

# **New Perspective on Gravity in the 21st Century: Gravity is the Equilibrium Effect between Atomic Structure and Quantum Vacuum**

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**Abstract:** Since Newton proposed the law of gravity, the nature of gravity has not been revealed. Many theories only describe gravity in terms of phenomena, attributing gravity to the inherent properties of mass, which is the geometric effect of mass on the curvature of space-time. Thus, denying the variability of gravity and denying the possibility of antigravity. This paper proposes that gravity is the structural mechanical effect of atomic mass, which is the coupling effect between the gravitational fields caused by the structural mass torque of atoms relative to the quantum vacuum, and the gravitational constant is actually the structural coefficient, without particle structure, there is no gravity. This paper synthesizes the knowledge of various related disciplines and valuable data from modern experiments, derives the structural information of gravitational constants according to the principle of energy equivalence and correspondence, and reveals that gravity is closely related to the basic atomic structure, thus making up for the shortcomings of Newton's theory of universal gravity. At the same time, the variability of gravity is revealed, which provides theoretical support for the possibility of antigravity, and reveals the intrinsic relationship of physical systems, which is conducive to the unified construction of theory.

**Keywords:** Atomic structure, equilibrium effect, gravity, quantum vacuum

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## **1. Introduction**

On October 7, 2008, the Nobel Prize selection committee said that the question of what causes gravity “poses a huge challenge to today’s physics”. The law of universal gravitation is a natural law of attraction between objects summarized by the great British scientist Newton in the 17th century on the basis of predecessors, which has promoted the rapid development of astronomy and aerospace [1]. However, it does not reveal the formation mechanism of gravity, but only describes the physical phenomenon mathematically, which is not complete. It does not specify the transmission speed of gravity, the boundary conditions of interaction, the media of interaction, the meaning of gravitational constant, the difference and relationship between inertial mass and gravitational mass, and there are problems such as gravitational over-distance action and the infinity of gravity. For this reason, for more than 300 years, numerous scientists have devoted themselves to the study of gravity one after another. Unfortunately, many studies still remain on the surface rather than on the essence, and no breakthrough has been made.

In order to solve the incompleteness of the law of universal gravitation, Einstein strongly introduced the

general theory of relativity, using the field equation to describe the relationship between mass and space-time distribution [2]. It equates the inertial mass with the gravitational mass, and points out that the speed of gravitational transmission is the speed of light, which eliminates the problem of gravitational over-distance action. However, the problem of infinity has not been solved, and the connotation of the gravitational constant is also unclear. Because the boundary conditions are not clear, the difference and relationship between inertial mass and gravitational mass cannot be clearly defined. The use of space as the medium of interaction has led to new problems, such as why can matter act on geometric space? Why does the space-time ripple caused by mass have the same transmission speed as light energy? It further deepens the opposition rather than unity between universal gravitation and weak force, strong force and electromagnetic force. Later, Einstein said, "Recapitulating, we may say that according to the general theory of relativity the space is endowed with physical qualities; in this sense, therefore, there exists an ether" [3].

It can be seen that both Newton and Einstein's theory of gravity is incomplete, they attribute gravity to the inherent properties of mass, regard the gravitational constant as the inherent coefficient of mass, and do not consider what physical connotation this minimum value that has a major impact on gravity is contained, and do not consider the major contribution of particle structure to gravity. So, they are unable to answer the following questions clearly. For example, what is the difference and connection between inertial mass and gravitational mass? What is the connotation of physical constants? What is the relationship between them? What is the relationship between charge and mass?

Of course, these issues are controversial. In fact, these physical existence problems are evident from a philosophical perspective, because physics focuses on local research while philosophy is good at holistic consideration. About 2500 years ago, the ancient Greek philosopher Aristotle, the Indian philosopher Sakyamuni, and the Chinese philosopher Laozi had already formed a global view of the universe, which was inherited by later philosophers such as Leibniz, Hegel, and Mach. The global view of the universe regards everything, time, and space as a unified whole.

The overall state is jointly determined by the parts, forming the basic spatiotemporal framework. Local motion is closely related to the overall motion, and is an absolute motion relative to the whole, independent of the choice of reference frame. The overall motion includes various levels of local motion. For example, the motion of objects on Earth is governed by the Earth system, which belongs to the Earth level. The Earth system is subject to a higher level solar system, while the solar system is subject to the Milky Way. The relationship of the entire universe is that lower level systems orbit higher level systems, and lower level systems always exist in higher level systems. The movement of all things have a unified process. Everything is like a component on a machine that interacts and interconnects, with a unique state at every moment.

There are no countless relative universes generated due to the different relative motion speeds of different parts. For example, the law of magnetic field generated by moving charges inevitably depends on the environment, and there is no magnetic field generated solely by different reference frames of motion. Otherwise, countless choices of reference frames will generate countless magnetic fields of different sizes and opposite directions.

Many times, the chaos caused by physics is related to thoughtlessness. For example, the Maxwell equation satisfies the Lorentz transformation because the speed factor hidden by the dielectric constant in the equation is ignored, which is actually equal to the preset constant speed of light. Another example is that the fundamental reason why the change in mass velocity in Compton's photoelectric experiment satisfies the mass-velocity relation of relativity is that the photoelectric interaction has a special quantum allocation mechanism, it can actually be derived from quantum theory combined with momentum and energy conservation. The key point is that both the incident and outgoing rays are at the speed of light, which determines that the change in mass and velocity in the momentum conservation formula is different from

classical theory. such problems are so on.

Guided by Materialistic dialectics, this paper comprehensively applies classical physics and quantum theory, relies on scientific experimental data, and flexibly uses various thinking methods to gradually deduce, demonstrate and elaborate the essence of gravity.

## **2. Basic Guiding Ideology and Reasoning Ideas**

Materialist dialectics points out that the material world moves, changes, and develops according to its inherent laws [4]. The law of unity of opposites is the fundamental law that promotes the continuous development of things from lower to higher levels. The world is not isolated, static, and one-sided, but is generally connected, evolving, and comprehensive.

Quantum theory points out that the universe is full of quantum and is a quantum vacuum [5]. There are basic energy units in the material world. According to the fact that particle annihilation and particle decay, particles and light quanta are isomorphic, particles are not out of thin air, but the closed energy form formed by the accumulation of quantum fluctuations. Particles and energy transform each other,  $mc^2 = hf$ , and the basic substance that constitutes the world is quantum. The universe is a unity. Everything is interconnected and macro and micro is homogeneous. No matter the strong force, weak force or electromagnetic force cannot be separated from the micro media. Similarly, gravity is no exception.

It is a one-sided view that gravitation is the natural attribute of matter and the effect of space-time bending. It only sees the static side of the macroscopic object but not the microscopic movement side; It can only see the side where the two objects do not contact directly, but not the side where the two objects depend on the quantum vacuum environment; It can only see the equivalent side of inertial mass and gravitational mass, but can't see the difference side of their properties, and can't see the dependency between gravitation and the formation of basic atoms.

Classical theory points out that force originates from the interaction between moving substances. The theory that gravitation can be transmitted without media is a myth without physical foundation and does not conform to the attribute of force. Different forms of force are essentially produced by different structures and motion forms of objects. Both electromagnetic theory and atomic theory have profoundly revealed the close relationship between atomic system and quantum vacuum.

In fact, in ancient China's long-term observation of nature, the concept of qi, yin and yang and balance in ancient China was formed, which in a word was "the movement of the opposite way" [6]. See China's Tao Te Ching, I Ching and other works. The essence of gravity is "the movement of the opposite way". The establishment and development of modern atomic theory and quantum theory provides richer experimental data and theoretical support for in-depth exploration of the relationship between all things. This makes it possible to explore gravity from the perspective of the kinetic structure of particles and the energy balance relationship of quantum vacuum.

There are many scholars who explore the mechanism of gravity from the perspective of "the movement of the opposite way" combined with quantum theory. For example, in the 90s of the 20th century, Wang [7] explained that gravity is the imbalance between the objects caused by the collision of energy particles and objects in space. In 2019, Chinese philosophical researcher Ci [8] proposed that "the reverse force leading to the center is the source of gravity", and pointed out that this itself is the core of Newton's classical mechanical theory, and the external force changes the state and motion trend of the object. Zhao [9] pointed out that the gravitational field is a gradient force field formed by the internal mass energy of an object under the quantum centripetal pressure of external space.

According to the philosophy of "everything is interconnected, macro and micro are unified", without particle structure gravity will no longer exist, so gravity must be closely related to the formation of the basic

atom. Considering that the gravitational constant is the coupling coefficient of two mass bodies and contains rich gravitational information, revealing it is conducive to better understanding the connotation of the gravitational formula. Considering the unity of the physical system, electricity, magnetism, heat and light are all different manifestations of the interaction between the atomic system and the quantum vacuum. Energy equivalence can associate the gravitation with the electromagnetic force. Therefore, this paper synthesizes electromagnetism, atomism, and quantum to find all kinds of relevant information through logic and correspondence principles, and transforms the relevant elements into three elements of mass, motion and space, thus revealing the hidden information of the gravitational constant, and then revealing the essence of gravity.

The above philosophical analysis is only a necessary speculation rather than an assertion on physical theory. It cannot directly solve specific physical problems, but rather provides appropriate guidance for physics, revealing potential doubts in relevant physical theories. Avoid the questions being avoided or vaguely bypassed. Based on this thinking, the following attempts to explore the mechanism of gravity from the perspective of particle structure.

### 3. Relevant Theoretical Knowledge of Physics

#### 3.1. Electrostatic Coulomb Law

$$\begin{cases} F = \frac{kq_1q_2}{r^2} = \frac{q_1q_2c^210'^{-7}}{r^2} \\ \text{SI}(k = c^210'^{-7}) = \text{N} \cdot \frac{\text{m}^2}{\text{C}^2} \\ \text{SI}(10'^{-7}) = \text{kg m C}^{-2} \end{cases} \quad (1)$$

#### 3.2. Magnetic Force Formula

$$\begin{cases} F = q_1v_1 \times B \\ B = \frac{\mu_0q_2v_2 \times e_r}{4\pi r^2} \end{cases} = \begin{cases} F_B = \frac{q_1v_1 \times q_2v_2 \times e_r}{r^2} \cdot 10'^{-7} \\ B = \frac{q_2v_2 \times e_r}{r^2} \cdot 10'^{-7} \end{cases} \quad (2)$$

Eqs. (1) and (2) are the expansion of electromagnetic coulomb formula, called dynamic coulomb formula [10].

#### 3.3. Electromagnetic Energy Relationship of Atom System

Electromagnetic, light and heat are the concrete manifestations of energy, and they are closely related to the motion of electric particles. Ground state energy relation of hydrogen atom system [11]:

$$hf_0 = m_e v_e^2 = \frac{e^2 c^2 10'^{-7}}{a_0} \quad (3)$$

$$h = \frac{e^2 c^2 10'^{-7} 2\pi}{v_e} \quad (4)$$

#### 3.4. Magnetic Flux Distribution of Hydrogen Atom

$$\xrightarrow{\text{Eq.(3)}} \frac{ev_e 10'^{-7}}{4\pi a_0^2} = \frac{m_e v_e^2 f_0}{2ec^2} \approx 1 \text{ kg s}^{-1} \text{C}^{-1}$$

The angular momentum  $ev_e 10'^{-7}$  is equal to the spatial distribution of the basic atom sphere  $4\pi a_0^2$ . According to Eq. (2):

$$\frac{ev_e 10'^{-7}}{4\pi a_0^2} = \frac{B_0}{4\pi} = 1 \text{ kg s}^{-1} \text{ C}^{-1} \Rightarrow B_0 = 4\pi \text{ kg s}^{-1} \text{ C}^{-1}$$

The magnetic induction intensity is actually determined by  $4\pi \text{ kg s}^{-1}$ , reflecting the close relationship between magnetism and the spatial distribution of moving substances. It can see that:

$$\begin{cases} ec^2 = \frac{1}{2} m_e v_e^2 f_0 = \frac{1}{2} m_e v_e^2 / t_0 \\ e = \frac{1}{2} m_e f_0 v_e^2 / c^2 \\ \mathbf{C} = \mathbf{kg s}^{-1} \end{cases}$$

It can be seen from the corresponding relationship of the above equation that the charge  $ec^2$  in the system is actually the output power of the periodic movement of the electron, while the charge is actually the rate of change of mass to time.

#### 4. Analysis of Gravitation Formula

Classical mechanics gives the experimental formula of gravitation:

$$F_G = G \frac{m_1 m_2}{R^2}$$

The formula describes the gravitational relationship between two relatively stationary masses, wherein the constant  $G$  is the coupling constant measured by experiments, which contains the gravitational coupling information between two relatively stationary objects in the quantum vacuum. To understand the connotation of the gravitational formula, it is obviously necessary to understand the connotation of the gravitational constant.

##### 4.1. Information Structure of Gravitational Constant

The gravitational constant is a minimum value that deeply affects the magnitude of gravity. According to the connotation of force, the gravitational constant is not a pure coefficient, but has structural information. Because force is the temporal derivative of momentum, the gravitational constant contains at least a velocity factor. In fact, the unity of the physical system determines that the gravitational constant  $G$  must have a close relationship with other physical constants. Considering the approximation of the universal gravitation formula and the electrostatic Coulomb formula, an attempt is made to find the correlation information between the two.

The unity of the physical world determines that both gravitational field and electromagnetic field have quantization characteristics. Considering the equivalence of energy, there must be equation  $nhf = Gm_1 m_2 / r = kq_1 q_2 / r$ , and a specific conversion relationship  $q = f(m)$  or  $m = f(q)$ . The basic physical information contained in constant  $G$  must be implied in equation  $G = kq_1 q_2 / m_1 m_2$ . Then, if we can find the relationship between the mass and the charge, we can find the information about the constant  $G$ .

Simplify  $nhf = Gm_1 m_2 / r = kq_1 q_2 / r$ , and let  $r = ct$ ,  $t = 1/f$ , we can get:

$$h = Gm^2 / c = kq^2 / c$$

According to Eq. (4):

$$G = hc/m^2 = ke^2 2\pi c/m^2 v_e \quad (5)$$

$$m = \sqrt{hc/G} \quad (6)$$

Among them,  $m$  is Planck's mass  $m_p$  which was first proposed by Planck [12], a German physicist, at the beginning of the 20th century.

The structural information of gravitational constant can be obtained from Eqs. (4)–(6):

$$\left. \begin{aligned} G &= \frac{ec^2}{m_p^2 v_e^2} ec 10'^{-7} \cdot 2\pi v_e \\ \left| \frac{ec^2}{m_p^2 v_e^2} \right| &= \frac{0.014}{0.014} \end{aligned} \right\} \Rightarrow \begin{cases} |G| = |ec 10'^{-7} \cdot 2\pi v_e| \\ |ec^2| = |m_p^2 v_e^2| \end{cases}$$

According to the correspondence,  $ec^2$  and  $m_p^2 v_e^2$  are physically related. Namely:

$$\begin{cases} G = ec 10'^{-7} \cdot 2\pi v_e \\ ec^2 = m_p^2 v_e^2 \\ SI(e) = C = SI(m_p^2) = kg^2 \end{cases}$$

The rationality of the correspondence depends on whether the correlation between physical quantities is reasonable. Later, it will be confirmed by the correlation of a series of physical quantities.

Therefore, the formula of gravitation can be expressed as:

$$F_G = G \frac{m_1 m_2}{R^2} = ev_e 10'^{-7} \cdot 2\pi c \frac{m_1 m_2}{R^2}$$

In the formula,  $ev_e 10'^{-7}/R^2 = B$ ,  $m_1 m_2 = q$ ,  $F_G = qcB2\pi$ , which is consistent with the dimension of Lorentz force  $F = qv \times B$ , indicating that the equivalent conversion of gravitation and electromagnetic force maintains the unity of dimensions.

But the constant  $G$  is still very abstract and difficult to understand its connotation intuitively. Fortunately, it is found that  $ev_e 10'^{-7} = 4\pi a_0^2$ , so the gravity formula can be expressed as:

$$F_G = G \frac{m_1 m_2}{R^2} = 4\pi a_0^2 \cdot 2\pi c \frac{m_1 m_2}{R^2}$$

## 4.2. Coordination of Physical Units

Due to the lack of horizontal connection in the physical system, the above derivation results will naturally be dimensionally inconsistent. For example,  $ec^2 = m_p^2 v_e^2 = \frac{1}{2} m_e v_e^2 f_0$ , it needs to be coordinated through correspondence. See Appendix B.

## 4.3. Connotation of Formula and Essence of Gravity

In the previous article, we have deduced the proportional relationship between electromagnetism and space-time distribution  $4\pi = ev_e 10'^{-7}/a_0^2 = B_0$ .  $4\pi$  corresponds to the space with energy substances, and magnetism is the effect of space energy substances responding to electromagnetic particles. In the gravity formula,  $4\pi m$  reflects the mutual response of particle matter and space matter. Gravitational field matter is closely related to electromagnetic field matter, but in different forms. Combining with quantum

theory, vacuum is not empty, and it is quantum vacuum. According to the Bohr radius  $a_0$  contained in the formula, it is known that the gravitation is inseparable from the basic atom and is related to the ground state quantum vacuum.

As shown in Fig. 1, atom is the unity of electromagnetism and mass, and hydrogen atom is the simplest atomic structure, which reflects the basic proportional relationship of system structure. The Bohr radius is not only the electromagnetic equilibrium radius of the proton and electron in the ground state, but also the space-time curvature of the gravitational field. It is precisely because of this mass torque that the gravitational field is generated.

$4\pi m a_0$  reflects the centripetal constraint of the quantum vacuum on the particles, forming a gravitational source with the Bohr radius as the mass torque, and  $4\pi m a_0^2/R^2$  reflects the gradient change of the gravitational field. Obviously, the existence of the limit radius  $R$  of gravity must be based on the premise of not destroying the curvature  $a_0$ , otherwise the gravitational mechanism will fail.  $c$  reflects that the speed of gravitational propagation is the speed of light. According to formula  $F = c \cdot dm/dt$ , the gravitational force is determined by the change of mass  $4\pi a_0^2 \cdot 2\pi m_1 m_2/R^2$ , and formula  $4\pi a_0^2 \cdot 2\pi m_2/R^2$  constitutes the frequency of mass  $m_1$ , namely:

$$F_G = c \frac{dm}{dt} = c m_1 \cdot \frac{4\pi a_0^2 \cdot 2\pi m_2}{R^2} = c m_1 f = \frac{c m_1}{t}$$

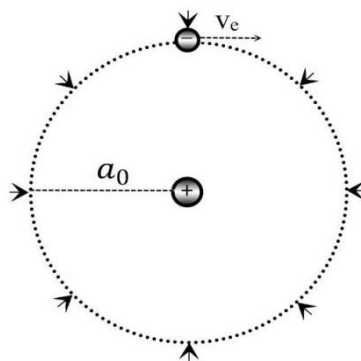


Fig. 1. The equilibrium between atomic structure and quantum vacuum.

Since the gravitational effect occurs between two bodies, the coupling relationship should be symmetric in form.  $4\pi m_1 a_0 \cdot 4\pi m_2 a_0/R^2$  reflects the symmetric coupling between particles. As shown in Fig. 2.

$$2F_G = 4\pi a_0^2 \cdot 4\pi c \frac{m_1 m_2}{R^2} = \frac{4\pi a_0 m_1 \cdot 4\pi a_0 m_2}{R^2} \cdot c$$

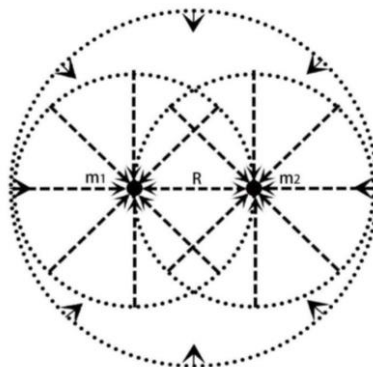


Fig. 2. Gravitational force between two particles.



In essence, gravitation is the trend effect of quantum field balance between particles. Particles and quantum vacuum are integrated, one is closed energy form, the other is open energy form. The centripetal constraint of the quantum vacuum environment on the particles forms a gravitational field with the Bohr radius as the mass torque. The internal and external balance of the particles is maintained through continuous exchange of energy to achieve particle stability. When there are two particles at the same time, the original equilibrium state of the single particle and the quantum vacuum is broken, so a new equilibrium must be obtained through coupling, thus, the coupling of the two gravitational fields produces a gravitational effect. Matter is not inherently cohesive. It is only under the interaction of internal and external environment that it has particle structure. For example, the corresponding orbital velocity at Bohr radius is  $v_e$ . It is this structural relationship of internal and external interaction that contains structural energy and force effects of various levels, such as nuclear energy and electromagnetic energy. Without the energy form of closed structure—particles, there is no gravity.

Therefore, the gravitational effect is not only the effect of the space-time structure of particles, but also the effect of the motion relationship of particles. The formula is as follows:

$$E_G = G \frac{m_1 m_2}{R} = k_B v_e^2 \cdot \frac{m_1 m_2}{R}$$

$$G = 4\pi a_0^2 \cdot 2\pi c = (v_e t_0)^2 \cdot 2c = v_e^2 \cdot 2c t_0^2 = v_e^2 \cdot 1.38506 \times 10^{-23} = k_B v_e^2$$

A large number of physical quantities are closely related, which proves the rationality of the correlation structure information of constant  $G$ . See Appendix A.

The above reveals the enormous impact of the mass torque of particles relative to quantum vacuum on gravity, which is greatly different from the previous consideration of gravity mechanisms mainly based on the density or geometric spatial distribution of mass. For example, the mass of an atom is mainly concentrated in the nucleus, and the radius of the nucleus is  $r \approx 10^{-15}$ . Compared to the Bohr radius, its perturbation to the quantum vacuum will be less than  $r^2/a_0^2 \approx (10^{-15})^2/(5.29 \times 10^{-11})^2 \approx 10^{-9}$  of the existing gravitational scale, that is,  $G = 4\pi r^2 \cdot 2\pi c = 4\pi(10^{-15})^2 \cdot 2\pi c \approx 10^{-20}$ . It can be seen that the contribution of the electromagnetic equilibrium radius of basic atoms to gravity is enormous. Without this curvature, it is not practical to only discuss the gravitational mechanism from the perspective of mass. Different particle structures obviously have different mass torques on quantum vacuum, and their effects are also very different. For example, although electrons and protons form atoms together, it is easy to know from the contribution of mass that protons are the main body of atoms. Electrons are only associated products to balance the charge of protons, and the electromagnetic balance radius is also an internal requirement of protons, which is why the gravitational constant contains the Bohr radius. Therefore, it is known that protons are the origin of universal gravitation rather than electrons, that is, universal gravitation is not related to electrons.

Thus, the relationship between the inertial mass and the gravitational mass is clear. Due to the fact that matter is the carrier of motion, in order to change its current state, external forces must be applied to it. Without external forces, it must maintain its current state. The so-called force is essentially a manifestation of energy exchange, and maintaining the current energy state is inertia. The carrier of energy is matter, and the magnitude of inertia is related to mass, which is inertia mass.

For particles, they are closed energy bodies that are relatively stationary due to the constraints of the quantum vacuum environment. The influence of particle mass on quantum vacuum is reflected through the exchange of energy. Therefore, the inertial mass of particles must become the foundation of gravitational mass, so gravitational mass must be equivalent to inertial mass. However, due to the correlation between



the existence of gravity and the structure of particles, different structures have varying forms of inertia mass disturbance to quantum vacuum, and the effects are also different. Therefore, not all of them are gravitational effects, but may be other forms of force effects. Therefore, inertial mass is a necessary and non necessary condition for gravity, especially when the particle structure is disintegrated, gravity will disappear with it. This is the connection and difference between inertial mass and gravitational mass.

#### 4.4. Verification of Relevant Experimental Data

$$\left. \begin{array}{l} G = 4\pi a_0^2 \cdot 2\pi c \\ c = 2.99792458 \times 10^8 \\ a_0 = 5.29177 \times 10^{-11} \\ \pi = 3.14159 \end{array} \right\} \Rightarrow G = 6.62846 \times 10^{-11}$$

Compared with the modern experimental data of gravitation constant, the ratio of the two is about 1.007. This is the value in the ideal state. The atomic space state in the real environment will have some deviation.

#### 4.5. Relevant Experimental Verification

Chinese scientific researchers Wuqing Liu, Jinsong Feng, Liangzao Fan, Huawang Li and others have respectively carried out relevant experiments and found that the temperature change of objects has an impact on gravity.

Liu [13] pointed out that in the electromagnetic shielding box, the weight of the two magnets in the repulsion state is smaller than the attraction state. The capacitor weighs less after charging than before charging. Feng [14] pointing out that the weight increases after ferro magnetization. Guan *et al.* [15] pointed out that the higher the temperature of the object, the smaller the absolute value of universal gravity. Feng and Fan [16] pointed out that after repeated experimental test results of the Chinese Institute of Metrology, the experiment reflected the physical changes of weight reduction and weight gain with temperature rise and temperature drop. Feng [17] proves for the first time the existence of gravitational waves: there is not only dynamic gravity between celestial bodies, but also dynamic universal repulsion.

Through continuous and dynamic modulation of the temperature of the water in the insulated bucket with a cover at a certain distance from the vacuum tank, the mutual repulsion (or attraction) between the large and small lead balls of the Cavendish torsion balance (gravity constant tester) in the vacuum tank and the phenomenon of the lead ball heating (or cooling) were observed in real time.

During the experiment, the ambient temperature in the vacuum tank has not changed all the time, which means that the heat has neither entered nor released from the vacuum tank. Moreover, there is neither magnetic force nor electric field force in the vacuum tank. Therefore, the experimenters believe that this phenomenon can only be related to gravity, and have analyzed the impact of energy on the atomic structure.

In fact, this experiment just reflects that gravity is closely related to atoms. When the atomic temperature changes, the whole atomic system will have structural changes accordingly. The change of the rate of the electrons outside the nucleus produces thermal radiation. When the heat is isolated, the direct influence of the electrons on the lead ball in the vacuum tank can be eliminated, and then the atomic nucleus is left. Thermal radiation is an electromagnetic wave that can be isolated, but gravity cannot be isolated, which just shows that gravity is the balance effect between atomic nucleus and quantum vacuum structure, and temperature changes cause nuclear motion changes to seek the structural balance again, resulting in attraction or repulsion effect.

It can be seen from various relevant data that these experiments have been repeated for many years, and the results of different people's experiments are the same, and the confidence is very high.

The common point of the above experiments is that under the condition of shielding electromagnetic

force and heat insulation treatment, the measured objects have gravity abnormalities. Whether it is temperature change, magnet interaction, charging, magnetization, it will affect the internal shape of the atom. For example, the increase in temperature is an entropy increase process, relative to the orderliness of the atomic structure, it is exactly an inverse process, so it will inevitably cause changes in the atomic structure and cause changes in the gravitational field.

#### **4.6. Confidence Analysis**

The dialectical philosophy of “everything interconnected, macro micro unified” mentioned above points out that gravity is closely related to atomic structure and quantum vacuum, and this idea is fully reflected in the new gravitational formula. The new gravity formula has a clear and profound structure and answers questions about gravitational propagation speed, over distance action, media, infinity, inertial mass, and gravitational mass, which just makes up for the shortcomings of Newton’s experimental physics formula. A large number of physical constant correlation and constant structure information data are highly consistent, all of which support the rationality of the gravitational constant structure (see Appendix A). In addition, experiments conducted by experimenters have revealed that gravity is closely related to atomic structure, all of which fully demonstrate the highly reliable results obtained above.

As for the application of Newton’s gravitational formula to calculate the slight deviation of physical phenomena such as Mercury perihelion precession, light deflection, radar echo delay, gravitational red-shift, etc., mainly because physical phenomena are complex and diverse, and must be adjusted according to the factors mastered in the actual measurement process. In fact, the gravitational constant in Newton’s gravitational formula is the result of actual measurement, and its formula reflects the information under that measurement. Applying the model directly to other different situations without correction is inherently problematic. Many scientific researchers have explained this from different angles. Zhu [18] found that there is a tangential vortex force in the rotational motion of objects in many years of experimental teaching, which explained the problem of Mercury precession. Tang [19, 20] considered the speed of light propagation and gravitational delay effect of gravity, and the calculation results were well consistent with the observation results.

In addition, a macro case is added here as a reference for the relationship between gravity and particle structure. It is well known that neutron stars are high-density celestial bodies between white dwarfs and black holes. Modern physical theory believes that the reason why neutron stars do not continue to collapse is because neutrons are fermions with strong compressive properties. According to the viewpoint of this article, the gravitational limit is closely related to the atomic structure (in which protons, including those in neutrons, play a leading role). The existence of gravity must be premised on the existence of the atomic structure, and gravity cannot exceed its own limit to break its own structure. Neutron stars happen to be at the limit of gravitational collapse. To break this limit, unless there are other forces acting.

#### **5. Conclusion and Significance**

In summary, the macroscopic gravitational phenomenon is not a natural property of matter, nor is it caused by the curvature of space-time, but a comprehensive effect determined by the mutual constraints of atomic structure, motion state and quantum vacuum environment. Gravity is closely related to the Bohr radius, which is the structural radius of elementary atoms in the ground state. The gravitational field derives from the mass torque of the atom to the quantum vacuum.

$$F_G = G \frac{m_1 m_2}{R^2} = e v_e 10^{-7} \cdot 2\pi c \frac{m_1 m_2}{R^2} = 8\pi^2 c a_0^2 \cdot \frac{m_1 m_2}{R^2} = k_B v_e^2 \cdot \frac{m_1 m_2}{R^2}$$

The gravitational radius must be based on the coexistence of particles. If it exceeds a certain boundary, gravity will fail.

Corollary 1: Since gravity is closely related to the atomic structure, there is no gravitational effect without the atomic structure, so not all mass particles have gravitational force, such as electrons only have electromagnetic effects rather than gravitational effects. Therefore, inertial mass and gravitational mass are both identical and different. Inertial mass is a necessary condition rather than a sufficient and necessary condition for gravitational mass. Particles that do not participate in gravitational effects do not have gravitational mass.

Corollary 2: The existence of gravity is conditional, it depends on the relationship between the particle structure and the quantum vacuum, and once the structure changes, then gravity must also change, as reflected in the experiment. Thus, anti-gravity is achievable.

It can be seen that all secrets are hidden in the relationship between the structure of particles and the quantum vacuum environment. Particles themselves contain enormous energy, and by mastering their structure and motion laws, they can drive the movement and changes of matter through regulation, changing traditional dynamic modes.

## 6. Prospect

Natural science is formed by the convergence of bits and pieces of discovery, and every leap forward in science and technology is linked to new scientific discoveries and new theories. This paper provides a new cognitive perspective for human beings to reveal the nature of gravity, which is conducive to correcting past cognitive biases, providing theoretical references for gravity-related research fields such as antigravity, and promoting the development of new science. With the rapid development of earth civilization, human beings have set their sights on the deep space of the universe. Whether the community with a shared future for mankind can achieve leapfrog development again in the 21st century depends on the insight and vision of the scientific community. It is believed that mankind will usher in a newer, brighter tomorrow.

## Appendix A. Physical Quantity Correlation and Dimension

The physical system is composed of seven basic physical quantities (mass, time, length, electric current  $I$ , Temperature, amount of substance  $n$ , luminous intensity  $i$ ). The core physical quantities are mass, time and space, and other physical quantities are developed around these three physical quantities. All physical quantities in a physical system are composed of quantities and units. The unit represents the attribute of things, and the quantity reflects the change. Physical research is actually a quantitative relationship between matter, space and time.

Physical constants are basic values that describe the behavior of matter and energy. The relationship between physical constants is a complex and important research field in physics. Understanding these relationships enables us to predict the behavior of physical systems and understand the underlying structure of physics more deeply.

However, due to the lack of horizontal connection between various disciplines in the development process, the dimensions between physical quantities cannot be established corresponding to each other, and the essential properties of physical quantities cannot be clarified. Such as what is the charge? What is quality? What is the nature of temperature? To solve these problems, an effective way is to establish the equivalent relationship of various experimental formulas, and find the correlation of each physical quantity in the formula through the correspondence law. From the series of results obtained, we can see that they are highly reliable. Examples are as follows:

Energy equivalence relationship of electromagnetism, thermodynamics and quantum:

$$hf_0 = \frac{ke^2}{a_0} = \frac{e^2c^210'^{-7}}{a_0} = m_e v_e^2 = 3k_B T_0$$

$$h = ec \cdot \frac{ec10'^{-7}}{a_0 f_0} = ec \cdot 1.38 \times 10^{-23} = eck_B$$

$$hf = eck_B f = 3k_B T$$

According to the corresponding relationship:

$$\begin{cases} h = eck_B \\ T = ecf/3 \end{cases}$$

This result is consistent with the correlation between Planck constant and charge, speed of light, and Boltzmann constant in black body radiation theory. Wherein, equation  $T = ecf/3$  reveals that the essence of temperature is the change of electric charge. As a physical quantity to describe the energy, temperature actually corresponds to the space-time relationship of moving matter.

$$\frac{ke^2}{a_0} = m_e v_e^2 \Rightarrow \frac{ev_e 10'^{-7}}{4\pi a_0^2} = \frac{m_e v_e^2 f_0}{2ec^2} \approx 1 \text{ kg s}^{-1} \text{C}^{-1}$$

$$\begin{cases} ec^2 = \frac{1}{2} m_e v_e^2 f_0 = \frac{1}{2} m_e v_e^2 / t_0 \\ e = \frac{1}{2} m_e f_0 v_e^2 / c^2 \end{cases}$$

This result reveals that the essence of charge is the movement and change of electromagnetic mass.

Similarly, the corresponding physical quantity correlation can also be obtained through the energy equivalence of universal gravitation and electromagnetic force. See the text for the specific derivation process.

$$\frac{kq^2}{r} = G \frac{m_1 m_2}{r}$$

$$G = ev_e 10'^{-7} \cdot 2\pi c = 8\pi^2 c \alpha_0^2 = k_B v_e^2$$

From the information structure of gravitational constant  $G$ , we can further obtain the space-time structure of Boltzmann constant and the relationship between Planck constant and Boltzmann constant:

$$k_B = 2ct_0^2 = 2\lambda_0/f_0$$

$$h = eck_B$$

Then reveal the space-time structure of magnetic flux quantum:

$$\Phi_0 = h/2e = (ct_0)^2 = \lambda_0^2 = 2.07 \times 10^{-15}$$

where,  $t_0 = 1/f_0$  is the period of motion of hydrogen atom electrons around the nucleus, and  $f_0$  is the corresponding frequency.

From equation  $h = eck_B$ , we can also find that the coefficient of equation  $h = eK$  in photoelectric effect

is  $K = ck_B$ ; The coefficient of Wien's formula  $M = af^3 \exp^{-\beta f/T}$  in black body radiation is  $\beta = ec$ , Wien's formula is  $M = af^3 \exp^{-ecfk_B/k_B T}$ ,  $ecf$  is temperature  $T$ , and  $\exp^{ecfk_B/k_B T}$  is  $\exp^{hf/k_B T}$  in Planck black body formula  $M = \frac{2\pi h}{c^2} f^3 (\exp^{hf/k_B T} - 1)^{-1}$ .

In addition, by comparing the relationship between temperature and frequency in the equivalent formula of electromagnetic energy, it can be seen that the proportional coefficient of temperature and frequency  $Cv$  in Wien displacement law is essentially  $f/T = 1/qc$ .

$$Cv = f/T = 5.88 \times 10^{10}$$

$$T = ecf/3 \Leftrightarrow C'_v = f/T = 3/ec = 6.24 \times 10^{10}$$

Formula  $C'_v = f/T = 3/ec = 6.24 \times 10^{10}$  reflects the corresponding relationship between the full frequency and temperature, while coefficient  $Cv$  reflects the corresponding relationship between the maximum frequency of spectral radiation and temperature. Obviously,  $Cv$  is slightly smaller, accounting for about 94%.

These physical quantities describe the spatiotemporal distribution and energy exchange of material movement and are related to each other, which shows that the theories of various related disciplines are closely related. See Table A1 for more associations, it shows the relationship between physical quantities, and all dimensions correspond to each other. For example:

$$\text{Dim } e = \text{SI}(m_e v_e^2 f_0 / 2c^2) = \text{kg} \cdot \text{s}^{-1} = \text{C}$$

$$\text{Dim } e = \text{SI}(2 \times 10^{17} a_0 t_0) = \text{kgm}^{-1} \text{s}^{-2} \cdot \text{m} \cdot \text{s} = \text{kg} \cdot \text{s}^{-1} = \text{C}$$

$$\text{Dim } 10^{17} = \text{SI}(1/10^{-7}) = \text{C}^2 \text{kg}^{-1} \text{m}^{-1} = \text{kg m}^{-1} \text{s}^{-2}$$

$$\text{Dim } h = \text{SI}(4 \times 10^{17} a_0 t_0 \lambda_0^2) = \text{C}^2 \text{kg}^{-1} \text{m}^{-1} \cdot \text{m} \cdot \text{s} \cdot \text{m}^2 = \text{kgm}^2 \text{s}^{-1}$$

Table A1. Correlation between Physical Quantities

Constant Category	Physical Constant Correlation
Planck constant $h$	$h = eK = eck_B = ec \cdot 2c/f_0^2 = 2e\lambda_0^2 = 2e\Phi_0 = e/2R^2$
	$h = e^2 c^2 10^{-7} 2\pi/v_e = ke^2 2\pi/v_e$
	$h = m_0 c^2 = 4 \times 10^{17} a_0 t_0^3 c^2 = 4 \times 10^{17} a_0 t_0 \lambda_0^2$
Gravitational constant $G$	$G = ev_e 10^{-7} 2\pi c = 8\pi^2 a_0^2 c = k_B v_e^2 = hv_e^2/ec$
Boltzmann constant $k_B$	$k_B = h/ec = 2c/f_0^2 = 2\lambda_0 t_0 = 2\Phi_0/c = ec 10^{-7} 2\pi/v_e$
Electrostatic constant $k$ , Dielectric constant $\epsilon_0$ , magnetic permeability $\mu_0$	$k = 1/4\pi\epsilon_0 = c^2 10^{-7} = 10^{-7}/\epsilon_0 \mu_0$
	$\mu_0 = 4\pi 10^{-7}$
elementary charge $e$	$e = hf_0^2/2c^2 = m_e v_e^2 f_0/2c^2 = m_0 f_0^2/2 = m_p^2 v_e^2/c^2$
	$e = h/K = h/ck_B = h/2\Phi_0 = 2hR^2 = 2 \times 10^{17} a_0 t_0$
electron mass $m_e$	$m_e = 2ec^2/v_e^2 f_0 = h/v_e 2\pi a_0 = m_0 f_e = 4 \times 10^{17} a_0 t_0^3 f_e$
Bohr electron velocity $v_e$	$v_e = 2\pi a_0 f_0$
Bohr radius $a_0$ , period $t_0$ , frequency $f_0$ , wavelength $\lambda_0$	$a_0 = v_e/2\pi f_0 = v_e t_0/2\pi$
	$\lambda_0 = c/f_0 = ct_0$
fine structure constant $\alpha$	$\alpha = 2\pi a_0/\lambda_0 = v_e/c$
Magnetic flux quantum $\Phi_0$	$\Phi_0 = h/2e = ck_B/2 = \lambda_0^2$

Rydberg constant $R$	$R = m_e v_e^2 / 2hc = hf_0 / 2hc = \mathbf{1/2\lambda_0}$
cut-off frequency and voltage coefficient $K(U = Kf, h = eK)$	$K = U/f = h/e = ck_B = \mathbf{2\lambda_0^2} = 2\Phi_0$
Klitzing constant $R_H$	$R_H = h/e^2 = 2\lambda_0^2/e = 2\Phi_0/e = \mathbf{\lambda_0^2/10'^7 a_0 t_0}$
Planck mass $m_P$	$m_P^2 = hc/G = m_e f_0/2 = ec^2/v_e^2 = e/\alpha^2$ $= \mathbf{2 \times 10'^7 a_0 t_0/\alpha^2}$
Basic quantum mass $m_0 s^{-1}$	$m_0 = h/c^2 = ek_B/c = 2e/f_0^2 = \mathbf{4 \times 10'^7 a_0 t_0^3}$
Electron mass and energy frequency $f_e$	$f_e = m_e/m_0 = m_e c^2/h$
Remarks column	1.The boldface represents the space-time structure of physical quantities.
	2. $\mathbf{SI(10'^{-7}) = kg m C^{-2}, SI(e) = kg s^{-1}}$

## Appendix B. Coordination of Physical Units

### 1. About the Connotation of Quality

Matter is the carrier of motion, and mass refers to the quantity of matter. Because the specific form of microscopic matter cannot be observed directly, it can only be measured indirectly by certain means. Therefore, the mass is closely related to the measurement. Only from the perspective of measurement can the mass be described. In physics, the mass is mainly described through specific physical relations, such as force, momentum, and energy. They are all descriptions of the relationship between the motion and change of matter, that is, the spatiotemporal change of matter.

Due to the historical limitations of the development of science, the description of physical quantities is limited by the level of measurement at that time. In the pre atomic era, mass was mainly described at the macroscopic weight level; In the atomic era, the description of mass has entered the atomic level, and today, the description of mass has entered the quantum era. Quantum theory describes the energy relationship of mass as follows:

$$mc^2 = hf$$

Basic Planck energy is:

$$h = mc^2/f = m_0 c^2 = 6.62607 \times 10^{-34} \mathbf{kg m^2 s^{-1}}$$

Basic quantum mass  $m_0 s^{-1}$ :

$$m_0 = h/c^2 = h/c^2 = 7.377 \times 10^{-51} \mathbf{kg s}$$

Mass frequency corresponding to 1 kg:

$$1 \mathbf{kg} = m_0(f_1 + f_2 + f_3 + \dots + f_n) = 1/m_0 \mathbf{kg} = 1.3556 \times 10^{50} m_0 s^{-1}$$

The relationship between the basic quantum mass and the frequency of 1 kg mass:

$$m_0 s^{-1} = 1/f \mathbf{kgs^{-1}} = T \mathbf{kg s^{-1}} = |\mathbf{T}| \mathbf{kg}$$

Among them,  $f_1 + f_2 + f_3 + \dots + f_n$  represents 1 kilogram of material composed of all different

frequencies of energy.

## 2. Coordination of Physical Units

There is a problem in the text. According to the correspondence, the corresponding unit of formula  $ec^2 = m_p^2 v_e^2$  is  $C = \text{kg}^2$ , while the corresponding unit of formula  $ec^2 = m_e v_e^2 f/2$  is  $C = \text{kg s}^{-1}$ . The two are not consistent. What is the reason? How to coordinate? To solve this problem, we must understand the particularity of dimensions in the physical system.

As we all know, the square of length is the area. But mass is different from length, and the square of mass cannot change the property of mass. In physics, the unit of force only includes the mass unit  $\text{kg}$ , not  $\text{kg}^2$ . Therefore, in the gravitation formula, one mass unit is offset by the unit of coefficient  $\text{SI}(G) = \text{kg}^{-1} \text{m}^3 \text{s}^{-2}$ , so that  $\text{SI}(m_1 m_2) = \text{kg}^2$  becomes  $\text{kg}$ . So,  $m_1 m_2 = n \text{ kg}$ .

In physics, physical quantity is composed of quantity and unit. The unit represents the nature of things, and quantity reflects changes. While force is the temporal derivative of momentum  $F = d(mv)/dt$ , the force exerted on one mass in the gravitation cannot be separated from another mass, where one mass is the frequency  $N$  of the other mass, that is  $m_1 m_2 = m_1 \cdot |m_2|$ . Since gravitation exchanges energy at the speed of light through vacuum quantum, gravitation is actually determined by the changing mass, that is  $F = c \cdot dm/dt$  (the Gravitational formula confirm this view), and because the energy is quantized, it can be seen that the mass is also quantized, and the corresponding Number of changes can be equivalent to the frequency. For example, the electronic mass-energy is expressed as  $m_e c^2 = hf_e = m_0 c^2 f_e$ , Therefore, the actual form of mass in gravitation formula is:

$$\begin{cases} m_1 m_2 = m_1 \cdot f \\ \text{SI}(m_1 m_2) = \text{SI}(m_1 \cdot f) = \text{kg s}^{-1} = C \end{cases}$$

In this way, the problem of incongruity between the dimensional transformation of charge and mass between gravity and electromagnetic force is solved.

$$\begin{cases} ec^2 = m_p^2 v_e^2 = f_p \cdot m_p v_e^2 \\ \text{SI}(e) = \text{SI}(m_p^2) = \text{SI}(f_p \cdot m_p) = \text{kg s}^{-1} = \text{kg}^2 \end{cases}$$

## Conflict of Interest

The author declares no conflict of interest.

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