Article

Dark Matter Puzzle Solution

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Dark Matter Puzzle Solution

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Abstract: Dark energy is the primordial energy of the universe. It was not created and will not be destroyed. Dark energy is the "stuff" out of which universal space is made off. Stellar objects exist in dark energy which is a kind of superfluid energy, that we do not know much about it. In interstellar areas, dark energy has a Planck energy density that diminishes in the center of stellar objects accordingly to the amount of their mass. Motion and rotation of stellar objects put in motion and rotation also surrounding dark energy around them. The rotation of supermassive black holes in the center of spiral galaxies rotates the surrounding dark matter and causes the so-called "dark matter effect". The orbital velocity of stars that are rotating around the central black hole is not diminishing with the distance, as is the case in our solar system. There is no hidden dark matter that causes this effect. The cause is the rotating dark energy of the entire area of the galaxy around the central black hole.

Keywords: dark energy; dark matter; Lense-Thirring effect

1. Introduction

In our solar system, the rotational velocity of planets is diminishing with the distance from the Sun. This was also expected by the stars that are rotating around the SMBHs in the center of spiral galaxies. Zwicky discovered back in 1930-40 that this is not the case. The measured orbital velocity of stars that are further away from the central SMBHs is not declining as supposed by laws of motion and gravity (see Figure 1 below). Back in 1930-40 Zwicky proposed the existence of hidden dark matter in the galaxies. This hypothetical dark matter should increase gravity and should be the cause of measured orbital velocities of stars [1,2].

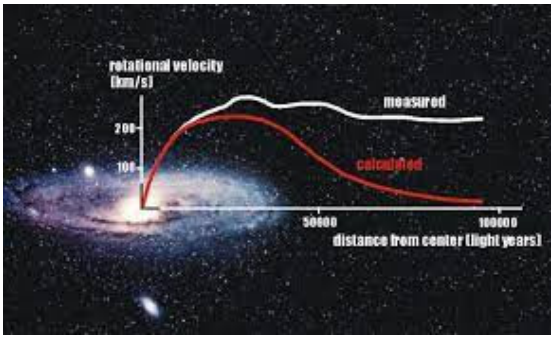

Figure 1. Orbital velocities of stars.

After 80 years of intense search dark matter was not discovered yet [3,4]. Some physicists suggested that dark matter is non-existent and that we should modify our models of gravity [5]. In this article, the third solution is proposed: the model of gravity is correct, and the physical origin of stars' orbital velocity is rotating dark energy.

2. Rotating Dark Energy

Orbital time of a star that is orbiting around the central black hole of a given galaxy we calculate as follows:

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$$T = 2\pi\sqrt{\frac{r^3}{Gm}} \qquad (1),$$

where r is the distance from the central black hole, G is the gravitational constant and m is the mass of the central black hole. SMBHs are rotating around their axis with a high angular velocity which generates relativistic mass m_{rel} [6]. Relativistic mass is causing the orbital velocity of stars to be higher than the calculated orbital velocity in the frame of Newtonian physics. Equation (1) is transformed into the equation below:

$$T_{rel} = 2\pi\sqrt{\frac{r^3}{Gm_{rel}}} \qquad (2).$$

We calculate the orbital velocity of a given star as follows:

$$v_{rel} = \frac{d}{T_{rel}} \qquad (3),$$

where d is the length of its orbit. The orbital velocity of dark energy that surrounds a given star we calculate as follows:

$$v_{de} = \omega_{de} r \qquad (4),$$

where ω_{de} is the angular velocity of dark energy in the star's orbit and r is the radius of the star's orbit. The total orbital velocity of the star is the sum of its relativistic orbital velocity and the orbital velocity of dark energy:

$$v_{total} = v_{rel} + v_{de} \qquad (5).$$

The angular velocity of rotating dark energy depends on the age of the galaxy. The older galaxy bigger the angular velocity of dark energy. In the formation of a galaxy, when the central black hole starts rotating over time also dark energy starts rotating. The orbital velocity of dark energy around the central black hole of a galaxy is the biggest near the black hole and appears there first. By time also areas of more distant dark energy start orbiting around the central black hole. The older galaxy higher the orbital velocity in distant areas.

Mercury's precession is 43 arcseconds in 100 years, and its orbiting time is 88 days. In one orbiting period, this is 29 km, which in 100 years is 12028 km [7]. We calculate the orbital velocity of the dark energy on Mercury's orbit as follows:

$$d = vt \qquad (6),$$

where d = 29000 m, and orbital time t = 88 days.

$$v = \frac{29000m}{7.603 \cdot 10^6 s}$$

$$v = 0.00381\ ms^{-1}$$

$$v = 3.81\ mms^{-1}$$

The orbital velocity of dark energy on the Mercury orbit is 3.81 millimeters per second. The orbital velocities of dark energy on the orbits of stars circulating around centers of spiral galaxies are much bigger than in the solar system because galaxies are much older than the solar system. The Milky Way galaxy is old about $1.63 \cdot 10^{10}$ years. The solar system is old about $4{,}6 \cdot 10^9$ years. That's why the impact of the rotating dark energy on the planet's precession is small in comparison to the impact of dark energy rotation on the stars that rotate around the central black hole of Milky Way, Sagittarius A^*. Einstein's calculation of Mercury's precession is right, but it does not explain its physical cause which is the motion of dark energy in Mercury's orbit.

3. Experimental Proof for Rotating Dark Energy

The idea that universal space is a kind of superfluid liquid is entering the mainstream of physics [8,9]. Imagine that you put a wooden ball in the water. When you start the rotation of the ball at the beginning only the water that is near the ball starts rotating. By the time also water that is farther from the ball will rotate. The experiment was done using a round steel bawl diameter of 40 cm filled

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with 10 cm of water. In the center of the bawl a wooden ball with a diameter of 3 cm was placed. The ball was fixed on the axis of the motor that was switched on. The angular velocity of the wooden ball was $\omega = 30\ s^{-1}$. It took 56 seconds, and also the water that was 20 cm far from the center of the wooden ball was rotating with the angular velocity $\omega = 30\ s^{-1}$.

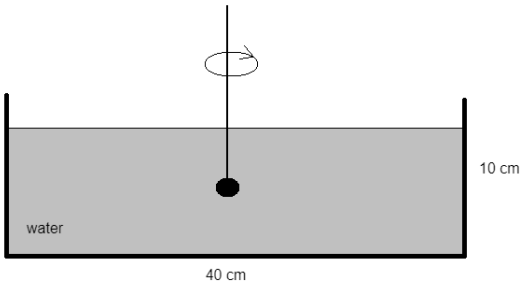

Figure 2. Increased angular velocity of water.

Considering dark energy that is the physical origin of universal space a kind of superfluid it is suggested in this article that also in spiral galaxies angular velocity of dark energy is increasing and this is causing the observed orbital velocities of stars that are orbiting around the central black holes.

4. Discussion

We have to overcome the idea that the universal space exists on its own and is filled with dark energy. The fact is that dark energy is the physical origin of the universal space. The idea of an "empty space" in which dark energy exists is false. This "empty space" is "dark energy". Galaxies and stars are moving in dark energy. Seeing the universe from this perspective gives us a more realistic picture. The Lense-Thirring effect [10] is the effect of dark energy rotation around a stellar object that rotates around its axis. This effect is causing the precession of planets in our solar system and is causing the additional orbital velocity of stars that are orbiting central black holes of spiral galaxies.

Gravity as a consequence of space curvature is a mathematical model that can be replaced by gravity as the vector of space that points from the higher energy density of dark energy to the lower energy density of dark energy. The vector model of gravity is a physical model, it explains the physical origin of gravity; every physical object is diminishing the energy density of dark energy exactly for the amount of its mass and energy. This is the extension of the mass-energy equivalence principle on dark energy which is the physical origin of superfluid space:

$$E = mc^2 = (\rho_{PE} - \rho_{cE})V \qquad (6),$$

where m is the mass of the object, V is the volume of the object, ρ_{PE} is the Planck energy density of dark energy in interstellar space and ρ_{cE} is the energy density of dark energy in the center of the physical object. Gravity is immediate and has no carrier, gravity is embedded in the variable energy density of dark energy [11]. There is no direct gravitational force between stellar objects. The area of the higher energy density of dark energy around the galaxy is pushing towards the central black hole where the energy density of dark energy is at the minimum. This difference in energy density of dark energy generates gravity.

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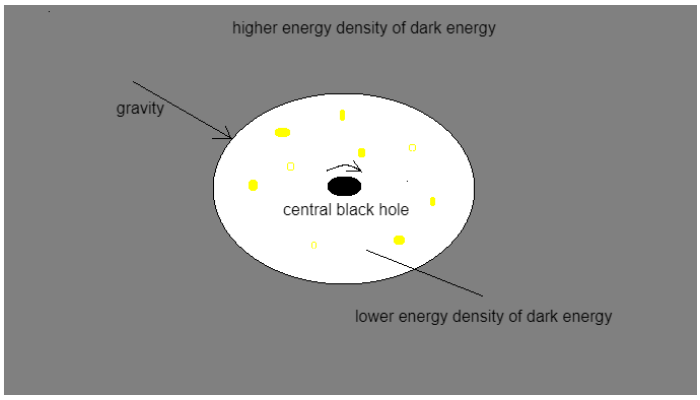

Figure 3. Difference in energy density of dark energy generates gravity.

This model of gravity works well from the macro scale (galaxy) to the micro scale (proton) without the hypothetical graviton. Dark energy, also named "superfluid space" is a four-dimensional type of energy in which three-dimensional physical objects are caught [12]. There-dimensional mass is diminishing the four-dimensional energy density of dark energy which is generating gravity.

From the historical perspective, at the beginning of the 20th century, mathematical physics overruled experimental physics. In special relativity, time is introduced as a 4th physical dimension of space without having experimental data confirming this model. The Lens-Thirring effect today is still seen as a frame-dragging effect of space-time [13]. Time is the duration of an object's motion in space. Duration enters existence when being measured by the observer. Time is an emergent physical quantity created when observer compares the rate (motion) of a clock with the motion of physical object in space. There is no physical time in space [14]. The Lens-Thirring effect is the displacement of space. Space rotates with the rotating stellar objects. Space is a type of energy, the idea of "empty space" having only geometrical properties and being deprived of physical properties is from the phenomenological point of view weakening of physics. This is the weak point of general relativity that can be improved by substituting the curvature of space with the variable energy density of space, as it is presented in Eq. (6). All phenomena of general relativity can be described by the variable energy density of space [15]. General relativity is a successful mathematical theory with the leak of physical meaning. Substituting the curvature of space with the variable energy density of space, physical meaning is achieved. The more space is curved, the lesser its energy density. The variable density of space carries gravity.

The proposal of this article that dark energy is the energy of space makes sense because "empty space" cannot exist. Space is not filled with dark energy, space itself is dark energy. Seeing space as a superfluid it is obvious that rotating stellar objects will also rotate dark energy. Might be that at first sight, this looks "too simple" but it has physical meaning. If Zwicky had such a view, he would not predict the existence of dark matter.

In the model presented in this article, we have 5% energy in the form of ordinary matter in the universe and 95% in the form of dark energy. The challenge of physics is to search if ordinary matter can be seen as a form of dark energy. Here seems the right direction to reach the grand unification theory. Dark matter is seen as a primordial energy field of the universe, and elementary particles as different excitations of this primordial field. In this vision, Big Bang cosmology as one big explosion before time and expansion forever is not appropriate anymore, because the universe is a timeless phenomenon. "The beginning" of the universe is the wrong question, the right question is "how does the universe work?" The crucial question is: "What happens in the centers of SMBHs"? Central black holes are creating huge jets made out of elementary particles. From where do these particles come?

Jets are well documented and still today we do not know how they are created [16]. Jets are an essential part of a deeper understanding of spiral galaxies. Orbital velocities of stars are an essential part of a deeper understanding of spiral galaxies. Development of the model that will explain both phenomena would be good progress.

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Dark energy as the fundamental primordial field of the universe excludes the possibility of singularities in the universe. “Infinite pressure”, infinite temperature” in the first moment of the big bang have no physical meaning. Also, “infinite gravity” in the center of SMBHs has no physical meaning. Infinities are the result of a century-long mathematical supremacy over physics. SMBHs without gravitational singularities are closer to the physical way of seeing because if we predict gravitational singularity in a centre of SMBH then we have to calculate how this singularity is diminishing by the distance The problem seems unsolvable. In the centre of SMBHs energy density of dark energy diminishes but it is not coming close to zero. With Eq. (6) we calculated the value of energy density ρ_{cE} in the centre of a black hole ASASSN-14li, in the centre of the Sun, in the centre of the Earth:

- in the centre of ASASSN-14li: $\rho_{cE} = \rho_{PE} - 4.55 \cdot 10^{24} Jm^{-3}$
- in the centre of the Sun: $\rho_{cE} = \rho_{PE} - 1.27 \cdot 10^{20} Jm^{-3}$
- in the centre of the Earth: $\rho_{cE} = \rho_{PE} - 1.65 \cdot 10^{13} Jm^{-3}$.

We see that the energy density of dark energy in the black hole ASASSN-14li is 10^4 smaller than in the centre of the Sun. Here is the possible explanation for jets, it might be that in the centre of SMBHs energy density of dark energy is so low that atoms become unstable. They fall apart into elementary particles that form huge jets. In this perspective SMBHs are the rejuvenating systems of the universe, they transform old matter into fresh energy in the form of jests [17]. Sbitnev has developed a model where elementary particles are different vortexes of superfluid quantum space [18] that here is understood as dark energy. Elementary particles that build atoms are different vortexes of dark energy. When the energy density of dark energy is too low, atoms become unstable because the diminished energy density of dark energy changes the electromagnetic forces between electrons and protons.

The value of energy density of dark energy in the centre of proton is $\rho_{cE} = \rho_{PE} - 6.02 \cdot 10^{34} Jm^{-3}$ which is 10^{10} lower than in the centre of ASASSN-14li. Hawking has predicted that a proton could be a mini black hole [19]. Seeing the proton as a vortex of dark energy is comparable with the SMBH that is taking in the old matter and transforming it into fresh energy in the form of jets. Also, a proton could be a vortex of dark energy, taking in at the equator and throwing it out at the poles. Recently an article was published with the mathematical model of the point vortex model [20]. Further research in this direction could give us promising results in unified field theory as well as in cosmology. Erwin Schrödinger's view: "What we observe as material bodies and forces are nothing but shapes and variations in the structure of space", is offering the development of physics with unexpected results.

5. Conclusions

With the right understanding of the Lens-Thirring effect, we can elegantly describe the additional orbital velocity of stars orbiting around the central black holes of spiral galaxies. There is no need to introduce dark matter, and there is no need to introduce modified theories of gravity. The Lens-Thirring effect is the effect of rotational dark energy around the stellar objects that are rotating around their axis. Also, Mercury's precession is caused by the rotational dark energy in its orbit.

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