Inferring the Source of Cosmic Expansion Forces from the Presence of Charge in Space

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ABSTRACT

The accelerating expansion of the universe suggests the presence of a repulsive force exceeding gravitational attraction. This study explores the asymmetry in electron and positron production during the formation of the universe, which may have led to a residual charge imbalance. If a uniform but minuscule charge density pervades the universe, the resulting electrostatic repulsion could drive cosmic expansion. Through mathematical modeling, we demonstrate that even an extremely slight charge density variation can result in accelerated expansion, aligning with current observations.

1. INTRODUCTION

Recent observations confirm that the universe is undergoing accelerated expansion, yet the underlying mechanism remains unclear. Dark energy is widely considered a primary factor, but its physical nature is still unknown. This study examines the potential role of cosmic charge distribution in contributing to expansion through electrostatic repulsion.

2. COSMIC CHARGE DISTRIBUTION AND EXPANSION MECHANISM

2.1. Electron-Positron Production Asymmetry

During the early universe, the production of electrons and positrons was not entirely symmetrical, leading to a present-day surplus of electrons over positrons. If the residual charge in the universe is not electrically neutral and is approximately uniformly distributed throughout, it could induce additional electrostatic effects.

2.2. Uniform Charge Distribution and Electrostatic Effects

If a weak but pervasive charge density exists throughout the universe, the electric fields it generates would largely cancel out due to symmetry, making direct observation challenging. However, the overall electrostatic repulsion between similar charges could drive cosmic expansion.

2.3. Electrostatic Repulsion and Mathematical Model of Expansion

If we consider the universe as a three-dimensional bubble in four-dimensional space, as depicted in Figure 1. The following calculations are for the gravitational attraction and electrostatic repulsion between two cosmic spatial regions separated by a distance L, each having a mass M and a charge Q. The schematic diagram is shown in Figure 2.

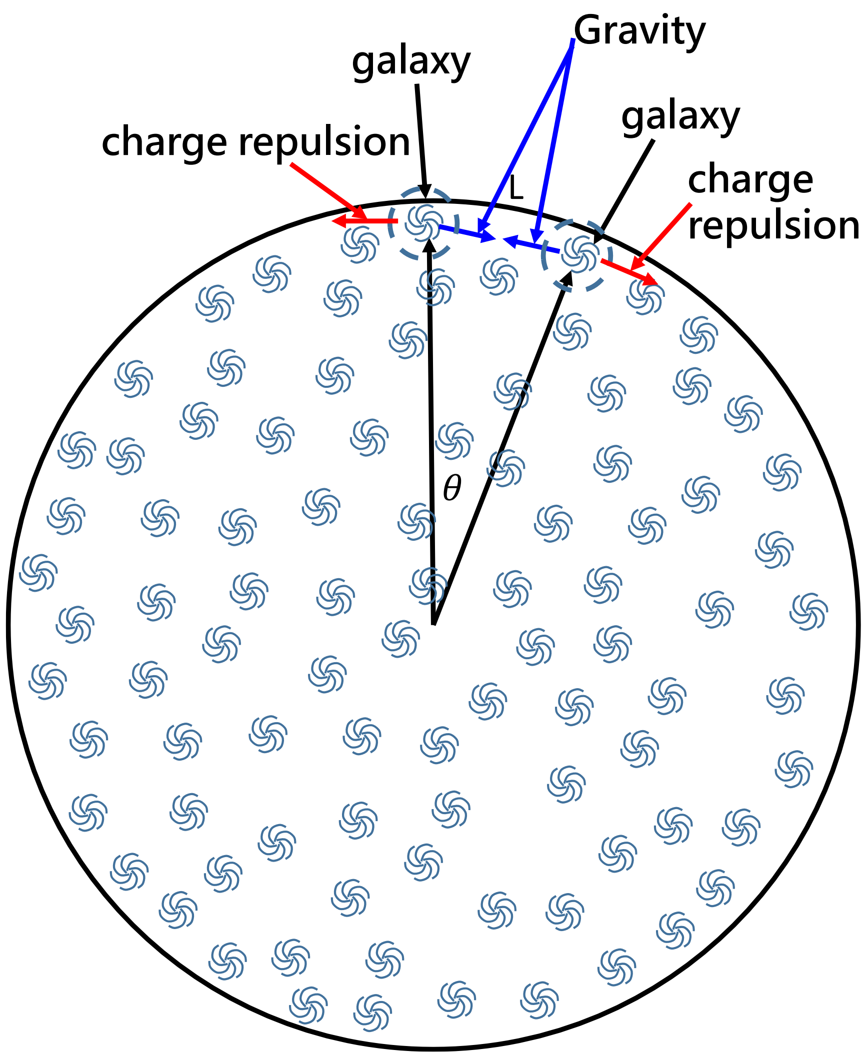

Figure 1. The universe as a bubble in four-dimensional space, with three-dimensional space represented in a simplified two-dimensional form.

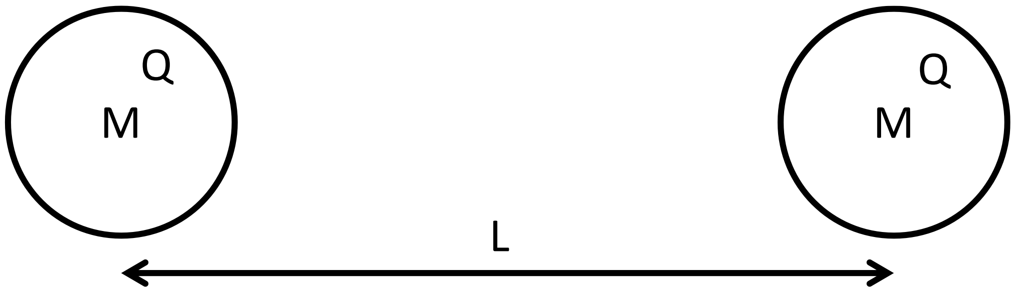

Figure 2. Two cosmic regions separated by distance L, each containing mass M and charge Q.

The gravitational attraction between these two spaces can be expressed as shown in the first equation [Ref.1]:

$$F_G = G\frac{m_1 m_2}{L^2} = G\frac{M^2}{L^2} \quad \dots\dots\dots (1)$$

$$G = 6.67430 \times 10^{-11}\, m^3/(kg \cdot s^2)$$

The electrostatic repulsion between these two spaces can be expressed as shown in the second equation [Ref.2]:

$$F_Q = -\frac{q_1 q_2}{4\pi\epsilon_0 L^2} = -\frac{Q^2}{4\pi\epsilon_0 L^2} \quad \dots\dots\dots (2)$$

The relationship between the vacuum permittivity and the vacuum permeability is shown in the third equation [Ref.3]:

$$\epsilon_0 = \frac{1}{c^2\mu_0} \quad \dots\dots\dots (3)$$

The value of the vacuum permeability is shown in the fourth equation [Ref.4]:

$$\mu_0 = 4\pi \times 10^{-7}\frac{Vs}{Am} = 4\pi \times 10^{-7}\frac{Nms}{C} \times \frac{s}{Cm} = 4\pi \times 10^{-7}\frac{Ns^2}{C^2} \quad \dots\dots\dots (4)$$

Substituting the fourth and third equations into the second equation yields the fifth equation:

$$F_Q = -\frac{Q^2}{4\pi\epsilon_0 L^2} = -\frac{c^2\mu_0 Q^2}{4\pi L^2} = -\frac{Ns^2c^2Q^2}{10^7C^2L^2} \qquad \dots\dots\dots (5)$$

When the repulsive force is greater than the gravitational force, the sixth equation can be obtained:

$$F_G + F_Q < 0 \Rightarrow \frac{Ns^2c^2Q^2}{10^7C^2L^2} > G\frac{M^2}{L^2}$$

$$\Rightarrow\ Q^2 > \frac{10^7C^2G}{Ns^2c^2}M^2 = \frac{10^7C^2G}{kg\cdot mc^2}M^2 = \frac{10^7C^2(6.67430\times10^{-11})}{kg^2(2.997925\times10^8)^2}M^2$$

$$= 7.42616\times10^{-21}\frac{C^2}{kg^2}M^2 \qquad \dots\dots\dots (6)$$

The average mass density of the universe is approximately 9.9×10^{-27} kg/m³ [Ref.5]. Substituting this into the sixth equation yields the seventh equation:

$$Q > 8.53134\times10^{-37}\,C/m^3 = 5.32483\times10^{-18}\,e/m^3 = e/(572662m)^3 \qquad \dots\dots\dots (7)$$

The charge density that makes the repulsive force greater than the gravitational attraction is shown in the seventh equation.

3. RESULT AND DISCUSSION

Calculations reveal that when the cubic region of space in the universe with an edge length of 572 km has an excess of more than one electron in terms of negative charge or a deficit of more than one electron in terms of positive charge, the resulting electrostatic repulsion exceeds gravitational attraction, contributing to cosmic expansion. As this charge density is below current observational limits, its effects remain undetected.

Unlike gravity, which attracts matter and could lead to collapse into black holes, electrostatic repulsion naturally disperses charge, preventing clustering. This mechanism provides an alternative explanation for cosmic expansion that aligns with observational data.

4. CONCLUSION

This study proposes that a slight non-neutral charge distribution throughout the universe may contribute to its accelerated expansion. Our mathematical model demonstrates that even an extremely low charge density can significantly impact expansion, consistent with current observations. Future observational and experimental research could further validate this hypothesis and explore its connection to dark energy theories.

NOMENCLATURE

A = Unit of electric current, ampere

c = Speed of light

C = Unit of electric charge, coulomb

e = Charge of a single electron

ϵ_0 = Vacuum permittivity

F_G = Gravitational attraction

F_Q = Electrostatic repulsion

G = Gravitational constant

kg = Kilogram

L = Distance between the observed objects

m = Meter

M = Total mass of the observed region

m_1 = Mass of object '1'

m_2 = Mass of object '2'

N = Unit of force, newton

Q = Total charge of the observed region

q_1 = Charge of object '1'

q_2 = Charge of object '2'

s = Second

μ_0 = Vacuum permeability

V = Unit of voltage, volt

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DATA AVAILABILITY STATEMENT

Not applicable

DECLARATIONS

Conflict of interest statement

The author has no conflicts of interest to disclose.

Author Contributions

Kuo Tso Chen designed the study, performed the experiments, analyzed the data, and wrote the manuscript.

Ethics Approval

I confirm that the manuscript has been approved by the author for publication. I declare that the work described herein is original research and that it has not been published previously.

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