

# Rethinking the Principle of Inertia

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An old principle of inertia can explain special relativity in a new way. With a proper understanding of motion, the speed of light is constant  $c$  only with reference to the source of emission, while the magnitude of its average velocity remains constant  $c$  regardless of the motion of the emitter. This interpretation on the invariance of light speed was published in a previous report, but the purpose now is to make that presentation more clear. And for something new, a self-sufficient cause for inertia is to be explored.

## 1. Introduction

The concept of inertia was alien to the physics of Aristotle. Aristotle believed that a body was only maintained in motion by the action of a continuous external force. But in the late Middle Ages, Jean Buridan (1295 – 1358) developed the idea of impetus, the first step toward the modern concept of inertia. Today's principle of inertia states that a body under the action of no force can only move uniformly in a straight line. However, Buridan maintained that impetus could be not only linear, but circular as well. This idea of circular impetus was later used by Copernicus (1473 – 1543) to explain planetary motion. Circular motion was thought to be the natural thing, but this way of thinking did not go without question. Galileo Galilei (1564 – 1642) formulized a new principle of inertia, and later his work was refined and codified by Isaac Newton (1642 – 1727) as the first law of motion.

Newton's first law now serves at the very foundation of theoretical physics, but still that principle could be wrong. Henri Poincaré (1854 – 1912) was a French mathematician, theoretical physicist, and a philosopher of science. In his 1905 publication, *Science and Hypothesis*, Poincaré battles with the principle of inertia. A short piece from that publication follows: "A body under the action of no force can only move uniformly in a straight line. Is this a truth imposed on the mind *a priori*? If this be so, how is it that the Greeks have failed to recognize it?" Poincaré continues, "If it be said that the velocity of a body cannot change, or there is no reason for it to change, may we not just as legitimately maintain that the position of a body cannot change, or that the curvature of its path cannot change, without the agency of an external cause? Is, then, the principle of inertia, which is not an *a priori* truth, an experimental fact? Have there ever been experiments on bodies acted on by no forces? And, if so, how did we know that no forces were acting?" From this Poincaré concludes, "Newton's first law could be the consequence of a more general principle, of which the principle of inertia is only a particular case." The purpose of this review is to rethink the principle of inertia, and to put forward a reasonable cause for a body's resistance to any change in its state of motion.

## 2. Copernicus vs. Newton

Newton's first law says that a body remains in its state of being at rest or of moving uniformly in a straight line, unless acted upon by an external force. There are no exceptions to the rule for it is thought to be an act of Nature. But is it really so? In his sec-

ond law, Newton said that a change of motion is proportional to the applied force and occurs in the same direction as that force. But there is more to the story. Newton's laws of motion describe relationships between external forces acting on a body and the motion of the body, but they do not consider effects of force from within a body. When a body is pulled into a circular path of travel, the pulling force creates tension throughout the body. Due to this tension, the body's momentum is held at a right angle to the force. Subsequently, the body pulls to break away from the force so as to move in a straight line, but the pull away has nothing to do with Newton's first law. The force causes it. Yet as formulated by Newton, the first law is more than a special case of the second law. The importance of the first law is to establish frames of reference for which the other laws are applicable, such frames being called 'inertial' frames. But to say the first law is verified by the second law is simply not true. Motion in a straight line could be a special case of the second law, while generally everything moves about inertial frames of natural and free circular motion.

The idea of circular impetus was used by Nicolaus Copernicus (1473 – 1543) to explain planetary orbits. This principle of motion was much like today's principle of inertia, except it pertained to circular motion. The concept of natural and free circular motion can be applied to all celestial motions; including the axial rotations of celestial bodies. (Elliptical orbits are explained in the author's original paper, *New Physics Based on Force-Free Circular Motion* [1].) And so for the purpose of discussion we can hold the following two assumptions. (1) A body acted upon by force tends to move in a straight line *due to the force*, and therefore it tends to keep moving in a straight line upon removal of that force. In other words, Newton's first law is only a special case of his second law. (2) Any motion produced by force is carried by the original force-free circular motion of the universe.

A reasonable extension of this idea is that all radiation transmits with a natural curve in its path. The curve is due to the circular motion of its source. Indeed, light emits in a straight line due to force, but still it maintains the original free circular motion of its source. For this reason, the faster a star rotates, the more curved its light becomes. The same kind of effect results from the orbit of a star. To see what happens with this sort of motion, suppose a star maintains a fixed straight-line distance from Earth. Any curve in the path of light will increase its length of travel from emitter to receiver, and the greater the curve becomes, the longer the distance will be. But because any increase in length of

travel is proportional to an increase in angular speed, the motion of a star has no effect on the apparent speed of its light. In the context of this report, the apparent speed of light refers to the magnitude of its average velocity, and it should not be confused with *average* speed. Apparent speed is total *displacement* divided by elapsed time, while average speed is total *distance* divided by elapsed time. The average velocity for any number of 360° rotations within a given period of time is zero, and so a logical assumption is that no degree of a star's rotation, or its orbit, will affect the apparent speed of its light.

The emission of light from a source on Earth is no different from the emission of light from a star, except we see it from a different point of view. Unlike a star and its light, the emission of light from a source on Earth is in the same rotating inertial frame as the observer. Because of this, the speed of light is constant  $c$  with reference to the source of emission, but its path of travel is curved by the free circular motion of the Earth itself. Moreover, any curve in light due to the Earth's rotation is affected by the light's direction of travel. The path of an eastward moving light signal is longer and more curved than a westward moving light signal. Still, the emission speed of light is constant  $c$  relative to its source. Thus, the *apparent* speed of light from a source on Earth remains constant only with reference to the fixed non-rotating Earth Centered Inertial (ECI) frame. The Global Positioning System (GPS) confirms this to be true. When the apparent speed of light is measured with the Global Positioning System, we find that it is  $c - v$  or  $c + v$ , in which  $v$  is the rotation speed of the Earth where cities are located.

### 3. A Self-Sufficient Cause for Inertia

Inertia is the resistance of any physical object to a change in its state of motion. Indeed we know it exists, but what is the root cause of inertia? Before we try to understand, let us think about what happens when a body is moved by force.

Motte's 1729 translation of Newton's second law reads: If a force generates a motion, a double force will generate double the motion, a triple force triple the motion, whether that force be impressed altogether and at once, or gradually and successively. And this motion (being always directed the same way with the generating force), if the body moved before, is added to or subtracted from the former motion, according as they directly conspire with or are directly contrary to each other; or obliquely joined, when they are oblique, so as to produce a new motion compounded from the determination of both.

According to Motte's translation, a motion imposed upon a body is never truly taken away; it is only masked by the addition of yet more motion. For example, a baseball player adds motion to a ball when he pitches the ball to a catcher. But what happens when the ball is caught? Does the motion of the ball come to a stop? Not really—the force of a catcher only adds more motion to the ball of equal magnitude but opposite in direction to that imposed by the pitcher. Thus, the two underlying motions of the ball cancel one another, and the ball appears in a state of rest. A totally separate but similar thing takes place at the atomic level.

Newton's laws of motion describe relationships between external forces acting on a body and the motion of the body, but

they do not consider effects of force *within* a body. And so how do atoms of a body react to force impressed upon that body? Before we speculate, let us suppose force-free circular motion truly exists. This principle of inertia can be applied to the workings of an atom [1-2]. In an updated model of the atom, the spin of an electron is strictly an inertial effect. Accordingly, such a spin represents a rotating inertial frame of reference. What is more, the spin is actually a dual spin with one spin perpendicular to the other. Protons and neutrons spin with the same sort of motion. As a result, the motion of a body is continuously carried and turned by the spinning parts of its atoms. The spinning parts are therefore saturated with motion of every possible direction, but if each motion is equal in magnitude, then the motions cancel each other in a state of equilibrium. But during acceleration of a body, new motion is added to the spinning parts of its atoms. This change of motion is then carried by the spinning parts and turned 180° in opposition to the acting force. In other words, its momentum is the source of a body's resistance to force. But when acceleration of a body stops, all motions within the body return to a state of equilibrium. Its spinning parts remain saturated with motion of every possible direction, but because the motions are all of equal magnitude, the individual motions cancel one another. At this point, the body as a whole moves with constant and uniform motion, while internally the body is in a state of equilibrium. This state of equilibrium cannot be distinguished from a state of rest. By this account, the cause of a body's resistance to any change in its state of motion is explained by motion itself, or what is called self-evidence.

### 4. Conclusion

The importance of Newton's first law is to establish frames of reference for which the other laws are applicable. Hence, a newly defined principle of inertia—one involving force-free circular motion—demands a complete overhaul of most everything in theoretical physics; including relativity theory, quantum mechanics, big bang theory, and cosmology. And so in conclusion, a new principle of inertia gives opportunity for new and improved theories of the universe.

### Definitions

1. A body acted upon by force tends to move in a straight line *due to the force*, and therefore it tends to keep moving in a straight line upon removal of that force. In other words, Newton's first law is only a special case of his second law.
2. Any motion produced by force is carried by the original force-free circular motion of the universe.
3. Apparent speed is the magnitude of a body's average velocity. Average velocity is total displacement divided by elapsed time.

### References

- [1.] Mitch Emery, "New Physics Based on Force-Free Circular Motion", Proceedings of the Natural Philosophy Alliance Vol. 3, No. 1: 24-36.
- [2.] Mitch Emery, "Electron Spin and the Emission of Photons", Proceedings of the Natural Philosophy Alliance 4 (1) 58-59 (2007).