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Dark Energy Might Not Exist–The Accelerated Expansion of the Universe Might Be a Direct Result of Correcting Gravity

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Dark Energy Might Not Exist—The Accelerated Expansion of the Universe Might Be a Direct Result of Correcting Gravity

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Abstract

The "universe" we observe is actually a flat rotating cluster of galaxy clusters within it. Under the framework of the modified gravity theory, the universal gravitational constant G decreases as the universe expands. Under the effect of inertial centrifugal force, the radius of this observed rotating "universe" (galaxy cluster) increases at an accelerated rate. The so-called accelerated expansion of the "universe" is not driven by dark energy; dark energy does not exist.

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Introduction

Dark energy and dark matter are likened to two dark clouds in the sky of physics in the 21st century. The emergence of the dark energy problem stems from the contradiction between human observations of the expansion of the universe and theoretical derivations. Its core lies in explaining why the universe is accelerating its expansion. The following is a review of its background, key evidence and theoretical predicaments:

1. Observation background and the proposal of problems

A. The discovery of Cosmic expansion:

At the beginning of the 20th century, Hubble, through observing the redshift of galaxies, discovered that the universe was expanding and that the retrogressive speed of galaxies was proportional to their distance (Hubble's Law) [1]. At this time, the expansion of the universe is regarded as a deceleration process dominated by gravity.

B. The unexpected discovery of the accelerating expansion of the universe:

In 1998, Adam Ries' team and Thor Palmat's team, through observing distant Type Ia supernovae, discovered that the expansion rate of the universe was not slowing down as expected due to gravity, but was accelerating. [2,3] This phenomenon cannot be explained by known ordinary matter and dark matter, suggesting the existence of an unknown energy with repulsive properties - dark energy.

2. The main characteristics and theoretical hypotheses of dark energy

A. Basic characteristics:

-Dark energy is a kind of energy that fills space and has a negative pressure intensity. Over long distances, it manifests as an anti-gravitational effect, causing the universe to expand at an accelerated rate.

-It accounts for 68.3% to 73% of the total mass energy of the universe [4,5], and is almost evenly distributed or does not clump together.

B. Mainstream theoretical models:

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-Cosmological constant (Λ) : The concept of "vacuum energy" proposed by Einstein in 1917 has been reapplied to explain dark energy. This model assumes that dark energy is an attribute of space itself and has a constant energy density [6,7].

-Scalar field model: It holds that dark energy is a dynamic energy field (such as the fifth element or modal space), and its energy density varies with time.

3. The conflict between theory and observation

A. The vacuum energy density predicted by quantum field theory is 120 orders of magnitude higher than the observed value, creating a huge contradiction [8,9].

B. The cosmic coincidence problem: Why can the vacuum precisely dominate expansion during the current cosmic period?

C. Changes in the properties of dark energy: In 2024, the DESI team discovered that the influence of dark energy might weaken over time, which is inconsistent with the assumption of the constancy of cosmological constants [10].

Overall, the dark energy problem stems from the need for observations and theoretical explanations of the accelerating expansion of the universe. At its core, it is one of the fundamental unsolved problems in physics.

Recent observations by the James Webb Space Telescope (JWST) have found that approximately two-thirds of galaxies rotate in a consistent direction rather than randomly [11]. According to the principle of the reference frame of motion [12], rotation must exist relative to a certain physical reference frame. If the "universe" as a whole is rotating, then its reference frame must be related to a more macroscopic framework (the universe), which implies that the "universe" we observe is actually just a cluster of galaxy clusters within the universe.

If we assume that the "universe" we observe is merely a rotating cluster of galaxy clusters within the universe and that the universe is expanding at a decelerating rate, then based on the modified theory of gravity, can we conclude that the rotating "universe" or cluster of galaxy clusters we observe is expanding at an accelerating rate? In the article "The Modification of Newton's Gravitational Law and its Application in the Study of Dark Matter and Black Hole" [13], the author modified Newton's formula of universal gravitation by using the principle of superposition of spatial energy fields and concluded that the gravitational constant G would decrease as the universe expanded (Formula 2.15). The author conjectures that, as the universe expands and the gravitational constant G decreases, all rotating galaxies and rotating clusters of galaxies in the universe should undergo accelerated expansion.

The theoretical derivation that as the universal gravitational constant G continuously decreases due to the expansion of the universe, all rotating galaxies and galaxy clusters will accelerate their expansion

According to the modified theory of gravity [13] (Formulas 2.15-2.18 and 3.18-3.21), the radius of a rotating galaxy will increase at an accelerated rate (that is, $\frac{d^2R}{dt^2} > 0$). The following is a derivation strictly based on the original theory:

Key theoretical basis

1. From the evolution of the gravitational constant G [13] (Formula 2.15),

$$G = A\sum_{i=1}^{n}\frac{M_i}{r_i^2} \tag{1}$$

it can be known that: the universe expands → the distance ri between celestial bodies increases → $G \propto \frac{1}{r_i^2}$ monotonically decreases. In formula (1): A is a constant, Mi is the mass of any object in the universe, ri is the distance between the center of mass of that object and the center of mass of a celestial body with mass, and the sum sign is the sum of all celestial bodies in the universe.

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2. From the relationship between stellar velocity and radius [13] (Equations 3.18-3.21) (when 0<r <R)

$$v^2 = r \cdot E_2\,(r) \tag{2}$$

$$E_2\,(r) \propto \frac{1}{r} \tag{3}$$

Observation requirements (flat rotation curve) → $v^2 \approx$ const must be met.

3. Prove that the radius increases at an accelerated rate

Step 1: Establish the relationship between the radius R(t) and the cosmic scale factor a(t). The expansion of the universe scales all distances proportionally:

$$r_i\,(t) = r_{i,0} \cdot a(t) \tag{4}$$

In Formula (4), r_i (t) is the distance between any two celestial bodies at time t, $r_{i,0}$ is the initial distance between these two celestial bodies, and a(t) is the scale factor,a(t) > 1. Substituting Equation (4) into the expression of G (Equation (1)) gives:

$$G(t) = A\sum_{i=1}^{n}\frac{M_i}{[r_i(t)]^2} = \frac{1}{a^2(t)}\sum_{i=1}^{n}\frac{M_i}{{r_{i,0}}^2} \propto \frac{1}{a^2(t)} \tag{5}$$

From [13] (Equation 2.16)

$$E_2(r) = G_0\sum_{i=1}^{n}\frac{M_i}{r_i^2} \propto G = A\sum_{i=1}^{n}\frac{M_i}{r_i^2} \tag{6}$$

and v2=r·E2(r)=const (observation constraint), it can be obtained that:

$$v^2 \propto r(t)\cdot G(t) \propto r(t)\cdot\frac{1}{a^2(t)} = constant \tag{7}$$

It is solved from Formula (7) that:

$$r(t) \propto a^2(t) \tag{8}$$

It is concluded from Equation (8) that:

$$R(t) = ka^2(t) \tag{9}$$

In Equation (9), R(t) is the radius of the rotating galaxy and k is the coefficient.

Step 2: Calculate the acceleration of the radius change

The first derivative of radius (rate of change):

$$\frac{dR}{dt} = 2ka\frac{da}{dt} \tag{10}$$

The second derivative of radius (acceleration of change):

$$\frac{d^2R}{dt^2} = 2k\left[\left(\frac{da}{dt}\right)^2 + a\frac{d^2a}{dt^2}\right] \tag{11}$$

The dynamics of the expansion of the universe: The scale factor a(t) always satisfies $\frac{da}{dt} > 0$(expansion).Even if the universe slows down and expands $\left(\frac{d^2a}{dt^2} < 0\right)$, from the definition of the Hubble parameter:

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$$H = \frac{1}{a}\frac{da}{dt} \tag{12}$$

it can be obtained that:

$$\frac{dH}{dt} = -H^2 + \frac{1}{a}\frac{d^2a}{dt^2} \tag{13}$$

During the period dominated by matter (without dark energy), $a(t) \propto t^{2/3} = \alpha t^{2/3}$, [14–16], where α is a positive constant. From this, it can be concluded that:

$$\frac{da}{dt} = \frac{2}{3}\alpha t^{-1/3} > 0 \tag{14}$$

$$\frac{d^2a}{dt^2} = -\frac{2}{9}\alpha t^{-4/3} < 0 \tag{15}$$

Substituting formulas (14) and (15) into formula (11) for the acceleration of radius change of rotating galaxies, we obtain:

$$\frac{d^2R}{dt^2} = 2k\left[\left(\frac{2}{3}\alpha t^{-1/3}\right)^2 - \alpha t^{2/3}\left(\frac{2}{9}\alpha t^{-4/3}\right)\right] = \frac{4}{9}k\alpha^2 t^{-2/3} > 0 \tag{16}$$

So, the constant $\frac{d^2R}{dt^2} > 0$ holds true. Rotating galaxies expand at an accelerated rate.

Discussion

From Formula (16), we can obtain:

$$\frac{d^3R}{dt^3} = -\frac{8}{27}k\alpha^2 t^{-5/3} < 0 \tag{17}$$

That is to say, as time goes by, the acceleration of the expansion of rotating galaxies and rotating galaxy clusters is constantly decreasing. If the "universe" we observe is merely a rotating cluster of galaxy clusters within the universe, then the acceleration of the expansion of this "universe" should also be constantly decreasing. The current mainstream observational results [17–19] are consistent with the conclusion that the expansion acceleration of the "universe" is constantly decreasing.

Conclusions

1. Under the framework of the modified gravity theory, the universal gravitational constant G decreases as the universe expands. To satisfy the observed flat rotation curve (v≈ constant), the radius of the rotating galaxy needs to satisfy
$R(t) \propto a^2(t)$. Mathematical derivation proves that the radius of the rotating galaxy increases at an accelerating rate.
2. Under the framework of the modified gravity theory, the universal gravitational constant G decreases as the universe expands, and the radii of all rotating galaxy clusters, rotating galaxies and rotating celestial bodies increase at an accelerating rate.
3. The "universe" we observe is actually a flat rotating cluster of galaxy clusters within the universe. Under the framework of the modified gravity theory, the universal gravitational constant G decreases as the universe expands. Under the action of centrifugal force, the radius of this observed rotating "universe" (a rotating cluster of galaxy clusters) increases at an accelerated rate. The so-called accelerated expansion of the "universe" is not driven by dark energy; dark energy does not exist.
4. As time goes by, the acceleration of the expansion of the "universe" (a rotating cluster of galaxy clusters) is constantly decreasing.

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