Title

Dark Field Theory: Deriving Hubble's Law and Explaining Cosmological Phenomena through a Mutual Induction Model of Gravity and Space Expansion

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Abstract

This study proposes a novel theoretical framework in which the mutual induction between gravity and space expansion is interpreted analogously to electromagnetic induction. The core concept is gravitomagnetism, an effect that has been experimentally verified, which is reinterpreted as a vector field termed the “Dark Field.” This field is induced by temporal changes in gravity and drives spatial expansion, represented by the expansion force equation

$$\mathbf{F} = \mathbf{p} \times \mathbf{d}$$

from which Hubble's law

$$\mathbf{v} = H\mathbf{s}$$

is mathematically derived. The theory presents the possibility of explaining a variety of cosmological phenomena—such as dark energy, the formation of voids and the Big Bang, and the anomalous galaxy rotation curves attributed to dark matter—using a single unified equation.

1. Introduction

The accelerating expansion of the universe and anomalies in galactic rotation curves have traditionally been explained by invoking dark energy and dark matter. However, these entities have not yet been directly detected, and their true nature remains unclear. This study seeks to address these unresolved issues by extending the traditional concept of gravity. The “Dark Field,” a novel vector field proposed to explain space expansion, is in fact anticipated by general relativity and experimentally validated through gravitomagnetism. This field, physically induced by dynamic changes in gravity, provides a conceptual and mathematical basis for naturally deriving Hubble’s law.

2. Theoretical Background

2.1 Electromagnetic Induction and Physical Analogy

In electromagnetism, a time-varying electric field induces a magnetic field, as formalized in Maxwell’s equations. By extending this framework to gravity and space, the following analogies emerge:

Electromagnetism	Cosmological Analogy
Electric charge q	Mass m
Electric field $\mathbf{E}$	Gravitational field $\mathbf{g}$
Magnetic field $\mathbf{B}$	Dark field $\mathbf{d}$
$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$	$\mathbf{F} = m\mathbf{v} \times \mathbf{d}$

The dark field $\mathbf{d}$ represents the tendency of spacetime to expand and is considered a vector field whose magnitude corresponds to the time-dependent Hubble parameter:

$$|\mathbf{d}| = H(t)$$

2.2 Gravitomagnetism: The Empirical Basis for the Dark Field

Gravitomagnetism, a prediction from general relativity, describes how rotating or moving masses generate magnetic-like effects in spacetime. First proposed by Lense and Thirring in 1918, the effect was experimentally confirmed by NASA’s **Gravity Probe B** mission (2004–2011), which detected frame dragging around Earth. This implies that changes in the gravitational field can induce effects in the form $\mathbf{v} \times \mathbf{B}$, which mathematically matches the dark field formulation:

$$\mathbf{F} = \mathbf{p} \times \mathbf{d}$$

Consequently, the dark field can be understood as a cosmological extension of gravitomagnetism, a physical phenomenon already observed in nature.

3. Derivation of Equations

3.1 Fundamental Relations

- Electric force:
  $\mathbf{F} = q\mathbf{E} = \frac{kQq}{r^2}$
- Gravitational force:
  $\mathbf{F} = mg = \frac{GMm}{r^2}$
- Magnetic force:
  $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$
- Expansion force:
  $\mathbf{F} = m\mathbf{v} \times \mathbf{d}$

Using momentum $\mathbf{p} = m\mathbf{v}$, the expansion force becomes:

$$\mathbf{F} = \mathbf{p} \times \mathbf{d}$$

3.2 Induction from the Equation of Motion

Starting from Newton’s second law:

$$\mathbf{F} = \frac{d\mathbf{p}}{dt} = m\mathbf{a} + \mathbf{v}\frac{dm}{dt}$$

Integrating both sides over time:

$$\int \left(\mathbf{a} + \frac{\mathbf{v}}{m}\frac{dm}{dt}\right) dt = \int \mathbf{v} \times \mathbf{D}\, dt$$

Left-hand side:

$$\int \mathbf{a}dt + \int \left(\frac{\mathbf{v}}{m}\right) dm = \mathbf{s} \times \mathbf{D} - \int \left(\mathbf{s} \times \frac{d\mathbf{D}}{dt}\right) dt$$

If there is no mass change $(dm/dt = 0)$, the extra terms vanish:

$$\mathbf{v} = \mathbf{s} \times \mathbf{d} \Rightarrow \mathbf{v} = H\mathbf{s}$$

A natural derivation of **Hubble’s Law**.

4. Discussion

4.1 Structural Equivalence of Gravitomagnetism and Expansion Force

Gravitomagnetism arises from mass motion and spacetime rotation—precisely the mechanism by which the dark field is hypothesized to drive space expansion. The Gravity Probe B results demonstrate that moving mass induces a vector field capable of distorting spacetime, supporting the physical reality of the dark field $\mathbf{d}$.

4.2 Omnidirectional Expansion

Since gravity acts in all directions, a cross-product-based expansion force would also act isotropically. The vector nature of the dark field allows space to expand uniformly, regardless of collisions or directional constraints.

4.3 Dark Matter and Galaxy Rotation

If the induced vector field of space itself can emulate gravitational effects, then anomalous galactic rotation curves could be explained without invoking dark matter. The cyclic mutual induction between gravity and the dark field could sustain gravitational effects even in the absence of visible mass—accounting for dark matter–like behavior.

5. Conclusion

This study introduces a new theoretical model for deriving Hubble's Law based on a mutual induction relationship between gravity and space expansion, rooted in the analogy to electromagnetic induction and grounded in the empirically confirmed phenomenon of gravitomagnetism. The dark field can be viewed not as a hypothetical entity but as an extension of already verified gravitational behavior. This framework provides a potential unified explanation for numerous cosmological puzzles, including dark energy, dark matter, void formation, and galaxy rotation curves. Future research should focus on quantitatively testing this theory against observational data.

References

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