Article

Gravitational Force: Electromagnetic Force Generated by Induced-Polarised Charges on the Surface of an Object

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Gravitational Force: Electromagnetic Force Generated by Induced-Polarised Charges on the Surface of an Object

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Abstract

Newton's law of gravity is a logical error of circular argument. Mass in the physical sense does not exist. Gravitational force is an electromagnetic force generated by induced-polarised charges on the surface of an object. Gravity follows the same laws as electromagnetism. Galaxies are a structure of matter, not a pattern of motion. There is no dark matter in galaxies. Galaxies are like magnetic monopoles and repel each other. There is no dark energy in the universe. Objects have only charge properties. There is only electromagnetism in the universe, and electromagnetism manifests itself only on the surfaces of objects. The universe is unified by the electromagnetic force.

Keywords: gravitational force; Newton's law of gravity; mass; circular argument; induced-polarised charge; electrization; surface charge density; Coulomb force; electromagnetic force; relativity; dark matter; dark energy; Debye length

1. Introduction: Gravitational Cloud

In 1900, Lord Kelvin gave a speech at the Royal Society. He said, "The edifice of physics has been completed, and all that remains is some finishing work ... There are, however, two clouds hanging over her beautiful and clear sky." The first cloud dissipated, special relativity emerged, and the second cloud dissipated, quantum mechanics emerged.

In fact, there is a much larger and longer staying cloud over the edifice of physics, and it is the gravitational cloud.

1.1. Newton's Law of Gravity Is Not Correct

1.1.1. Newton's Law of Gravity Is a Logical Error of Circular Argument

In 1687, Newton generalised Newton's law of gravitation from Kepler's Laws:

$$F = G\frac{m_1 m_2}{r^2} \quad (1)$$

How is the mass (m) in the formula obtained? Taking the Earth, the mass of an object on the Earth is the gravitational force of the Earth on that object. Mass is the numerical magnitude or relative ratio of the gravitational force. In a word, mass is gravitational force itself. Therefore, Newton's law of gravity is a circular argument using gravity to prove gravity, a logical error[1]. Newton himself admitted that he did not know the nature of gravity. In a letter to Bentley, he said, "You sometimes speak of gravitation as an essential and intrinsic property of matter. Please do not attribute this concept to me. Because I cannot pretend to know anything about what causes gravity, I need to spend more time thinking about it ...Gravity must be caused by some agent that performs according to a

[1] Circular argument means that the truth of the argument is dependent on the truth of the thesis to be proved. Or the argument and the thesis are the same, not independent of each other. For example, to prove the thesis that "opium is hypnotic", the argument used is "opium has hypnotic power", is a circular argument. A circular argument is a logical error. The argument "mass" in Newton's law of gravity is the thesis "gravity" itself. Newton's law of gravity is also a logical error of circular argument that uses "gravity" (mass) to prove "gravity".

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certain law, but whether that agent is material or immaterial, I have to leave to the reader to consider for himself" [1].

In 1905, Einstein proposed the special theory of relativity, deriving the variation of gravitational forces in the case of relative motion. In his later years, he also worked unsuccessfully on the unification of gravitational and electromagnetic forces.

To this day, we still do not know the nature of gravity.

1.1.2. Newton's Law of Gravity Does Not Hold Outside the Solar System

Newton's law of gravity is generalised from empirical data of the Earth and the solar system, and is self-consistent for the Earth and the solar system. What would be the result of taking this law into the Milky Way, or putting it between galaxies?

Newton's law of gravity states that the magnitude of the gravitational force is proportional to the mass of the object. In a galaxy, such as the Milky Way, the stars in the outer ring of the galaxy are revolving at a much greater speed than would be expected by Newton's law of gravity. The mass of visible matter in the Milky Way cannot explain the gravity required for such high-speed motion. Newton's law of gravity cannot hold in the Milky Way.

Newton's law of gravity states that two objects with mass must attract each other. Then, galaxies would also be attracted and close to each other because of their mass. But astronomical observations have found that galaxies are separated from each other. The more distant a galaxy is from Earth, the faster it moves away. It's as if the universe is expanding, even at an accelerating rate. This is the exact opposite of what Newton's law of gravity predicts. Newton's law of gravity doesn't hold between galaxies either.

1.2. Gravity-Related Queries

Since mass is not the factor that produces gravity, what is the factor that produces gravity?

1.2.1. What Might be the Factor That Produces Gravity?

The reason why Newton's law of gravitation (equation 1) is self-consistent in the solar system is that, firstly, the form of the equation is probably correct. Secondly, the factor that produces the gravitational force may happen to be proportional to the gravitational force. We replace m_1 and m_2 with Q_1 and Q_2, and G with K, with r unchanged, the formula for Newton's law of gravitation becomes:

$$F = K\frac{Q_1Q_2}{r^2} \quad (2)$$

This is consistent with the Coulomb's law formula for electrostatic charges:

$$F = k\frac{q_1q_2}{r^2} \quad (3)$$

So, is the gravitational force a Coulomb force between two electrostatic charges? If it is a Coulomb force, where is the charge?

1.2.2. Why Are There Only Attractive Forces Between Objects and No Repulsive Forces?

In the Coulomb force, opposite charges attract each other and like charges repel each other. Why is there only attractive force between two objects and no repulsive force? If it is due to opposite charges, why do two objects have opposite charges? Further, is there a gravitational force between any two objects, or is there a gravitational force between two objects that has a mutual relationship?

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1.2.3. How Are the Stellar Magnetic Fields Created?

Whether it is a planet or a star, or a neutron star or a black hole, all have magnetic fields. Until now, we did not know how the stellar magnetic fields are produced. Magnetic fields generally arise from the movement of electric charges or currents. At present, an idea called *the dynamo theory* suggests that the magnetic field of a star, such as that of the Earth, comes from a conducting fluid inside the Earth. In other words, the electric charge flowing inside the Earth produces the Earth's magnetic field. According to electromagnetism, when an object is placed in an electric field, under electrostatic equilibrium conditions, the induced-polarised charge exists only on the surface of the object, regardless of whether the object is a conductor or a dielectric. There is no charge inside the object. Even the charge in the internal cavity of a conductor can only act on the outside world by affecting the surface charge of the conductor. In the absence of an electric field, the charge inside a conductor or a dielectric is shielded and does not act on the outside world (see 6.3 of this paper). There is no charge inside the star, and even if there were a charge, this charge would not act on the outside world.

1.2.4. Is There a Charge on the Surface of the Star?

If it's not the charge inside the star that creates the magnetic field, could it be the charge on the surface of the star that forms a current and creates a magnetic field as the star rotates?

According to the documentary film: *Gravity and Me: The Force That Shapes Our Lives* [2], the Earth's gravitational force increases slightly when heavy rainfall occurs on Earth's landmasses. Why does heavy rainfall cause the Earth's gravity to increase? The documentary does not give an answer. The mass of the falling rain is not worth mentioning compared to the mass of the Earth of 5.972×10^{24} kg. It is not possible that the falling rain caused the Earth's mass to increase, resulting in the Earth's gravity becoming stronger. So, is it the heavy rainfall that causes an increase in the free charge on the Earth's surface that causes the Earth's gravity to become stronger?

1.2.5. What Exactly Is the Significance of Einstein's Theory of Relativity for Gravity?

In 1905, based on the principle of the invariance of the speed of light and the principle of relativity, Einstein derived the special theory of relativity. In 1915, based on the principle of the equivalence of gravitational force and acceleration, Einstein formulated the general theory of relativity. The concepts of relativity, such as the length contraction effect, the clock-slow effect, the mass increase effect, and the curvature of space-time, are full of mystery. Relativity is about gravity, but what does it say about the property of gravity? Is this property the same as that of the electromagnetic force?

These questions may all relate to the nature of gravity.

2. Gravitational Force Is an Electromagnetic Force Generated by Induced-Polarised Charges on the Surface of an Object

2.1. Gravitational Forces are Coulomb Forces

2.1.1. Generation of Gravitational Force

There is a charged object *A*, and another object *B* is placed in the electric field generated by *A*. Whether *B* is a conductor or a dielectric, it will be induced or polarised, and the surface of *B* object will rapidly generate opposite charges. If *B* is a conductor, a free induced charge is generated on its surface. For most metallic conductors, the time to generate an induced charge and reach electrostatic equilibrium is about 10^{-14} seconds, and the thickness of the induced charge is 10^{-10} metres, or about the thickness of 1 to 2 atoms. If *B* is a dielectric, a bound polarised charge is generated on its surface. The time to produce a polarised charge and reach electrostatic equilibrium is longer than that for an induced charge, but the rate of production of the polarised charge is still very fast [3,4]. Also, the

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surface charge density of an induced charge is much greater than the surface charge density of a polarised charge.

In this way, the surface of object *B* will form a charge opposite to that of object *A*. Since the two objects have opposite charges, a Coulomb force of mutual attraction develops between them. This is the gravitational force.

Gravitational force is produced on the same principle as a magnet attracts iron. By placing a block of iron near the magnet, the magnetic field of the magnet "magnetises" the iron, causing the iron to have opposite poles. Between the magnet and the iron block, there is then an electromagnetic force of mutual attraction due to the opposite magnetic poles. Therefore, we can also refer to the process by which objects generate induced-polarised charges as "electrization," the gravitational force can be seen as the Coulomb force of mutual attraction that arises when an object is "electrized".

In the solar system, the Sun's electric field induces and polarises the Earth, causing opposite charges on the Earth's surface, and a Coulomb force of mutual attraction is created between the Earth and the Sun. The electric field of the Earth, in turn, induces and polarises the objects on the Earth, causing the surfaces of the objects on the Earth to develop opposite charges, and the Coulomb force of mutual attraction between the objects on the Earth and the Earth.

Gravitational force is not a force between any two objects with mass. Gravitational force exists only between a charged object that produces an electric field and an object with an opposite charge that is induced and polarised by this electric field. Gravitational force is the Coulomb force between these two oppositely charged objects.

2.1.2. The Magnitude of the Gravitational Force

The gravitational force is the Coulomb force, which, according to the formula for Coulomb's law (equation 3), is proportional to the charge carried by the object. The total charge of a surface uniformly charged object is $Q = S \times \sigma$.

According to Gauss's theorem, the electric field strength in the vicinity of a surface uniformly charged sphere is:

$$E \approx \frac{\sigma}{\varepsilon_0} \quad (4)$$

The greater the surface charge density (σ), the greater the electric field strength in the vicinity of the charged sphere. Similarly, the greater the surface charge density of the induced-polarised charges on the surface of an object, the greater the electric field strength in the vicinity of this object and the greater its Coulomb force.

The Sun is the plasma, the surface charge density of induced-polarised charges on the surface of the Sun is large, the electric field strength near the Sun is large, and the Coulomb force near the Sun is large. Other stars are like the Sun. Planets are composed of molecules or atoms. The binding force of molecules or atoms on charges is strong, the surface charge density of induced-polarised charges on the surface of planets is small, the electric field strength near the planets is small, and the Coulomb force near the planets is small.

There is a large amount of water on the Earth's surface, and the water causes a layer of salt solution to form on the Earth's surface. There are more free charges in the salt solution, the surface charge density of induced-polarised charges on the Earth's surface is greater, the electric field strength near the Earth is greater, and the Coulomb force near the Earth is greater. The earth's gravity increases slightly after heavy rainfall occurs on the earth's dry land, it is because the heavy rainfall makes the dry land surface form a salt solution, the land surface has more charged particles, the strength of the electric field becomes larger, and the Coulomb force near the Earth becomes larger. This is an important evidence for the thesis of this paper.

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2.1.3. Generation of the Star's Magnetic Field

When a star rotates, the induced-polarised charges on the surface of the star form a current around the axis of rotation of the star, and this current is the cause of the stellar magnetic field. In the case of the star rotation speed is not fast, the star magnetic field strength is mainly related to the surface charge density[2]. Stars such as the Sun have a large number of free charges on their surfaces, and the magnetic field strength in the vicinity of the star is large. Planets have only a small amount of bound charges on their surfaces, and the magnetic field strength near planets is small. The surface of the Earth is a salt solution with a high surface charge density, and the strength of the magnetic field near the Earth is much higher than that of the other planets.

The dynamo theory that explains the magnetic field of a star suggests that the conducting fluid inside the star is the cause of the star's magnetic field. This theory is wrong. All stars are induced and polarised by the surrounding electric field, and after induction and polarisation, the electric charge exists only on the surface of the star; there can be no electric charge inside the star. Even if there were a charge inside the star, this charge would be shielded (see 6.3 of this paper).

2.1.4. An Estimate of the Sun's Magnetic Field Strength

The Sun is a star with a strong, active magnetic field, as can be seen from the intense activity on the surface of the Sun, such as sunspots, solar flares, and solar winds. Like metals, plasma is also a conductor, and conductors have a very high dielectric constant. Therefore, as plasma, the Sun has a very high surface charge density of induced-polarised charges. This is consistent with the Sun's super mass (gravity). We know that the Sun's mass is 330,000 times that of the Earth's, so the strength of the Sun's magnetic field may be underestimated [5].

There are various types of solar magnetic fields, and the solar magnetic field here refers to the magnetic field produced by the induced-polarised charges on the surface of the Sun as it rotates. This solar magnetic field is generated in the surface layer of the solar plasma, not in the interior of the Sun or in the solar atmosphere.

The mass of the Sun is *330,000* times the mass of the Earth, since $m \propto q$ (See 2.2.2 of this paper), the charge carried by the surface of the Sun is 330,000 times that of the Earth ($Q_S=Q_e\times330,000$). $Q = S\times\sigma$, then $S_s\times\sigma_s=S_e\times\sigma_e\times 330,000$. Since the surface area of the Sun is *12,000* times that of the Earth ($S_s/S_e= 12,000$), calculation gives $\sigma_s/\sigma_e= 27.5$, the Sun's surface charge density is 27.5 times that of the Earth. In addition, the Sun rotates *4* times faster than the Earth's rotation. The magnetic field strength is proportional to the amount of charge generating the magnetic field and proportional to the speed of charge motion, $27.5\times 4 = 110$, the Sun's magnetic field strength is *110* times the Earth's magnetic field strength. If the Earth's magnetic field strength is *0.5* gauss, $0.5\times 110= 55$, the Sun's magnetic field strength may be *55* gauss.

2.2. Gravitational and Electromagnetic Forces Follow the Same Laws

2.2.1. Relatively Stationary Inertial Systems and Relatively Moving Non-Inertial Systems

For the sake of comparison, we narrow the scope. Firstly, whether we are talking about inertial and non-inertial systems in classical mechanics, or relatively stationary and relatively moving systems in electromagnetism, we are describing the relationship between two objects or two charges with interacting forces.

Secondly, by inertial system, we mean the relationship between two objects that are relatively stationary with gravitational force; by relative stationary system, we mean the relationship between two charges that are relatively stationary with Coulomb force. We will refer to them collectively as relatively stationary inertial systems (hereinafter referred to as "condition 1").

[2] According to the formula for the magnetic field generated by moving charges $B = \frac{\mu 0}{4\pi}\frac{qv}{r^2}$ (without considering vectors), the magnetic field strength is proportional to the amount of charge and proportional to the speed of the charge motion.

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By non-inertial system, we mean the relationship between two objects in relative motion with gravitational force; by relative motion system, we mean the relationship between two charges in relative motion with electromagnetic force. We refer to them collectively as relatively moving non-inertial systems (hereinafter referred to as "condition 2").

Einstein's special theory of relativity describes the situation in which the gravitational force changes under condition 2.

2.2.2. Under Condition 1, Gravitational and Coulomb Forces Follow the Same Laws

The formula for Newton's law of gravitation (equation 1) and the formula for Coulomb's law (equation 3) are formally identical. We know that mass is gravity, gravity is Coulomb force, Coulomb force is proportional to charge, so mass is also proportional to charge. Since $m \propto q$, Newton's law of gravitation formula and Coulomb's law formula are equivalent.

2.2.3. Under Condition 2, Relativistic Gravity and Electromagnetism Follow the Same Laws

Special relativity describes the situation in which the magnitude of the gravitational force between objects changes under condition 2. The relativistic factor is:

$$\gamma = \frac{1}{\sqrt{1-v^2/c^2}} \quad (5)$$

And the relativistic gravitational force formula can be written as:

$$F = G\frac{m_1 m_2}{r^2\sqrt{1-v^2/c^2}} \quad (6)$$

Under condition 2, the magnitude of electromagnetic force between charges also changes. Two charges in relative motion can be viewed as an electromagnetic force on a stationary charge in a magnetic field created by another moving charge, and this force is the Lorentz force. The Lorentz force is the relativistic effect of the Coulomb force. The Lorentz factor is the same as the relativistic factor (equation 5), and the formula for the electromagnetic force for charges in relative motion can be written as:

$$F = k\frac{q_1 q_2}{r^2\sqrt{1-v^2/c^2}} \quad (7)$$

Since $m \propto q$, the relativistic gravitational force formula (equation 6) and the electromagnetic force formula for relatively moving charges (equation 7) are equivalent.

However, Einstein incorrectly attributed the change in the gravitational force under condition 2 to an increase in mass that did not exist:

$$m_2 = \frac{m_0}{\sqrt{1-v^2/c^2}} \quad (8)$$

2.2.4. Gravitational Force, like Coulomb Force, Is Conservative and Long-Range Force

If there is a pair of internal forces in a mechanical system, and if this force does work, the magnitude of the work is related only to the relative positions and not to the path, this force is a conservative force. Gravity and the Coulomb force are both conservative forces.

Also, both gravity and electromagnetism are long-range forces.

2.2.5. Gravitational Waves are Electromagnetic Waves

The speed of gravitational waves is the same as the speed of electromagnetic waves, which is about *300,000* kilometres per second. Gravitational waves are electromagnetic waves. The currently measured wavelength of a gravitational wave is *2,000* kilometres and the frequency is *150* hertz. Gravitational waves are weak energy waves.

There are no separate gravitons; a graviton is a photon.

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3. Mass in the Physical Sense Does Not Exist

3.1. Objects Do Not Have the Property of Mass

3.1.1. Mass Is Gravity Itself

What we commonly refer to as mass is the gravitational force of the Earth on an object. Mass is the numerical magnitude or relative ratio of the gravitational force, the gravitational force itself. Mass is not a property of an object, and there is no such thing as a mass that is independent of and produces gravity. Therefore, Newton's law of gravity is a logical error of circular argument and mass in the physical sense does not exist.

3.1.2. The Theory that Mass Causes Gravity Is a Coincidence

Since $m \propto q$, the formula for Newton's law of gravity (equation 1) is equated with the formula for Coulomb's law (equation 3), which is why Newton's law of gravity is self consistent. It's a coincidence, not a truth.

3.1.3. It Is Not Mass That Curves Space

Einstein's theory of general relativity holds that massive objects, such as stars, curve space, and that other objects move along the curved space, and even light moves along the curved space. In reality, massive objects such as stars are objects with a large amount of charges. Other objects that have been electrized by them and carry opposite charges are attracted to them, which have nothing to do with the curvature of space. Similarly, the powerful electromagnetic force of a star attracts light (electromagnetic waves) and changes the direction of the light (electromagnetic waves). This is the nature of the electromagnetic force itself, and also has nothing to do with the curving of space.

A change in space-time can change the magnitude of the gravitational force by changing how much electric flux there is. But conversely, a change in the magnitude of the gravitational force is not necessarily the result of a change in electric flux, much less a change in space-time. Gravity is not space-time bending, gravity is the electromagnetic force generated by induced-polarised charges on the surface of an object.

3.1.4. Within the Galactic and Cosmic Scales, There Is also No Mass

Galaxies are a structure of matter, not a pattern of motion. It is not dark matter that sustains galaxies, but another form of electromagnetic force, independent of mass (see 4. of this paper). The dark energy that causes galaxies to separate from each other is also another form of electromagnetic force, also independent of mass (see 5. of this paper).

3.1.5. Mass Does Not Exist in the Microscopic World Either

The so-called mass gap in the Yang Mills equation, which describes the microcosm, means that the equation does not require mass to hold true. This just means that mass does not exist in the microscopic world either.

3.2. Remove the Fog of Mass so that Physics Can Evolve

3.2.1. The Mass Fog Has Been Hanging over Us

Mass is a commonly used measurement tool, and we have become accustomed to thinking of mass as a property of how much matter there is. The intuition is that the larger the volume of the same object, the greater the gravitational force of the Earth on it and the greater its mass. Conversely, the larger the volume of an object, the greater the mass of the object and the greater the gravitational force of the Earth on it. Mass has been misinterpreted as the factor that produces gravity.

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Gravity is a Coulomb force, and the magnitude of the gravitational force is related to the induced-polarised charge on the surface of the object, independent of the volume of the object. The problem is that we don't know gravity is a Coulomb force, much less have access to the amount of weak charge on the surface of an object. Since the volume of an object is indeed approximately proportional to its mass (the Earth's gravitational force), and since mass is a readily available parameter, mass naturally becomes the cause of gravitational force. In addition, Newton's law of gravity is self-consistent in the solar system, and Einstein proposed the mass increase effect in special relativity. All of this reinforces the misperception of mass.

3.2.2. The Concept of Mass Must Be Eliminated for Physics to Develop

Mass is an illusion and does not exist in the physical sense. We must eliminate the concept of mass from the laws and formulas of physics and restore the charge property of an object before physics can develop.

4. No Dark Matter in Galaxies: Galaxies Are a Structure of Matter, Not a Pattern of Motion

4.1. Definition of Dark Matter

In galaxies, such as the Milky Way, stars in the outer ring of galaxies revolve much faster than expected by Newton's law of gravity. The mass of visible matter in the galaxy cannot generate enough gravitational force to maintain such a high speed of motion of the outer ring of stars. It was then thought that there was an invisible dark matter in the galaxies. The dark matter provides more mass and more gravity to keep the outer ring of stars moving at high speeds.

4.2. Composition of Galaxies

Galaxies are star systems made up of thousands of stars, each of which is a magnetic particle, and planets play an insignificant role in galaxies. In galaxies, stars are attracted to each other with opposite magnetic poles. The Sun's magnetic field strength is 110 times stronger than the Earth's (see 2.1.4 of this paper), and the surface area of the Sun is 12,000 times larger than that of the Earth. The gravitational force between two stars similar to the Sun at the same distance is many, many times greater than the gravitational force between the Earth and an object on the Earth [3]. The electromagnetic gravitational force between stars is much greater than we realise.

4.3. Shape of Galaxies

When multiple magnetic particles are combined together, they form specific arrangements and structures, such as chains, clusters, or networks [6,7], with the electromagnetic force of oppositely attracting magnetic poles between them. Galaxies composed of stellar magnetic particles may also form such arrangements and structures. Together with the rotation of galaxies, various shapes of galaxies in the universe are formed, such as barred spiral galaxies, elliptical galaxies, whirlpool galaxies, and so on. The Milky Way is a barred spiral galaxy when viewed from the disc of the Milky Way.

[3] According to the formula for the force between magnets $F = \frac{\mu 0}{4\pi}\frac{m_1 m_2}{r^2}$, the electromagnetic gravitational force between two magnets is proportional to the product of their magnetic moments. According to the magnetic moment equation $m=I \cdot S \cdot n$, the magnetic moment is proportional to the product of current strength and coil area. Since the strength of the current is proportional to the strength of the magnetic field, the electromagnetic gravitational force between two stars is at least (110 x 12,000) x (110 x 12,000) = 1.7424 x 10^{12} times the gravitational force between the Earth and an object on Earth.

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4.4. Crystal Structure of Galaxies

Magnetic particles can, under certain conditions, assemble into an ordered secondary structure, and this secondary structure combined together forms a magnetic crystal [8,9]. Galaxies are composed of stellar magnetic particles, and the stellar magnetic particles in a galaxy may form a crystal structure. When viewed from the side of the galactic disc, the Milky Way may be a crystal structure.

4.5. Galaxy is a Material Structure, Not a Pattern of Motion

In our solar system, the eight planets move around the Sun. The gravitational force between the inner planets and the Sun is high, and the inner planets move fast; the gravitational force between the outer planets and the Sun is low, and the outer planets move slowly. This is the Keplerian motion of the planets in our solar system.

The Milky Way is different from the solar system. The Milky Way is crystalline matter made up of magnetic particles of stars. The Milky Way is a structure of matter, not a pattern of motion. Like the Earth's rotation, the Milky Way also rotates as a super-sized object as a whole, with the outer ring of stars moving as fast as the inner, or even faster.

4.6. Dark Matter Does Not Exist in Galaxies

The Milky Way is a super-sized object with a material structure, not a pattern of motion. Dark matter is not required for the maintenance of the Milky Way and does not exist. Other galaxies, like the Milky Way, do not have dark matter.

5. No Dark Energy in the Universe: Galaxies Are like Magnetic Monopoles and Repel Each Other

5.1. Definition of Dark Energy

According to Newton's law of gravity, all objects attract each other because of their mass. Galaxies in the universe also attract each other and eventually merge together. However, astronomical observations have found that galaxies in the universe are separated from each other. The more distant the galaxies are, the faster they separate, and the universe is expanding, as if it were expanding even at an accelerated rate. People do not know the cause of the expansion of the universe, so they believe that there is an invisible dark energy in the universe and that the dark energy causes the galaxies to separate and the universe to expand.

5.2. Spin Ice and Magnetic Monopoles

Spin ice is a crystal composed of magnetic ions. The arrangement of the magnetic ions is similar to the arrangement of hydrogen ions in water ice, hence the name. Spin ice is made up of individual tetrahedral vertices joined together, with one magnetic ion at each vertex. Near absolute zero, the arrangement of these magnetic ions follows the "ice law": In each tetrahedron, two ions have their north poles pointing inwards and two ions have their north poles pointing outwards. If, for some reason, the poles of one of the magnetic ions in the tetrahedron are flipped, the "ice law" is broken. The flipped spins (magnetic poles) then extend like a domino effect, forming a chain of spins with their heads and tails, and at the end of the chain a magnetic monopole is formed [10].

5.3. Crystal Structure of Galaxies and Galactic Magnetic Monopoles

As mentioned earlier, galaxies composed of magnetic particles of stars may be a crystal structure. In galaxies, the magnetic poles of stars also flip, as the north and south poles of the Sun do periodically. Like spin ice, this flipping may extend like a domino effect, forming a chain of spins

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with their heads and tails, at the end of which a magnetic monopole is formed. Galaxies may be magnetic monopoles and have a high probability of forming like magnetic monopoles.

Whether the flipping of the Sun's magnetic poles is autonomous or caused by the flipping of the magnetic poles of other stars is unclear. It is currently believed that the Sun's magnetic poles flip every 11 years as a result of violent nuclear fusion reactions within the Sun and the differential rotation of the Sun.

5.4. Mutual Exclusion of Like Magnetic Monopole Galaxies

A large number of like magnetic monopole galaxies, in cosmic space, will repel and separate from each other, which is the phenomenon we see in the expansion of the universe. As two like magnetic monopole galaxies approach each other, the repulsive force becomes stronger as the distance decreases, and the shape of the edges of the galaxies changes. The warped structure we observe in the Milky Way's progression may be the result of repulsive forces generated by the nearby Sagittarius dwarf galaxy as it approaches the Milky Way, causing the structure of the Milky Way's edge to change.

5.5. Opposite Magnetic Monopole Galaxies Merge with Each Other

Frequent flips of the stars in a galaxy may cause a galaxy to become an opposite magnetic monopole unlike other galaxies. This occasional opposite magnetic monopole galaxy is attracted to and merges with nearby magnetic monopole galaxy to form a larger galaxy. There is evidence that galaxy merger events have occurred many times during the evolution of the universe.

5.6. There is No Dark Energy in the Universe

The long-term repulsive force between like magnetic monopole galaxies in the universe is the reason for the separation of galaxies and the accelerated expansion of the universe, and is unrelated to dark energy. Dark energy is not needed for the expansion of the universe, nor does it exist.

6. The Universe Is Unified by the Electromagnetic Force

6.1. Objects Have Only Charge Properties

From the point of view of forces, objects have only the charge property and no other properties. The mass property of an object does not exist.

6.1.1. Positive and Negative Charges

Electric charge is made up of positive and negative charges, and they are separable. Like charges repel each other, and opposite charges attract each other.

6.1.2. South and North Poles

Moving charges produce a magnetic field, which consists of a south pole and a north pole, which cannot be separated. Like magnetic poles repel each other and opposite magnetic poles attract each other.

6.1.3. Electrization and Magnetization

An object can be induced and polarised by the electric field of another electrically charged object, producing opposite charges on its surface. This phenomenon can also be called “electrization”. Some objects can be “magnetised” by the magnetic field of another magnetic object, producing opposite poles.

6.1.4. Charge Has a Shielding Effect

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A positive charge is shielded by the surrounding negative charges so that the positive charge inside cannot be felt by the outside world. A negative charge is also shielded by the surrounding positive charges so that the negative charge inside cannot be felt by the outside world.

6.2. There is Only Electromagnetic Force in the Universe

6.2.1. Several Forms of Force

Charge, through the combination of objects, forms various forms of force in the universe. So far, we have identified four basic forces in the universe: gravitational, electromagnetic, strong and weak. In fact, there is also a force that causes galaxies to separate from each other. All of these forces are electromagnetic.

6.2.2. Ways of Action of Electromagnetic Forces

Electromagnetic forces act in three ways: electromagnetic attraction, electromagnetic repulsion, and zero-action. All electromagnetic attractive forces are forces generated between opposite charges or opposite magnetic poles. All electromagnetic repulsive forces are forces generated between like charges or like magnetic poles.

6.2.3. Gravitational Forces are Coulomb Forces (see 2.1 of this Paper)

6.2.4. The Force Between Galaxies is Electromagnetic Repulsion

The force that causes galaxies to separate from each other is the electromagnetic repulsion between like magnetic monopoles (see 5. of this paper).

6.2.5. The Strong and Weak Forces Are also Electromagnetic Forces

In the 1960s, Weinberg and others proposed a theory that unified the weak and electromagnetic forces, which are collectively known as the electroweak force. It was later discovered that the strong, weak and electromagnetic forces could be extrapolated backwards to the same starting point where the three forces are unified [11].

Like the electromagnetic force, the strong and weak forces are long-range forces. Due to the limitation of the Debye length, the strong and weak forces can only exhibit the characteristics of short-range forces (see 6.3.1 of this paper).

6.2.6. The Various Chemical Bonds on Earth are also Electromagnetic Forces

Covalent, ionic, and metallic bonds are all electromagnetic forces. The three intermolecular forces, dispersion, induced, and orientation, are also electromagnetic forces. The weak intermolecular interaction force is also known as electromagnetic force, in which hydrogen bonds are the basis for the formation of life.

6.2.7. All Bosons are Photons

There is only electromagnetic force in the universe and all bosons are photons.

6.3. Electromagnetic Forces Manifest Themselves only on the Surface of Objects

Objects are composed of various particles, and electromagnetic properties are only exhibited on the surface of the object.

6.3.1. Constituent Particles of an Object and the Debye Length

The Debye length is supposed to reflect the shielding effect of charges in the plasma. There are a large number of charged ions in the plasma, and any one of them is always surrounded by opposite

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charged ions. Its electric field can only act within a certain distance, beyond which its electric field will be shielded by the electric field of the surrounding opposite ions. This distance is the Debye length of the plasma. In the plasma, only less than the Debye length, two ions have interaction; greater than the Debye length, will not show the electromagnetic properties of ions and interaction.

In fact, every object has its own constituent particles and Debye length. The particles that make up the Earth are molecules, and the distance between molecules is the Debye length of the Earth's constituent particles. The particles that make up the Sun are plasma ions, and the distance between plasma ions is the Debye length of the Sun's constituent particles. The particles that make up galaxies are stars, and the shortest distance between stars is the Debye length of the galaxy's constituent particles. Beyond the Debye length, the electric or magnetic field of the constituent particles is shielded, and the object does not exhibit the electromagnetic properties of its constituent particles. As a result, only the particles on the surface of an object will exhibit the electromagnetic properties of that object, or in other words the electromagnetic properties of an object will only be exhibited on the surface of the object.

The Debye length also causes the strong and weak forces to exhibit the characteristics of short-range forces. The strong and weak forces are also electromagnetic forces, and electromagnetic forces are long-range forces. Since the strong and weak forces are confined to the interior of the nucleus, their distance of action is limited by their Debye length, causing them to appear as short-range forces.

6.3.2. An object exhibits only the electromagnetic properties of its surface

In the absence of an electric field, whether it is a conductor or a dielectric, due to the shielding effect of the electric charge, the electromagnetic properties of the constituent particles inside an object cannot be manifested, the object only manifests the electromagnetic properties of its surface.

In the presence of an electric field, an induced-polarised charge is generated on the surface of an object, whether it is a conductor or a dielectric. The state of the induced-polarised charge on the surface of an object is the state in which the object manifests its electromagnetic properties externally. In the presence of an electric field, even if there is a charge in the internal cavity of the conductor, this charge cannot manifest the electromagnetic properties of the object. The charge in the cavity can only change the electromagnetic properties of the object by changing the charge on the outer surface of the conductor[4].

6.3.3. All Objects in the Universe Exhibit only Their Surface Electromagnetic Properties

All objects in the universe, whether microscopic particles or macroscopic objects, exhibit only their surface electromagnetic properties.

The intermolecular forces are the Coulomb forces generated by the electric dipoles that manifest themselves on the surfaces of the molecules.

The gravitational force of a planet is the Coulomb force manifested by the induced-polarised charges on the planet's surface. The magnetic field of a planet is generated by the induced-polarised charges on the planet's surface moving around the planet's axis of rotation.

The gravitational force of a star is the Coulomb force manifested by the charges of plasma ions on the star's surface. The star's powerful magnetic field is generated by the large number of free charges on the star's surface moving around the star's axis of rotation.

The repulsive force between galaxies is also the electromagnetic force between like magnetic monopoles formed on the surface of galaxies (see 5. of this paper).

[4] Under electrostatic equilibrium conditions, the outer surface of a conductor carries a charge Q. According to electromagnetism, if a charge q is placed in the inner cavity of the conductor, the charge on the outer surface of the conductor becomes: $Q+q$.

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