Propagation of Force

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In the text "Propagation of Force", I discuss about the unidirectional and omnidirectional forces and how they propagate. I also explain why the force is inversely proportional to the square of the distance. Moreover, I argue about how the motion of one object affects other object through the propagation of forces.

Keywords

Forces; unidirectional; omnidirectional; inversely proportional to the square of the distance;

1. Introduction

Objects move under force, and the force on objects is emitted by other objects. All objects in the universe both receive and emit forces. We don't know exactly how the object emits and receives the force. We just see the object moving due to the force. Despite of this situation, it will not affect me to discuss how an object affects other objects through forces, that is, how the forces propagate and interact with matter.

2. What Forces Exist in Real World

Firstly, we need to determine what forces exist in the real world. At present, we know from human experience that there are gravitational force, electrostatic force, magnetic force, and light in the real world. Light is also a kind of force, but there are some differences from the other three forces. I will discuss the light in detail in the text "Photon". The phenomena of these four forces can be seen everywhere in our daily life, and the elementary particles they interact with respectively are also very clear. Electrostatic and magnetic forces interact with electrons and protons, the gravitational force interacts with mass particles (neutrino), and light also interacts with electrons and protons. These correspondences between forces and particles have been verifies by many phenomena and experiments, which are beyond doubt. These four forces all exist in the form of "forciton", a word I created to refer to elementary unit of forces. This forciton is not real, it is just a general term for photon, graviton, electrostaton and magneton collectively. It is needless to argue the existence of photons and gravitons. The existence of electrostaton and magneton that are the elementary units of electrostatic and magnetic forces respectively, have not yet been verified, but their propagation mode and speed are the same as gravitational force. And even though they are either attractive or repulsive, the electrostatic force, magnetic force and gravitational force can all be regarded as omnidirectional force. It's just because that we have long misunderstood electricity and magnetism, which misled us to avoid pursuit in this path. But the discovery of gravitons has provided an evidence for the existence of other forcitons.

Specifically, light exists in the form of photons, gravitational force exists in the form of gravitons, while electrostatic force exists in the form of electrostatons, and magnetic force exists in the form of magnetrons. The photon is the only unidirectional force (unidirectional means moving in only one direction), while the other three forces are all omnidirectional forces (omnidirectional means moving in all directions). The omnidirectional force starts to propagate in all directions at the same time from the positions where the radiating particles (electric charge, magnetic charge, massiton) locate and will scatter to more and more positions on a spherical surface as it propagates. I don't know how this omnidirectional propagation is realized, but its phenomenon is ubiquitous. Unlike a particle that can only occupy one position in one timebase, multiple forcitons can occupy one same position in one timebase, or multiple forcitons can be superposed at one same position at the same time, and eventually they will be merged into a resultant force.

3. How Forces Propagate

We cannot create an electron and then see how the electrostatic force is produced, but we can move an electron to see its effect on other electrons or protons. From many phenomena and experiments, we have known that the magnitude of these forces changes with propagation distance, except for light. The force carried by the photon will not change with the propagation distance. The reason is that it is a unidirectionally propagated force, and the force will not be scattered to multiple positions as an omnidirectional force. While the omnidirectionally propagated forces have a common feature that the force decreases with the increase of the propagation distance, that is, the magnitude of the force is inversely proportional to the square of the distance. The reason why the force decreases with increasing distance is because the total magnitude of force that a particle can produce in one timebase is a constant value, and this force is scattered to more and more positions as it propagates. Therefore, the farther the distance is, the smaller the force is, because the force of which the total magnitude is constant is scattered to more positions. For example, in timebase 0, the force and the particle are at the same position. In timebase 1, this force begins to propagate outwards. Because it is an omnidirectional force, it is evenly distributed to all directions during propagation, or it is evenly scattered to multiple positions, and all these positions together can form an approximatively spherical surface. In timebase 2, the positions that this force scattered to expand from a smaller spherical surface to a larger spherical surface, that is, the force at each position on this smaller spherical surface is scattered to more positions on the larger spherical surface. As the propagation distance increases, the area of the spherical surface continues to expand, and the number of positions on the spherical surface also increases. The force scattered to each position also becomes smaller, as shown in the Figure 1 below.

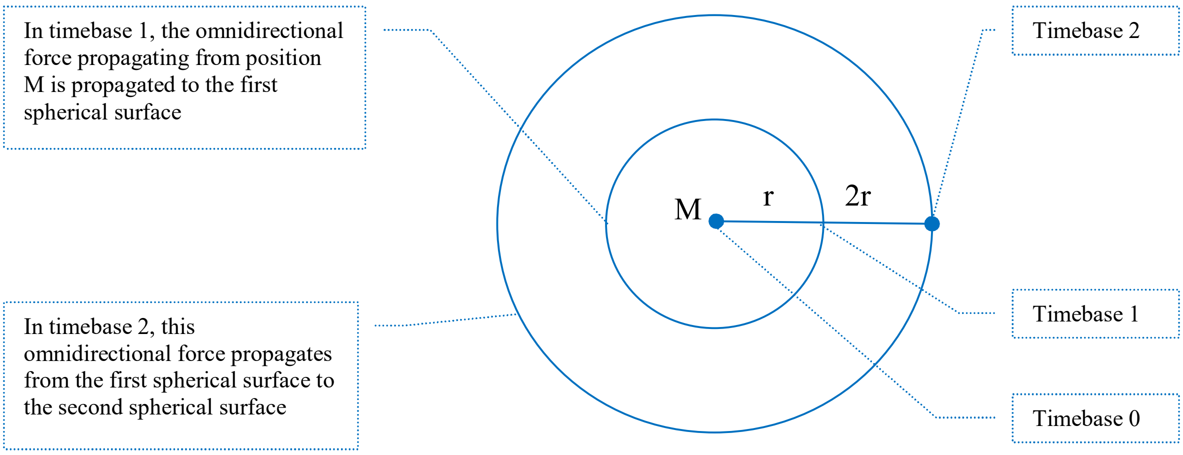

Figure 1: Propagation of omnidirectional force

In the Figure 1 above, suppose that two particles M and m are separated by R, and the gravitational force between them is $\mathrm{F} = \mathrm{G}\frac{Mm}{R^2}$. Now we do not consider the gravitational force of m to M, but only consider the gravitational force of M to m. Then the gravitational force of M to m is at position M in timebase 0, the propagation distance is r in timebase 1, and the propagation distance is 2r in timebase 2. So the total magnitude of the gravitational force propagating from the position M should be exactly the same in timebases 0, 1, and 2, except that it is at one position M in timebase 0, and at multiple positions on the smaller spherical surface in timebase 1, and at more positions on the larger spherical surface in timebase 2. According to the gravitational force formula and the spherical area formula $\mathrm{S} = 4\pi R^2$, the sum of the forces at all positions on the smaller spherical surface and the larger spherical surface can be obtained, namely $\mathrm{Fs} = \mathrm{G}\frac{Mm}{R^2}4\pi R^2 = \mathrm{G\,Mm}\,4\pi$. Wherein, the $\mathrm{Fs} = \mathrm{G}\frac{Mm}{R^2}4$ is only the force at one position on the spherical surface, and if I use this value to time the total area of the spherical surface, I can obtain the sum of all forces at all positions on the spherical surface. It can be seen from this relational expression that no matter how the distance (radius) changes, the total magnitude of forces of a particle at all positions on the spherical surface with any distance as the radius is a constant value, which is equal to the value of the force at the initial position M. It can be concluded that the omnidirectional force does not decrease as the propagation distance increases, but it is evenly scattered to all positions on an approximatively spherical surface as the distance increases. So when we measure the force at one position on the spherical surface, we will find that the magnitude of the force is inversely proportional to the square of the distance. This omnidirectional propagation mode of the gravitational force is also applicable to electrostatic and magnetic forces, but not to light. In this way, how the propagation directions and the magnitude of the omnidirectional forces change with the increase of the propagation distance, are clearly explained. The propagation direction of the omnidirectional force is the radius of the sphere. The center of the sphere is the particle that radiates the omnidirectional force. The magnitude of the force depends on the area of the spherical surface, or the number of positions on the spherical surface, or the square of the radius of the sphere.

3. How Fast Forces Propagate

From many phenomena and experiments, we also know that the influence of these forces on objects also varies with the change of propagation distance. The farther the distance, the later the influence happens. In other words, force propagates at a certain speed, and this speed is the speed of light. Or we can understand it in this way that the speed of light is not the speed of light propagation, but the speed of force propagation, and light is just a kind of force. The fact that light, electrostatic force and magnetic force propagate at the speed of light has been widely recognized, and the two events GW170817 and GRB170817A that occurred in 2017 also provided the best evidence that the propagation of gravitational force is also at the speed of light. Therefore, we should all accept the basic assumption that "all forces propagate at the speed of light" until there is concrete evidence that refutes this viewpoint. Then according to the force propagating at the speed of light and the relationship between force and motion, it is possible to guess the motion of an object under electromagnetic force or gravitational force.

As shown in Figure 2 below: Suppose there is a positively charged object P at position 1 and a negatively charged object E at position 7 in a space, the distance between the two is 2 R, and the distance travelled by light in time T is R. The object P moves from position 1 to position 2 in time T, and then moves from position 2 to position 3 in the second same time T, and so on, with same distance of S. The time when P at position 1 is T0, the time at position 2 is T1, the time at position 3 is T2, and so on, the duration is T. At T0, the distance between P and E is 2R, and P and E are at rest for much longer than 2T. The big circle and the small circle in the figure below represent the reachable range of the electrostatic force within 1T and 2T respectively when P is at positions 1, 2, 3, 4, and 5. The force on E at time T0 is F, so when P is at positions 1, 2, 3, 4, and 5, the force on E is shown in the following table.

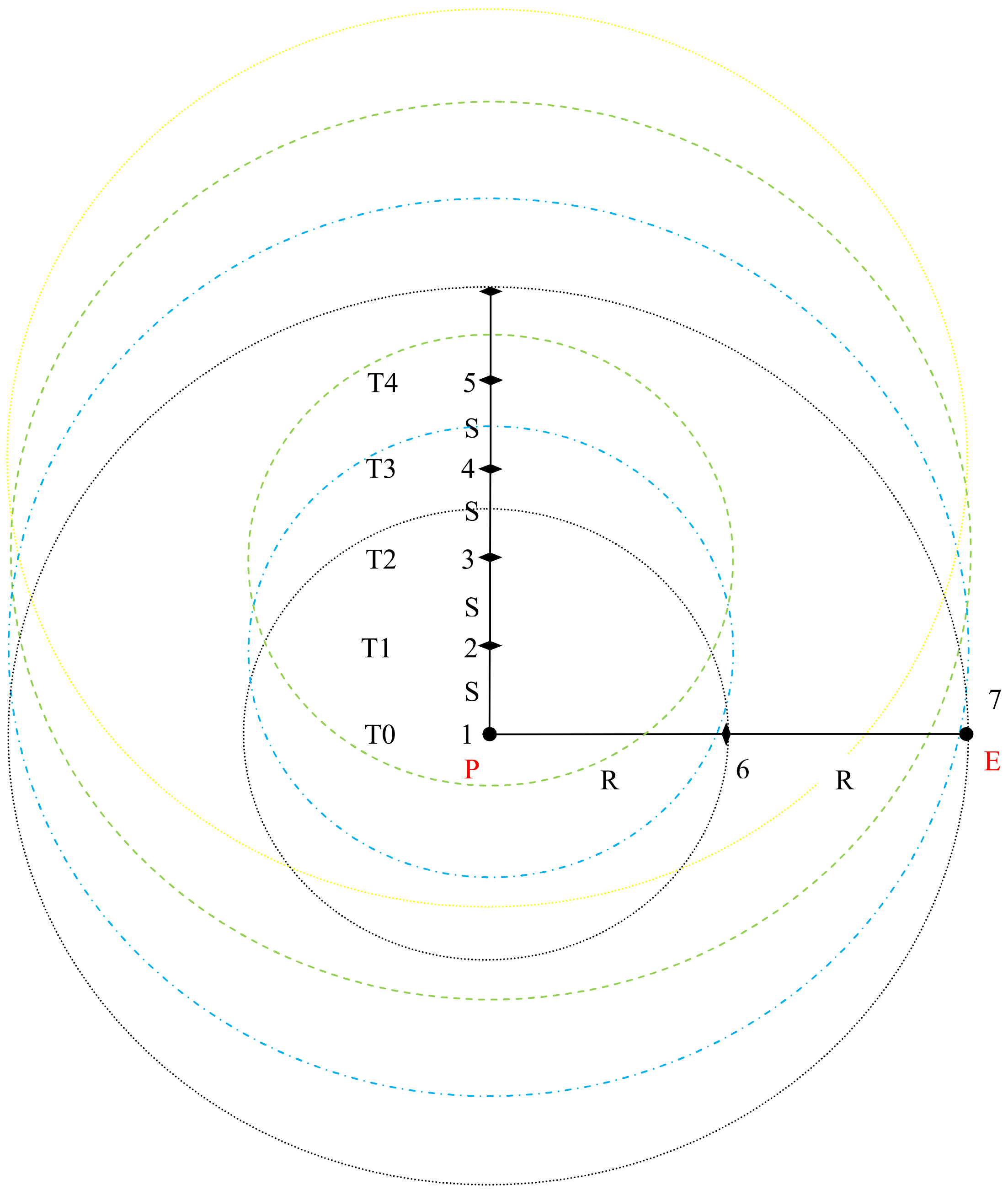

Figure 2: Propagation of omnidirectional force from moving object

time	P's position	Force on E
T0	1	The electrostatic force has propagated from position 1 to the position of E. At this time, the force is F, and the force direction is from 7 to 1.
T1	2	Although P has moved to position 2, but the electrostatic force at position 6 at time T0 has propagated to position 7, so the force is still F at this time, and the force direction is from 7 to 1.
T2	3	Because the electrostatic force at position 1 at time T0 propagates to

		position 6 at time T1, and to position 7 at time T2, the electrostatic force from position 2 at time T1 only reaches the small blue circle, so the force is still F at this time, and the force direction is from 7 to 1
T3	4	Because the electrostatic force at position 1 at time T0 propagates to position 6 at time T1, propagate to position 7 at time T2, and has passed position 7 at time T3, there is no electrostatic force from position 1 at this time. And the electrostaton leaving from position 2 at T1 only reaches the big blue circle, not to position 7, so at this time no electrostaton arrives at position 7, so the force is 0 and there is no direction.
T4	5	At this time, there is no electrostatic force from position 1, and the electrostatic force from position 3 has not reached position 7, so only the electrostatic force from position 2 reaches position 7, but because the distance from 2 to 7 is slightly longer than the distance from 1 to 7, therefore, the force is slightly smaller than F at this time (the value can be obtained by the Pythagorean theorem), and the force direction is from 7 to 2

The above Figure 2 and table show in the simplest way the influence of the change of the position of P over time on the magnitude and direction of the force on E or its position 7. Ignoring P movement due to the force of E, we simply discuss the changes of forces at position 7 over time with the changes of P positions. If the motion direction and speed of P are known, then the electrostatic force of P on E can be expressed by the following relational expression. Wherein, F is the electrostatic force of P on E; K is the electrostatic force constant (Coulomb constant); Uppercase Q is the charge of P, and lowercase q is the charge of E; T is the duration of P movement; V is the speed of P movement; C is the speed of light; P is the angle between PE and P movement direction.

$$\mathrm{F} = \mathrm{K}\frac{Qq}{T^2(V^2 + C^2 - 2VC\cos P)}$$

This is a minimal example. The situation in the real world is much more complicated, because one position can have many forces in one timebase, and the forces at each position will change every timebase. It is conceivable that every position in the space around us will be continuously occupied by multiple forces, and these forces come and go. In other words, the forces at all positions will continue to change. It is not difficult to see why the motion of objects on the earth ground will be affected by other distant celestial bodies in the universe, because the gravitons from other celestial bodies have already reached the earth and are continuing to arrive.

If we replace the two objects in the above example with two celestial bodies, we can also use the similar relational expression below to explain the motion of the two celestial bodies due to gravity. Because they are only affected by gravity and other forces can be ignored, I only need to change the type and number of particles that generate force and the constant of force. Wherein, F is the gravitational force of P on E; G is the gravitational constant; Uppercase M is the mass of P, lowercase m is the mass of E; T is the duration of P movement; V is the speed of P movement; C is the speed of light; P is the angle between PE and P movement direction.

$$\mathrm{F} = \mathrm{G}\frac{Mm}{T^2(V^2 + C^2 - 2VC\cos P)}$$

4. Conclusions

In the real world, the phenomena are everywhere that movement of celestial bodies and the propagation of gravitational force result in the change in the orbits of surrounding celestial bodies. For example, the orbit of the moon is constantly changing due to the movement of the earth. The most famous example is the precession of Mercury's perihelion. It is known that the sun is constantly in motion, causing the orbits of the celestial bodies moving around it to change ceaselessly. All other celestial bodies in the entire solar system are following the moving sun, and the sun's movement is approximately the motion in a straight line at a uniform speed, which means that the speed and movement direction of the sun change very little over time. However, it can be seen from the relational expression above that as long as V changes, then F will change, and the change of F will alter the magnitude and direction of the gravitational force on E, which will lead to a change in the motion of E. For Mercury, due to the large eccentricity of Mercury's orbit and its closeness to the sun, the change in this trajectory is very obvious.

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Huan Liang wrote the original draft and final version of above paper.

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All data, models, and code generated or used during the study appear in the submitted article.

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