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Origins and Unification of the Four Fundamental Forces of Nature

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Abstract The four fundamental forces of nature are extremely important because they dominate the formation and evolution of the universe. However, until now, their physical origins and essential qualities have not been explained with wide acceptance. Based on new and solid understandings, this paper provides new explanations for the origins and essences of these four forces, that is, all four fundamental forces originate from the electric force and can therefore be unified as one force. First, the gravitational force is a synthetic electric force produced by a huge number of electric charges via non-uniform charge distribution. Next, based on a novel inference of nuclear structure, which is strongly supported by observed phenomena, the strong and weak forces are also deduced to be electric forces. These introduced new understandings can explain observed confusing phenomena simply and effectively, such as "dark matter," "dark energy," "flat galaxies," "filamentary nebulae," and "gamma-ray bursts" in nuclear fission or fusion and from black holes. The author presents these new understandings in an effort to find the natural truth earlier.

Keywords: gravitational force; strong force; weak force; unification of the four fundament forces; classical space-time; dark matter; dark energy

Introduction

According to the current standard theory, there are four fundamental forces in the universe. In order of increasing strength, they are the gravitational force, the weak nuclear force, the electromagnetic force, and the strong nuclear force. According to the current mainstream view in the academic community, these four forces have different origins and different intrinsic qualities, including different interaction strengths and different effective distances. These four forces are fundamentally important because they dominate the formation and evolution of the universe.

However, what are the physical origins and essential qualities of these forces? Where do they come from? How do they work? Until now, these questions have not been answered with wide acceptance. Many attempts have been made to answer these questions. Although various inferences and hypotheses have been proposed, the observed phenomena are still not explained satisfactorily. At present, the standard answer is only that these four forces are special and different from each other, as written in school textbooks worldwide. However, this answer cannot provide the true essential qualities of these forces.

The author now has new understandings of these questions. These understandings are still based on the classical space-time view and can be grasped through common sense. In other words, explaining the origins and nature of the four fundamental forces does not require unusual speculations or even unimaginable whimsies.

After thinking through the appearances and delving deep into the substance, the author has realized that all four fundamental forces originate from the electric force. Some originate from the electric force simply, while others originate from the electric force more complexly. For example, the magnetic force originates simply from the electric force, but the gravitational force originates in a

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more complex manner. The gravitational force is a synthetic electric force produced by a huge number of electric charges via non-uniform charge distribution.

The author has also deduced that the strong nuclear force originates from the electric force. This deduction is based on suppositions about exceptional proton and neutron structures, or exceptional nuclear structures. With such structures, protons and neutrons can be held together by the electric force, negating the need for a special strong interaction force to explain the cohesion of multiple protons in the nucleus.

Similarly, a special weak interaction force is not needed to explain the radioactive decay emitted from atoms with high atomic numbers. As the number of protons and neutrons in the nucleus increases, more collisions, which are driven by the electric forces, occur. As a result, some photons, electrons, and small groups of bound protons with neutrons are emitted, forming gamma, beta, and alpha decay rays.

The supposed proton and neutron structures are strongly supported by observed phenomena, including gamma-ray bursts in nuclear fission and fusion reactions, photon appearing after electron-positron annihilation, photon splitting into electron and positron in high-energy collision, and gamma-ray bursts from black holes.

Thus, the four fundamental forces of nature have the same origin and can be unified into one force: the electric force. Although these new understandings are currently inferences and lack direct experimental evidence, some of them have been confirmed indirectly by the experimental and astronomical observations.

The Gravitational Interaction Force

What is the gravitational force? This question is particularly difficult to answer due to the strange and mysterious behaviors of the gravitational force. Many people, including famous scientists, have made great efforts to find the answers but without satisfactory results.

The gravitational force is crucial. It is the foundation of everything in the universe. Without it, there would be no Earth and universe. From atoms and molecules to galaxies and galaxy clusters, all things move, gather, burst, and evolve under the influence of the gravitational force.

According to new understanding, the gravitational force is a synthetic electric force produced by a huge number of electric charges through non-uniform charge distribution. The origin of the gravitational force is not very complicated, but insight is needed to find the truth through confusing appearances.

1. Observation of the Gravitational Force

In the physics textbook, there is a description of the early discovery of electric charge and the attractive and repulsive forces between two charges [1]. As early as 600 BC, the ancient Greeks discovered that if amber was rubbed, it would attract light objects, such as wool. Today we know that the amber acquired net electric charges, or became "charged." The net charges on the amber would attract the wool.

When you rub a plastic rod with fur and a glass rod with silk, both become "charged" and can attract other light objects. If you perform experiments by rubbing a plastic rod with fur and a glass rod with silk, you will find the plastic rod can be attracted by the glass rod. However, two plastic rods rubbed with fur or two glass rods rubbed with silk repel each other. Today we know there are two kinds of electric charges: negative and positive, produced by rubbing a plastic rod with fur and a glass rod with silk, respectively. The rubbed fur and silk also become "charged". When the signs of the charges on two rods are the same, they repel each other. When the signs on two rods are opposite, they attract each other. The rubbed plastic rod and silk become negatively charged, while the rubbed glass rod and fur become positively charged.

When wool is attracted by "charged" amber, you need to consider more: the wool is not rubbed with any material and has not acquired any net charge. It is neither negatively nor positively charged. An "uncharged" object should be electrically neutral and, in theory, should not be attracted to or

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repelled by a "charged" object, regardless of whether the charge is negative or positive. So why does the "charged" amber attract the "uncharged" wool?

Here, the generation and influence of induced electric charges are involved. In an object, there are free electric charges that can move easily from one region to another. If an external electric field exerts force on an object, the free charges will move, changing the distribution of total charges. This change affects the electric fields in and out of the object, as the electric field generated by the charges within the object can exert force externally. Thus, the regional distribution of electric charges and the spatial distribution of the electric field influence each other, and the equilibrium of charge and field distributions is determined by both.

Free electric charges in an object arise because some atoms have weaker attractions to their electrons, allowing them to escape more easily. Additionally, many objects contain polar molecules. These molecules have equal amounts of positive and negative charges but an uneven distribution, forming an electric dipole. The dipole moment direction of a polar molecule may change with the external electric field. Furthermore, non-polar molecules can become polarized under an external field, with positive and negative charge centers shifting from concentric to non-concentric status. Similarly, electrically neutral atoms can undergo atomic polarization, altering their positive and negative charge centers shifting from concentric to non-concentric status too.

The movements of free charges, changes in dipole moment directions of polar molecules, and emergences of polarized non-polar molecules and atoms form induced electric charges. These induced charges alter the distribution of electric charges and the spatial distribution of electric fields inside and outside the object. The amount of induced electric charges depends on the number of molecules and atoms within the object; generally, the greater the mass of the object, the more induced electric charges it has.

Under an external electric field, the change in the distribution of free and induced charges is the key reason why "charged" amber can attract "uncharged" wool. Whether an object is electrically neutral or has net positive or negative charges, the external electric field will change the charge distribution within that object.

Suppose that the "charged" amber is close to the "uncharged" wool. If the amber has net positive charges, it will exert a positive electric field on the wool, attracting the free negative charges in the wool to the amber side, keeping them close. Since the amounts of positive and negative charges in the electrically neutral wool are equal due to conservation of electric charge, the amount of net negative charges increased in the region close to the amber will equal the amount of net positive charges increased in the region farther from the amber. Because the net negative charges are closer to the amber than the net positive charges, the amber's attractive force on the net negative charges is slightly greater than its repulsive force on the net positive charges. Thus, the net force exerted by the amber on the wool is attractive. This net force is much smaller than the real attractive or repulsive force of the amber on the wool, but it is enough to pick up a light object such as the wool as shown in Figure 1.

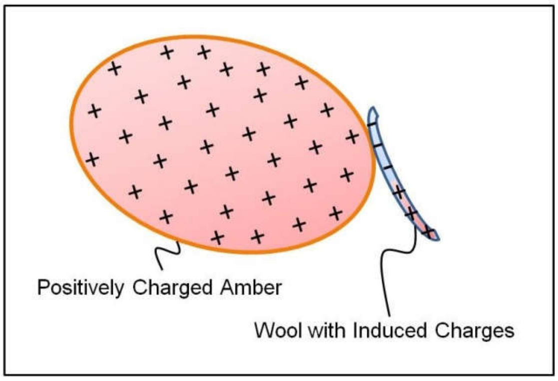

Figure 1. The "charged" amber picks up "uncharged" wool. The net positive and net negative charges are distributed in the red and blue regions, respectively.

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At the same time, the polar molecules and polarized non-polar molecules and atoms in the wool will produce two kinds of induced net charges. Under the positive electric field of the amber, the center of all induced net negative charge distribution will be closer to the amber, and the center of all induced net positive charge distribution will be farther from the amber. The location difference between the two charge centers will make the amber's attractive force slightly larger than its repulsive force on the wool, which helps to pick up the wool.

The produced attractive force between the amber and wool is a synthetic electric interaction force produced by a huge number of electric charges in both the amber and wool. Though the wool is small, it may contain a huge number of molecules and atoms, and thus a huge number of electric charges.

If the amber is replaced by a negatively "charged" plastic rod, the plastic rod can also pick up the "uncharged" wool. In this case, the plastic rod will exert a negative electric field on the wool. The negative field will attract net free positive charges close to the rod and push net free negative charges far from the rod. Because the amounts of the two kinds of net free charges in their respective regions in the wool are equal, but the region distances from the rod are different, the net force of the plastic rod on the wool will be a small attraction force, sufficient to pick up the light wool too. The two kinds of induced net electric charges in the wool will produce a similar small attractive force between the plastic rod and the wool, helping to pick up the wool too. Thus, whether an object has net positive charges or net negative charges, the "uncharged" wool will always be attracted by the "charged" object.

The author answered why a small "uncharged" piece of paper can be attracted by a "charged" object in an electromagnetism examination at the university with such a detailed explanation when young but did not think further at that time, and was unaware that understanding such a phenomenon approached realizing the origin of the gravitational force.

2. Origin of the Gravitational Force

From understanding that a "charged" object can attract an "uncharged" object to realizing the origin of the gravitational force, the key step is recognizing that the non-uniform distribution of electric charges, that is, the regions with net positive and net negative electric charges can emerge spontaneously in an initially electrically neutral object, or in an object that is initially thought to be electrically neutral. In other words, the gravitational force can spontaneously originate between two "uncharged" objects.

Now, the author has realized that the attractive force of a "charged" object exerting on an "uncharged" object is not only the electric force but also the gravitational force. To affirm this recognition, certain mystifications must be overcome.

In an electrically neutral object, due to various reasons, an initial variation in the electric charge distribution will disrupt the uniform charge distribution, causing the appearance of net positive or negative electric charge(s) at a site. Many factors can cause such an initial variation, such as different movements of free electric charges, different thermal vibrations of polar and non-polar molecules and atoms, varying densities of these molecules and atoms, and different physical and chemical characteristics of the object's different regions including substance composition, form, state, temperature, pressure, electric and thermal conductivities, and so on. Due to the numerous possible causes of the initial variation, the existence of the net electric charges at a site in an object is common.

For example, Earth is a typical object with non-uniform distributions of electric charges and fields, and these non-uniform distributions should be generated spontaneously. Within Earth's interior, there are various compositions with different physical and chemical characteristics, such as shapes, sizes, states, densities, temperatures, pressures, fluidities, and electric or thermal conductivities. These differences inevitably cause non-uniform distributions of electric charges and fields. Furthermore, these non-uniform distributions are changing continuously. The Earth's magnetic field is caused by the continuous flow of a huge number of electric charges. Measurements have also shown that Earth has a complicated non-uniform electric field distribution on the Earth's

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surface, which can be used as a map for ground navigation. This kind of map may be more reliable than the GPS system since it cannot be destroyed.

The events that happen on Earth may occur on other celestial bodies. Additionally, what happens on a large object, such as the Earth, may also occur on smaller objects, such as wool. For free electrons, polar molecules, non-polar molecules, and atoms, objects like wool are large enough.

When two objects approach each other, if the object 1 has a region with net electric charges, these charges will produce net electric field that affects the object 2. This external electric field even being weak will alter the object 2 initially uniform charge distribution, making it non-uniform. The non-uniform distribution in the object 2 will produce a new electric field, exerting force back on the object 1. This will further alter the electric field in the object 1, affecting the object 2 again. In this way, the non-uniform charge distributions in both objects will increase, causing more net electric charges to appear in certain regions, thereby strengthening the electric fields in and out both objects.

Thus, the electric interaction forces produced between two objects can start from nothing and increase from weak to strong. Of course, there are limitations to these increases. With continuously movements of the free charges in the two objects, the amounts of net positive and net negative charges increase in different regions, producing stronger repulsive forces to the free charges with the same signs moving to these regions. This will gradually reduce the movements of the free charges in both objects. There are similar limitations for the induced net electric charges from polar molecules, non-polar molecules and atoms in the two objects. Therefore, these increases will eventually reach equilibriums in the net electric charge distribution and electric field distribution within and between the two objects. Thus, the increase in electrical attractive force between the two objects will stop at a balanced value, determined by the specific situations of the two objects.

This produced electrical force can cause two objects to attract each other even if they are initially electrically neutral. These objects can be any objects in the universe and can have different shapes, states, compositions, densities, pressures, temperatures, electric and thermal conductivities, and more. These objects can be as large as galaxies and galaxy clusters, and as small as molecules and atoms because even the atoms can become tiny electric dipole when they are polarized to have separated positive and negative charge centers. This electrical attractive force is actually the gravitational force, which is the origin of the gravitational force.

Understanding how an attractive force can arise spontaneously between two initially electrically neutral objects may be challenging. However, if a non-uniform charge distribution can be induced in electrically neutral wool by an external electric field, why cannot a non-uniform charge distribution be induced in a neutral object by inevitable charge distribution variation? Furthermore, if a "positively charged" amber or "negatively charged" plastic rod can attract "uncharged" wool, why cannot the Earth, which is a huge electric dipole (see explanations below), attract the "uncharged" objects on its surface, including every one of us? Compared to an amber or plastic rod and wool, a person to the Earth is much smaller than wool to the amber or plastic rod. Regardless of whether the electric field exerted by the Earth on a person is positive or negative, it is similar to whether a positively charged amber or a negatively charged plastic rod is close to wool, the wool will be attracted to the charged object, and therefore, the person will always be attracted to the Earth.

Actually, it is very easy and common for net electric charges and, thus, a net electric field to appear spontaneously in an initially electrically neutral object. Pay special attention here, just the misunderstanding about it has prevented people from realizing the origin of the gravitational force for a long time.

The electric interactional force between two initially electrically neutral objects can spontaneously generate from nothing, grow from weak to strong, and eventually reach a balanced value. These changes cannot be seen visibly because the movements of the free electric charges and the polarizations of the polar and non-polar molecules and atoms are movements of electrons and shifts of electric charge centers. Furthermore, these movements and shifts occur at very high speeds. Because these processes start from nothing, grow and finish instantly, and cannot be seen, they are the reasons why the gravitational force seems strange and mysterious.

In the interactions participated by a huge number of positive and negative electric charges, the most electrical attractive forces are cancelled by the electrical repulsive forces as the electric charges have opposite signs. Thus, the net electrical interaction force is weak, and so though the gravitational force is the electric force, the gravitational force strength is much smaller than the electric force. It is the reason that the strength of the gravitational force is about 37 orders of magnitude smaller than the electric force, but both have the same extremely long interaction distances. It is another confusing difficulty for many people to understand the gravitational force.

As described above, the more the number of the atoms or the molecules in the object, the more the free and induced electric charges in the object, the stronger the generated net electric field. The stronger net electric field will produce larger gravitational force. It is the reason why the object having more mass can produce larger gravitational force.

At present, what is the mass? This question has not been clearly explained. In physics, the concept of mass has two meanings: one is gravitational mass, and the other is inertial mass. Based on the new understanding of the gravitational force, an object's gravitational mass represents the net attractive force exerted on the object by the synthesized electric field of the total Earth's electric charges when the object is motionless relative to the Earth. An object's inertial mass represents the net attractive force exerted on the object by the synthesized electric field of the total electric charges distributed in the space through which the object is moving. This new understanding of the mass can explain the real physical nature of Einstein's mass-energy conservation law

$$E = mC^2. \quad (1)$$

Because both of the gravitational mass and inertial mass are expressions of the interaction force strengths, the energy change caused by interaction force and motion will naturally cause the so-called mass to change.

3. Calculation of the Gravitational Force

As described above, the gravitational force is generated by non-uniform distribution of electric charges in an object. The non-uniform distribution of charges may be very complicated, which makes the analysis and calculation of the resulting electric fields difficult. To simplify the analysis and calculation, the concept of the "mass center" used in mechanics is employed.

Every object is composed of many small regions, and each region experiences a gravitational force. If all the gravitational forces exerted on these small regions are synthesized into a single gravitational force, then the point where this synthetic gravitational force is exerted at is the "mass center" of the object. Similarly, two net "charge centers" can be defined to describe the distribution of net electric charges in an object.

In an object, regardless of the complexity of the distributions of the net positive and net negative charges, all electric forces generated by the net positive charges can be synthesized into a synthetic net positive electric force. The point at which this synthetic net positive electric force is exerted on another object is the net positive "charge center" of that object. In the same way, the net negative "charge center" of the object is defined.

With this simplification, any object with non-uniform charge distribution can be regarded as having a net "positive charge center" and a net "negative charge center." All net positive charges in the object are considered concentrated at its "positive charge center," and all net negative charges are considered concentrated at its "negative charge center." Because these two charge centers are almost impossibly at the same point exactly, nearly any object with non-uniform charge distribution can be regarded as an electric dipole, as shown in Figure 2.

The theoretical electric dipole is a pair of two point electric charges with equal magnitude and opposite signs (a positive charge q and a negative charge $-q$). A small distance $\boldsymbol{l}$ is between two point charges. The electric dipole moment $\vec{\boldsymbol{p}}$ is the product of the distance $\boldsymbol{l}$ and the charge q

$$\vec{\boldsymbol{p}} = q\vec{\boldsymbol{l}}, \quad (2)$$

where $\vec{\boldsymbol{P}}$ and $\vec{\boldsymbol{l}}$ are vectors. The direction of the electric dipole moment $\vec{\boldsymbol{P}}$ is from the negative point charge to the positive point charge.

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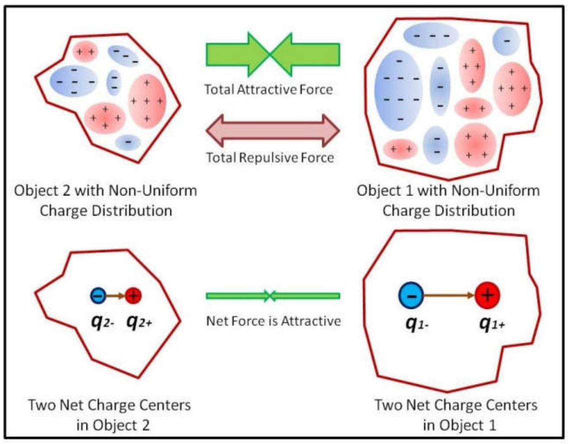

Figure 2. The electric interaction force between two objects with non-uniform charge distributions. The total net positive and negative charges in two objects may be regarded as concentrated in their charge centers represented by red and blue circles with charge amounts q_{1+}, q_{1-}, q_{2+} and q_{2-}.

When an object with a non-uniform charge distribution is regarded as an electric dipole, q is the absolute value of the total net positive charges or the total net negative charges in the object. Additionally, in the object, the distance between the net "positive charge center" and the net "negative charge center" may not be small. However, if the size of the object is much smaller than the scale related to the considered problem, such as considering the attraction between a planet and a star in the universe, the size and shape of the object are less important. Thus, the distance between the net positive and net negative "charge centers" in an object may be treated as small, so the object with a non-uniform charge distribution may reasonably be regarded as an ideal electric dipole.

The electrical field strength $\vec{\boldsymbol{E}}$ of the electric dipole at the distance of R is [2]

$$\vec{\boldsymbol{E}} = \frac{1}{4\pi\epsilon_0 R^3}[3(\vec{\boldsymbol{P}} \cdot \vec{\boldsymbol{R}})\vec{\boldsymbol{R}} - \vec{\boldsymbol{P}}]. \tag{3}$$

In Equation (3), $\vec{\boldsymbol{R}}$ is unit distance vector along R direction. From Equation (3), we know that when the direction of the vector $\vec{\boldsymbol{R}}$ changes, the electric field strength $\vec{\boldsymbol{E}}$ changes too. When the direction of $\vec{\boldsymbol{P}}$ is the same as or opposite to the direction of $\vec{\boldsymbol{R}}$, the electric field strength $\vec{\boldsymbol{E}}$ becomes E_S or E_O

$$E_S = \frac{2P}{4\pi\varepsilon_0 R^3}, \tag{4}$$

$$E_O = \frac{-2P}{4\pi\varepsilon_0 R^3}. \tag{5}$$

The E_S in Equation (4) is positive, which expresses a repulsive force away from the dipole to a positive point charge. The E_O in Equation (5) is negative, which expresses an attractive force towards the dipole to a positive point charge. And when the direction of the dipole moment is perpendicular to the direction of $\vec{\boldsymbol{R}}$, the electric field strength $\vec{\boldsymbol{E}}$ becomes E_P

$$E_P = \frac{-P}{4\pi\varepsilon_0 R^3}. \tag{6}$$

The E_P in Equation (6) is negative. Please note that E_P is a deflective force.

Then, a puzzle arises: if the electric field strength of an object with a non-uniform electric charge distribution is not isotropic, why haven't we observed obvious changes in the gravitational force with the relative direction between two attractive objects? For example, many planets orbit stars in circular paths in the universe.

The reason is that, although the electric field of an electric dipole may exert repulsive, attractive, or deflective forces on another electric dipole, in most cases, the repulsive and deflective forces will ultimately change to an attractive force. This occurs because, when the interaction force between two electric dipoles is repulsive, both electric dipoles are in states of highest electric potential energy. Such states are unstable. Any change in the electric charge distribution in one of the two objects will

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produce a deflective force between these two electric dipoles. This deflective force will rotate the two electric dipoles.

Of course, in some cases, the gravitational force between two attractive objects still changes with their relative direction, which is one of the reasons that some planet orbits around the stars are elliptic.

Below, the interaction forces between two electric dipoles are calculated. First, supposing the directions of two electric dipole moments are the same as shown in Figure 3. The first electric dipole moment $\vec{P}_1$ consists of positive pinot charge q_{1+} and negative point charge q_{1-}. The second electric dipole moment $\vec{P}_2$ consists of positive pinot charge q_{2+} and negative point charge q_{2-}. The distance between the positive and negative point charges of the first dipole moment $\vec{P}_1$ is r_1. The distance between the positive and negative point charges of the second dipole moment $\vec{P}_2$ is r_2. The distance between the centers of two electric dipoles is R.

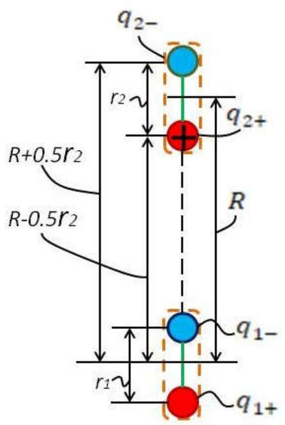

Figure 3. Interaction forces between two electric dipoles when dipole moment directions are same.

From Equation (3), the first electric dipole will produce the electrical field $\vec{E}_1$ at the distance R from its center

$$\vec{E}_1 = \frac{1}{4\pi\varepsilon_0 R^3}\left[3\left(\vec{P}_1 \cdot \vec{R}\right)\vec{R} - \vec{P}_1\right]. \quad (7)$$

In Equation (7), $\vec{R}$ is unit distance vector along R direction. In the electrical field $\vec{E}_1$, the positive point charge q_{2+} of the second electric dipole will feel a force $\vec{F}_{q2+}$ as

$$\vec{F}_{q2+} = q_{2+}\,\vec{E}_1 = \frac{2q_{2+}\vec{P}_1}{4\pi\varepsilon_0 (R-0.5r_2)^3}, \quad (8)$$

the direction of force $\vec{F}_{q2+}$ is along the direction of $\vec{R}$. The negative point charge q_{2-} of the second electric dipole will feel a force $\vec{F}_{q2-}$ as

$$\vec{F}_{q2-} = q_{2-}\,\vec{E}_1 = \frac{2q_{2-}\vec{P}_1}{4\pi\varepsilon_0 (R+0.5r_2)^3}. \quad (9)$$

The direction of force $\vec{F}_{q2-}$ is also along the direction of $\vec{R}$. Because the absolute values of q_{1+} and q_{1-} are equal, and the absolute values of q_{2+} and q_{2-} are also equal, when $R \gg r_1$ and $R \gg r_2$, the total force felt by the second electric dipole in the electric field $\vec{E}_1$ is $\vec{F}_T$ approximately

$$\vec{F}_T = \vec{F}_{q2+} + \vec{F}_{q2-} \doteq \frac{6r_1r_2}{R^2}\frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{R^2}\vec{R}. \quad (10)$$

In Equation (10), if $\frac{\sqrt{6}r_1q_1}{R}$ is replaced by m_1, $\frac{\sqrt{6}r_2q_2}{R}$ is replaced by m_2, and $\frac{1}{4\pi\varepsilon_0}$ is replaced by gravitational constant G, then Equation (10) becomes Newton's gravitational law

$$\vec{F}_G = G\frac{m_1m_2}{R^2}\vec{R}. \quad 11)$$

We can see that the physical essence of the mysterious mass is just the net electric charges. More strictly speaking, the mass is another expression of the amount of the net electric charges multiplied by the length of the electric dipole and divided by the distance between the two related objects.

In fact, the electromagnetic theory, and especially the modern electromagnetic theory developed over more than two hundred years since Coulomb, has strongly hinted that the gravitational force is the electric force. Compare the famous Newton's law of gravitational force F_G:

$$F_G = G\frac{m_1m_2}{R^2}, \quad (12)$$

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and the famous Coulomb's law of the electric force F_E:

$$F_E = K\frac{q_1 q_2}{R^2}. \tag{13}$$

We can see that their expressions are very similar. Equation (12) expresses the attractive gravitational force generated by two point-like objects with masses of m_1 and m_2. Equation (13) expresses the attractive electric force generated by two point electric charges of q_1 and q_2. G and K are proportionality constants whose numerical values depend on the system of units used. R is the distance between two mass centers or two charge centers. If two masses in Equation (12) are replaced by two charges in Equation (13) without considering the difference of the dimensions of two constants G and K, then Equation (12) becomes Equation (13). Because m_1 and m_2 are mass, and q_1 and q_2 are net electric charges, the dimensions of the constants G and K are different naturally. Considering that the gravitational force is generated by a huge number of electric charges, and that the most of the electric forces produced by the electric charges with opposite signs have been cancelled, the values of the constants G and K have large difference naturally.

The striking similarity between Equation (12) and Equation (13) strongly hints that the gravitational force is the electric force. If the natures of two physical forces are different, their expressions should be significantly different. Where else can we find such similarity between the expressions of two different physical forces?

Another hint indicating that the gravitational force is the electric force is that the gravitational wave propagation speed equals to electromagnetic wave propagation speed. Since the gravitational force is the electric force, the gravitational wave propagation speed is equal to the electromagnetic wave propagation speed naturally.

Equation (10) expresses the interaction force between two electric dipoles when two dipoles have the same directions. This interaction electric force is just the gravitational force between two objects. According to Equation (10), the gravitational force has the following properties:

First, since the gravitational force is produced by net electric charges q_1 and q_2, the gravitational field is the electric field.

Second, the gravitational force strength depends on the force direction, meaning that the gravitational force is anisotropic.

Third, replacing $\frac{\sqrt{6}r_1 q_1}{R}$ with m_1 and replacing $\frac{\sqrt{6}r_2 q_2}{R}$ with m_2, because in most cases, $R \gg r_1$ and $R \gg r_2$, and q_1 and q_2 are net electric charges, so the magnitudes of m_1 and m_2 are much smaller than the magnitudes of q_1 and q_2. This is why, although the gravitational force is electric force, the strength of the gravitational force is much smaller than the strength of the electric force.

Fourth, the values of r_1, r_2, q_1 and q_2 in Equation (10) are not fixed because they are determined by electric charge distributions in two objects. Since variations of charge distributions in two objects can change the values of r_1, r_2, q_1 and q_2, the gravitational force between two objects is not fixed even their so-called masses don't change.

These characteristics make the gravitational force exhibit strange and mysterious behaviors, causing confusing phenomena observed in the universe. Some of these phenomena have puzzled humans for a long time. However, by using new understandings of the gravitational force, these confusing phenomena can be explained simply and effectively. On the other hand, these phenomena may be regarded as indirect evidences of the correctness of the introduced understanding.

Even though the difference between Equation (10) and Newton's law is not significant for applications on the Earth, this discrepancy has still caused inaccuracies in advanced engineering calculations, such as for spacecraft flight. Furthermore, Newton's laws no longer explain quite a few observed physical phenomena.

Below, the forces between two electric dipoles with different moment directions are analyzed. As shown in Figure 4, the case where the directions of two electric dipoles are perpendicular to each other is considered. In Figure 4, the first electric dipole moment $\vec{P}_1$ consists of positive and negative point charges q_{1+} and q_{1-}, and the second electric dipole moment $\vec{P}_2$ consists of positive and negative point charge q_{2+} and q_{2-}. The distances between the positive point charge q_{2+} and the

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positive and negative point charges q_{1+} and q_{1-} are R'. The distances between the negative point charge q_{2-} and the positive and negative point charges q_{1+} and q_{1-} are $R'+r'$ approximately.

The positive point charge q_{1+} and negative point charge q_{1-} produce repulsive force $\vec{a}$ and attractive force $\vec{b}$ to the positive point charge q_{2+}. The synthesized force of $\vec{a}$ and $\vec{b}$ is $\vec{c}$. The positive point charge q_{1+} and negative point charge q_{1-} produce attractive force $\vec{a'}$ and repulsive force $\vec{b'}$ to the negative point charge q_{2-}. The synthesized force of $\vec{a'}$ and $\vec{b'}$ is $\vec{c'}$. Note that $\vec{a}$, $\vec{b}$, $\vec{c}$, $\vec{a'}$, $\vec{b'}$ and $\vec{c'}$ all are vectors. The components along the x-axis of two synthesized forces $\vec{c}$ and $\vec{c'}$ are x_+ and x_-, and the components along the y-axis of two synthesized forces $\vec{c}$ and $\vec{c'}$ are y_+ and y_-. Since two components y_+ and y_- have equal magnitudes with opposite directions, they are cancelled. Two components x_+ and x_- are added to each other since they have equal magnitudes and same directions. Therefore, the electric field of the first electric dipole $\vec{\boldsymbol{P}}_{\boldsymbol{1}}$ exerts a net deflective force on the second electric dipole $\vec{\boldsymbol{P}}_{\boldsymbol{2}}$. Under this deflective force, the electric dipole $\vec{\boldsymbol{P}}_{\boldsymbol{1}}$ and electric dipole $\vec{\boldsymbol{P}}_{\boldsymbol{2}}$ will rotate to have the same directions.

The directions of two interacting electric dipoles cannot remain perpendicular to each other for long. As long as an electric dipole is affected by a deflective force, its dipole moment direction will rotate. The rotation of the electric dipole does not require the rotation of the actual physical body. It only requires changes in the distribution of the net electric charges, including free and induced charges in the object. Such changes occur very quickly and are not visible. Therefore, when considering only the gravitational force between two objects, because the directions of two electric dipoles are almost always the same, the gravitational force between the two objects can be expressed only by Equation (10).

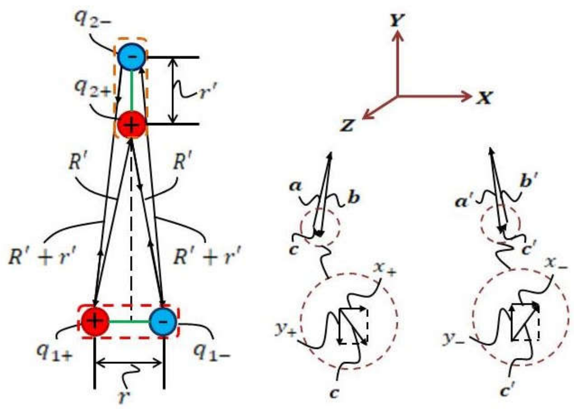

Figure 4. Interaction forces between two electric dipoles when the directions of the dipole moments are perpendicular to each other.

When three objects interact with each other, the free and induced charges in each object are redistributed in response to the electric fields generated by the other two objects. If each object is simplified as an electric dipole, each object will interact with two external electric dipoles. Thus, the redistribution of the free and induced charges in each object may be regarded as forming two electric dipoles. Each of these electric dipoles in one object responds to an external electric dipole in another object, making the problem an analysis of the interactions among six electric dipoles. When more objects interact, the gravitational force analysis becomes more complex. However, the redistribution of electric charges in each object may still be regarded as forming multiple electric dipoles in principle, with each electric dipole responding to an external electric dipole in another object.

4. Truths of the Confusing Phenomena

With new understanding of the gravitational force, the causes of some observed astronomical phenomena, which have confused people for a long time, can be explained easily and effectively. On the other hand, these phenomena may be regarded as indirect evidences for above introduced new understanding.

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In addition, the current mainstream theories of the gravitational force are based on Einstein general relativity and quantum mechanics. Einstein believed gravitational force originates from space-time curvature [4], while quantum mechanics posits that the gravitational force comes from the exchange of quantum particles [5]. Because the general relativity describes gravity as a smooth, continuous distortion of space-time, but quantum particles are discrete and discontinuous energy packets. The general relativity is inherently incompatible with the quantum mechanics. This contradiction makes the unification of the four fundamental forces of nature impossible. However, with the new understanding of the gravitational force, this incompatibility may be removed easily.

4.1. Causes of the Flat Galaxies and Filamentary Nebulae

So far, almost all observed celestial systems, including solar system, galaxies, and galaxy clusters, have approximately flat spherical shapes. Why do these celestial systems have flat shapes? Or how can we explain the formation of these flat shapes? Now, we have the answers. Such shapes are caused by the anisotropy of the gravitational force as expressed by Equations (3), (4), (5) and (6). Because most celestial bodies can be regarded as electric dipoles, and the attractive force of the electric dipole is along the direction of the dipole moment, any two celestial bodies are attracted to each other along a line, and most of these lines rotate relative to other lines. When numerous celestial bodies are attracted to each other and to a stronger attractive center simultaneously, they move closer to each other along various lines and toward the attractive center, tending to form a common plane consisting of various rotational lines. Thus, the numerous celestial bodies will form an approximately flat spherical spatial distribution from their previous random spatial distribution.

The Hubble Space Telescope has discovered Filamentary Nebulae (also called as Veil Nebulae or Cirrus Nebulae) [6]. These nebulae may have immense sizes of more than 130 light-years at a distant location of about 2,400 light-years. This is one of the most astonishing discoveries in the universe recently. These nebulae have asymmetric and non-homogeneous structures, including filaments and loops. Remarkably, these structures challenge the consensus of the universe being homogeneous. However, these structures just prove the new understanding about the gravitational force, that is, the gravitational force is anisotropic. The electric field of the electric dipole is effective only along a certain direction, or along a plane when the dipole rotates. As a result, the numerous celestial bodies including gas, dust, planet, star, galaxy and galaxy cluster, may form the filaments or loops with huge sizes.

4.2. Rotation of the Celestial Bodies and Galaxies

Atoms consist of electrons, protons, and neutrons, and neutrons are also composed of an electron and a proton. All of these particles have their own rotational angular momenta and magnetic moments. In the following, the origins of the rotational angular momenta and magnetic moments of the electron, proton, and neutron will be given in section "Origin of the Electron Spin Angular Momentum and Magnetic Moment". All the rotational angular momenta and magnetic moments of the electrons, protons, and neutrons in an atom combine to form a synthesized net rotational angular momentum and a net magnetic moment. Please note that most of the rotational angular momenta and magnetic moments of the electrons, protons, and neutrons in an atom will offset each other because of their opposite directions or signs.

Any celestial body is made up of atoms, and so any celestial body will have a synthetic rotational angular momentum and a synthetic magnetic moment, which are the sums of the net rotational angular momenta and net magnetic moments of all atoms in that celestial body. Most of the net rotational angular momenta and net magnetic moments of the atoms in a celestial body will offset each other too because of their opposite directions or signs. Since every celestial body has a net rotational angular momentum, every celestial body rotates.

At the same time, as celestial bodies have motion momentums, when two celestial bodies are attracted to each other, as long as their motion momentum directions are different, the attractive force between them will change their moving directions, causing the two bodies to start rotating around each other. When multiple celestial bodies are attracted to their attractive center, they will rotate

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around that center, causing the rotation of a celestial system. Many rotational celestial systems compose a rotational galaxy, and many rotational galaxies form a rotational galaxy cluster.

4.3. Misconception of the Dark Matter

At present, dark matter is almost a basic consensus regarding the universe constitution. Otherwise, how to explain why the faraway spiral arms of the giant galaxy and the galaxies on the outskirts of the galaxy cluster don not collapse when they move at much faster speeds [7]. According to current gravity theory, the celestial bodies including fast-moving stars in the spiral arms and the galaxies on the galaxy cluster outskirts must have much greater masses to produce required stronger attractive forces to keep them within the galaxy and galaxy clusters. Since the predicted matter cannot be found, a large quantity of unseen dark matter must exist in these spiral arms and cluster outskirts. However, despite many attempts, no any sign of the dark matter has been found.

The new understanding of the gravitational force can solve this difficult problem easily and effectively. According to the electric dipole model described above, the gravitational force between any two objects can change with object dipole lengths r_1 and r_2, and net electric charges q_1 and q_2 in the two objects as expressed by Equation (10). The values r_1, r_2, q_1 and q_2 are determined by charge distributions in the two objects. Many factors, including substance state, temperature, pressure, density, conductivity, and mutual interactional electric field strength, can change the charge distributions in the two objects and increase the attractive force between them. Thus, the celestial bodies in the spiral arms of the galaxy and in the galaxies on the galaxy cluster outskirts may have much larger attractive forces than estimated without much greater visible masses, allowing them to rotate at faster speeds without collapsing. The dark matters are not required for formation and evolution of the universe. There is no dark matter in the universe.

4.4. Misconception of the Dark Energy

Dark energy has almost become a basic consensus regarding the universe composition too. The reason is that a special kind of unseen energy is required to explain why the distant galaxies are moving away from us at increasing speeds [8].

First, we must determine if the entire universe is expanding at accelerated pace. In the universe, various celestial bodies including planets, stars, galaxies, and galaxy clusters, move at different speeds and in different directions, including at accelerated speeds. It is common that some of them move away from each other, while others move close to each other. However, these diverse movements, including accelerated ones, differ from the expansion of the universe and the accelerated expansion of the universe.

Even if some parts of the universe are really expanding at accelerated rates, the new understanding of the gravitational force can explain it without problem. It has been indicated that the strength of an object gravitational force may increase or decrease including continually increase or decrease with the change or continually change of the electric charge distribution within the object. This is because the values of r_1, r_2, q_1 and q_2 in Equation (10) may change including continually change with the distribution of the charges in the attractive objects due to various reasons. Thus, the gravitational force could become stronger including stronger and stronger than the estimated. Therefore, parts or even whole of the universe might be moving away from us at accelerated speeds, without requiring the dark energy to explain the accelerated expansion. There is no dark energy in the universe too.

4.5. Slow Growth of the Early-Stage Stars

As described above, also based on the new understanding of the gravitational force, the gravitational force of an object may be stronger or weaker than the estimated based on its normal mass. Thus, when the gravitational force is weaker, the growths of the stars slow down, resulting in unexpected baby stars still existing somewhere in the universe [9].

4.6. Compatibility of the Gravitational Force Theory and the Quantum Mechanics

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Because the gravitational field is the electric field, the gravitational force can be unified with the electromagnetic force completely. Furthermore, if the electric field can be well described by quantum mechanics, the gravitational field can be as well described by the quantum mechanics too. Therefore, the new theory of the gravitational force is fully compatible with the quantum mechanics. In addition, the satisfying unification of the gravitational force and electromagnetic force opens a hopeful door for the ultimate unification of the four fundamental forces of nature.

Nature of the Magnetic Force

The magnetic force originates from the electric force. It is produced by moving electric charges or a collection of moving electric charges, that is, by the motion or rotation of the electric field. Magnetic and electric fields almost always accompany each other.

In fact, microscopic particles carrying electric charges are always moving and rotating. Apart from random thermal motions, electrons, positrons, and even neutral neutrons all have magnetic moments. Although the magnetic moments of electrons, protons, and neutrons are observed in experiments, their genuine physical origins are not clear. The author indicates that these magnetic moments are indeed produced by real rotations of the electric fields of electrons, protons, and neutrons. Please note that the neutron still has a non-uniform electric field distribution effective in the extremely close vicinity of the neutron. More detailed descriptions of the structures of the photon and neutron are given in the paper titled "Origin of the Light" [10].

The magnetic field is produced by the moving or rotating electric field, and so the magnetic force originates from the electric field. The magnetic force and the electric force are the basic causes for forming the universe and driving its evolution.

Origin of the Strong Interaction Force

The strong interaction force is considered one of the four fundamental forces of nature, and its main role is to enable multiple protons to be assembled together in the tiny nucleus. The strength of the strong force is roughly 100 times that of the electromagnetic force. The effective interaction distance of the strong force is just about $1fm = 1 \times 10^{-15}m$. The strength of the strong force drops much quickly than the rate of $\frac{1}{R^2}$.

In the nucleus, the distances among the protons are very short. According to current theory, the repulsive force between two protons can be as large as dozens of kilograms, and in many cases, a proton may be repelled by dozens of protons. Thus, there must be a strong attractive force to prevent nuclear collapse. However, how is this strong nuclear force produced? This strong nuclear force is very difficult to imagine.

To understand the real intrinsic nature of the strong nuclear force, the microscopic structure of the atomic nucleus must be investigated further. One way to investigate the nuclear structure is to know what the nucleus is made of or what is stored in the nucleus.

1. Possible Structure of the Nucleus

It is known that any nuclear reaction, whether it is nuclear fission or nuclear fusion, will produce an extremely strong gamma-ray burst. The gamma-ray consists of high-energy photons. These phenomena strongly suggest that a lot of high-energy photons are stored in the nucleus.

The author should emphasize that the gamma-ray burst is not transferred from the mass of the nucleus. The abstract concept of "mass-energy transfer" is not true, although many people are familiar with it and believe it. Here, we must clarify that mass is mass, and energy is energy; they are different things and cannot change into each other. In familiar natural phenomena, such as the burning of an object or the fission and fusion of nuclei, the substance, that is, the mass, does not disappear, although the mass becomes light including x-ray, ultraviolet light. visible light, infrared light, microwaves, and so on. This is because light are photons and the photons even with extremely low frequencies are still the substances.

In the following, we will explain that the photon is the real substance. In other words, before burning, fission, or fusion, the photons are bound together as a bulky substance with easily detectable weight and electromagnetic field. After burning, fission, or fusion, the photons are separated individually as light without easily detectable weight and electromagnetic field. However, the photons still exist there as the substance. The concept of the mass-energy transfer is completely wrong. Light is the substance, not the energy, or light is the substance with energy, not the pure energy.

Thus, the gamma-ray burst is just the release of real substance from the nuclei directly, because every nucleus inherently consists of a lot of photons.

Another evidence proving that the photons are the most basic building blocks of any substance is that almost all black holes in the universe emit extremely strong gamma-rays. This means that under the most ultimate conditions, including extremely high pressures and temperatures, any substance will be broken into its basic units, that is, the photons.

Any substance consists of atoms, and every atom consists of protons, neutrons, and electrons. Therefore, it is a reasonable deduction that the neutron consists of multiple photons, and the proton consists of multiple photons but lacks an electron, which leaves the proton and still stays in the atom.

The author has inferred that the photon is an extremely tiny electric dipole consisting of an electron and a positron pair. This inference is based on the following well-known observed phenomena: 1. The photon appearing after electron-positron annihilation; 2. The photon splitting into an electron and positron in high-energy collisions. More explanations of this inference are provided in the paper titled "Origin of the Light" [10].

As an electric dipole, even though it is extremely tiny, the net electric field of the photon is not zero within very close area around the photon. However, because the sizes of the electron and positron are extremely small, and the distance τ between them is very short since they are bound tightly due to their strong electric fields with opposite signs. According to Equations (3), (4), (5), and (6), the net electric field of the photon is only effective in the small range around the photon because the net electric field strength of the photon drops quickly with the distance R at a rate of $\frac{\tau}{R^3}$. For a distant observer, the photon is almost electrically neutral, meaning there is almost no net electric field for the photon, as shown in Figure 5. The positive and negative electric fields of the positron and electron are represented by the red dotted line and the blue solid line, respectively. We can see that these two fields almost completely overlap for a distant observer, so the net field strength is almost zero for a distant observer.

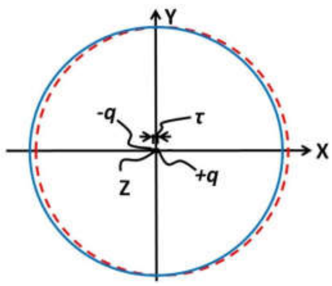

Figure 5. The positive and negative electric fields of the positron and electron of the photon observed by a distant observer.

But, for a nearby observer, the net electric field of the photon is not zero. In other words, every photon has its electric field within very short distance R as shown in Figure 6. The positron and electron are represented by a red circle and a blue circle, respectively. We can see that if near the positron, the net field is positive, and if near the electron, the net field is negative. Thus, multiple photons can be combined together within a tiny volume in the way that the positive end of each photon attracts the negative end of its adjacent photon in series or in parallel.

The calculations of the electric field strengths of the photon are described in detail in the paper titled "Origin of the Light" [10]. The calculation results show that at the site with the distance of $R =$

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$1fm$ from the photon center, the electric field strength is from $2.9\times10^{16}\frac{V}{m}$ to $2.9\times10^{19}\frac{V}{m}$ $(\frac{V}{m}=\frac{Volt}{meter})$ for photons with dipole moment lengths of $10zm$ $(1zm = 1\times10^{-21}m)$ to $10am$ $(1am = 1\times10^{-18}m)$. Please note that taking the photon dipole moment length with such a large range (from $10zm$ to $10am$) is due to the fact that the photon size cannot be estimated accurately at present. Such a large electric field can certainly bind multiple photons tightly within a small range.

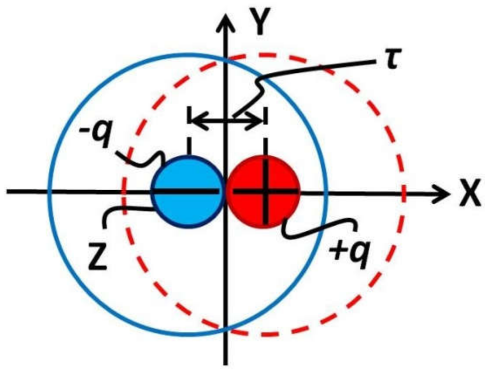

Figure 6. The positive and negative electric fields of the positron and electron of the photon observed by a nearby observer.

However, as the distance R increases, the electric field strength of the photon decreases rapidly. For example, at the site with the distance of $R = 1\mu m$ from the photon center, the electric field strength drops to from $2.9\times10^{-11}\frac{V}{m}$ to $2.9\times10^{-8}\frac{V}{m}$ for photons with dipole moment lengths of $10zm$ to $10am$. Therefore, measuring the electric field strength of a photon is very difficult. This is why a photon is regarded as having no electric field.

These calculation results show that the author's inference of the nuclear structure is reasonable because the results are consistent with observational data. This explains why the effective interaction distance of the so-called strong force is about $1fm = 1\times10^{-15}m$ (Please note that when multiple photons are bound together, their synthesized net electric strength has a shorter effective distance too), and why the strength of the strong force drops more quickly than expected rate of $\frac{1}{R^2}$.

The neutron and proton might consist of a photon shell or several photon shells. The photon shell consists of multiple photons in such a way that the positive end of each photon attracts the negative end of its adjacent photon in series, as shown in Figure 7.

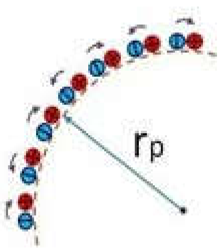

Figure 7. The hypothetical photon distribution of a partial photon shell in the proton or neutron. The photons' dipole moment directions are parallel to the shell's surface.

In Figure 7, each photon is represented by an electric dipole consisting of a positron (small red circle) and an electron (small blue circle). In this section of the photon shell of the neutron or proton, the dipole moment directions of the photons are parallel to the shell surface. Supposing the spherical shell has a radius of r_p. The full structures of the proton and neutron, which describe the entire distribution of the photons in the proton and neutron, cannot be provided now due to the need for more nuclear information and analysis.

Since each neutron consists of multiple electric dipoles, although the sum of all electric dipole fields of the neutron is zero, in the vicinity very close to the neutron, the net electric field is not zero.

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For example, in the regions near the positrons, the net fields are positive, and in the regions near the electrons, the net fields are negative. Thus, binding multiple neutrons one by one in the nucleus is possible and only requires the electric force. It should be mentioned that, according to current theory, there is no explanation for how multiple neutrons are kept in the nucleus since the neutrons are electrically neutral.

Compared to the neutron, each proton just loses an electron. Since the mass of a proton is 1836.5 times the mass of an electron, there should be at least several hundred photons, that is, several hundred positrons or electrons, in each proton. Additionally, in the above paragraph titled "Origin of the Gravitational Force," it has been explained that the gravitational mass expresses the attractive force strength exerted on an object by the synthetic electric field of the total Earth electric charges when the object is motionless relative to the Earth. Thus, when the photons are released from a proton, the total mass of all photons released from a proton may be much larger than the mass of a proton because the measured synthetic electric field strength of a proton is much less than the sum of the electric field strengths of all separated photons from a proton. In other words, the number of photons stored in a proton may be much larger than several hundred.

Consequently, in each proton, the sum of the positive electric fields of all positrons is only slightly larger (being over 1 in several hundred or in much more than several hundred) than the sum of the negative electric fields of all electrons. Such a small difference between the positive and negative net electric fields in each proton cannot create a force strong enough to repel another nearby proton. The net positive electric force of each proton in the nucleus can only make the nucleus unstable when the number of protons becomes large, which helps to cause emissions of radioactive decay rays.

In a similar way to the neutron, when very close to the proton, the net electric field is not uniform; it is positive in some areas and negative in others. Thus, multiple protons can be bound with or without neutrons in the nucleus. Therefore, the forces binding multiple protons, with or without neutrons, in the nucleus can be solely electric forces. It is not necessary to introduce the idea of a special strong interaction force to bind multiple protons in the nucleus.

Due to unavoidable thermal vibrations, the photons in neutrons and protons continuously fluctuate around their average positions. These fluctuations, coupled with the attractive and repulsive forces received from adjacent photons, may cause the photons to rotate on their own, resulting in the photons having angular momentum and magnetic moment as well. This maybe is another reason causing photonon's rotation (detailed explanations about photon rotational angular momentum and magnetic moment are given in the paper titled "Origin of the Light" [10]).

2. Origin of the Electron Spin Angular Momentum and Magnetic Moment

When a proton and an electron meet, they attract each other because they have electric charges with opposite signs. However, in some cases, the electron cannot combine with the proton tightly to become a neutron and keep a short distance from the proton. Thus, one proton and one electron compose the simplest atom, with an atomic number of 1.

When such an atom is formed, the charge center of the electron does not coincide with the charge center of the proton. Therefore, the negative electric field of the electron cannot cancel the net positive field of the proton uniformly and completely. This results in a non-uniform distribution of the synthetic electric field in the vicinity of the proton, i.e., near the nucleus.

However, for the electron and proton, the effective interaction distances of their net electric fields are much larger than their physical sizes (the proton diameter is about $1 \times 10^{-15}m$, and the diameter of the electron is smaller further). Thus, even if the charge centers of the electron and proton don't coincide with each other, since the distance between charge centers of the electron and proton is small (the atom diameter is about $1 \times 10^{-10}m$), for a distant observer, the negative electric field of the electron can still almost completely cancel the net positive electric field of the proton. Therefore, the distant synthetic electric field strength of the atom is almost zero, and such an atom can be considered electrically neutral.

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In the proton, the electric charge cannot be stored within a point-like volume. Furthermore, the positive electric field distribution of the proton is non-uniform. For example, the proton has a magnetic moment, which means that the proton's electric field distribution has a centrally symmetric axis. Thus, the electron may stay in a small area near the proton where the proton's net positive electric field is relatively high, and so the electron doesn't rotate around the proton. Of course, the electron cannot remain still in that small area and cling to the proton. The inevitable thermal motion will make the electron move restlessly in that small area and keep a small distance from the proton.

For an atom consisting of a proton and an electron (hydrogen), its distant electric field strength is zero. But the electric field distribution in or near the atom is non-uniform. If close to the electron, the net electric field is negative, and if close to the nucleus (proton), the net electric field is positive. It is very important that the electron can stay near the nucleus and doesn't need to rotate rapidly around it. Thus, some confusions can be eliminated:

1. Since the electron doesn't rotate around the nucleus, no continuous electromagnetic radiation is emitted from the atom.

2. The electron is close to the nucleus and the electron's electric field is around the nucleus, because the effective length of the electron's electric field is much larger than the nucleus size, the electron seems to exist at any position around the nucleus at any time. Thus, the seemingly strange behaviors of the electron, such as its exact position, don't require using wave function and probability to describe. Here, it should be emphasized that in many cases, the detected thing is the electric field of the electron, not the electron (core) itself.

As described above, when a proton meets another proton, including the proton attached to an electron, because the electric field distribution on each proton's surface is not uniform since each proton consists of multiple photons, the surface region of one proton with a net positive electric field will attract the surface region of another proton with a net negative electric field. In this way, two protons may bind each other with or without neutrons to compose a nucleus of two protons. Such a nucleus will bind two external electrons to form an atom with an atomic number of 2.

Because the net electric forces between the nucleus and the two external electrons are attractive, two external electrons are drawn as close to the nucleus as possible. Meanwhile, since two external electrons repel each other due to their same negative charges, they attempt to push apart. As a result, the electrons are positioned on opposite sides of the nucleus at a suitable distance where the attractive and repulsive forces are balanced as shown in Figure 8.

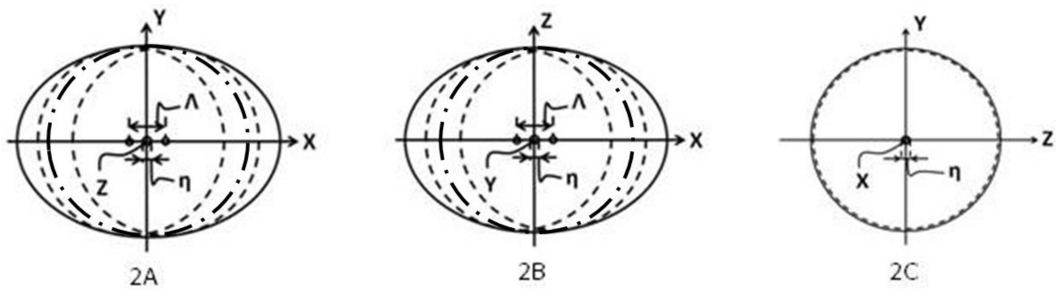

Figure 8. The positions of the electrons in the first electron shell are such that the centers of the two electrons are located on the x-axis with a distance of Λ. The diameter of the nucleus is η.

In Figure 8, the electric charge centers of two external electrons are located on the x-axis with a distance of Λ. The diameter of the nucleus is η. The centers of the spherical electric fields of two electrons are not concentric, so the distribution of the combined negative electric field of the two electrons is ellipsoidal (drawn by solid line in Figure 8), with a central symmetric axis along the x-axis. Although this field distribution is ellipsoidal, it can approximately cover the spherical field distribution of the nucleus (drawn by dot-dash line in Figure 8). The two electrons outside the nucleus form an electron shell.

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The two electrons located on both sides of the nucleus, with a short distance between them, cause a very important result. Each electron will exert a strongly repulsive force on the other electron, and the direction of this repulsive force will continuously change with the fluctuations of the two electrons. During these complex movements, an equivalent tangential repulsive force will be generated on both electrons, causing them to rotate on their own quickly. Thus, the two electrons rotate fast and in opposite directions. This is the physical origin of the electrons' rotational angular momentum and magnetic moment. The rotation directions of the two electrons are opposite, so their angular momenta and magnetic moments have opposite signs. The electron angular momentum and magnetic moment are extremely important. They are fundamental sources for creating the rotational angular momenta and magnetic moments of protons, neutrons, and atoms.

The structures of atomic electron shells with more electrons are not discussed further. Here, the author indicates some properties of the atomic electron shells as follows:

1. Each electron in the shell stays within a certain area close to the nucleus with unavoidable thermal vibrations but does not rotate around the nucleus.

2. In each shell, mutual electrical repulsive forces with unavoidable thermal vibrations generate equivalent tangential forces exerting on all electrons, which make all electrons rotate on their own and thus have spin angular momenta and magnetic moments with different values.

3. In a fully occupied shell, the repulsive forces between every two adjacent electrons should be as equal as possible.

4. The synthetic electric field generated by all electrons in the fully occupied shell should be symmetrical around a central axis because the nuclear net positive electric field is symmetrical around a central axis due to the net magnetic moment of the nucleus.

5. With increase of electrons in each shell, the synthetic net electrical field distribution of the electrons in each shell gradually becomes closer to a sphere.

Origin of the Weak Interaction Force

According to current theory, the weak interaction force plays the main role in the radioactive decay emissions from the nucleus. The radioactive decays of subatomic particles produce alpha rays, beta rays, and gamma rays from the atomic nucleus with high atomic numbers. The alpha ray is composed of a helium nucleus consisting of two protons and two neutrons. The beta ray is composed of high-energy electrons. The gamma ray is composed of high-energy photons. Observations show that the atomic nuclei of atoms with high atomic numbers are unstable and produce radioactive decay rays spontaneously.

According to the current theory, photons are generated by the transitions of electrons between electron sub-shells or shells in the atom. Also, based on the current theory, there are no electrons or very few positrons in the nucleus since each proton has only one positron. Therefore, the beta ray and gamma ray cannot be emitted from the nucleus. Thus, the beta ray and gamma ray emissions should have no relation to the weak interaction force. The weak interaction force just causes the alpha ray emission because only the protons and neutrons are components of the nucleus. This is a huge contradiction for existing theory and makes the current theory about the weak interaction force more confusing.

However, if we suppose that the protons and neutrons are composed of the photons and that the photon is composed of a pair of an electron and a positron, the radioactive decay rays emitted from the nucleus can be explained easily. As explained above, the nucleus is filled with many photons. In the nuclei of atoms with high atomic numbers, there are more protons and neutrons, and so more electric dipoles consisting of the positrons and electrons. With increases of protons and neutrons in the nucleus, due to various reasons, including random thermal motions, the collisions among the protons and neutrons increase too. The lighter collisions produce alpha rays. In the alpha rays, two protons and two neutrons are still combined. The heavier collisions produce gamma rays. In the gamma rays, a positron and an electron are still combined. The heaviest collisions produce beta rays. In the beta rays, the electrons become separated particles completely.

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In atoms, electrons, positrons, protons, and neutrons are all bound tightly in the nucleus. Thus, only very strong forces can break them into separated pieces. When these separated pieces go out from the nucleus, regardless of whether they are single electrons, pairs of an electron and positron (the photon), or groups of two protons and two neutrons (helium nucleus), the produced beta rays, gamma rays, and alpha rays all have high energies. The forces driving protons, neutrons, and electrons to collide with each other are electric forces because the collisions are just processes of these microscopic particles pushing other microscopic particles with electric forces. Thus, the so-called weak interaction force is the electric force too. The radioactive decay ray emissions don't need a special weak interaction force. There is no weak interaction force in the nucleus.

Conclusions

The four fundamental interaction forces of nature are essentially electric interaction forces. Some are simple electric forces, while others are complex. Thus, the four fundamental forces of nature can be unified as one force.

These new understandings are just inferences by the author and currently lack direct experimental evidence. In particular, some parts of the paper, such as those concerning the structures of electron shells, are more open to discussion. The author's purpose is to share these understandings for discovering the natural truth sooner.

Although these understandings currently lack direct experimental evidence and some may seem impossible to test in the foreseeable future, some inferences have been indirectly confirmed by astronomical and experimental observations. The author is confident in these understandings and welcomes discussions on this paper.

Disclosure

This paper is written partially based on the specifications recorded in the following patent applications:

1. Canada patent application titled "Methods of Changing Gravitational Force and Producing Electric Current", which was filed on August 8, 2024 (Project Publication Date: 02/08/2026) with application number: 3,251,371.

2. USA patent application titled "Methods of Changing Gravitational Force and Producing Electric Current", which was filed on August 9, 2024 (Project Publication Date: 02/12/2026) with application number: 18/799,600.

The author declares no competing interests in this work.

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