IASET:Journal of Applied and Natural Sciences (JANS)
ISSN(P): Applied; ISSN(E): Applied
Vol. 8, Issue 1, Jan–Jun 2023, 1–12

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

BLACK HOLES AND QUASARS IN THE LIGHT OF NEW PHYSICS

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ABSTRACT

The article indicates that Roger Penrose's theory of black holes, based on the General Theory of Relativity, is unable to describe the behavior of a system and, in particular, a black hole in dynamics, since the formation of new particles during the development of a black hole leads to a violation of symmetry in time. After the discovery of galactic dark matter and intergalactic dark energy, which form 95% of the mass-energy of the Universe, the further development of the theory of the origin and evolution of black holes lies on the path of rejection of the geometric theory of gravity in general relativity of Einstein and the recognition of a fifth interaction between dark and baryonic matter. New astronomical observations of recent years say with certainty that black holes in their development into quasars become not a gravedigger of baryonic matter, but a factory of baryonic matter for new galaxies.

***KEYWORDS**: Dark Matter, Baryonic Matter, Black Hole, Quasar*

***PACS:** 01.10.Fv, 04.50.-h, 12.10.Kt, 95.36. + X, 98.80.-k*

1. INTRODUCTION

The black hole and the quasar are two of the most intriguing mysteries in the universe. No one can say with certainty what it is, why they exist and what processes occur inside them. A quasar cannot exist without a black hole, and a black hole, in turn, can do without a quasar. Many people know that quasars are the brightest objects in the universe. But the fact that quasars are born as a result of the evolution of black holes is still very few people know. Let's take a closer look at the hypothesis explaining the degeneration of black holes into quasars. In the formulation of the Nobel Committee it is written that the prize is awarded to Penrose for "the discovery that the formation of black holes is a reliable prediction of general relativity." This formulation reflects the fact that even before Penrose's work it was known that a sufficiently dense object (for example, a gas cloud, a star, or a cluster of stars) can collapse into a black hole. However, previous calculations were based on many assumptions, the most important of which were the spherical shape of the objects in question and various simplifying assumptions about the properties of collapsing matter. Penrose was able to propose a new revolutionary method that allows you to establish the possibility of collapse without any special assumptions about the nature and geometry of the "collapsing" body when a few simple conditions are met. The foundations of this method were formulated in Penrose's classic 1965 work, "Gravitational Collapse and Space-Time Singularities" published in Phys. Rev. Lett. 14, 57. [1]. In light of the recent discoveries of galactic dark matter and intergalactic dark energy, which make up 95% of the mass energy of the Universe, Roger Penrose's conclusions do not look so unambiguous [2]. According to the results of astronomical observations of the Planck telescope, the Universe consists of [3]:

- Dark energy (68.3%)
- Dark matter (26.8%)
- Common (baryonic matter) (4.9%)

Of approximately 5% of baryonic matter, 4/5 of the mass is in the interstellar medium, and only 0.5% of the average density of the Universe is concentrated in stars. Dark matter fills a fifth of galactic space. It has been found that a dark matter halo forms spheres around galaxies, stars, planets and black holes, which rotate with them (Figure. 1) [4].

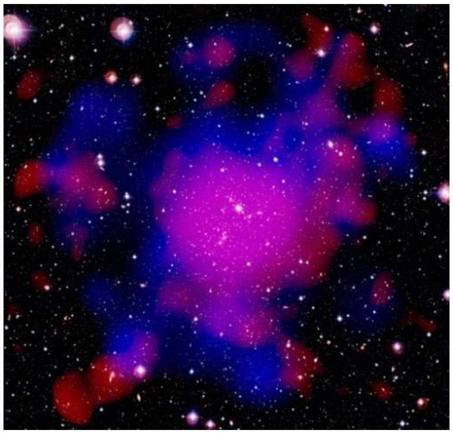

Figure 1: Components of the Cluster of Galaxies Abell 2744. White Color - Galaxies, Red Color - Hot Gas and Blue color Dark Matter.

In early 2020, scientists managed to register small clumps of dark matter - only 1/10 000 and even 1/100 000 of the mass of the Milky Way. And for dark matter these are indeed very shallow meanings. Detection is made possible by gravitational lensing of light. If there is even a small cluster of dark matter in the galaxy lying in the foreground, or on the line of observation, the observed picture is distorted. Based on these distortions, we can conclude about the size of the clots. As you know, massive objects can refract rays of light. Not much, but at large distances of millions of light-years, deviations will be noticeable. This characteristic gives rise to the effect of gravitational lensing, thanks to which we can see the light from distant stars that are behind galaxies or other massive objects (Figure.2)

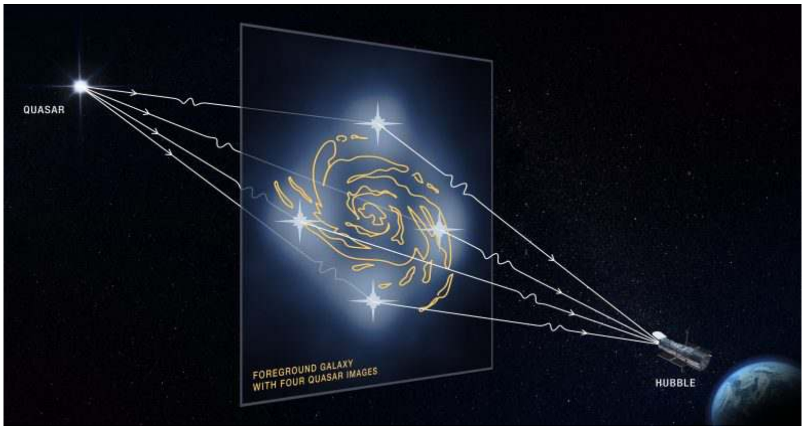

Figure 2: The Effect of Gravitational Lensing.

By the way, for the discovery of the rotating nucleus of a superblack hole in the center of our galaxy, two other physicists, German Reinhard Henzel and American Andrea Gez, became laureates of the 2020 Nobel Prize, along with Roger Penrose. In the new cosmology, a dark matter halo can appear in the primary Universe as a rather dense object that can shrink (they say, collapse) under the action of gravitational forces into a black hole. The question arises whether such astrophysical configurations of the core – dark matter halo can be formed at all and whether they remain stable on cosmological time scales. A new article by Carlos R Argüelles, Manuel I Díaz, Andreas Krut, Rafael Yunis "On the formation and stability of fermionic dark matter haloes in a cosmological framework" gives an affirmative answer to this question [5]. Moreover, the results obtained prove that a dark matter halo with a core – halo morphology is a very likely outcome at the nonlinear stages of structure formation of black holes. Moreover, the results obtained prove that a dark matter halo with a core – halo morphology is a very likely outcome at the nonlinear stages of structure formation of black holes. In general, agreeing with the conclusions of the authors of the article [5], I consider it necessary to note that the authors' appeal to the general theory of relativity as a necessary element for the gravitational collapse of the dark matter nucleus before the formation of a black hole is completely unfounded. In my article "Roger Penrose and Black Holes" it is indicated that the further development of the theory of the origin and evolution of black holes lies on the path of abandoning Einstein's geometric theory of gravity in general relativity and recognizing the fifth interaction between dark and baryonic matter [2]. The new concept of gravity allows one to describe the gravitational interactions of bodies similar to the electric and magnetic interactions and does not contradict other experimentally substantiated approaches to describing the phenomenon of gravity and inertia, in particular, some models involving dark matter, like a superfluid [6]. At the same time, experiments show that if an external field acts on the vacuum, then the creation of real particles is possible due to its energy [7,8]. Precisely because the vacuum is not a virtual but a real physical object (dark matter) and has a structure, the vacuum polarization leads not to virtual, but real radiation corrections to the laws of quantum electrodynamics [7].In the theory of gravitation, vacuum polarization is also present, and theoretically it is manifested at extremely small Planck distances ~ 10^{-35}m. It is assumed that the processes of gravitational polarization of vacuum play an important role in cosmology [7]. The hypothesis of the existence of an inhomogeneous quantum vacuum (dark matter) in the form of vacuum domains allowed Dr. Vyacheslav Dyatlov, Professor of the Siberian Branch of the Russian Academy of Sciences it possible to determine the energy of a quantum vacuum domain (VD) in electric, gravitational, magnetic and spin fields [8]. Based on this, Dr. Vyacheslav Dyatlov suggests calculating the energy of a vacuum dipole (VD) as a four-dipole in four fields (E - electric, M - magnetic, G - gravitational, S - spin) in the following form:

$$W = W_E + W_G + W_M + W_S \tag{1}$$

Where

$$W_E = -\mathbf{dE}_0; \qquad W_G = -\mathbf{d}_G\mathbf{E}_{0G};$$
$$W_M = -\mu_0\,\mathbf{l}_M\mathbf{H}_0; \qquad W_S = -\mu_{0G}\,\mathbf{l}_S\mathbf{H}_{0S}.$$

- $\mathbf{d}$ and $\mathbf{d}_G$ are two VD dipoles - electric $\mathbf{d}$ and gravitational $\mathbf{d}_G$
- $\mathbf{l}_M$ and $\mathbf{l}_S$ are two VD moments - magnetic $\mathbf{l}_M$ and spin $\mathbf{l}_S$.
- μ_0, μ_{0G} magnetic and magneto spin permeability;
- $\mu_0 = 1.257 \times 10^{-6}$ m· kg· c^{-2} ·A^{-2} $\mu_{0G} = 0.9329 \times 10^{-26}$ m · kg^{-1}

Generally speaking, the fields $\mathbf{E}_0$, $\mathbf{E}_{0G}$, $\mathbf{H}_0$, **and H0S** depend on the spatial coordinates, but they can be approximately considered constants within the domain. Consequently, the dipole forces acting on the quantum vacuum region, guided by the work of Academician Tamm [10], can be defined as follows:

$$\mathbf{F}_{DE} = -\nabla W_E; \tag{2}$$

$$\mathbf{F}_{DG} = -\nabla W_G; \tag{3}$$

$$\mathbf{F}_{DM} = -\nabla W_M; \tag{4}$$

$$\mathbf{F}_{DS} = -\nabla W_S; \tag{5}$$

Where

- $\mathbf{F}_{DE}$ is the force acting on the high pressure as an electric dipole;
- $\mathbf{F}_{DG}$ is the force acting on the VD as on a gravitational dipole;
- $\mathbf{F}_{DM}$ is the force acting on the VD as a magnetic dipole (magnetic moment);
- $\mathbf{F}_{DS}$ is the force acting on the VD as a spin dipole (spin moment);
- ∇ is the operator of the gradient [9].

These forces are involved in the fifth fundamental interaction between the quantum vacuum and baryonic matter. Dr. Jonathan Feng of the University of California, Irvine said in a 2017 press release: “For decades, we have known about four fundamental forces: gravity, electromagnetism, and strong and weak nuclear forces. The discovery of a possible fifth force acting between baryonic and dark matter will completely change our understanding of the Universe, which will entail the unification of the fifth force and dark matter ”[11]. The axial rotation of the black hole core will be due to the formation of a magnetic field of monstrous values of 2,000 Tesla. Taking into account all the properties of the magnetic field in the new electrodynamics [12] makes it possible to detect, in addition to the well-known transverse Lorentz forces, also the longitudinal forces of the magnetic field, the rotation of the core of black holes, stars and planets [13].

At the edge of a black hole, the quantum vacuum is in a conditionally stressed state, as a result of which it is polarized in a quantum manner. Nothing of the kind follows from Einstein's General Theory of Relativity. Einstein's general relativity, in general, is incompatible with quantum concepts. And quantum theory, in turn, cannot operate with dimensionless material points that are manipulated by general relativity. Studying the behavior of quantum fields near a black hole, Stephen Hawking predicted that a black hole necessarily radiates particles into outer space and thereby loses mass [14]. This effect is called Hawking radiation (evaporation). To put it simply, gravitational and magnetic fields polarize vacuum (dark matter), as a result of which the formation of not only virtual, but also real particle-antiparticle pairs is possible. According to Hawking, on the surface of the event horizon, the direction of expansion of the generated particles ceases to be random, i.e. becomes polarized, namely, orthogonal to the BH surface [14]. The existence of stable Hawking radiation - the process of emission of various particles by a black hole - was first proved by specialists from the Israel Institute of Technology. The experiment, conducted by Israeli scientists, had to be repeated 97 thousand times over a period of 124 days. To create an analog of a black hole 0.1 millimeter long, the researchers required 800 rubidium atoms. It is assumed that in the future, experts will be able to extract energy from black holes using a singular reactor. According to the theory, the energy will be generated by Hawking radiation. Scientific material describing the creation of a sound-like black hole in the laboratory was published on February 19, 2021 on Phys.org. [15]. As a result, a huge amount of matter is thrown into the surrounding space of the black hole. This matter is a plasma of the most elementary particles of the universe. In fact, it is a huge and still very dense cloud of plasma, retaining the shape of a disk. Its rotation speed is close to the speed of light, and the direction of rotation coincides with the direction of rotation of the original black hole. Modern astronomers call such a disk a quasar (Figure. 3)

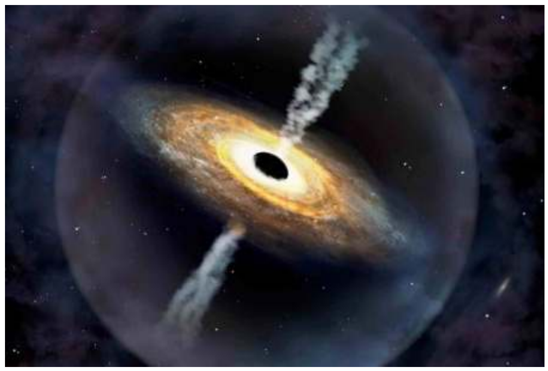

Figure 3: Quasar Ulas J1342+0928 Hides a Black Hole.

2. QUASARS FACTORIES OF BARYONIC MATTER AND THE SOURCE OF ALMOST ALL NEUTRINOS

In the laboratory, for the first time, a substance was obtained that has properties identical to the plasma in the vicinity of a black hole. This is stated in the joint work of Russian, Japanese and French scientists [16]. In laboratory conditions, accretion disks of a black hole were obtained. This is the kind of structure that results from a diffuse material with a rotational moment on a massive central body. The compression of matter, as well as the release of heat as a result of the friction of the differentially rotating layers, leads to the heating of the accretion disk. Plasma flowing from one component of the system to another has a significant angular momentum: it appears due to orbital motion. Therefore, plasma particles cannot fall on the star radially. Instead, they move around it in Keplerian orbits. As a result, a plasma disk is formed, in which the velocity distribution corresponds to Kepler's laws. According to it, the layers located closer to the star will have high speeds. However, due to friction between the layers, their velocities are leveled, and the inner layers transmit part of their angular momentum outward. As a result, the inner layers approach the star and eventually fall on its surface. In fact, the trajectories of individual plasma particles are in the form of spirals that slowly twist. The radial displacement of matter in the accretion disk is accompanied by the release of gravitational energy, part of which is converted into kinetic energy (acceleration of gas movement when approaching a star), and the other part is converted into heat and heats the disk matter. Therefore, the accretion disk emits thermal electromagnetic radiation. The kinetic energy of the gas upon collision with the surface of the star is also transformed into thermal energy and radiated. The main property of the formation of such X-ray sources will be strong magnetic radiation. Its magnetic field and induction can reach several thousand Tesla, researchers from the LaPlaz Institute, NRNU MEPhI and the CELIA laboratory of the University of Bordeaux note in their work [16]. The uniqueness of the experiment is that the parameters of the obtained plasma do not need to be scaled; they correspond to the actual parameters of the plasma in the vicinity of the black hole of close binary systems of the Cygnus X-1 type.

Matter with a temperature of billions of degrees, a density of 10^{18} particles per cm^3 and a frozen-in magnetic field of more than 2,000 Tesla was formed in the volume of the target for several picoseconds. It is these parameters that can be found in plasma in the active region of X-ray sources. The volume of incandescent magnetized matter was sufficient to have the main characteristics of its cosmic prototype. This was also facilitated by the experimental conditions, in particular, the fact that inside the plasma volume the magnetic fields were directed towards each other in such a way that in the area of contact of the opposing magnetic lines, the annihilation of the magnetic field took place, leading to the appearance of fluxes of electrons and positrons with velocities close to the speed of light. This process resembles the birth of relativistic electron-positron pairs found in near-Earth space during reconnection - an explosive contact between two magnetic field lines in thin layers of the Earth's magnetosphere, studied in detail by the MMS mission [17].

The experiment showed that the technique developed by an international group can create not only quasi-stationary magnetic fields of record magnitude, but also simulate the state of the plasma arising in them with a high energy density of matter and electromagnetic energy. As a result, we get an electron-positron mixture in the vicinity of the black hole, consisting of approximately equal numbers of negative electrons and positive positrons. In a free state, electrons and positrons annihilate - this is an indisputable fact. However, in the accretion disk, electrons and positrons are not entirely free. They continue to rotate by inertia within the plasma disk at about the speed of light. And it is this speed, or rather the force of inertia, that keeps them from direct collisions and complete mutual destruction. At this stage, electrons and positrons form dipole structures - positroniums. Experimentally, such a pair was first discovered in 1951 by the German physicist Martin Deutsch and reliably established by Professor DB Cassidy and his assistant A. P. Mills, Jr. in 2007 [18]. Cassidy and Mills calculated that in their experiment the density of positronium atoms was 10^{15} per cm^3. Calculations show that with an increase in this density by three orders of magnitude, these atoms at a temperature of 15 kelvin will merge into a single quantum system Bose-Einstein condensate [18]. The authors of the article "Fundamental dissipation due to bound fermions in the zero temperature limit" physicist Samuli Autti et other Have established that particles in a superfluid adhere to an object, protecting it from interaction with a bulk superfluid, thus preventing the decay of a superfluid [19]. “Superfluid helium-3 feels like a vacuum to a rod moving through it, even though it's a relatively dense liquid. There is no resistance, no resistance, ”said physicist Samuli Autti of Lancaster University in the UK. "I find it very intriguing." A superfluid is a liquid that has zero viscosity and zero friction and therefore flows without losing kinetic energy. They are relatively easy to make from bosons of the isotope helium-4, which, when cooled to just above absolute zero, slow enough to overlap and form a cluster of high-density atoms that act as a single “superatom.” However, these “superatoms” form only one type of superfluid liquids. The behavior of dark matter in this energy state is similar to the behavior of atoms in a Bose-Einstein condensate (quantum fifth state of matter) obtained at a matter temperature close to absolute zero - 273.5 Celsius or 0 Kelvin (Figure 4) [19].

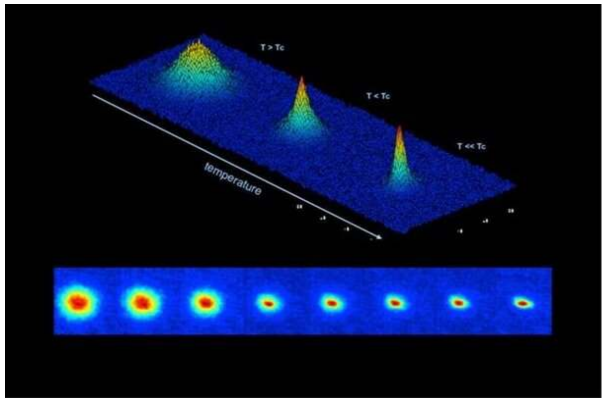

Figure 4: Bose-Einstein Condensate (BECS).

Now physicists say that instead of studying empty space, they can create a Bose-Einstein condensate and study the quantum vacuum. In it, sound particles and photons are heard in the background vacuum. The sound is not generated by the detector, but it is heard due to the acceleration. The Unruh effect creates a thermal response of an accelerated detector as it moves in a vacuum. Another type of super fluid liquid is based on the boson sibling, fermion. Fermions are particles that include atomic building blocks such as electrons and quarks. When cooled below a certain temperature, fermions are bound into so-called Cooper pairs, each of which consists of two fermions, which together form a composite boson. These Cooper pairs behave exactly like bosons and can therefore form a super fluid liquid. The team created their fermionic superfluid liquid from helium-3, a rare isotope of helium that is missing one neutron. When cooled to one ten-thousandth of a degree above absolute zero (0.0001 Kelvin, or -273.15 degrees Celsius), helium-3 forms Cooper vapor (Figure. 5) [19].

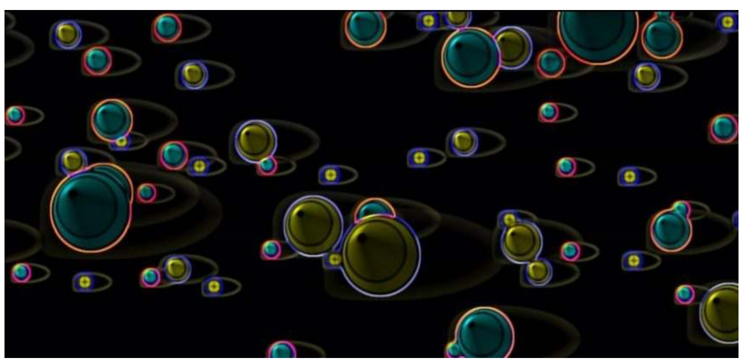

Figure 5: Medium of Superfluid Liquid Helium-3.

The substance of the plasma disk is gradually stratified into electrons-positrons and neutrons. The massive appearance of neutrons on the outskirts of the plasma disk marks a fundamentally new stage in the life of the formation of the universe. From this moment, the assembly line for the production of chemical elements begins to work. Experimental physics has established for certain that a free neutron decays into a proton and an electron in about 15 minutes. Due to this, the most widespread substance in the universe is born at the exit - hydrogen. Hydrogen atoms gradually accumulate inside the rotating plasma disc. At some point, the density of hydrogen reaches a critical value. and the free escape of neutrons from the plasma disk becomes difficult. The next cycle of synthesis of atoms of matter begins. Free neutrons are forced to combine with the protons of the previous hydrogen cycle. As a result, the familiar atoms are formed from two protons and one neutron. This is nothing more than the next chemical element in the periodic table - helium. Such cycles in a neutron centrifuge are repeated for each new chemical element. Moreover, the further along the periodic table we move, the denser the outer nucleon layer becomes and the fewer atoms of the new substance are formed at the exit. It is for this reason that in our universe, hydrogen makes up 70% of the total mass of all chemical elements. The described process allows us to understand how the synthesis of all chemical elements of the universe proceeds. This is not an explosive thermonuclear fusion in the depths of several generations of stars, but a neat assembly of atoms of chemical elements from elementary particles using a very fast plasma centrifuge. Such a synthesis of atoms of matter, in contrast to thermonuclear fusion, is an extremely energy-intensive process. In our case, the source of energy is a black hole. To be absolutely precise, its mass is multiplied by the square of the speed of light. Despite the colossal amount of this energy, the synthesis of chemical elements must sooner or later stop. Previously, astrophysicists believed that as soon as a quasar appears in a galaxy, the formation of stars in it ends almost immediately. Later, astrophysicists established that there are galaxies that live with quasars, however, they are cold, that is, their reserves of cold gas are not depleted, and the birth of stars can continue (Figure 5) [20].

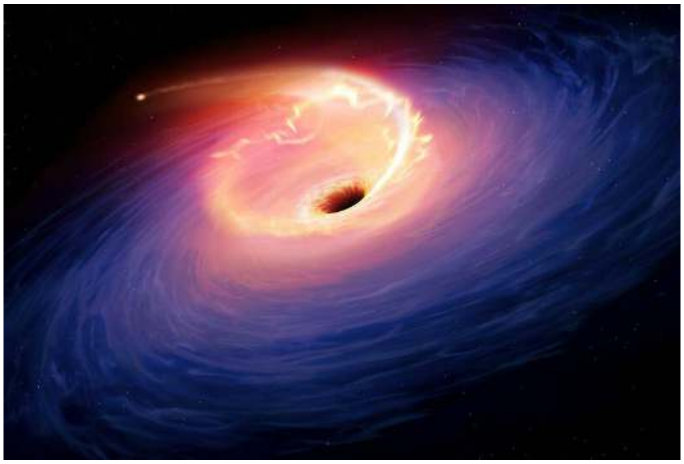

Figure 6: Galaxy CQ4479 Is Capable of Producing About 100 Stars Per Year.

Allison Kirkpatrick, associate professor at the University of Kansas at Lawrence, says: "Galaxy CQ4479 shows us that the existence of active black holes does not always stop the birth of stars." This statement runs counter to current scientific knowledge about such systems [20]. Astrophysicists are observing the cold quasar using NASA's unique SOFIA infrared telescope. It is installed on board a Boeing 747 aircraft. First of all, astronomers are concerned about the process of energy release near a black hole. If it increases, it can stop the formation of stars. Thanks to CQ4479, it became clear that even such a process as the presence of active black holes does not instantly affect the process of star birth. And this certainly does not agree with the scientific predictions known so far [20]. For 2021, scientists have planned a new study, with the help of which they will try to find out whether this happens in other galaxies, whether processes such as the birth and development of a star and the growth of a black hole take place inside them simultaneously. In addition, it will help to understand what effect quasars have on the shape of the galaxy within which they exist. In addition to baryonic matter, astrophysicists have established that quasars of supermassive black holes in the centers of galaxies are the source of almost all neutrinos that come to Earth from space [21, 22]. Neutrinos, which travel at very high speeds, are good candidates for hot dark matter. In particular, they do not emit or absorb light - they appear "dark". It has long been assumed that neutrinos, which come in three different types, have no mass. But experiments have shown that they can change (fluctuate) from one species to another. Importantly, scientists have shown that this change requires mass on them - making them a legitimate candidate for hot dark matter. Several years ago, physicists at the Pierre Auger Observatory discovered the first hints that all these particles are of extragalactic origin. Three years ago, researchers at the IceCube Antarctic Neutrino

Observatory discovered one of the possible sources of these neutrinos - blazar TXS 0506 + 056. Blazar is located in the constellation Orion, from which light travels to Earth for about 4.33 billion years. The formation of superluminal neutrinos is associated with the collision of ultrahigh-energy protons with surrounding photons, at which neutrinos appear and a proton disappears. Protons or heavier nuclei, accelerated to super high-energy in the vicinity of a dark hole, collide with the nuclei of atoms or with low-energy photons. In this case, π- and K-mesons are produced, the decay of which gives rise to high-energy cosmic neutrinos. It can be assumed that baryonic matter (proton) passed into a particle of hot dark matter (neutrino) with energy absorption. The process leading to the production of gamma rays and neutrinos generated by the interaction of protons with acceleration to ultrahigh energies with matter is shown in (Fig. 7) One of the possible reactions in the interaction of protons with acceleration to ultrahigh energies with matter is described by the formula (6) [21].

$$p + X \rightarrow \pi^0 + Y \rightarrow \gamma + \gamma + Y \quad (6)$$

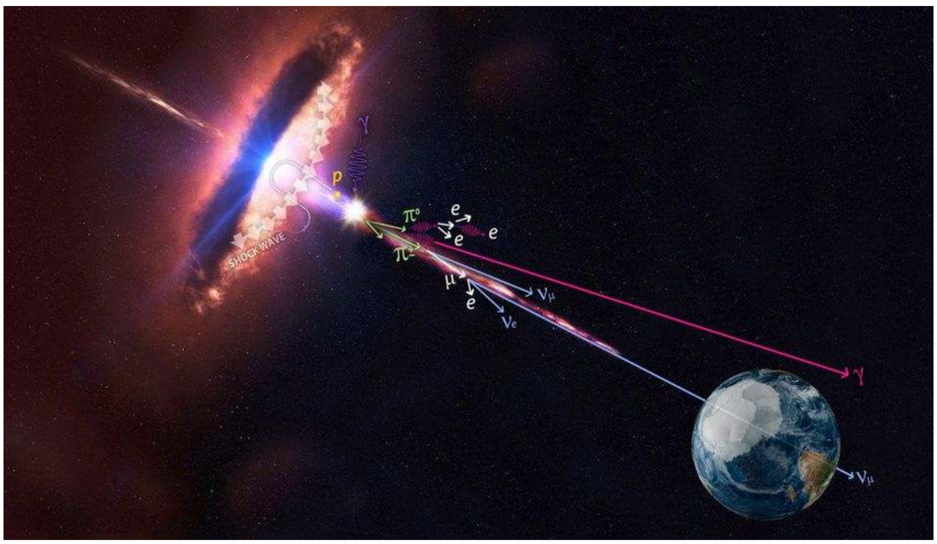

Figure 7: Artistic Depiction of how Blazar Accelerates Protons that Generate Points, Which in Turn Generate Neutrinos And Gamma Rays. Neutrinos are Always the Result of Hadrons Reactions. Gamma Rays Can Appear in both Hadrons and Electromagnetic Interactions.

Although neutrinos react very weakly with matter, the likelihood of a reaction increases with energy, which is why superluminal neutrinos have been detected with confidence by the Ice Cube Observatory.

3. CONCLUSIONS

Thus, new astronomical observations of recent years say with certainty that black holes in their development into quasars become not a grave-digger of baryonic matter, but a factory of baryonic matter for new galaxies.

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