A Novel and Straightforward Approach to Fundamental Scientific Problems

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Abstract

This paper introduces a new approach to solving fundamental scientific problems, such as the origin of gravitation, the nature of Newton's gravitational force, and what the universe is made of, along with unexpected findings. The core idea of this study is that every mathematical formula in physics must correspond to a physical process or existence. Since Newton's formula for gravity has been repeatedly validated and proven useful, it is employed in this study. Through a detailed analysis of Newton's formula, I uncovered many astonishing findings and resolved several long-standing fundamental scientific problems. These findings are significant for a better understanding of the universe. Furthermore, it has been demonstrated that this new approach is both useful and effective.

Many fundamental scientific problems have remained unsolved for hundreds or even thousands of years. For example: What is the universe made of? What are the natures of matter and space? What are the origin and nature of the gravitational force described by Newton's gravity formula? Why is a free-falling elevator, in accelerated motion, considered an inertial reference frame? Where did the first driving force of the universe come from? We cannot fully understand the universe clearly and accurately until these fundamental problems are resolved.

Newton discovered that natural phenomena, such as apples falling to the ground, the parabolic motion of cannonballs, and the moon hanging in the sky, all follow the same natural law. He summarized this as the law of universal gravitation and proposed that there is a force of mutual attraction between any two objects in the universe, which he called "universal gravitation." Its calculation formula is $F = GMm/r^2$ [*1*]. However, he was never able to determine the origin of this force. Additionally, he could not address other fundamental questions, such as why this force acts at a distance and what its nature is.

Although Einstein's general theory of relativity appears to solve some of these problems on the surface, it actually sidesteps them. In Einstein's theory, Newton's gravitational force cannot be calculated. However, the existence of this force is beyond doubt. It can not only be calculated but also measured with instruments. Furthermore, human practical activities demonstrate that this force exists everywhere. Yet, to this day, we still do not know how this force originates, what its nature is, or why it acts at a distance.

This indicates that resolving these questions is of great theoretical significance for understanding gravity and the universe.

Since these problems have remained unsolved for a long time, it is essential to explore different approaches and ideas. This study is one such attempt.

It is important to clarify that the gravitational force referred to in this paper specifically pertains to the force F calculated using Newton's gravity formula. It does not necessarily correspond to the mutual attractive force described in Newton's Law of Gravity.

Idea

I believe that all mathematical formulas in physics must correspond to specific physical processes and existences. Therefore, if we can identify all the physical processes and existences related to Newton's gravitational formula, we will uncover the origin of gravity. Once the origin of gravity is understood, we can address questions about its nature or essence and why it acts at a distance.

Method and procedure

Since it is impossible to directly observe the physical processes and all phenomena described by Newton's gravitational formula $F=GMm/r^2$, it is necessary to decompose it into two distinct formulas:

$$F=GMm/r^2 \longrightarrow \quad F=mg \ (1) \text{ and } g=GM/r^2 \ (2)$$

From these two formulas, it can be seen that the first one represents the generation of force F, and the second one represents the generation of free-fall acceleration g.

Clearly, in the physical process that generates force F, free-fall acceleration g is indispensable. However, in the process of generating free-fall acceleration g, force F is not required.

This indicates that the origin of free-fall acceleration g does not depend on force F, whereas the origin of force F is inseparable from free-fall acceleration g. In terms of sequence, free-fall acceleration g is generated first, followed by force F. From a causal perspective, free-fall acceleration g is the cause that generates force F, meaning that force F is a result of free-fall acceleration g. This interpretation is the opposite of the causality in Newton's law of gravity, where force F causes acceleration g directly.

Thus, the origin of force F becomes clear: it arises from free-fall acceleration g.

In other words, identifying the origin of free-fall acceleration g is the key to solving the problem of universal gravitation. To find this origin, we can further analyze the equation $g=GM/r^2$. The detailed procedure is illustrated in Figure 1.

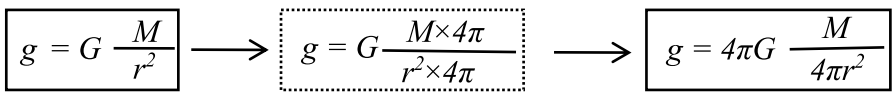

Figure 1. The transformation of equation $g=GM/r^2$ by multiplying both the numerator and denominator on the right side of the equation by 4π. Here $4\pi r^2$ represents the surface area of a sphere is the spherical area.

Since G is a constant, multiplying by 4π does not change its nature, and we can define a new constant $G_m=4\pi G$. This gives us the following expression:

$$g=G_mM/4\pi r^2$$

The physical meaning represented by this formula is quite clear. Here:

- g is the acceleration due to free fall,
- G_m is a new physical constant,
- M is the mass of the object, and
- $4\pi r^2$ represents the surface area of a sphere.

If we consider the sphere as a spherical physical field, then $M/4\pi r^2$ represents the field strength within this spherical field. This relationship can be illustrated graphically, as shown in Figure 2.

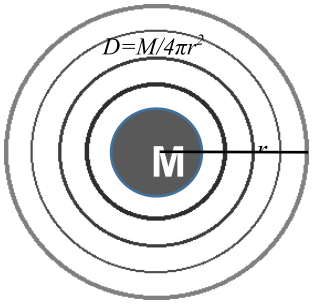

Figure 2. Schematic diagram illustrating the relationship between the spherical property field and the object, as derived from the results. The solid sphere at the center represents an object with mass M, while the surrounding rings depict the property field around the object. The variable r represents the radius of the property field. Matter is the inseparable unity of solid and field.

This analysis shows that for an object with mass M, there exists a spherical physical field surrounding it. The strength distribution of this field follows the relationship $M/4\pi r^2$. If we use the letter D to represent the field strength, then:

$$D=M/4\pi r^2$$

Thus, the formula for free-fall acceleration g becomes:

$$g=G_mD$$

From this result, we can draw the following conclusion: Matter consists of both a massive solid and a massless spherical field surrounding it. Both the solid and the field are fundamental natural properties of matter. In other words, matter is an inseparable unity of the solid mass and its surrounding field. For this reason, we can refer to this spherical field as the "property field of matter," or simply "the property field."

From the equation $g=G_mD$, we can see that the magnitude of the free-fall acceleration g is entirely determined by the strength of the property field, D. This indicates that the origin of free-fall acceleration g is rooted in the property field of matter. Therefore, the origin of free-fall acceleration has been fully explained.

Discussion and conclusions

1. Since the origin of free-fall acceleration g comes from the property field, which is a fundamental natural property of matter itself and not due to any external force, this implies that free fall is a force-free motion. This conclusion aligns with the description provided by Einstein's elevator thought experiment, though Einstein did not know the underlying reason. Now we understand that free-fall acceleration originates from the property field of matter.

Because free-fall acceleration originates from the property field, all objects within the same property field experience identical acceleration during free fall. This discovery reveals the key concept that Einstein was searching for: free-fall acceleration is a natural outcome of the property field surrounding matter. Therefore, the conclusion is clear—free fall is truly a force-free motion.

2. From the causal relationship between force F and acceleration g, we can deduce that Newton's gravitational force F is actually generated when an external force offsets the free-fall acceleration g. In other words, an object in free fall is not subject to any force. However, if another object obstructs the free fall of the first object, an interaction force arises between the two objects. The magnitude of the force that offsets the free-fall acceleration g corresponds to the force calculated by Newton's gravitational formula.

   Given this understanding, Newton's gravitational force should be viewed as a reaction force, while the external force that counters the free-fall acceleration g is the action force. In this way, the nature of Newton's gravity is explained—it is a reaction force. Because it is a reaction force, its action is instantaneous, and there is no "action at a distance" as traditionally thought. This also explains why gravity cannot be shielded.

   Thus, all problems related to gravitation are resolved. The conclusions are as follows: The origin of Newton's gravitational force lies in free-fall acceleration, and its nature is that of a reaction force. These insights challenge and transform our understanding of Newton's law of gravity.
3. Since free fall is a force-free motion and we now understand that acceleration g causes force F, the question of the universe's first driving force is naturally resolved. In the universe, free-fall motion occurs before any force arises. Therefore, the conclusion is that the first force in the universe originates from free fall.
4. The relationship between mathematical formulas, physical processes, and physical existence is crucial for solving problems in physics. Relying solely on mathematical calculations without considering the underlying physical processes and realities makes it difficult to resolve physical problems. Moreover, when mathematics is used without regard for physical processes, incorrect causal relationships may emerge from the calculations.

   Newton's unsolvable dilemma regarding gravitation arose because he reversed the causal relationship between acceleration g and force F, relying solely on mathematical calculations. Once the causality is clarified through an understanding of physical processes and existence, the problems can be resolved immediately. The conclusion is that physical problems must be solved through physical methods, not just mathematical ones.
5. It is clear that the key to understanding gravity is not the force F, but the free-fall acceleration g. Once the origin of free-fall acceleration g is clarified, all problems related to gravitation can be easily resolved. The conclusion is that the origin of acceleration g is the critical factor in solving the problem of gravitation, rather than the force.
6. Newton, in his time, viewed gravity as a mechanical phenomenon. In reality, gravity is a property of matter, not a mechanical phenomenon, because the free-fall acceleration g originates from the property field of matter. Gravity is a physical phenomenon resulting from the fundamental natural properties of matter, not from the application of force.

Therefore, the conclusion is that Newton's Laws of Motion are not suitable for addressing problems related to gravitation.

7. Because the free-fall acceleration g originates from the property field of matter, it indicates that the dark matter phenomena should be caused by the massless property field of matter rather than by the massive particles of matter.
8. From the formula $g=G_mD$, we can see that the ratio between free-fall acceleration g and property field strength D is a constant:

$$G_m=g/D$$

This means that, at any point within a property field, the ratio of free-fall acceleration g to field strength D remains the same. This is an important discovery. Since this constant reflects the unified relationship between the material solid and the property field, I call it the "unification constant." This is a new fundamental physical constant. Given its clear physical meaning, it is fully qualified to replace Newton's gravitational constant, whose physical meaning remains unclear. The conclusion is that Newton's Law of Gravity is theoretically incorrect.

9. From the results of this study, we can conclude that matter consists not only of solid components but also of field components. Matter is, in fact, an inseparable unity of solid and field. This challenges the traditional view that matter must have mass. Although the property field has no mass, it remains an indispensable component of matter. The conclusion is that the massive solid and the massless field together constitute the entirety of matter. Matter is the inseparable unity of both solid and field.
10. With this understanding of the nature of matter, the question of "what is the universe made of" becomes self-evident. The abstract representation of the universe can be illustrated as shown in Figure 3.

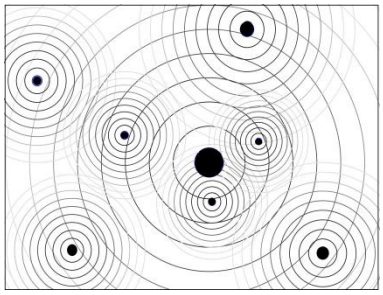

Figure 3. Schematic diagram of the material universe. The solid black dots represent celestial bodies, while the surrounding rings illustrate the property fields associated with them. The diagram emphasizes that the entire universe is composed solely of matter, with no other components.

The entire universe is composed solely of matter. Celestial bodies consist of the massive solid component of matter, while the universal space is made up of the massless property field of matter. There is no such thing as absolute space or absolute vacuum in the universe. The conclusions are as follows: The universe is entirely made of matter, and all physical phenomena—such as gravitation and energy—originate from the two fundamental properties of matter: the massive solid and the massless property field.

11. There is no equivalence between g (free-fall acceleration) and a (acceleration due to force). Acceleration a is generated when an object is subjected to a force, whereas g is provided by the property field of the external environment acting on a falling object. In terms of physical processes, a and g are opposites. When an external force causes an object to change speed, acceleration a is generated. Conversely, when an object experiencing free-fall acceleration g is subjected to an external force that offsets its g, interaction occurs.

    If the magnitudes of a and g are equal for the same object, then the force generating a and the force offsetting g are exactly the same in magnitude. However, the forces involved are different in nature: the force in F=ma is an action force, while the force in F=mg is a reaction force. These physical processes are entirely distinct.

    Therefore, there is no attractive force involved in so-called gravitational phenomena. The conclusion is that accelerations g and a are fundamentally different in nature, and gravitation cannot be explained by acceleration a.
12. The r in the equation $F=GMm/r^2$ should not be interpreted as the distance between two objects. Instead, it originates from $4\pi r^2$ and represents the radius of the spherical property field surrounding an object. Using r as a distance can be misleading. The inverse square law actually reflects the inverse relationship between the surface area of a sphere and the physical strength within that spherical field. Therefore, the conclusion is that r in Newton's gravitational formula should not be treated as a distance in physical theory.
13. In Newtonian mechanics, force is regarded as the sole cause of changes in the speed and direction of a body. However, this study demonstrates that the speed of a freely falling body can change without any applied force. This indicates that force is not the only cause of acceleration. Changing the speed and direction of an object is distinct from changing its state of motion. The default state of motion for an object in free fall is accelerated motion. Preventing a falling object from accelerating constitutes a change in its state of motion. Although accelerated motion involves a change in speed, it does not equate to a change in state of motion. It is accurate to say that force is responsible for changing the state of motion, but this is not the same as changing speed and direction. Thus, the conclusion is that the concept of force should be redefined: force is not the only cause of changes in speed and direction.
14. These remarkable findings validate the methods and ideas utilized in this study, proving them to be correct and effective. This research sets a strong precedent for addressing more fundamental theoretical problems in physics. The conclusion is that all basic physical theories should be reevaluated through this new approach and perspective.

References

1. Any physics textbook that covers Newton's Law of Gravity.

Acknowledgments

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