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Review Article

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On the Essence of Gravity

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Abstract

Heavy water has a different boiling point than water, but gravity cannot separate heavy water from water in the ocean, indicating that neutrons have inertial mass but no gravitational mass. The working principle of the cyclotron shows that the particles accelerated by the cyclotron are either not affected by the Earth's gravity or are less affected by the Earth's gravity. By comparing the common characteristics of particles that are not affected by gravitation with those of particles that are affected by gravitation, it is found that the gravitational field of an object is composed of the magnetic moments of the orbiting electrons of a large number of atoms or ions. The essence of gravitational field is magnetic field; the essence of gravity is magnetic force.

Keywords: Gravitational Field, Gravity, Newtonian Gravity, Modified Gravity, MOND

Introduction

Analysis of the Essence of Gravity

Until now gravity has been thought to exist between any two particles of matter in the universe. But this axiom is actually just an unproven hypothesis. Let's look at which particles of matter are affected by gravity, and which particles of matter might not be affected by gravity. The nature of gravity can be analyzed by summarizing the characteristics common to particles that are subject to gravity and those that may not be subject to gravity.

Particles or Matter Affected by Universal Gravitation

- Single free atoms [1,2]
- Gas molecules：The existence of the atmosphere shows that free atoms and molecules are bound by the earth's gravity, or that gravity exists on free atoms and molecules.
- All matter made up of atoms and molecules：All matter on Earth made up of atoms and molecules has weight, and so is subject to gravity.
- Plasma：The sun can produce a gravitational field, which means that objects made of plasma can produce a gravitational field. Plasma is an ionized gas com-posed of atoms stripped of some electrons and positive and negative ions pro-duced by the ionization of atomic groups. The common feature of these ions is that they have orbital electrons orbiting the nucleus.

Particles or matter that may not be affected by universal gravitation

- Neutrons are not subject to gravity

Water made of heavy hydrogen (deuterium) is called heavy water, or D_2O, and its density is about 1.11 times that of ordinary water. If heavy water is indeed heavier than ordinary water, the heavier water, according to the principle of gravity differentiation (the closer the interior of the earth is to the center of the earth, the greater the density of matter) should be distributed on the seafloor, so there should be a layer of heavy water on the seafloor. Obviously, there is no such layer of heavy water on the seafloor. Otherwise, the heavy water could be extracted directly from the seafloor without the costly separations. The absence of a heavy water layer on the seafloor suggests that gravity cannot separate heavy water from water. From the difference of inertia mass between heavy water molecules and water molecules leading to the difference of boiling points between heavy water and water, it can be seen that heavy water and water can be separated by centrifugal method. From the above analysis we can see that for heavy water, gravity and inertial forces are not equivalent. So , the inertial mass is not the same as the gravitational mass for heavy water. Since the heavy water molecule has two more neutrons than ordinary water, it can be concluded from all the above analysis that neutrons have inertial mass but no gravitational mass, and neutrons are not subject to gravitation.

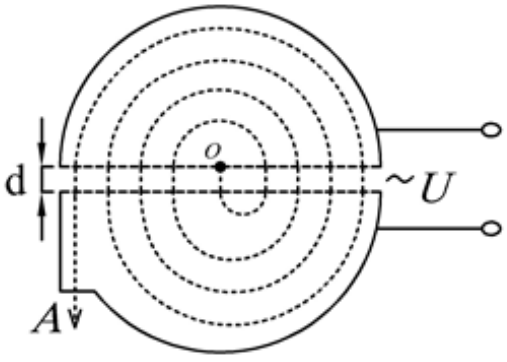

Figure 1: the schematic diagram of the cyclotron

● Particles that can be accelerated by a cyclotron have the potential to be free from gravity.

As we know, cyclotron is an experimental device that uses magnetic field to turn and uses electrostatic field to accelerate charged particles in horizontal plane, as shown in Figure 1. Galileo had shown that when a small mass and a large mass fall together from the same height, both will hit the ground at the same time. Thus, the acceleration of an electron or proton in free fall in a vacuum device on Earth is also g ($9.8m/s^2$). Since particles accelerate and move in the cyclotron with no vertical force other than their own gravity, and a free-fall body falls 4.9 centimeters in 0.1 second, it does not take 0.1 second for the particles to hit the ground, which means the cyclotron should not work. The ability of the cyclotron to work properly for a long period of time means that the particles being accelerated are unaffected or very little affected by the Earth's gravity. Particles that can be accelerated in a cyclotron for long periods of time include electrons, positrons, protons, alpha particles (helium nuclei), and various heavy ions (nuclei). The common feature of such particles is that there are no orbital electrons rotating around the nucleus. In fact, up to now, we have not searched for any articles on single electron, single proton, single neutron, single alpha particle, or single heavy ion (nuclei) free-fall measurement experiments, but there is no lack of single atom free-fall measurement experiments [1,2]

By summarizing the above experimental facts and natural phenomena, we can see that gravitational field is created by a mass of particles (atoms or ions) with orbiting electrons orbiting around a nucleus. Only particles (atoms or ions) with orbital electrons rotating around the nucleus, and objects made up of a large number of such particles, are subject to the gravitational field. Or gravity exists only between objects made of atoms or ions, or between objects made of atoms or ions and atoms or ions.
Since the orbital electrons rotating around the nucleus produce a magnetic field, we can infer that the gravitational field is composed of a large number of magnetic moments produced by the orbital electrons, and its essence is a magnetic field.
Since the orientation of the magnetic moments of the orbital electrons is isotropic, the magnetic fields of these magnetic moments cancel each other out to a large extent, so the gravitational field is very weak with respect to the electrostatic field or magnetic field.

Discussions

Relationship between Gravitational Mass and Inertial Mass

According to the above discussion, the gravitational mass of an object is proportional to the number of orbital electrons contained in the object. Because the number of orbital electrons in the object is proportional to the number of protons and neutrons in the object, and the inertial mass of the object is also proportional to the number of protons and neutrons in the object. Therefore, in general the gravitational mass of an object made of atoms or ions is proportional to its inertial mass. That is why the equivalence principle works. However, the ratio of gravitational mass to inertial mass is different for different materials.

Why do Objects always Attract rather than Repel Each Other?

We know that magnetism has both attractive and repulsive forces, and if the nature of gravitation is magnetism why is there only attraction between two objects and no repulsive force? In order to answer this question, the author has done experiments simulating the causes of gravitation using Bucky balls (a kind of magnetic ball). If we compare Bucky balls to atoms, the magnetic moments of Bucky balls are equivalent to those of atoms, and the binding force between Bucky balls is equivalent to the chemical bonds between atoms or molecules of matter.

In the experiment, 216 Bucky balls with a diameter of 5mm were used. During the experiment, it is found that the Bucky ball is always attracted to each other, and the action of the repulsive force always leads to a small rotation of the Bucky ball, and then immediately it is changed to mutual attraction. A large number of Bucky balls are always attracted to each other and unite into a cluster rather than repel each other and disperse. Clusters combined with large numbers of Bucky balls can be compared to macroscopic objects composed of large numbers of atomic molecules. One of the contents of this experiment is to test whether two groups composed of large numbers of Bucky balls are always attracted to each other, and thus to verify the conclusion that "gravity is the interaction between objects composed of large numbers of atoms or ions". Another content of the experiment is to test whether a single Bucky ball and such a mass of Bucky balls are also always attracted to each other, thus verifying the conclusion that "gravity also exists between an atom or ion and an object made up of a large number of atoms or ions".

The following is a description of the experiments:

When two Bucky balls are brought close together, they are always attracted to each other, and the attraction is very strong. The effect of the repulsive force is only to cause a small rotation of the Bucky balls, and then the Bucky balls immediately become attracted to each other and unite. The 216 Bucky balls were then divided into two groups of about 108. Each group of Bucky balls is combined into a nearly spherical mass. Let two clumps of Bucky balls get close to each other and find that they are always attracted to each other. Although in some directions there is a weak repulsive force, the repulsive force only causes the clumps of Bucky balls to make a small rotation that turns the clumps in the direction of attraction. The attraction between two clumps of Bucky balls is very weak compared to the attraction between two Bucky balls.

Then, let a Bucky ball and a clump of Bucky balls get close to each other and find that they are always attracted to each other. Although in some directions there is a weak repulsive force, the repulsive force only causes the Bucky ball to make a small rotation to the position where it is attracted to the clump of Bucky balls.

Here are the interpretations of these experiments:

• Although all Bucky balls have a magnetic South Pole and a magnetic North Pole, identical poles repel each other, and different poles attract each other, the repulsive force becomes smaller and smaller as the distance between the two Bucky balls becomes larger and larger in the process of repulsion. In the pro-

cess of mutual attraction, the distance between the two Bucky balls becomes smaller and smaller, which leads to the attraction becoming larger and larger. Therefore, the process of mutual repulsion of Bucky balls is unstable. As long as there is a slight rotation, Bucky balls will immediately become attracted to each other. So Bucky balls are always attracted to each other. The interaction between Bucky balls is similar to the interaction between atoms, which always attract each other at great distances (through the interaction of atomic magnetic moments).

• A large number of Bucky balls that are close to each other tend to attract each other and stick together, rather than repel each other and move away. This phenomenon is similar to the way that large numbers of atoms can always combine into macroscopic objects when they come close to each other. Because the strength of Bucky ball's magnetism determines the strength of the clump of Bucky balls, it can be inferred that the strength of atomic magnetic moment is the key factor to determine the strength of materials.

• Although there are both attraction and repulsion, between two clumps composed of Buckyballs, the, repulsive force becomes smaller and smaller as the distance between the two clumps becomes larger and larger in the process of repulsion. In the process of mutual attraction, the distance between the two clumps becomes smaller and smaller, which leads to the attraction becoming larger and larger. Therefore, the process of mutual repulsion of the clumps is unstable. As long as there is a slight rotation, the clumps will immediately become attracted to each other , so the clumps composed of Bucky balls are always attracted to each other.

• The attraction between two clumps of Bucky balls is much weaker than the attraction between two Bucky balls, which is consistent with the fact that gravitation is much weaker than magnetism. Because after a large number of Bucky balls are combined into a clump, the magnetic field of the Bucky balls cancels out each other, and the remaining magnetic field is very weak, so the mutual attraction between two clumps composed of a large number of Bucky balls is much weaker than that between two Bucky balls. When a large number of atoms combine into macroscopic objects, the magnetic field of the atomic magnetic moments also cancels out most of each other, and the remaining magnetic field is very weak, so the gravity is much weaker than the magnetic force.

• Because any interaction between two objects made of atoms or ions is essentially the sum of the interactions between the magnetic moments of the orbital electrons contained in the objects. Since the magnetic moments of the orbital electrons of the atoms or ions contained in objects can rotate freely, when two or more objects interact, the orbital electrons of the atoms or ions comprising the objects will automatically adjust the directions of their magnetic moments to ensure that any two objects are always attracted to each other. That's the secret of gravity.

Since the atoms or ions of liquid or gas are relatively easy to rotate compared with those of solid, it is speculated that the gravitational constant of universal attraction between liquid or gas is greater than that between solid of the same material. For example, if all the test conditions remain unchanged, the gravitational constant between two bottles of water is larger than between the same two bottles of ice. This conjecture needs to be tested experimentally. In the same way, solid powders are generally do not combined into clumps, but can be combined after melting or blending with water. Since the magnetic moment of the atom is easily rotated after the solid powder is melted, the atom will automatically adjust the Angle of its magnetic moment so that all atoms are attracted to each other and combine into a mass. When the liquid mass cools and solidifies, it becomes a solid. When the solid powder is mixed with water, the powder particles can easily turn, which can automatically turn to the Angle of mutual attraction and combine into a mass, and when the mass dries, it still does not disperse. This is how mud bricks are made.

Why does the spin-magnetic moment of electrons, protons and neutrons not contribute to the formation of the gravitational field? Electrons, protons, and neutrons are also not subject to gravitational fields?

Since the spin of electron is an intrinsic property of electron, the magnetic moment of electron spin has only two orientations, +1/2 and -1/2, so it cannot rotate freely [3]. Therefore, the spin magnetic moment of the electron does not contribute to the formation of the gravitational field of the object, and the electron is not affected by the gravitational field. In the same way, proton and neutron spin magnetic moments do not contribute to the formation of the gravitational field of an object, and protons and neutrons are not affected by the gravitational field [4,5].

Do photons have gravitational mass?

Whether a photon has a gravitational mass can be determined by whether the gravitational field produces a red shift or a blue shift At present, the academic circles believe that gravitational redshift is the phenomenon that the light emitted by a light source will shift its spectral line to the long wave direction (red end) when it propagates to a smaller gravitational field. Because if the photon has a gravitational mass, it needs to overcome the gravitational force of the celestial body to do work when moving away from the celestial body, so the energy of the photon is getting smaller and smaller, and the wavelength is getting longer and longer. However, the relevant experiments only proved that the change of gravitational field would cause the wavelength of light to change, but did not indicate whether the wavelength of light would increase or decrease with the weakening of gravitational field [6-8]. In other words, the relevant experiments do not indicate whether gravity gives the spectrum a redshift or a blue shift.

If the photon has no gravitational mass, then the photon does not have to overcome the gravitational force of the celestial body to do work when moving away from it. According to the nature of time, the time on the object is proportional to the blackbody radiosity of the object or the frequency of the radiated photons [9]. Therefore, the time on the photon is proportional to the frequency of the photon. The higher the frequency of the photon, the faster the time:

$$t = \sigma \gamma \qquad (1)$$

Where σ is a constant. According to general relativity, time is related to the strength of the gravitational field as follows [10]:

$$t = t_0 \sqrt{1 - \frac{2GM}{c^2 R}} \qquad (2)$$

In Formula (2), t_0 is the time on the photon when the gravitational field is 0. From (1) and (2) we obtain:

$$\gamma = \gamma_0 \sqrt{1 - \frac{2GM}{c^2 R}} \qquad (3)$$

In Formula (3), γ_0 is the photon frequency when the gravitational field is 0. According to Formula (3), the frequency of the photon (γ)will increase with the increase of the distance from the center of the earth (R), that is to say, the light emitted by the light source will shift its spectral line to the short-wave direction (blue end) when propagating to a smaller gravitational field. We can test this by measuring the frequency of the same beam at different heights on the ground.

Judging whether photons have gravitational mass from black hole formation analysis

According to the existing black hole theory, when leaving the black hole, photons have to overcome the gravitational field of the black hole to do work, so their energy becomes smaller and smaller, and when they reach the event horizon of the black hole, their energy becomes zero. Therefore, photons can't leave the black hole. But as the photon goes from the outside of the black hole to the black hole it gets more and more energetic, and as the photon enters the event horizon, time stops, the frequency of the photon is infinite which means the energy of the photon is infinite, and there's a problem that can't be solved. Therefore, the current theory of black holes can't explain why black holes are black.

According to equation (7.13) and the nature of time, it can be seen that the following conditions must be met to turn the whole celestial body into a black hole [9,11]:

$$t(R) = t_0 \sqrt{1 - \frac{2GM}{c^2 R}} = 0 \qquad (4)$$

That is：

$$R = \frac{2GM}{c^2} \qquad (5)$$

According to Formula (3), when the photon moves toward the black hole, the closer it is to the black hole, the smaller its frequency will be. When the photon reaches the event horizon of the black hole, time on the photon stops and the photon has zero frequency (i.e., zero energy). Therefore, the so-called black hole phenomenon occurs because the energy density of space is so high that the photons entering the space stop in time and their frequency becomes zero.

Related experiments

Using simple pendulum experiments to prove that the gravitational mass of the object is proportional to the number of orbital electrons contained in the object

In order to prove that the gravitational mass of the object is proportional to the number of orbital electrons contained in the object, the author specially designed the following pendulum experiment to verify: Use a metal hammer and a non - metal hammer each to make two pendulums of equal pendulum length. Place the two pendulums in a vacuum chamber. Swing the two pendulums and measure the swing period of the two pendulums separately. From the swing equation of simple pendulum:

$$\frac{d^2\theta}{dt^2} = -\left(\frac{m_G}{m_I}\right)\frac{g}{L}\theta \qquad (6)$$

The angular frequency ω can be obtained:

$$\omega = \sqrt{\frac{m_G g}{m_I L}} \qquad (7)$$

In the above equations, m_G is the gravitational mass of the pendulum, m_I is the inertial mass of the pendulum, L is the pendulum length of the simple pendulum, θ is the angular displacement of the swing, and g is the gravitational acceleration. According to Equation (7), when the pendulum length L is determined, the larger the angular frequency ω, the larger the ratio of the gravitational mass and inertial mass. Since metals contain a large number of free electrons, the ratio of gravitational mass to inertial mass of metals is assumed smaller than that of nonmetals. According to Equation (7), the angular frequency ω of the metal hammer pendulum should be less than that of the non-metal hammer pendulum. Therefore, this experiment can verify whether the gravitational mass of the object is proportional to the number of orbital electrons contained in the object.

Drop the feather and the metal ball simultaneously in a vacuum to verify that the feather land first

According to the following equation when the object is in free fall:

$$m_I a = G\frac{M_G m_G}{r^2} \qquad (8)$$

we can obtain:

$$a = G\left(\frac{m_G}{m_I}\right)\frac{M_G}{r^2} \qquad (9)$$

In equation (8) and equation (9), m_G is the gravitational mass of the object, m_I is the inertial mass of the object, and M_G is the gravitational mass of the earth. According to Equation (9), the acceleration a of the falling body is proportional to the ratio of the gravitational mass to the inertial mass of the body. Because metals contain a large number of free electrons, the ratio of the number of orbital electrons to the number of protons and neutrons, that is, the ratio of gravitational mass to inertial mass, is relatively small compared to nonmetals, so the acceleration of gravity of metal objects at the same height on Earth is relatively small compared to nonmetals. So we can predict that if you drop a feather and a metal ball simultaneously in a vacuum, the feather will land first.

Suggestion:

1. Use a variety of metal (such as silver, copper, iron, lead, etc.) balls with different conductivity for this experiment.
2. Since feathers are affected by air resistance, the experiment must be carried out in a high vacuum environment.

Verify that the weight of a solid increases as it melts

Because the atoms in a liquid rotate more easily than in a solid, it is speculated that the gravity between the liquid and the Earth is slightly greater than the gravity between the solid and the Earth of the same material and inertial mass. Ice can be used in the experiment to see if the total weight is slightly larger when it is melted into water.

About the elimination of gravity

Since gravity is generated by the orbital electron magnetic moment of atoms or ions, reducing the number of orbital electrons of atoms or ions or changing the macroscopic orientation of orbital electron magnetic moment of material can reduce the gravity of objects. Because strong electric or magnetic fields can ionize matter or change the macroscopic orientation of the magnetic moment of orbital electrons in the material, the gravity of an object should be reduced under strong electric or magnetic field.

Why does the solar wind cause the loss of atmosphere? Because the solar wind can strip away the outer orbital electrons of atmospheric molecules, the gravitational mass of atmospheric molecules decreases and they can more easily escape the Earth's gravity [12].

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