Cosmological gamma-ray bursts as a result of simultaneous "evaporation" of black holes.

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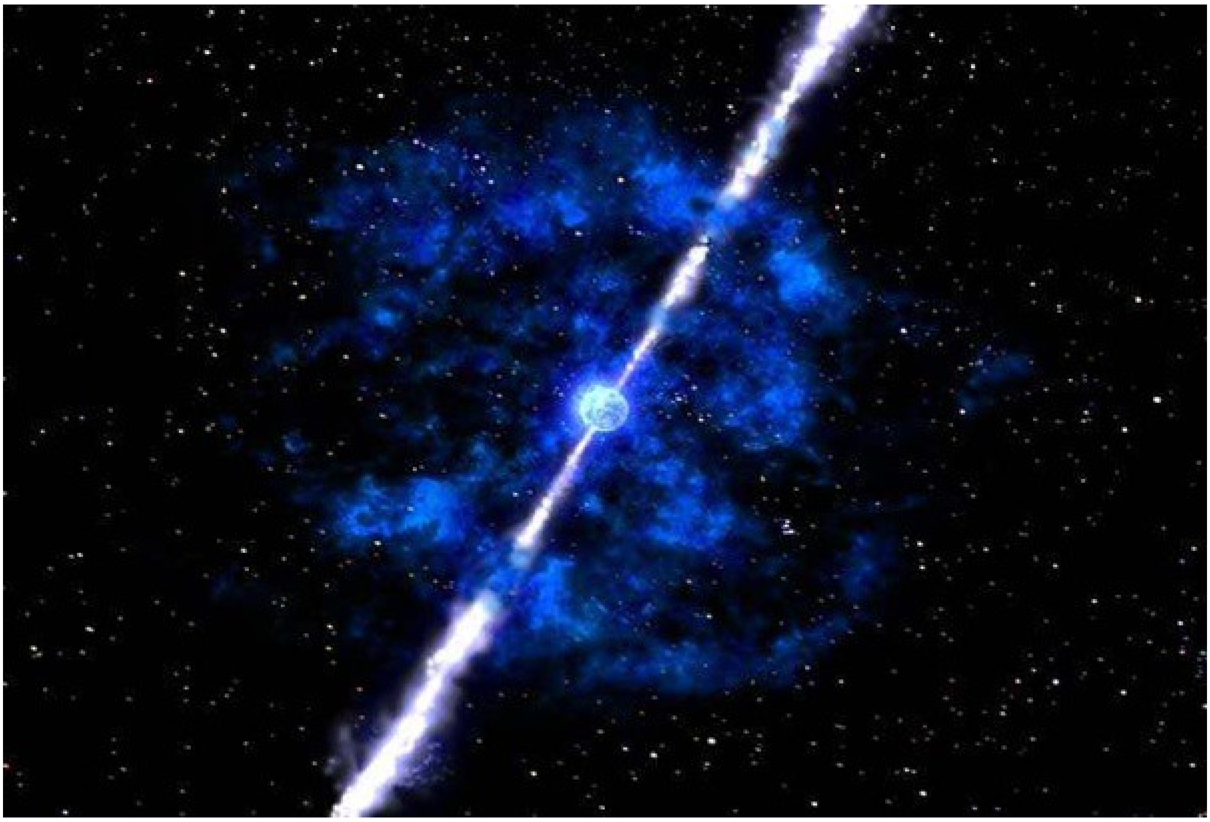
Abstract: A new theory is proposed here a cosmological gamma ray bursts. In black holes, the matter annihilates with the formation of virtual photons (bosons), due to the lag of the gravitational field effect. The effect of the lag of the gravitational field leads to an increase in the speed of rotation of the black hole. But, since the rotation speed cannot exceed the speed of light in a vacuum, then at a certain "deformation" of the space-time continuum, inevitably begins the annihilation of matter with the formation of virtual photons (at the first stage). After complete annihilation, all virtual photons are one-momentally radiated and a become a real photons, therefore, we see a cosmological gamma-ray burst, early radiation did not occur due to the slowing down (actually stopping) of time in a black hole.

Keywords: cosmological gamma ray bursts, black holes, gravitational field lag effect, galaxy, virtual photons, Louis de Broglie oscillatory hypothesis.

INTRODUCTION.

Cosmological gamma-ray bursts are one of the most grandiose and mysterious events in our Universe. The gigantic energy, which is released in a split second, amazes the imagination, the distance at which they occur is literally "the edge of the Universe". On average, 1.5 new scientific publications on cosmic gamma-ray bursts enter literature every day [1]. But despite this, there is no generally accepted theory describing this natural phenomenon. The classic definition of gamma-ray bursts is: a cosmological gamma ray burst is a gigantic short-term cosmic emission of energy in the form of gamma radiation with photon energy from 30 KeV - 500 KeV up to 100 GeV, lasting from a few seconds to ten seconds (can last from milliseconds to an hour). It is very important to note that the energy of photons with E > 500 KeV is beyond the electron-positron pair production threshold, that is, if one imagines that gamma-quanta are born by particle annihilation, then these particles must be heavier than electrons and positrons. The initial burst is followed by a long-lived "afterglow" emitted at longer wavelengths (X-ray, UV, optics, IR, radio). Most of the observed gamma ray bursts is a relatively narrow beam of high-power radiation emitted during a flash, see figure (Illustration of gamma ray burst (NASA/Zhang & Woosley)):



Such a gamma ray literally illuminates and “pierces” the entire visible Universe. The giant photon energy of this “gamma spotlight” will destroy all life on its way (if a gamma ray burst hits a living thing and they are in the same galaxy, then there is no chance to survive, if the gamma ray burst comes from another galaxy, then the chances of survival increase by as the distance from the source of the beam). Sources of gamma ray bursts are located billions of light-years from Earth, which indicates their extreme power and rarity. In just a few seconds of the flash, as much energy is released as the Sun would have allocated for 10 billion years of glow, the Sun’s rest energy is actually released (literally, according to Einstein's formula E = m*c^2, the mass of our Sun is processed into radiation). For a million years, only a few gamma ray bursts are found in one galaxy. All observable gamma ray bursts occur outside of our galaxy (remind that we consider the "cosmological" gamma ray bursts that come from other galaxies).

For the first time, a gamma ray burst was accidentally registered on July 2 in 1967 by the American military satellite "Vela" [2]. More than 50 years have passed, a lot of gamma ray bursts have been registered, hundreds of theoretical models have been built, but nevertheless the process of researching gamma ray bursts is far from finished and gamma ray bursts remain one of the biggest mysteries of astrophysics. The greatest surprise is the release in a few seconds of a grandiose energy (the rest energy of the stars) in the form of gamma photons, and the photons have energy from 30 KeV to truly enormous 100 GeV and more (ultra-high energy gamma radiation).

RESULTS AND DISCUSSION.

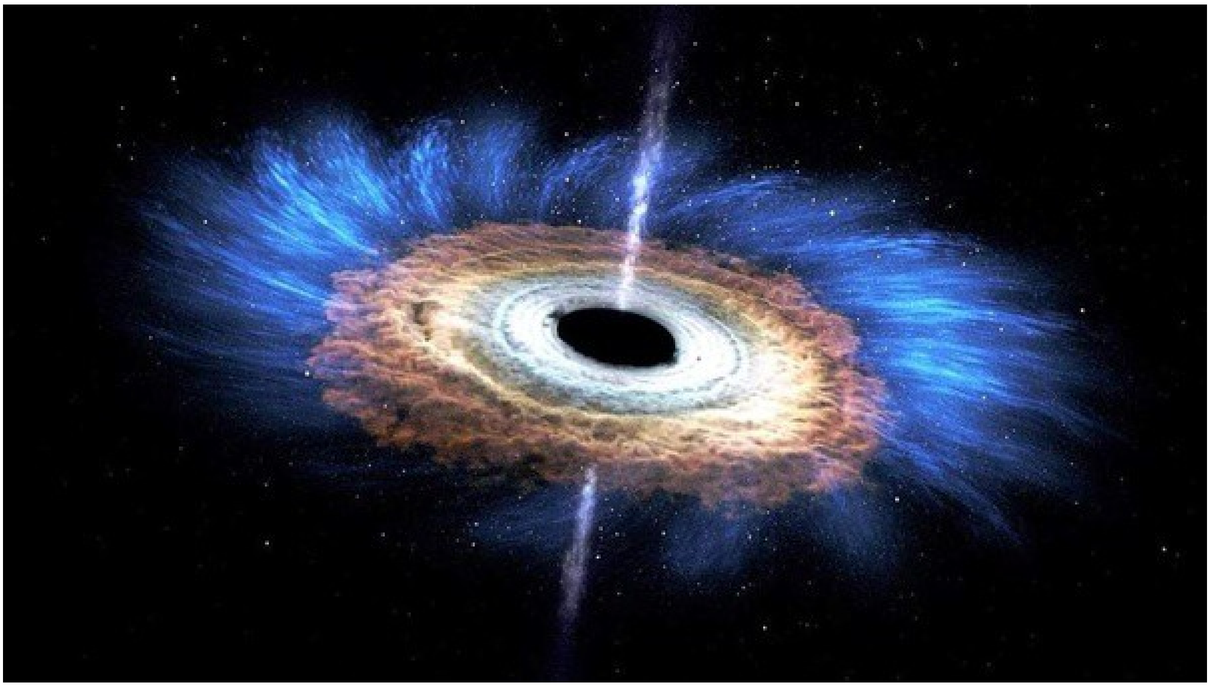
It can be shown that annihilation of black holes (after their complete evolutionary cycle) cause the cosmological gamma ray bursts. But, in order to arrive at this paradoxical conclusion, we must first remember as the effect of the gravitational field lag leads to an increase in the speed of rotation of the outer regions of galaxies [3]:

«The above quotations logically explain the anomalously high speed of rotation of the outer regions of galaxies (it is in fact the same): since the velocity of propagation of the gravitational interaction is equal to the speed of light, an increase in the velocity of the masses will always be used to compensate for the retarded potential (the field lag). The increase in the velocity of the masses will always be used (the greater the velocity of the masses, the stronger the gravitation), since this is the only way to maintain the constancy of the rate of gravitational interaction, and otherwise can not be (according to GRT).

In other words, if we have a system of masses (for example, a galaxy), then this system in a certain way curvature the space-time continuum, which expresses the metric tensor corresponding to this curvature in accordance with general relativity. But, the gravitational interaction is constant and equal to the speed of light. Therefore, in order for the corresponding, curved space-time continuum to satisfy this condition (the constancy of the velocity of gravity equal to the speed of light between different masses in this continuum), the gravitational field of the mass system must have a certain intensity (energy) that is regulated by the speed of the masses themselves. That is, if the mass system is large (for example, a galaxy), then in order to compensate for the retarded potential effect (in other words, the field lag), the masses will need to increase the speed, which is observed with the rotation speeds of the outer regions of galaxies. Naturally, the larger the distance at which the interaction takes place (if other components are equal), then the field delay will be stronger and the masses will be more accelerated, and therefore an anomalous increase in the rotation rates of the outer regions of the galaxies is noticed. If there were no increase in the velocities of mass motion, then the speed of gravitational interaction (between masses in the given system) would be greater than the speed of light, and according to the general theory of Einstein this is impossible, hence the effect of mass acceleration».

Now let's analyze what happens in the center of the galaxy (remember that because of the finiteness of the speed of gravitational interaction, there arises an "effect of the gravitational field lag", which leads to an increase in the rotational speeds of the outer galactic regions. For clarity, look at the photo of the Andromeda galaxy (Robert Gendler/Science Photo Library via Getty Images):

The outer regions of the galaxy are accelerating, but the effect of the field lag that led to this, it acts not only on the outer regions of the galaxy, but also on the center of the galaxy. The gravitational field of the system of masses due to the effect of the field lag should have a certain intensity (energy), which is governed by the speed of the masses themselves (let us select, for example, the center of the galaxy and a certain outer area - a bright star). The outer area of the galaxy (star) is accelerating, the center of the galaxy should also accelerate, that is, Galactic Center will more intensively rotate around its axis, since this is the only way to increase the intensity of the gravitational field in the center (at this stage it is not essential what the center of the galaxy). The Galactic Center sizes are significantly smaller than the galaxy sizes, therefore the outer layers of the Galactic Center will rotate at speeds much larger than the outer areas of the galaxy. It is also natural that the Galactic Center of the galaxy will gravitationally interact with all parts of the galaxy, so the intensity of the gravitational field in the center of the galaxy will be much greater than at the periphery, which will be manifested by an increase in the mass of the Galactic Center of the galaxy (such as pumping masses in galactic center compare with the flow of dark matter into the center of galaxies), and also with a significant increase in the rotation speed of the Galactic Center. But the speed of the body (which has a non-zero rest mass) in our Universe has its limit, and this limit is the speed of light in a vacuum. Therefore, the outer layers of the Galactic Center cannot rotate at the speed of light, or at a speed greater than the speed of light. But the “pumping” of the mass in the center of the galaxy and the increase in the rotation speed of the Galactic Center are associated with the mass and size of the galaxy (i.e., are independent), and therefore at a certain point in time a situation may arise when the effect of field lag will force the outer layers of the Galactic Center to rotate speed greater than the speed of light. But this cannot be by definition (in accordance with A. Einstein's theory of relativity). What then will happen? To answer the question, let us remember which particle can move at the speed of light. The answer is obvious: this is a real photon, which has a rest mass equal to zero (a virtual photon can have a speed much higher than the speed of light in a vacuum). This inevitably implies that in the situation described above (when the outer layers of the Galactic Center should rotate at a speed greater than the speed of light), the baryonic matter of the outer layers will begin to be "transformed" into photons (that is, the annihilation process actually takes place), and on the outer layer of Galactic Center photons will rotate (the nature of these photons, their "movement", we will consider further in the text), and they will not be able to leave this layer. So the black hole is born. The outer side of the Galactic Center (that is, the de facto black hole) photons will not be able to leave due to the giant gravitational attraction to the center of the Galactic Center. For an illustration of this, look at the image of a black hole (A star getting ripped apart by a black hole. NASA's Goddard Space Flight Center):



Naturally, the radius of the Galactic Center on which photons must move at the speed of light is called the "gravitational radius", which in the simplest case of a spherically symmetric black hole is equal to the Schwarzschild radius. But it is interesting to note that at distances smaller than the Galactic Center radius, that is, at distances smaller than the gravitational radius, the rotation speed of the Galactic Center will be less than the speed of light (after a certain thickness of the photon layer) and therefore towards the center of "transformed" in photons will not occur (more precisely, it is not so critical). But, due to the gigantic intensity of the gravitational field, all the baryonic matter in the center of the Galactic Center (with a certain radius less than the gravitational radius) will be literally crushed into non-structure particles, that is, fundamental particles, namely leptons and quarks.

And therefore, in the center of the Galactic Center (or black hole) there will actually be a quark-gluon plasma with impurities of electrons and positrons (more precisely, leptons). The fact that, under the pressure of a black hole, baryonic matter goes into the "bouillon" of fundamental, that is, structureless particles, is logical due to the fact that a structureless particle cannot be further "crushed and divided", this is an indivisible foundation of our matter. The pressure of a black hole can be accepted either very large, or even infinitely large, therefore with such a "squeezing" of baryonic matter we will get only structureless particles.

Let us make a small digression about the quark-gluon plasma. According to the Big Bang theory, during the first moments of the explosion, the substance also remained in a state of quark-gluon plasma for some time. Now, a quark-gluon plasma can form for a short time during collisions of very high energy particles (the lifetime of a quark-gluon plasma is billionths of a split second). But considering that time in black holes is significantly slowed down (according to the theory of relativity), the formation and existence of quark-gluon plasma in black holes is quite reliable. This is confirmed by the fact that according to the results of some studies, there is a quark-gluon plasma in the center of neutron stars. There is also a hypothesis that atomic nuclei in their composition, in addition to protons and neutrons, contain "droplets" of quark-gluon plasma (the nucleus is considered as a heterophase system).

Let us return to our galaxy Galactic Center (that is, to the black hole): if for some reason the intensity of the Galactic Center gravitational field increases (due to the fall of a substance on it, or again due to the effect of the field lagging), then "transformed" quark-gluon plasma in photons will continue and the width of the "photon layer" will grow (the ball of the "photon layer" will grow from the periphery to the center). Therefore, gradually, as the intensity of the Galactic Center (black hole) gravitational field increases, the thickness of the "photon layer" will increase (the number of quark-gluon plasma will decrease). As this happens, the pressure inside the "photon layer", which is actually the "boson layer", will also increase and will obey the Bose-Einstein statistics.

Considering the wave-particle nature of the particles, the "photon ball" can be represented in two ways.

The first way is as the movement of real photons in a circle at the speed of light. It should be noted that if there was a movement of real photons, then theoretically (with some assumptions) they could leave the black hole, which is impossible by definition.

The second way is as the movement of virtual photons in the "photon sphere". It is important that when a virtual photon moves, momentum is preserved (virtual photons transfer momentum, but not energy), and therefore the angular momentum of the galaxy during the "transforming" of quark-gluon plasma into virtual photons will be preserved. Virtual photons cannot be emitted by definition (in our case), since time actually stopped in a black hole, and they simply do not have time to "radiate".

It is well known that the separation of particles into real and virtual has an exact meaning only in the absence of a strong external field and is ambiguous in areas of space-time, where the external field is strong. But, due to a strong deceleration of time in a black hole (Galactic Center), actually stopping it, this condition does not apply to our situation: what a strong field can be or radiation if the time has de facto stopped, everything will be weak and quasi-weak. Virtual photons move at a speed much higher than the speed of light in a vacuum, so we must recognize our photons ("photon ball") as virtual photons. And it is virtual photons that are formed during the annihilation of quark-gluon plasma in a black hole, which due to the effect of time dilation do not have time to "radiate", that is, go into real photons. This outer layer of virtual photons (black hole) will have a temperature close to absolute zero, since virtual photons do not transfer energy (the energy of a virtual photon is zero, $E = 0$) and therefore there will be no heating, which is observed in reality (and this despite the quark-gluon plasma in the center).

It is worth noting that when annihilation of a quark-gluon plasma produces virtual photons whose energy is zero, the energy does not disappear anywhere, since time actually stopped, and the "violation" of the energy conservation law for such an insignificantly small time period Δt (actually $\Delta t \to 0$, $\Delta t \sim 0$, but it (period of time) goes on forever) allowed by Heisenberg uncertainty principle for energy ΔE:

$$\Delta E * \Delta t \geq \hbar/2$$

After the emission of a gamma ray burst (in fact, the black hole evaporates), all the energy "returns" and the energy conservation law is not violated (it was broken for an insignificantly short period of time $\Delta t \to 0$, $\Delta t \sim 0$).

It is necessary to clarify that $\Delta E = 0$ for photons follows from the fact that if an infinitely small period of time $\Delta t \sim 0$ lasts indefinitely long (observer in a black hole), then in the Heisenberg uncertainty principle will be put its “real” duration in a black hole, that is, $\Delta t \sim \infty$, and from the uncertainty principle we get $\Delta E \sim 0$.

An infinitely small period of time ($\Delta t \to 0$, $\Delta t \sim 0$) can be represented as the oscillation period of elementary particles according to Louis de Broglie [4, 5]: “In quantum theory, I assumed that there is a periodic process associated with the electron as a whole (the material point). This process for an observer stationary relative to an electron would occur over the whole space with the same phase and would have a frequency γ = (m*c^2)/h”.

From this frequency we can easily obtain the oscillation period of the electron (note that the Louis de Broglie oscillation hypothesis can be applied to all elementary particles, including photons):

$$E = h*\gamma = m*c^2$$
$$\Delta T = 1/\gamma = h/(m*c^2)$$

From here it becomes clear that the electron oscillation period is 8.09 * 10^(- 21) second:

$$\Delta T = 1/\gamma = h/(me*c^2) = 8.09 * 10^{-21}\ s$$

and in the black hole this oscillation period becomes infinitely large, that is,

$$\Delta T \sim \infty$$

or 8.09 * 10^(- 21) s → ∞,

$\Delta T \to \infty$.

Therefore, during the annihilation of a positron and an electron in a black hole, there is impossible emission of real photons, since $\Delta T \to \infty$, therefore virtual photons are formed.

In the general case, a virtual particle is an object that is characterized by almost all the quantum numbers inherent in a real elementary particle, but for which the relationship between the energy and the momentum of the particle is broken. Virtual particles, having been born, cannot “fly away to infinity,” they must either be absorbed by a particle, or disintegrate into real particles. But, our virtual photons can violate this “prohibition” due to the effect of time dilation (actually stopping it) and therefore virtual photons of the “photon layer” exist indefinitely.

Fundamental interactions known in physics occur in the form of exchange of virtual particles (according to the wave-particle duality principle and the principle of close interaction, any interaction between elementary particles consists in the exchange of field quanta ensuring this interaction). The relativistic-invariant quantity Q^2 = E^2 - (pc)^2 - (mc^2)^2 is taken as a measure of virtuality of a particle, and Q^2 can take both positive and negative values. The energy-momentum vector of a virtual particle can be spacelike. Therefore, the same process with the participation of a virtual particle for observers in different reference systems may look different:

from the point of view of one observer, the process may be the emission of a virtual particle, and from the point of view of another observer, this same process will be the absorption of a virtual antiparticle. The speed of a virtual particle has no direct physical meaning, virtual photons have an infinitely large speed. This follows from the fact that the speed of a virtual particle is determined from its momentum p, energy E, and the speed of light by the formula:

$$v = (p*c^2)/E$$

For virtual photons, $E = 0$, $p > 0$, from which infinite speed follows.

The virtual photons around the circumference "envelop" the "photon ball" of the black hole with their wave, and make it possible to present all the photons of the black hole (or Galactic Center) in a state of superposition (see further in the text). Strictly speaking, the virtual interaction distance does not exceed the Compton wavelength of a quantum (interaction carrier, in our case, a photon). And therefore for virtual photons, the range is not limited (the rest mass of the photon is zero, and from the De Broglie formula we get an unlimited radius), and therefore the virtual wavelength will be consistent with the characteristic dimensions of the black hole.

In the process of evolution of the above considered Galactic Center of the galaxy (or a black hole in the center of the galaxy), in the end, at some point in time, the entire quark-gluon plasma will be "transformed" into virtual photons, and in the center of such a "photon ball" formed the last several virtual photons. At this moment, our Galactic Center will be a giant superposition of virtual photons, which will instantly turn into real photons, which will produce a giant gamma-ray burst.

It should be noted that quark-gluon plasma is an opaque ideal fluid [6, 7]. In addition, the quark-gluon plasma is a strongly coupled quantum system; therefore, when it was "transformed" (annihilated), virtual photons were actually formed in a bound quantum state (superposition of photons). That is, until the moment of radiation, all photons (de facto bosons) were in superposition. And only with radiation, they acquired their characteristics (for example, radiation frequency), which were determined by the characteristic dimensions of the photon ball (whose radius actually was the uncertainty of the virtual photon coordinates according to Heisenberg uncertainty principle) and the characteristic dimensions of the quark-gluon plasma before the end of the annihilation. The characteristic dimensions of the photon ball (mass, radius, radius of the quark-gluon mass before the end of annihilation) should completely determine the spectrum and power of the gamma ray burst.

The bound state of all virtual photons before radiation actually means that after the annihilation of the residues of the quark-gluon phase, ALL the virtual photons were in superposition. That is, the emission of ALL photons began at the same time, and the emission time is determined by the minimum and maximum frequency of the gamma photon (that is, the spectrum), since it is clear that a photon with a higher frequency will radiate faster ($\gamma=1/\Delta t$). This leads to an important conclusion: the emission time of a gamma-ray burst will be shorter, the more uniform the photons are in frequency and the more energetic photons are emitted, and vice versa - if the gamma-burst photon energy spread is significant, then the gamma-burst emission duration will be significant (according to time) and will be determined by the frequency of the least energetic photon. Real photons will fly at the speed of light perpendicular to the plane of the galaxy in opposite directions to form a gamma ray beam (this is due to the laws of conservation of momentum and angular momentum).

It is also necessary to add that when all the quark-gluon plasma annihilates, it is clear that the giant gravity will disappear, and we will get an unimaginable number of virtual photons, which will immediately begin to "radiate", since with the disappearance of the giant gravity time will begin to flow normally, therefore we will get it simultaneously a huge amount of real gamma photons.

For an observer who would be in (on) a black hole (or Galactic Center), the annihilation of quark-gluon plasma into virtual and real photons (i.e., the evolution of a black hole) would occur for an insignificantly short period of time (oscillation period of elementary particles , $\Delta t \to 0$, $\Delta t \sim 0$). But that period of time would last indefinitely in black hole ($\Delta t \sim \infty$). For a third-party observer associated for example with the Earth, the annihilation time would be measured in millions and billions of years (infinitely many such periods of time Δt ($\Delta t \to 0$, $\Delta t \sim 0$)), which is quite clear considering the time dilation in black hole according to the theory of relativity.

CONCLUSION.

Thus, according to the presented theory, black holes are gigantic factories for the processing of baryonic matter into gamma rays in our Universe. Moreover, the annihilation of quark-gluon plasma (with impurities of electrons and positrons, more precisely, in the general case, leptons) easily explains the whole spectrum of gamma photons with cosmological gamma bursts: from 30 KeV to 500 KeV up to 100 GeV and more. The energy of photons with E ~ 500 KeV is the energy of annihilation of electron-positron pairs. The photon energies from E > 500 KeV to 100 GeV and more are the annihilation energy of various quarks and antiquarks. We give the quarks rest energy [8, 9]:

u-quark = 1.5 — 3 MeV,

d-quark = 3 - 7 MeV,

c-quark = 1.25 GeV,

t-quark = 174.2 GeV,

s-quark = 95 MeV,

b-quark = 4.70 GeV.

Data of rest energy confirm the fact that the annihilation of quark-gluon plasma easily explains the entire spectrum of gamma photons during cosmological gamma bursts. In addition, black holes stop to be fantastic objects with “esoteric properties”, but are “factories” in which matter annihilates into gamma radiation (under the effect of a field lag effect). And most importantly, the study of black holes from these positions is a link between the macrocosm and the quantum world, and therefore will give answers to many questions of modern cosmology and quantum mechanics.

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