The Cause of Motion

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Abstract

In the text "The Cause of Motion", I argue the following 6 flaws in the definition of inertia and the law of inertia and propose a solution to correct these problems and mechanism for inertial motion. 1. The definition of inertia does not answer the cause why the object has inertia. 2. The law of inertia does not answer what is the cause of motion. 3. Stationariness and rectilinear motion at constant velocity are two effects that need two causes to explain. 4. We have not found the elementary particles or properties responsible for inertia in matter. 5. The inertial motion of the same matter in gaseous, liquid, solid or other states is completely different. 6. No experiment has proved the existence of inertia or the law of inertia.

Keywords

Motion; inertia; attraction and repulsion;

1. Introduction

The purpose of this text is to prove that force is the cause of motion, or at least to call for more people to explore what is the cause of motion. Because the answer to this question is almost related to the all the physical theories or the foundation of all our physical theories today is based on the answer to this question. The importance of this question far exceeds any other question; it is basically the starting point of our physical theories. So it can well be imagined that if we proceed in the wrong direction from the starting point, the farther we go, the more mistakes we will make. If I say that since the Newtonian era, our physical theories have been developing along a wrong direction, such statement is simply the craziest talk, or pure nonsense. But whether it is craziness or nonsense, any conclusion must be based on facts and drawn through rigorous logical argumentation. The problems we face in the physics community today are very obvious. If we continue to move in this direction, we cannot explain many phenomena at all, and it seems that we have reached a dead end, which can neither explain the phenomenon nor continue to develop. So going back to the starting point where we didn't have any physical theory, re-examining all phenomena and establishing a new unified physical theory may be a good choice. If we go back to the starting point of all physical theories, then force and motion and their relation would be this starting point I am talking about. Therefore, among the widely accepted physical theories today, inertia and the law of inertia (or Newton's first law) are the starting point. For example, Newton's first law makes the assumption of inertia, so Newton's second law is written as $F=ma$. Based on this relational expression, many other laws are deduced, including $W=fs$, $E_k=mv^2/2$, $E=mc^2$ and so on. So if $F=ma$ is wrong, it shall be $F=mv$, do all the equations derived based on this relational expression need to be corrected? It is actually very simple to demonstrate that "force is the cause of motion". The key is to explain that inertial motion is forced motion, in other words, to find the force that drives an object to do inertial motion. In the following, I will first enumerate and argue the flaws in the inertia and the law of inertia, then argue that "force is the cause of motion", and finally propose the mechanism of "force that drives an object to do inertial motion".

2. Deficiencies in the definition of inertia and the law of inertia:

First, let's take a look at the flaws in the definition of inertia and the law of inertia:

(1) **The definition of inertia does not answer the cause why the object has inertia.** First, let's take a look at the definition of inertia, which claims that "Inertia is the inherent property of a body that makes it oppose any force that would cause a change in its motion." Why does an object oppose any force that would cause a change in its motion? We did not explore the cause for it, but just gave it a name, called "inertia", and because inertia is everywhere, everyone seems to agree that objects do have a property called "inertia". But if we take a deep look into it, we will find that in addition to the explanation of "Matter having an inherent property", there is another logical explanation, which is that if an object is already under force, changing its state of motion requires overcoming the forces that already act on the object, and this can explain the phenomenon of inertia. Now we have two explanations, one is that matter itself has inertial property, and the other is that objects move due to force. Changing its motion state will be resisted by the original forces that already act on the body. For the second explanation, I don't need to list phenomena or experiments to prove its possibility, because this kind of situation can be seen everywhere in our daily life and it is self-evident. The key is to find the force that drives the body to do the inertial motion. If we really

found the property of inertia and its causes in matter, we can prove that the first explanation is correct. On the contrary, if we do not find this property, but found the evidence for the second explanation, then the inertia and the law of inertia will be demolished, which is the purpose of this text.

(2) **The law of inertia does not answer what is the cause of motion.** It claims: "An object at rest remains at rest, or if in motion, remains in motion at a constant velocity unless acted on by a net external force." The implication of this statement is that force is the cause of change in the motion of the object, not the cause of the motion of the object. From this, we can see the ambiguity. Isn't the cause of change in the motion the same as the cause of the motion? Is there a difference between causing an object to move and causing it to change motion? This question has not been answered. Furthermore, what motions are changed by force? For example, suppose there is an object that moves in a straight line at a constant velocity. During its motion, it is acted on by a constant lateral force perpendicular to the direction of its rectilinear motion. And then the object moves in a circle at a constant velocity. For this example, the lateral force does not change the direction and velocity of the rectilinear motion, but superposes the lateral direction and velocity on its basis. It can be seen that this lateral force actually causes the object to present the direction and velocity of lateral motion, and does not change the direction and velocity of the object's rectilinear motion. The lateral motion joins with the rectilinear motion, and finally forms a circular motion at a constant velocity. Although the lateral force causes a change in the motion of the object, it is actually the lateral force that causes the object to move laterally, and the original rectilinear motion of the object is not affected. Therefore, the lateral force is the cause of the lateral motion. When the lateral force is eliminated, the lateral motion disappears. When the lateral force is applied, the lateral motion appears. It can be seen from this simple example that force is the cause of the motion of an object. No matter whether the object was at rest or moving in a straight line at a constant velocity, the newly applied external force will cause the object to present a new motion. So from this point of view, the expression of Newton's first law is not wrong. When an object is not under a newly applied external force, it will maintain its original motion or stationary state. So now I just need to explain why the object can maintain its state of motion.

(3) **Stationariness and rectilinear motion at constant velocity are two effects that need two causes to explain.** When under no force, the object can remain stationary or move in a straight line at a constant velocity. But what is the cause for the object to remain at rest or move in a straight line at a constant velocity? We know that one cause can only lead to one effect. If inertia can cause object to remain at rest, how can inertia cause object to move in a straight line at an even velocity? The same cause leads to two completely different effects. This is like 1+1 can be equal to both 2 and 0, which is an obvious logical error. So these two effects must have their own causes, not same one cause. Because stationariness and rectilinear motion at a constant velocity are two states, in other words, stationariness and motion are two extremely different states. Motion means the position of object changes, while stationariness means the position of the object does not change. Obviously, one cause is needed for the position of object to be unchanged, and another cause is needed for the change of the position of object, and these two causes cannot be satisfactorily explained by just inertia. The cause why the object is stationary is because the object is not under no force or the resultant force on it is zero. So how can inertia keep an object moving in a straight line at a constant velocity? How does the inertia of an object know the direction and velocity of its own motion, and then ensure that the subsequent motion direction and velocity are exactly the same? As you know, with today's powerful human technology, we still can't make an object move in straight line at a relatively constant velocity. Then a more logical explanation is that the cause for the rectilinear motion at a constant velocity is because the object continues to be acted on by a force of constant magnitude and

unchanged direction. This force will always push the object to move in a straight line at a constant velocity until it is disturbed by the outside world. I believe that I have found a logical mechanism to explain this force of constant magnitude and unchanged direction. The details are described in the following text.

(4) **We have not found the elementary particles or properties responsible for inertia in matter.** Inertia is just a phenomenon, like electromagnetic phenomenon and gravity phenomenon. For electromagnetic and gravity phenomena, we have found the elementary particles that generate electromagnetic force and gravity inside the atom, and the one-to-one correspondence is very clear. But with regard to the phenomenon of inertia, no experiment has revealed which elementary particles or properties are specifically responsible for inertia. As for mass, the phenomenon produced by mass is gravitational motion, not inertial motion. Gravitational mass is the magnitude of gravitational force received by a mass particle being attracted by other mass particles in the universe. In other words, gravitational mass is the amount of universal gravitational force received by an object being attracted by other objects. Because we live on the earth, inertial phenomena and inertial motion are always in the earth's gravitational field, and the gravitational mass of an object is directly correlated with its own inertial motion, so this creates an illusion that makes people mistakenly believe that mass is closely related to the so-called "Inertia". The gravitational mass of the same object on the earth and on the moon is not equal, although there is no change in the quantity and composition of particles inside the object. This is why the inertial mass is equal to the gravitational mass, because we always use the gravitational mass to measure, not the real mass of matter (the number of particles that make up an object). From this simple example, it can be seen that it is wrong to attribute inertia to mass, because if inertia is an inherent property of matter itself, it shall not change when gravity changes. For example, the charge in the object will not change due to changes in outside gravity.

(5) **The inertial motion of the same matter in gaseous, liquid, solid or other states is completely different.** Such kind of phenomena can be seen everywhere in daily life, so I will only talk about one example in this text. For example, we can find a bucket to fill with water, and then turn the bucket, we will find that the water will rotate with the bucket. When we stop rotating the bucket, the water in the bucket will continue to rotate, and the rotation of water will gradually slow down, and finally stop. According to the theory of inertia, the fact that the bucket turns while the water does not turn and the water turns while the bucket does not turn can be interpreted by inertia. However, we can see from the specific phenomenon that when the bucket starts to rotate, the molecules in the bucket wall drive the water molecules next to the barrel wall to rotate, and then the outer water molecules drive the inner water molecules to rotate. In this way, the whole bucket of water starts to rotate. When the bucket stops rotating, the molecules in the bucket wall drive the water molecules next to the barrel wall to stop rotating, and then the outer water molecules drive the inner water molecules to stop rotating. From this we can see a very clear process of force propagation between molecules in the water. After that, we can freeze this bucket of water into ice, and then turn the bucket again, and we will find that after the water has frozen into ice, its motion is completely different from that of liquid water. If all other conditions remain the same, but the water in the bucket changes from liquid to solid, then the theory of inertia will not be able to explain why the inertial motion of the same matter is so different when is in liquid and solid state.

(6) **No experiment has proved the existence of inertia or the law of inertia.** Inertia is just a big assumption derived from phenomena, and no scientific experiment has measured or verified the existence of inertia. Because of the ubiquity of inertial motion and phenomena, everyone agrees with this explanation, so that there is no real inquiry into whether there are other explanations. Today's physics community pays

more attention to the development of new fields, and takes it for granted that the existing theories are proven and completely reliable truths. I personally haven't found any experiment that specifically verifies inertia or measures inertia. Of course, there may be such an experiment, and I personally don't know it. But a theory cannot be verified just by one phenomenon or experiment, it must be able to satisfy all known experiments and phenomena, without any counterexamples.

My first class of physics in junior high school was Newton's Three Laws. I think young people around the world probably started to learn this theory at this time. And such a most fundamental theory has so many flaws, but it is widely taught in middle school classrooms as an impeccable truth. I think we really need to go back and re-examine this theory and make a decisive judgment. Can the above flaws be corrected? My answer is yes, that is to abandon the assumption of inertia and use force as the cause of motion. If force is the cause of motion, not only will the above-mentioned flaws be perfectly corrected, but also all motion phenomena from the micro to the macro can be explained more clearly.

3. Argumentation for “Force is the cause of motion”:

In the following text, I will present my argumentation about "Force is the cause of motion":

(1) To prove that force is the cause of motion, we first need to know what force is and what motion is. We need the definitions of both. The term "Force" comes from experience. We see objects attract and repel each other, so we call this effect as force. Although this is not a strict definition, it does not cause ambiguity. Everyone knows what the term “Force” represents. Motion is defined as the change in the position of the object. Of course, I also need to define what a position is, and then define space and time, and explain what change is. In order to keep the text short, I will omit these definitions in this text, because the term “Position” does not lead to ambiguity and everyone knows what the term “Position” represents.

(2) Motion and stationariness are two states. If motion means that there is a change in the position of an object, then stationariness means that the position of an object remains unchanged. So what is the cause of stationariness? This answer is very clear, the object remain at rest when it is under no force (or the resultant force is 0). An object remains at its original position because it is not under force, that is, it remains at rest. This claim is self-evident, and this assertion is consistent with all known phenomena and experiments, and there is no counterexample.

(3) If an object is stationary because the object is not under force, then the object moves because the object is under force. In this way, the respective causes of motion and stationariness have been found. Because there are only two effects, stationariness and motion, then there are only two causes, with force and without force. The motion of an object includes all motions, regardless of constant velocity or variable velocity, straight line or curved line. Among them, the magnitude of the force determines the magnitude of the velocity, and the direction of the force determines the trajectory of the motion.

(4) For example, we toss the ball with our hand, the hand exerts thrust to the ball, and then the ball moves in the direction of this thrust. It can be seen that the ball can be thrown out only because of the thrust exerted by the hand. This has proven that force causes motion. And such phenomenon can be seen everywhere. If

an object is at one position, if the position of the object changes later, it must be caused by force that acts on the object. This causal relationship is self-evident and there is no counterexample.

(5) Now continue the above example. After throwing the ball by hand, the ball moves a certain distance in the pushing direction. After the hand and the ball are separated, no other external force continues to push the ball. What causes the ball to continue to move in the hand pushing direction? Whether or not there is a mechanism that can ensure the hand thrust will be locked within the ball after the ball being pushed by hand, and continue to push the ball in the direction of the hand thrust until it is disturbed by the outside world. Below I will use a two-atom model to explain the inertial motion of an object:

The force that drives an object to do inertial motion is actually the electromagnetic force between the atoms in matters, including electromagnetic attraction and repulsion. In the following text, I will only explain solids, because after clarifying the inertial motion mechanism of solids, the inertial motions of gases and liquids will be easily solved. A solid object is actually a multi-body system composed of multiple atoms bond together by electromagnetic attraction and repulsion. The electromagnetic attraction and repulsion that acted on each atom reach a balance. When an object is not under external force, it can keep its volume unchanged, or the distance between atoms inside the object remains unchanged, because the electromagnetic attraction and repulsion between the atoms inside the object reach a balance. At this time, if the object is compressed from all directions, that is to reduce the distance between its internal atoms, the compression will be resisted by the electromagnetic repulsion between the atoms, and the amount of change in its volume depends on the magnitude of the external force and the repulsion among the internal atoms. On the contrary, if the object is stretched to all directions, that is to increase the distance between its internal atoms, the stretching will be resisted by the electromagnetic attraction between the atoms, and the amount of change in its volume also depends on the magnitude of the external force and the attraction among the internal atoms.

Now if we only push or pull the object from one direction, after the external force stops acting on the object, the external force will continue to be propagated inside the object and will not disappear until it encounters other external interference. Specifically, taking pushing as an example, the outermost atoms being pushed on the surface of an object move a short distance in the pushing direction due to external force, and then the atoms in front are pushed to move along the pushing direction by electromagnetic repulsion, and so on. If the pushing force is sufficient, it will cause the atoms under the electromagnetic repulsion in front to move a large distance, far away from the balance between the attraction and the repulsion. After these atoms move a distance, they will in turn attract the atoms in rear to continue to move along the pushing direction. Since the electromagnetic force propagates at the speed of light, the atoms inside the object will be pushed by the repulsion at one moment, and then pulled by the attraction at the next moment. The direction of the attraction and repulsion is the same as the direction of the external force that initially pushed the object. Such movement of atoms inside the object is manifested as inertial movement on a macroscopic scale. If the object is not affected by any external factors, the electromagnetic attraction and repulsion on the internal atoms are exactly the same in magnitude and direction, so the object will continue to move in the direction that it was initially pushed. As shown in Figure 1 below:

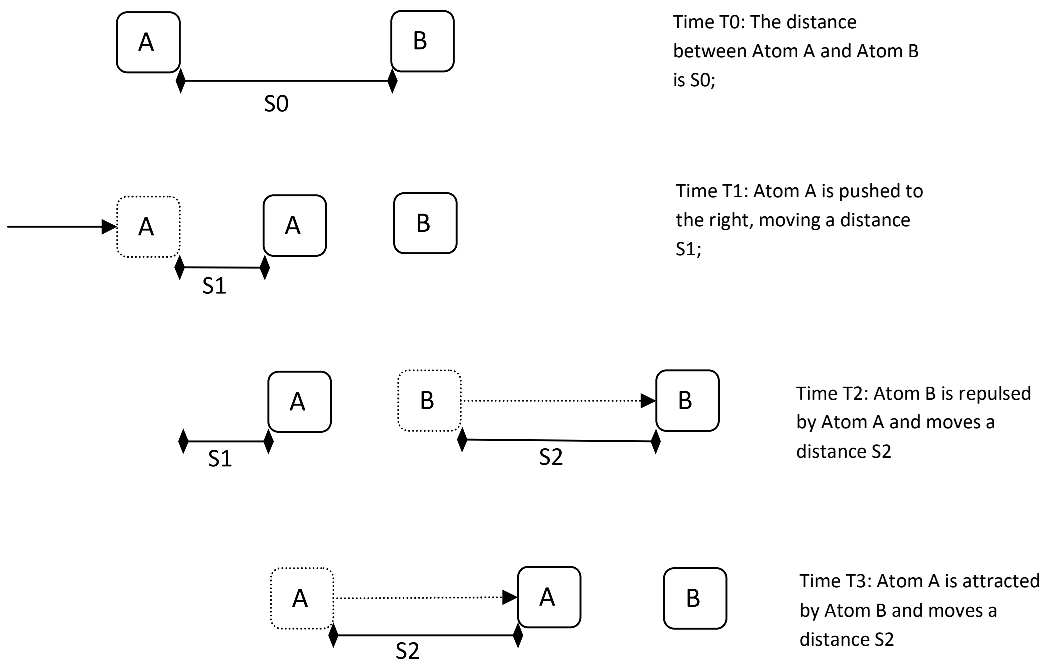

Figure 1: Inertial motion realized by the electromagnetic force between two atoms

As we all know, the magnitude of electromagnetic attraction and repulsion is proportional to the distance between two atoms. If the distance between Atom A and Atom B decreases, the repulsion between the two atoms will increase, and then this increased repulsion will cause the distance between the two atoms to increase; and then due to the increase in the distance between the two atoms, the attraction increases, and then this increased attraction will cause the distance between the two atoms to decrease. Because the distance change is proportional to the attraction and repulsion, the distance change between two atoms will be the same, and the attraction and repulsion between the two will also be the same. In the Figure 1 above, this means that the distances S2 = 2×S1. Let us look at the interaction process of the attraction and repulsion on Atoms A and B at each time:

At time T0, the attraction and repulsion on Atom A from Atom B are equal, and the attraction and repulsion on Atom B from Atom A are also equal;

At time T1, because Atom A moves distance S1, the attraction on Atom A from Atom B decreases, and the magnitude of this decrease is proportional to distance S1, and the repulsion on Atom A from Atom B increases, and the magnitude of this increase is proportional to distance S1;

At time T2, because Atom A moves distance S1, the attraction on Atom B from Atom A decreases, and the magnitude of this decrease is proportional to distance S1, and the repulsion on Atom B from Atom A increases, and the magnitude of this increase is proportional to distance S1. Now, Atom B is under double magnitude of the force that push the Atom A to move distance S1, so it moves distance S2 that would be double of S1, S2 = 2×S1; Now, the distance between Atom A and B would be S1 plus S0.

At time T3, because Atom B moves a distance S2, the repulsion on Atom A from Atom B decreases, and the magnitude of this decrease is proportional to the distance S2, and the attraction on Atom A from Atom B increases, and the magnitude of this increase is proportional to the distance S2. So Atom A will move S2 too because it is under the same magnitude of the force as Atom B at time T2.

In the above example, the process of interaction between attraction and repulsion is similar to that of a spring vibrator. Without any external interference, the process of interaction between attraction and repulsion will always go on. Because the force propagates at the speed of light, it can be ensured that the attraction and repulsion alternate, and the equilibrium state between attraction and repulsion will never be reached. Therefore, the aforementioned diatomic system will always move in the direction of the external force. If the mechanism of this diatomic system is extended to macroscopic objects with a huge number of atoms, similar motions will also present. If the mechanism of this diatomic system is extended to a single atom composed of one nucleus and multiple electrons outside the nucleus, the huge mass difference between the nucleus and the electrons outside the nucleus will not result in the similar motion, but the single atom will definitely continue a certain motion. Because for a multi-body system that bond together by the balances between attraction and repulsion, the external force that once acted on the system will never disappear, and it will continue to be propagated in this multi-body system until other external disturbances occur.

The aforementioned multi-body balance mechanism is not applicable to single particles, such as electrons, protons, or neutrons. However, there is currently no evidence that a single particle can continue to move without being driven by external forces. The reality is that we cannot exclude all external forces, and a single particle will always be affected by electromagnetic force and gravity. Therefore, for a single particle, there is currently no deterministic phenomenon or experiment that can confirm that a single particle has inertia. For example, in the electron beam, there are always multiple electrons, and the repulsive force between the electrons is large, and it is impossible to determine whether a single particle has inertia or is moved by force. As for single particle, although it cannot be completely ruled out that a single particle can move under no force, the situation where a particle moves under force is almost everywhere. So before there is a deterministic phenomenon or experiment, I think we shall accept that force is also the cause of the motion of individual particles.

4. Conclusions

In summary, if force is the cause of motion, then we need to redefine the relationship between force and motion. Now I conclude the relationship as follows: An object moves under force, the force is the cause of the object's motion, and the motion is the effect of the force. The object does not move when it is under a resultant force of 0; When the resultant force is greater than 0 and constant and the direction does not change, the object moves in a straight line at a constant velocity; When the resultant force is greater than 0 and constant but the direction changes, the object moves in a curved line at a constant velocity; When the resultant force is greater than 0 but the magnitude changes and the direction does not change, the object moves in a straight line at variable velocity; When the resultant force is greater than 0 but both the magnitude and the direction change, the object moves in a curved line at variable velocity; The relationship between the magnitude of force and the distance of motion can be written as: $D = \frac{\mathrm{FT}}{\mathrm{M}}$, wherein D is the movement distance; F is the resultant force on the object; T is the time window during which the resultant force is on particle and M is the mass of the object.

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References

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