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The Introduction of Additional Spacetime Distortion(ASD) and A New Interpretation of Dark Matter

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Abstract

This paper proposes a new interpretation for Essence of Dark matter with Additional Spacetime Distortion(ASD). ASD refers to the (non-linear) superposition of spacetime distortion fields. This research advocates dark matter is, by definition, ASD itself. phenomena related to Dark Matter are be explained consistently by ASD. this framework will provide a lot of explanation and insight for ASD & Dark Matter

In summary, As the superposition of spacetime distortion fields generated by mass becomes stronger, the gravitational lensing effect can also appear sufficiently. then It looks as if there is an invisible substance like Dark Matter in our eyes. In addition, The emergence of strong superpositions may induce greater spacetime distortions than linear combinations, as nonlinear terms manifest exponentially rather than linearly.

Keywords: astronomy — astrophysics — physics — galaxies — gravitation — spacetime

1. Introduction

In modern astrophysics, dark matter is generally considered to be an undiscovered form of matter, It is often assumed to be a new particle. But despite decades of experimentation and exploration, These particles have never been directly detected yet. These situations suggest the possibility that the nature of dark matter lies outside the particle model. In this work, we propose an alternative interpretation of dark matter and interprets dark matter as an effect formed by superpositions of space-time distortions created by existing masses. This could be a clue to explain the Dark Matter phenomenon.

And it is thought that ASD's gravitational lens effect can be better observed for same distortions of space-time when there is matter because matter is virtually blocking, absorbing, scattering the lights.

(Density refers to general substances Density and Naturally it includes particulate elements such as gas, molecular clouds, nebulae, interstellar matter, plasma etc.)

2. A mathematical foundation of ASD

The field equations of general relativity are as follows:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

This equation is nonlinear in nature. But in the case of weak gravity, The metric tensor can be approximated as follows:

$$g_{\mu\nu} = \eta_{\mu\nu} + h_{\mu\nu}, \quad |h_{\mu\nu}| \ll 1$$

$h_{\mu\nu} \propto T_{\mu\nu}$, The gravitational fields created by the two masses A, B superpose linearly:

$$h^{\text{total}}_{\mu\nu} = h^{(A)}_{\mu\nu} + h^{(B)}_{\mu\nu}$$

However, in practice, due to the nonlinearity of the field equations, a more accurate representation is as follows:

$$h^{\text{total}}_{\mu\nu} = h^{(A)}_{\mu\nu} + h^{(B)}_{\mu\nu} + N_{\mu\nu}(h^{(A)}, h^{(B)})$$

where $N_{\mu\nu}$ is the terms representing the nonlinear interaction of two gravitational fields, It includes complex components such as h^2, $h\partial h$, and inverse metric terms.

Therefore:

- In the weak field approximation, the gravitational field simply superposes linearly.
- A strong field requires a sum including even nonlinear interactions.
- The above equation sets $h_{\mu\nu}$, just two for understanding

3. The Exact Same Characteristics of Dark matter and ASD

ASD and Dark Matter don't interact with light. This is because, unlike matter, ASD is an distorted spacetime itself. The same goes for dark matter. they do not interact with light.

superpositions of spacetime distortion fields, ASD cannot also exist and move completely independently By definition. This is Exactly the same as dark matter. existing theories assume that dark matter is an virtual particle. But absolutely alone or independent motion like matter or particles has never been observed.

ASD and Dark Matter have gravitational effects on the outside. but It is not affected by gravity. It does not coagulate or collapse on its own. Because there is no mass (There is only indirect speculation that dark matter will be affected by gravity.)

By definition, ASD, Dark Matter goes by without colliding with anything.(still in the theoretical stage that dark matter can collide with other matter.)

4. Interpretation of ASD Perspectives on Dark Matter-Related Phenomena

4.1. Explanation of Galaxy's rotational speed & Halo

(1) The gravitational force (F_g) acting on an object in a circular orbit equals the centripetal force (F_c).

$$F_g = F_c$$

$$G\frac{M(r)m}{r^2} = \frac{mv(r)^2}{r}$$

Where G is the gravitational constant, $M(r)$ is the total mass within the radius r, m is the mass of an object in orbit, and $v(r)$ is the orbital velocity. If you clear one m and r from both sides:

$$G\frac{M(r)}{r} = v(r)^2$$

So to summarize for $v(r)$:

$$v(r) = \sqrt{\frac{GM(r)}{r}}$$

Since G is a constant here, the proportional relationship is as follows.

$$v(r) \propto \sqrt{\frac{M(r)}{r}}$$

Numerical examples (based on our galaxy):
0 kpc: 0 km/s (it's center)
1 to 2 kpc: rapidly increasing above 100 km/s
3-5 kpc: Increase to around 200 km/s,
8.5 kpc (the Sun's position): approximately 220 km/s (our Sun's orbital velocity).
10 to 20 kpc (optical outskirts): little change before and after 220 km/s (must be reduced in theory, but retained thanks to dark matter)
20-50 kpc (dark matter halo area): still constant around 220 km/s

First of all, The core of the galaxy's rotational speed problem is that the rotational velocity of ordinary matters remain nearly constant regardless of the distance from the galactic center. To explain the flattening of the speed, M(r) must increase as it moves away.
In other words, The total mass M(r) contained inside the orbit must increase linearly in proportion to the distance. but the volume of space increases much more rapidly as the cube of the distance. so the distribution of the internal mass must become thinner as it moves away from the center.(NFW (3) have shown that the density decreases to inversely proportional to the cube of r but no clear cause is available at this time.)

ordinary matters are densest in the center of the galaxy and decrease in density as it moves away from the center. However, the density of ordinary matter can't explain the galaxy's rotational speed of other objects. In other words, an additional source of gravity is needed. so the concept of Dark Matter Halo came in. the a entire galaxy is enveloped by a far more expansive dark matter halo. This halo extends for hundreds of thousands of light-years

The ordinary matters in the Dark Matter halo decreases as it goes outside the dark matter halo. If the density is low, ordinary matters to superpose the spacetime distortion fields diminished. as a result, the amount of ASD decreases. in the outermost regions of the dark matter halo, there are few objects sparsely. objects there also Exchange Weak Gravity and Even objects there rotate the galaxy at the same flat speed. also it is generally accepted that the halo's edge approximately matches the average conditions of the universe. There can be no ASD either by definition. In other words, ASD is distributed from the center of the dark matter halo to the end of it with the same distribution of Dark Matter. Both ASD and Dark Matter become less dense when going to the outskirts, and the area without Dark Matter is the area without ASD.

4.2. Bullet galaxy Cluster Collision

One of the most important events suggesting the existence of dark matter is the bullet Bullet galaxy Cluster Collision.(5) (Collision at speeds between 4500 and 6000 km/s) First of all, hot gas strongly collides with galaxies due to the action of electromagnetic force. while stars do not collide because the empty space is too huge. after the collision, the hot gas remained around at the point of collision. but the center of mass was laid out by galaxies and stars. This means that a gravitational source, which cannot be explained by visible matter has traveled with the star and galaxies. This suggests that invisible dark matter exists.

Exactly the same as the properties of ASD, In the event of a collision, ASD goes through everything. That is, distorted spacetime itself and has no interaction with electromagnetic force at all. also It doesn't collide with anything. From ASD's point of view, the stars passed without impact(It is safe to say that the distance between the stars are so far away that there is virtually no direct collision.). ASD just continued to goes with the stars without affected. ASD has never collided. ASD only gives gravity, but it's not affected by gravity

4.3. Core–Cusp Problem

The Core–Cusp problem (8) arises from a discrepancy between observational data and theoretical predictions. Observations indicate that the central regions of A dwarf galaxy and an LSB galaxy have a flat Density, constant-dark matter density core. but CDM and NFW(3) simulations's theoretical predictions predict a steep, cuspy form in dark matter Density as toward the center. This conflict challenges the validity of the standard CDM and NFW. this has led to alternative explanations involving baryonic feedback, warm dark matter etc.

total amount of ASD inevitably has correlation with ambient density. if density is lowered, it is like there is no material itself to superpose. (Excluding ultra-high density environments.) the dwarf galaxy, LSB has a core form of a general substance density in the center. These baryonic feedback processes, such as stellar winds and supernova-driven outflows, expel gas from the central regions of galaxies. As a result, the accumulation of matter is suppressed, helping to form a core-like density structure. Since ASD has no choice but to increase or decrease along the ambient density, it is considered appropriate that ASD, that is, Dark Matter, have a core form, constant-density core.

4.4. ASD Post Big Bang

Right after the Big Bang(6) from ASD's perspective, the superposition of spacetime distortion fields would have covered all the space at that time. and the same superposition may exist, but it never continues to occur consistent ASD. Irregular generation and disappearance of ASD with different strengths and different superpositions is likely to appear.

Ordinary Matter's Situation: Until about 380,000 years after the Big Bang, the universe was in a state of 'soup' filled with hot light (photon). Ordinary matter (proton, electrons) was under tremendous pressure as they violently interacted with the light. Because of the pressure of this light, ordinary matter could not aggregate no matter how much gravity pulled them. It was like trying to build a sandcastle in a strong storm.

The situation of ASD: On the other hand, ASD by definition does not interact with light at all. Therefore, it was not disturbed by the 'storm' of the pressure of light. ASD, calmly begin to clump together from the very beginning.

5. Gravitational Lensing and its Observational Challenges

Table 1. Detectability of lensing signatures by mass and distance

Mass $M(M_\odot)$	**Distance** D_L **(Mpc)**	**Expected** θ_E
10^{11} (Galactic Scale)	100	$\sim$ 1 UltraVisual
3×10^{10}	3×100	$\sim$ 0.3 First-second
10^9	100	$\sim$ 0.1 Ultra-angle
10^8	10	$\sim$ 0.01 Ultra-angle
10^7	1	$\sim$ 0.003 Ultra-angle

The basic lensing equation relates the observed image position $\vec{\theta}$, the true source position $\vec{\beta}$, and the deflection angle $\vec{\alpha}(\vec{\theta})$ as:

$$\vec{\beta} = \vec{\theta} - \vec{\alpha}(\vec{\theta}) \cdot \frac{D_{LS}}{D_S} \tag{1}$$

Here, D_{LS} is the angular diameter distance between the lens and the source, and D_S is the angular diameter distance between the observer and the source. For weak lensing by dark matter halos, the deflection angle $\vec{\alpha}(\vec{\theta})$ becomes exceedingly small. Consequently, the observed image position $\vec{\theta}$ is only minutely displaced from the true source position $\vec{\beta}$, leading to $\vec{\theta} \approx \vec{\beta}$. This tiny difference, often referred to as a subtle distortion, frequently falls below the detection limits of current instrumental resolution, making the direct measurement of weak lensing effects particularly challenging.

Interpretation of Observational Challenges As illustrated in Table 1, small or distant masses significantly reduce the Einstein radius (θ_E), making the detection of lensing signatures extremely challenging. For instance, even a $10^9 M_\odot$ dark matter halo acting as a lens at a distance of 100 Mpc would produce an Einstein radius of approximately 0.1 arcsecond. This value is critically close to, or often below, the typical angular resolution limit of the Hubble Space Telescope (around 0.05 arcseconds), making it profoundly difficult to observe such a faint distortion as a distinct entity. For even smaller mass or more distant lenses, the deflection angles (and thus θ_E) diminish further into the milliarcsecond (mas) range. Such minute bending angles render them undetectable by optical telescopes like HST, often requiring specialized instruments such as very high-resolution radio telescopes (e.g., VLBI) for any potential detection, or making them undetectable altogether.

6. Obeservation of dynamic changes in the inside of a black hole

From the ASD perspective, when black holes(7) interact, ASD will appear in Somewhere because of irregular superposition of each other's gravitational fields. it's likely to happen in a very short time. but it can be measured with the current technology. The information can measure changes inside the black hole during interaction.

7. Conclusion

After all, the most important point of this paper is to suggest that ASD is the dark matter itself. Currently, attempts to interpret dark matter by assuming virtual particles are ongoing, but not a single virtual particle has been found or detected. This implies that another interpretation, concept, or experiment is needed for it. This paper proposed the ASD framework as a new persuasive alternative, and this concept will serve as an opportunity to match and successfully know the identity of dark matter.

To talk a little bit more about density, As a result, ASD, Dark matter is created in an area because it is an "superposition" concept depending on the a general substance density of an area. For example, Gravity causes ASD and general substances to gather in a place with high gravity. It is not that there is ASD in that area, but that ASD is generated proportionally according to the density of the general substances. Therefore, it seems that Dark Matter do not exhibit completely independent movement. ASD has a certain value on average according to the density of the area. this way also seems appropriate to understand ASD, Dark Matter

If we talk about testing and validation methods Although observational methods are expected to be much easier to verify because they are astrophysical phenomena, experimental methods on the ground are to induce nonlinear superposition.

For example, install two high-mass objects as close as possible with only a small distance and observe the gravitational lens effect in the center, but the effect will be so slight, It may be difficult to observe, but there are advantages that we can adjust the light source and The position and mass of an object can be adjusted etc. A better experiment is actually checking the presence or absence of ASD by using an atomic clock after installation

The universe still hides many secrets from us, and this study provides a clue to reveal the dark matter.

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