Confinement of Gravity within Electromagnetism Based on Intrinsic Electric Dipoles

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Abstract

Modern Physics describes four fundamental interactions namely: Strong Nuclear Interaction, Weak Nuclear Interaction, Electromagnetic Interaction and Gravitational Interaction. Among these Interactions, the gravitational interaction is still not unified with others in a commonly accepted theory like Electroweak Theory or Quantum Chromodynamics despite many recent and previous trials. This research paper clarifies an attempt to confine gravitational interaction within electromagnetism based on intrinsic electric dipole of elementary particles. This proposed hypothesis is a novel approach method to answer unsolved problems related to gravity like hierarchy problem i.e., extremely weak nature of gravity, absence of anti-gravity and confinement of gravity within electromagnetism in a manner that is compatible with both General Relativity and Quantum Mechanics. Additionally, for the first time, it discusses attraction-repulsion inequality principle in electromagnetic dipoles and provides new equation related to this principle. Furthermore, it will introduce the concept of mass-charge equivalence as integration for Einstein's mass-energy equivalence while providing new definition for gravitons based on virtual photons and one step forward toward the theory of everything. Finally, and notably, it relies on experimental simulations and similarities rather than just pure theoretical explanations and assumptions.

Keywords: Gravity, Graviton, Fundamental Forces, Virtual Photons, Positronium, Intrinsic Electric Dipole, New Equation, New Constant Introduction

Introduction

Before **Newton**'s Discovery of Gravitational Force, The People knew the fact that heavy objects are heavy and the light objects are light. Falling of objects from higher altitude to the lower one was also known by people, including falling apples from trees, but they never knew the reason behind these phenomena. Newton explained all these phenomena by gravitational interaction and he put a law for it, known as Newton's Law for Gravity. In Newtonian terms; everything in the universe that has a mass instantaneously attracts every other mass, dependent on the value of their masses, the gravitational constant, and the square of the distance between them. But Newtonian gravity does **not** explain; Energy interaction with gravity (Red Shift, Blue Shift, bending of light near massive objects) and the speed of gravity which was proved to has the same speed of light by LIGO's detection of gravitational waves.

In comparison **Einstein**'s concept was based on the idea that space and time were unified into a fabric space-time, and that the curvature of space-time told not only matter but also energy how to move within it. Up to date, Einstein's **general relativity** has passed every observational and experimental tests**.** Despite all these facts but still Einstein's general relativity **cannot** provide the solution for the following problems:

- Unification of Gravity with one of the other three fundamental interactions
- The extremely weak strength of gravity (Hierarchy Problem)
- Why there is no anti-gravity (i.e., there is no repulsive gravitational interaction)
- Quantization of gravity
- Origin of Dark Matter

Several theories and hypotheses in both modern and classical physics had been developed to unify gravity with electromagnetism without achievement of a widely accepted theory, similar to the **Electroweak Theory** by **Glashow, Weinberg** and **Abdus Salam**, which unifies weak nuclear force with electromagnetic force. Among theories in Modern Physics and Physics Beyond Standard Model, which argue for providing solutions for the above-mentioned unsolved mysteries are; Emergent Gravity, Quantum Gravity, String Theory, Modified Newtonian Dynamics, etc. But none of the solutions provided

by these theories is totally accepted by scientific community and this is an active area of research in physics.

This study is an entirely new approach method for solving most of these problems based on new principle in electromagnetism that can embrace gravity. It provides new equation that is first of its kind, to connect gravity with electromagnetism and it gives new explanation for extremely weak nature of gravity. Additionally, this proposed unification of gravity with electromagnetism can be demonstrated through experimental simulations.

A Gap in Classical Electromagnetism

Classical Physics precisely described electromagnetism. There are well known laws and equations including; Maxwell's equations, Lorentz force law, Gauss's law, Faraday's law, Ampère's Law, Coulomb's law and Laplacian equation for more sophisticated charge distribution in spherical coordinates.

Despite all, there is a special situation in which these laws and calculations will not be able to predict observations and we need to introduce new equation in order to describe our observation and real interactions. This special situation happens when two group of charges either dipoles or multipoles, with net zero charges interact freely in unrestricted manner. For example, if we have a group of evenly distributed charges with net zero charge and a dipole group with net zero charge as shown in figure (1), according to most advanced calculations and simulations the interaction between them will be repulsive or attractive or null depending on their position and internal distribution, however what we observe, will be an always attractive interaction between them. In this special situation all currently available calculations and equations will be in apparent discrepancy with reality and observation. Same thing true for a group of evenly distributed charges (electric multipole) with net zero charge in one hand and an asymmetric charge in another hand, hence new equations in electromagnetism are needed to describe the strength and the direction of this always attractive force.

This phenomenon results from the following facts:

1- Rotation of either both or one of the dipole-multipole groups is easier than repulsion and the easiest path is always undertaken by them. Due the same fact, it will be extremely difficult to observe repulsive interactions between two free moving spherical permanent magnets with big difference in

size, if there is no external force to maintain repulsion. In order to observe repulsion, the groups should be precisely put in one line and both of them should be prevented from horizontal and vertical rotations. This fact can be described as dipole attraction-repulsion inequality principle or dipole repulsion maintenance principle in electromagnetism

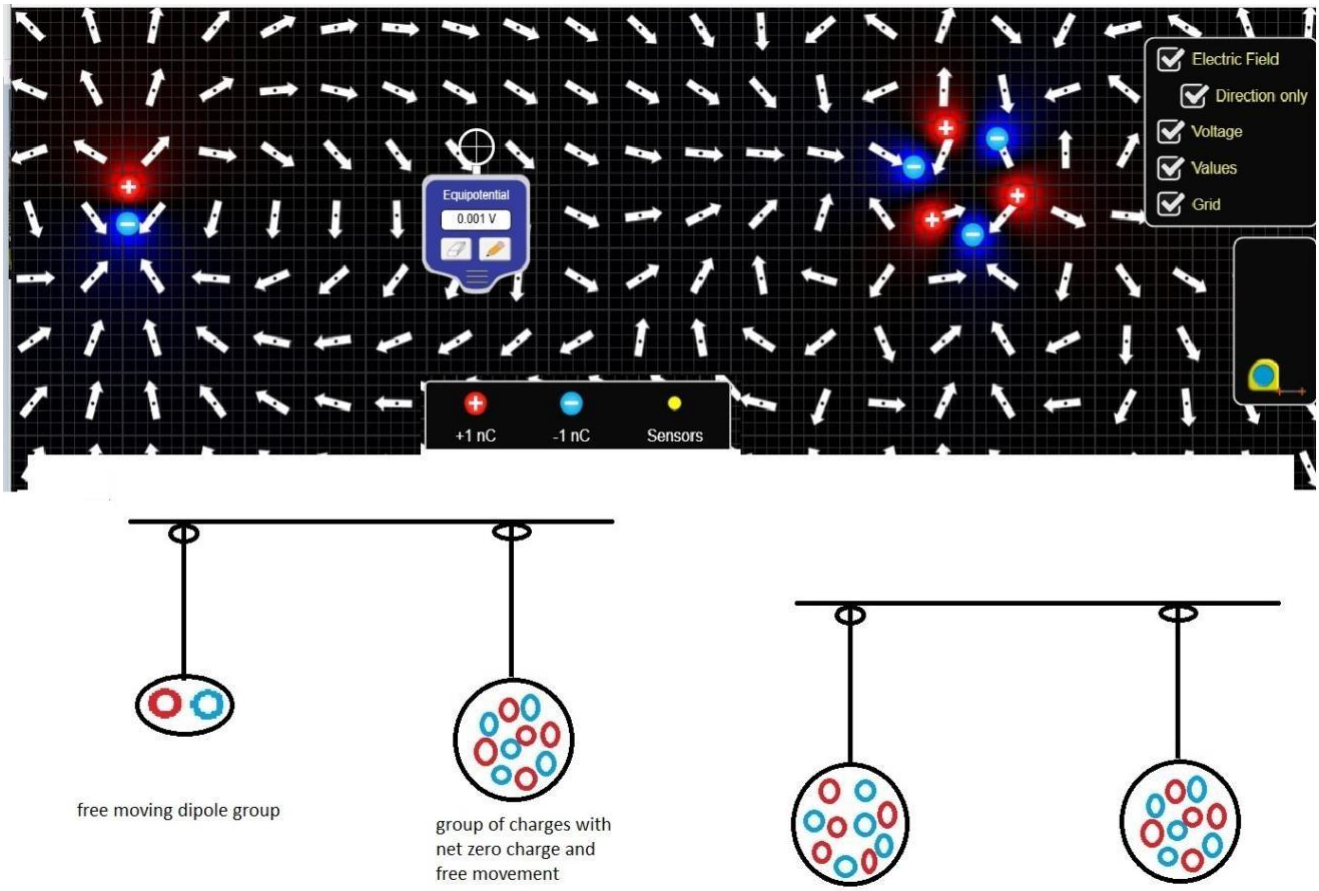

Figure (1): showing free moving charge groups pendulum (electric multipoles and a dipole) and a simulation for charges and fields provided by Interactive Simulations for Science and Math by Colorado University.

2. Due to particle-wave duality property of charge carriers the internal structure can never be stabilized. This fact can be described as instability principle.

3. The last fact is related to the distance dependent force strength. In electrostatics the strength of force is inversely proportional to the square of distance between charges as explained in Coulomb's second law. So, when a dipole is repelled from an electric field source the strength of repulsive force is gradually

decreasing while if attraction occurs, the strength of the attractive force is gradually increasing. This fact can be described as distant dependent imbalance.

To explain what happens in reality we need new equations. We will provide first relevant equation in the upcoming sections. This small gap in literature regarding electromagnetism can open a large window to an entirely new physics. In summary, if any electric dipole is placed in an electric field from alternative opposite charges (heterogeneous field), the dipole will be always attracted to the source of electric field. An asymmetric charge also behaves as dipole in this always attractive interaction, regardless the type of charge i.e., the negative and positive asymmetric charges are behaving similarly in this interaction.

This always attractive force is very weak due to electromagnetic cancellation effect*. The same principle also applies for magnetic force.

*Note:

- electromagnetic cancellation effect can be demonstrated by Electropermanent magnet. https://en.m.wikipedia.org/wiki/Electropermanent_magnet

- The action lab channel provided an experiment about it in YouTube. https://youtu.be/PMma3OJUHhs

Attraction-Repulsion Inequality of Electromagnetic Dipoles Inside Heterogeneous Fields

It is obvious that the amount of force needed to push or pull an object is the same if you use hands or a rigid instrument. But have you ever thought about inequality of repulsion and attraction of electromagnetic dipoles in a mixed electromagnetic field? **

To explain it, in a simplest easiest way, we can use a ball and a marble (marble a small ball not the rock) with either magnetic poles or electric charges. For example, if we bring two magnetic tools one in a ball shape and the other in the shape of a marble and trying to repel the magnetic marble with the magnetic ball, we can observe that the repulsion can never happen if there is no external forces to maintain it. In order to observe repulsion, the marble should be prevented from both rotation and deviation from a straight line. In the opposite to that, the attraction between them is very easily achieved without any external maintaining forces.

Same thing happens if we use a ball that has equal amounts of negative and positive charges in its surface (electric multipole ball) and an electric dipole marble.

If we understand this principle and remember that both electrons and positrons have intrinsic electric dipole moments hence slightly asymmetric charge, we can conclude that, if either an election or a positron (anti electron) is placed in a given distance to any neutral baryon, neutral atom or neutral molecule, the election or the positron will be attracted to the atom or the molecule. This attractive force is as weak as gravity and its always attractive force that is why, we consider this force as gravity.

Note: **Mixed Electromagnetic Field in this paper refers to the presence of mixture of opposite fields. For **electric field**, refers to the presence of positive and negative charges in the same particle or same group like presence of electrons and nucleons inside atoms, quarks inside baryons, or any other similar mixture of the opposite electric charges, hence another term can be chosen instead, like **Mixed Opposite Charges**, **Inhomogeneous Charge Distribution**, **Adjacent Reciprocal Electric Charges, Heterogeneous Charge Distribution,** etc.

Mathematical Approach

In this hypothesis, we assume the emergent force beyond the intermolecular force range from charge distribution (CD) of baryons and atoms as a gravitational force responsible for invariant mass as we explained above. However, regarding relativistic gravitational force, there's another mechanism for its generation, we will clarify it in our future work.

According to this study the invariant mass and relativistic mass have two different equations even though they have the same origin. thus;

Total mass = Invariant mass+ Relativistic mass

And according to this hypothesis;

Invariant mass = mass from heterogeneous charge distribution (HCD)

- The emergent force from HCD between two masses (m1, m2) is directly proportional to the absolute value of the sum of charge groups (q1,q2) because the charges are the driving force in this interaction as it is in Coulomb’s law.

- While it is indirectly proportional to the square of the distance between their charge centers(r^2) similar to both Coulomb's Law and Newton's Law of Gravity.
- Beside Coulomb's constant (K), there must be two reducing factors to show the degree of heterogeneous charge distribution hence the extent of electromagnetic cancellation effect from opposite adjacent charges within each group, we named these factors; Heterogeneous Charge Distribution Factors (HCD- F) thus the equation will be like that:

$$\mathbf{F = K (|q1|*|q2|) / (HCD\text{-}F1 * HCD\text{-}F2) r^2}$$ ► new equation Where:

F: is the emergent force from Heterogeneous Charge Distribution.

K: is Coulomb's Constant

HCD F1 & 2: are Heterogeneous Charge Distribution Factors for each group.

|q1| & |q2|: are absolute values of the sum of charges of elementary particles for each group i.e., the electrons and quarks (both valence quarks and sea quarks), not the sum of charges of baryons like protons and neutrons or any other composed particles.

r: is the distance between the charge centers of the groups.

Heterogeneous Charge Distribution Factors in the above equation could explain the extremely weak nature of gravity without need for extra dimensions as a new approach for solving hierarchy problem. Heterogeneous Charge Distribution Factor (HCD-F) is a unit-less factor which shows the degree of charge distribution heterogeneity, it is not a constant as each group or particle has its own extrinsic or intrinsic charge distribution. It should be noticed that, Coulomb's law cannot be assumed as a special case of the above equation, when both Heterogeneous Charge Distribution Factors are equal to one. Because we are dealing with newly described force and electromagnetic cancellation effect should be taken in consideration, so the heterogeneous charge distribution factors are always much less than one.

Heterogeneous Charge Distribution factors for elementary particles directly related to their electric dipole moment. So the HCD-F of electrons and positrons are the same, each quark has its own

HCD-F depending on their electric dipole moment which is equal to the HCD-F of their counter anti-quarks. The HCD-F of all composed particles like hadrons, baryons including protons and neutrons, atoms, exotic atoms, molecules, crystals and whole matter should essentially be the same as all of them provide the same heterogeneous electric field. this HCD-F can be used as a reference. For example, protons and neutrons however they have different valence charges but essentially, they are composed of three valence quarks and many sea quarks so both of them are providing a heterogeneous electric field but the proton also provides a pure positive electric field in addition to its heterogeneous electric field from its sea quarks and valence quarks.

We can further explain this by comparing an atom with its corresponding ion, both the atom and its ion composed of electrons and nucleons so they produce the same heterogeneous electric field but the ion possesses another additional pure electric field. This pure electric field is relevant to Coulomb's force, while the heterogeneous electric field is relevant to the force described in this study.

We can find the **reference Heterogeneous Charge Distribution Factor** (rHCD-F), by using the positronium atom characteristics. As it is the simplest exotic atom that is completely composed from two elementary particles, with highest charge to mass ratio and it is free from quarks and gluons, hence free from relativistic nuclear mass. If we take two positronium atoms with a known distance(r) between them;

Since $F = G\ m1\ m2 / r^2$ ► from Newton's Law for Gravity;

$G\ m1\ m2 /r^2 = K(|q1|*|q2|)/ (HCD\text{-}F1*HCD\text{-}F2)\ r^2$ ►from both above equations

► This equation is first of its kind to embrace both Coulombs Constant and Gravitational Constant.

Because the center of mass is the same as center of charge for positronium atoms;

$$G\ m1\ m2 = K\ |q1|*|q2| /(HCD\text{-}F1*HCD\text{-}F2)$$

And because HCD-F1 = HCD-F2 , m1 =m2 , and q1=q2 for positronium atoms;

$G*m_p^2 = K*q_p^2/HCD\text{-}F^2$

$HCD\text{-}F^2= K*q_p^2/(G*m_p^2)$

$HCD\text{-}F^2= K/G * q_p^2/m_p^2$

HCD-F=$\sqrt{(K/G)} * q_p/m_p$

HCD-F is reference Heterogeneous Charge Distribution Factor (rHCD-F). q_p: is the charge of two positrons (absolute value of the sum of charges of a positronium atom) m_p: is the atomic mass of a positronium (approximately the mass of two electrons - but not exactly).

By using this reference Heterogeneous Charge Distribution, we can **predict** the maximum number of sea quarks inside protons and neutrons or we can set the upper limit for sea quarks by the following equation:

G m1 m2 = K |q1|*|q2| /(HCD-F1*HCD-F2). ► from above mentioned derivatives

G mp mn = K |qp|*|qn| /(rHCD-F*rHCD-F)

Whereas:

mp= atomic mass of a positronium

qp= the sum of charges inside a positronium atom (|2e|)

rHCD-F= reference Heterogeneous Charge Distribution factor which is the same for atoms and hadrons

mn= total mass of a neutron from rest mass of quarks and relativistic mass of gluons

qn= the maximum hidden charge inside neutrons, from both valence quarks and sea quarks.

$|qn| = G\ mp\ mn\ rHCD\text{-}F^2 / K\ |qp|$

And this value is only to put the upper limit as the relativistic mass should be taken in consideration.

By the same method we can find the HCD-F of all charged elementary particles, and their value should be directly proportional to their electric dipole moment.

If we take electron as example, it will be like that:

G m1 m2 = K |q1|*|q2| /(HCD-F1*HCD-F2). ► from above mentioned derivatives

G mp me = K |qp|*|qe| /(rHCD-F*eHCD-F)

where:

me=rest mass of electron

qe= charge of electron

eHCD-F= Heterogeneous Charge Distribution factor of electron, hence for positron also. And it's the only unknown in the equation.

Experimental Simulation using Permanent Magnets or Electrostatic Objects

Real experimental simulations can provide strong evidence to support or disprove this hypothesis. Either electrostatic balls or magnetic tools can be used to make adjacently arranged alternative electrostatically negative and positive balls or adjacently arranged alternative north and south magnetic poles to make a mixture of opposite charge or a mixture of opposite magnetic poles in each group. Then the above-mentioned equations can be examined by using Heterogeneous Charge Distribution Factor (HCD-F) for each group in case of electrostatic bars or Heterogeneous Magnetic Distribution Factor (HMD-F) for each group in case of using magnetic tools.

Experimental simulation for atoms and baryons using electrically charged balls to mimic atoms and baryons can be used to prove or **disprove** this hypothesis thus the above-mentioned discrepancy and equations can be examined experimentally. And that’s the key difference of this study compared to other theories and hypotheses.

Similarities Observed in Chemical Bonds and Intermolecular Forces:

Among all similarities and differences in nature, there is a well-known example for the effects of heterogeneous charge distribution and its geometry on figuring out the electromagnetic force observed in both chemical bonds and intermolecular forces. For instance, the difference between electronegativity of two atoms in a given molecule will determine the nature of the chemical bond in such a way if this value is equal or less than 0.4 the bond is non polar covalent bond, if the value is in between 0.5 to 1.8 the bond is polar covalent bond finally if it's more than 1.8 the bond is ionic bond, but that's not always correct for example in case of CF4 (carbon tetrafluoride) however the electronegativity difference is between 0.5 to 1.8 the molecule is behaving as a non-polar molecule because of cancellation of two opposite molecular dipoles in a mirror effect (Chemistry LibreTexts, 2015) (Goyal, 2022). The above fact proves that both charge distribution and its geometry have a crucial role in determining the nature of the chemical bond. Furthermore, if the distance between two atoms in a given molecule is decreased there

will be a repulsive force trying to restore the original distance inversely if the distance is increased within the range of chemical bond there will be an attractive force between them. a simulation provided by **PhET** Interactive Simulations for learning purposes clarifies this interaction (University of Colorado Boulder, 2019).

According to most recent descriptions, the intermolecular force is always attractive and weaker in long range intermolecular forces. Surprisingly according to the modern science, the attractive force will disappear beyond intermolecular force range into a neglected level. if we notice that the intermolecular force is a resultant of heterogeneous charge distribution, we can conclude that even beyond intermolecular force range, another force still should be existed, because charge heterogeneity is preserved in molecular level, atomic level and even subatomic level. This neglected force is similar to the gravity in two points, it is an extremely weak force and it is an always attractive interaction. That is what we see as a beautiful similarity between these bonds and the gravity in our hypothesis, both of them based on heterogeneous charge distribution. The difference is that, extrinsic **dipole** formation and inequality in charge distribution, charge sharing are the basis for both chemical bonds and intermolecular forces but for gravity as we clarified above, the asymmetric charge and non-induced dipoles (intrinsic electric dipole) are the driving force. On the other hand, all charged elementary particles have masses. If there is only **one** charged particle with **zero** mass, this hypothesis will **no** longer work.

New Definition for Graviton

Based on our hypothesis, virtual photons which mediate electrostatic force are bidirectional and a **Graviton** can be defined as **two opposite adjacent virtual photons.** Furthermore, the hypothesis will be in agreement with both **General Relativity** and **Quantum Physics** by assuming Gravitons as the causative agent for apparently bending space-time and mediating attractive interaction among all massive particles. On another hand quantization of gravity is achieved based on electrostatics. And it's clear that electrostatic force is a part of unified electromagnetic interaction.

Future work:

Each of the following subjects can be a title for future relevant research papers, of course after making a paper from this preprint:

1. **Difference between Charge Center and Mass Center of Nucleons in Confined Gravity Concept**
2. **Gravity Interaction with Energy - Relativistic Gravity Explanation in Confined Gravity Model**
3. **Dark Energy and Dark Matter in Confined Gravity Model**
4. **Unification of Dark Matter Theory and Modified Newtonian Dynamics**

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