Title: Proof that Mass Expands Space

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Date: May 2, 2025

Abstract

This paper proposes that mass causes both gravity and expansion through a gravitomagnetic effect. The relation

$$Gm = c^2 s$$

links mass to space, accurately predicting cosmic scale and suggesting a unified origin of expansion and structure.

1. Introduction

Gravity is a force that attracts objects and has the property of contracting space. In contrast, if there exists a repulsive force that makes objects move apart, it can be considered symmetric to gravity. This paper hypothesizes that this expansion force is induced by mass and corresponds physically to gravitomagnetism. A relationship between mass and space is derived, showing that cosmic expansion, inflation, voids, galactic rotation curves, etc., can be explained without invoking dark energy or dark matter.

2. Mathematical Formulation of the Expansion Force

Hubble's law is expressed as:

$$v = Hs$$

Differentiating with respect to time:

$$a = \frac{dv}{dt} = \frac{dH}{dt}s + H\frac{ds}{dt} = \frac{dH}{dt}s + Hv$$

The time derivative of the Hubble constant is very small:

$$\frac{dH}{dt} \approx -2.32 \times 10^{-36}\, s^{-2}$$

Thus, it can be neglected at the observational cosmic scale, leading to the approximation:

$$a \approx Hv$$

Multiplying both sides by mass m yields the expansion force:

$$F = mHv$$

3. Gravitomagnetic Force and Cross Product Expansion

As an electromagnetic induction analogue of gravity, the gravitomagnetic force is defined as:

$$F = m(\mathbf{v} \times \mathbf{P})$$

The gravitomagnetic field $\mathbf{P}$ is given by:

$$\mathbf{P} = -\frac{G}{c^2}\frac{\gamma m\mathbf{v} \times \xi}{\xi^3} = \frac{o_0}{4\pi}\frac{\gamma m\mathbf{v} \times \xi}{\xi^3}$$

Where:

- $\gamma = \frac{1}{\sqrt{1-v^2/c^2}}$: Lorentz factor
- $\xi \equiv \mathbf{s} - \mathbf{s}'$: Separation vector
- m : Mass
- G : Gravitational constant
- c : Speed of light

Since gravity acts from all directions in the universe, an omnidirectional expansion force with a cross-product nature arises. The nature of the cross product is such that it acts regardless of direction, thus the inequality:

$$|\mathbf{v} \times \mathbf{P}| \leq |\mathbf{v}|H$$

Evaluating the cross product:

$$|\mathbf{v} \times \mathbf{P}| = \frac{G\gamma m v^2}{c^2 s^2}\sin^2\theta$$

Especially when the motion of mass is perpendicular to the gravitomagnetic field, i.e., $\theta = \frac{\pi}{2}, \sin^2\theta = 1$, we get:

$$|\mathbf{v} \times \mathbf{P}| = \frac{G\gamma m v^2}{c^2 s^2}$$

In the low-velocity limit ($v \ll c$), $\gamma \approx 1$:

$$|\mathbf{v} \times \mathbf{P}| = \frac{G m v^2}{c^2 s^2}$$

Setting this equal to the expansion force:

$$\frac{Gmv}{c^2 s^2} = H \quad \Rightarrow \quad Gm = c^2 s$$

4. The Mass–Space Relation

The derived relation:

$$Gm = c^2 s$$

Implies that mass "occupies" or "expands" space per unit distance. Rearranging:

$$GM = c^2 r \quad \Rightarrow \quad \frac{GMm}{r} = mc^2$$

This matches an extreme physical scenario where a mass is completely bound by gravitational potential energy equal to its rest energy.

Also, the Schwarzschild radius is:

$$r_s = \frac{2Gm}{c^2}$$

Half of this value corresponds to the derived s, indicating a deeper gravitational field than the black hole event horizon, suggesting a unique physical state.

Now substituting the total mass of the observable universe:

$$m = 6 \times 10^{53}\,\mathrm{kg}$$

$$s = \frac{Gm}{c^2} \approx 4.4495 \times 10^{26}\,\mathrm{m}$$

This closely matches the radius of the observable universe:

$$\approx 4.399 \times 10^{26}\,\mathrm{m}$$

with only 1.15% error. This strong numerical agreement suggests the equation may fundamentally explain cosmic expansion.

5. Explanation of Cosmological Phenomena

Big Bang
Initial mass concentration induces outward expansion through cross-product effects, allowing rapid spatial expansion even in the presence of possible collisions, leading to rapid matter separation.

Inflation
Short distances between masses result in large gravitational field variations, causing maximized induced expansion and super-inflation right after the Big Bang.

Voids
As galaxies pass, outward spatial expansion occurs. The more mass concentrates at the center, the more space expands in that direction, forming bubble structures.

Dark Energy
Since matter (mass) is abundant in the observable universe, if repulsion is induced by mass, there's no need to assume dark energy separately.

Dark Matter
If gravity and gravitomagnetism mutually induce each other like electric and magnetic fields, gravity can appear without visible mass.

Galactic Rotation Curves
A large gravitomagnetic field is induced in the direction of galactic rotation axes, and the gravity induced by this field explains the observed rotation velocity distributions.

Hubble Tension
The interaction between mass distribution and expansion rate across the entire universe can influence the observed expansion rate. Since the value of the Hubble constant can vary depending on the mass distribution in the universe, a model of expansion that more accurately reflects the mass distribution could potentially resolve the Hubble tension.

Anisotropy of the Cosmic Microwave Background (CMB)
In the early universe, large-scale regions of concentrated mass could have generated stronger gravitomagnetic effects, which might have created variations in the expansion rate of space. These differences could have contributed to the anisotropy observed in the CMB, which can be explained as a result of the imbalanced distribution of mass in the early universe and its corresponding impact on the expansion rate of space.

6. Conclusion

This paper derives a mass–space relation through the concept of gravitomagnetic induction and shows its numerical agreement with the current radius of the universe. This can be interpreted as direct evidence that mass expands space.

$$Gm = c^2 s$$

This equation may go beyond a theoretical relationship and serve as a key to understanding the structure and dynamics of the universe. It offers an alternative that explains several modern cosmological challenges without dark energy or dark matter.

Future Work

Future work should involve quantitative comparison with astronomical data and the development of a new dynamical framework (space mechanics) that unifies space, gravity, and expansion. Especially since this structure is similar to Maxwell's equations, it holds the potential for technological applications such as remote spatial manipulation and matter transmission.

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