyst: “A catalyst is a chemical that accelerates a reaction but does not diverge during a reaction”. Cosmic chemistry from gamma rays synthesizes baryonic matter! And the catalyst for the synthesis process is neutrino!

We can describe the cycle of energy and matter in the Universe (photons - baryonic matter, baryonic matter - photons). Let the universe have only photons. Given the generalized Compton effect, and using neutrino as a catalyst, we can synthesize baryonic matter (hydrogen). Stars are formed from hydrogen, and then, given the evolution of stars, we get the rest of the variety of baryonic matter. Neutrinos and antineutrinos are born and disappear from photons (like an ordinary pair of particles - antiparticles in vacuum). But, baryonic matter, sooner or later will end up in a black hole, and given the evolution of the black hole we will again receive photons [15] (the black hole will be annihilated, that is, it will turn into photons). The process of converting baryonic matter into photons (and vice versa) can last an infinite amount time. Moreover, this process is ongoing. Not all baryonic matter in the Universe turns into photons, but only that part of it that fell into a black hole. Similarly, the process of synthesis of baryonic matter also occurs constantly. Nature has solved the most difficult problem very elegantly!

It is interesting to note that the scattering of galaxies is a simple consequence of the chaotic motion of galaxies. Let us turn to a thought experiment. For clarity, imagine the Brownian motion of particles. See picture [16, 17].



The Brownian motion is the chaotic motion of the microscopic visible particles of a solid suspended in a liquid, which is caused by the thermal motion of the particles of the liquid.

And now, let the galaxies move randomly instead of solid particles. And consider the fact that galaxies in a collision can:

1) bounce off each other (elastic hit),

2) pass through each other, and then move away from each other,

3) they merge (inelastic hit).

Now let's think about what picture will be in a long time, if we know that the galaxies during the collision will mainly pass through each other, or merge into a single galaxy... That's right! After some time, from a fixed position, we will see the scattering of galaxies...

That is, the scattering of galaxies is a simple consequence of the chaotic motion of galaxies in the Universe (at first, when the distances between them are relatively small). Further, when the galaxies have already interacted, and began to move away from each other, they will begin to accelerate due to gravity [18] (at large distances), and we will see the already familiar picture of the scattering of galaxies. For a more detailed analysis of this issue about the acceleration of galaxies due to gravity, see the link 18.

Since the speed of light is finite, the observer will always see a part of the Universe with the h0 radius, that is, the limited volume of the Universe [18]. And in a limited volume of the Universe, an observer (from the center) after a while will see the scattering of galaxies. If we now move from a limited volume of the Universe (a certain radius h0) to a limitless Universe in space, there will be no scattering of galaxies. And there will be the usual chaotic motion of galaxies on the scale of the entire Universe, similar to the Brownian motion. From which it follows that our Universe is not expanding, but is a stationary dynamic system.

CONCLUSION.

Thus neutrino oscillations, which in reality are the transformation of some elementary particles into others under the action of photon energy actually revives, the dynamic model of a stationary Universe. The scattering of high-energy photons by neutrinos leads to the synthesis of neutrons, that is, in fact to the formation of baryonic matter. Baryonic asymmetry arises as a result of neutrino oscillations in antineutrinos. Considering the fact that in black holes there is a conversion of baryonic matter into photons, we obtain a closed cycle of conversion of photons into baryons and baryons into photons, that is, a dynamic model of the stationary Universe, which was developed by Fred Hoyle, Thomas Gold, Herman Bondi and others scientists [19, 20].

Since the scattering of galaxies is simply a consequence of the chaotic movement of galaxies in a limited volume of the visible part of the Universe,the model of a stationary Universe receives one more significant confirmation, since the unstationary of the Universe resulted from its expansion. And if there is no expansion of the Universe, but there is a simple chaotic motion of galaxies on the scale of the Universe, then the stationary model of our Universe restores its positions automatically, which is also confirmed by the circulation of energy and matter.

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