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Kaku's Stone And The Principle Of Inertia

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Abstract.-Kaku's stone is an almost dramatic update of a classic argument by Galileo Galilei published in 1632. In that argument, and with the expression "marvelous effect of nature", Galileo introduces the concept of preinertia. As far as we know, it is the only time in the history of physics that this "marvelous effect" has been considered. Preinertia is, in fact, a property of all physical objects unknown to contemporary physics. A universal and fundamental property: it is the reason why absolute motion is undetectable. And at the same time the reason why the nature of motion can only be absolute, although only the relative motion resulting from the different absolute motions of physical objects through the same real physical space is observable. This paper gives the reasons why preinertia should have been rediscovered from the principles of conservation of linear momentum and energy in an isolated system.

Keywords: Inertia, preinertia, uniform relative motion, absolute motion, detection of absolute motion, kinetic energy, linear momentum.

1. The overwhelming empirical evidence of preinertia

We must begin this article by defining, although not completely, the concept of preinertia:

> **Preinercia**: *Property of every physical object, including photons, by which it inherits the velocity vector of the physical object from which it is set in motion.*

As is evident, the incompleteness of the definition is due to the fact that it is not specified what kind of velocity, absolute or relative, is inherited. It will be shown later that the inherited velocity can only be the absolute velocity (anathema in contemporary physics).

The next obligatory point is to remember the words of Galileo, in the mouth of Sagredo, describing in 1632 the famous fall of a stone from the top of the mast of a ship in motion. In this description the reality of preinertia is already considered, although not with that word but with the expression "marvelous effect in Nature" (italic and color are ours) [1, p. 228]:

> Sagredo. If it is true that the impetus with which the ship moves *remains imprinted on the stone after it has separated from the mast*, and if it is also true that this motion does not hinder or slow down the straight downward motion natural to the stone, *it is bound to follow a marvelous effect in Nature*.

Evidently, that marvelous effect of nature is the preinertia just (incompletely) defined above. But unfortunately no one in the later history of physics, not even Newton, has ever again considered that marvelous effect of nature which is preinertia. How to qualify that oversight?

In any case, preinertia has overwhelming empirical evidence: every time here on Earth a physical object falls to the ground just below the place where it initiated the fall, and not several kilometers further, the reality of preinertia is being demonstrated. Or every time a physical object loses its mechanical contact with the Earth, no matter how short that loss of contact lasts, and the object does not shoot out at 370 km/s, the reality of preinertia is being demonstrated. So, hundreds of millions of times a day, here on Earth, the physical reality of preinertia is confirmed.

Preinertia is a universal property of all physical objects, even photons are preinertial [2, p. 385-404]. It is also a fundamental property very significant from the point of view of mechanics: it is the reason why absolute motion, if it existed, would be undetectable. And, above all, it is the reason why it is possible to deduce that all motion is, in fact, absolute. The relative motion of physical objects, the only observable one, is the immediate consequence of their different absolute motions through a unique real physical space. The reasons why this must be so in our observable universe are given below.

2. Preinertia, linear momentum and kinetics energy

Suppose that, emulating Galileo, and from the top of a mast of a modern ship moving with a uniform velocity v relative to the port, the famous contemporary physicist Professor Michio Kaku[1] holds in his hand a stone of mass m_k that he is going to drop from the top of that mast. If m_s is the total mass of the ship, including Professor M. Kaku but not his stone of mass m_k, and simplifying things a lot, the linear momentum p (in scalar terms) and the kinetic energy E of the ship before Professor M. Kaku drops his stone, would be:

$$p = (m_s + m_k)v \tag{1}$$

$$E = \frac{1}{2}(m_s + m_k)v^2 \tag{2}$$

Without preinertia, i.e., if Kaku's stone does not inherit the velocity v of the ship, from the moment Kaku drops his stone until it reaches the floor of the ship, both the linear momentum and the kinetic energy of the ship would each suffer an unacceptable loss given respectively by:

$$\Delta p = -m_k v \tag{3}$$

$$\Delta E = -1/2 m_k v^2 \tag{4}$$

loss that is recovered as soon as the stone reaches the floor and is again in mechanical contact with the ship. Unacceptable loss, which even if it only lasts 1 second, violates the conservation of linear momentum and kinetic energy of the ship.

Therefore, Kaku's stone must inherit the motion of the ship when M. Kaku drops it (preinertia), and must maintain it (inertia) while it falls and rejoins the ship when it reaches its floor. This brief but effective argument must be applied to any physical object that ceases to be in contact, momentary or definitive, with another physical object on which it was at rest, for example the Earth, before being set in motion. For example, when you jump vertically and fall on the same place on which you jumped, and not several kilometers further (argument used in classical Greece to demonstrate the immobility of the Earth).

Thus, since we discovered the motions of the Earth, we humans have had a double opportunity to deduce the existence of preinertia as a mechanical property of all physical objects:

1. The motion of all (billions) of objects that initiate their own motion from the Earth, where they were at rest.
2. The unacceptable violation of the conservation of linear momentum and kinetic energy. Violations that disappear spontaneously as soon as the objects set in motion recover their state of rest on the Earth.

But, with the exception of Galileo, we have not taken advantage of either of these two opportunities. In the end, their rediscovery has been a pure work of the most random chance. And the officialdom of contemporary physics continues to disregard the reality of preinertia and its enormous importance in mechanics: preinertia explains, as we shall see briefly in the last section of this paper, the undetectability of absolute motion and the absolute nature of all motions through the same real physical space, although only relative motions can be detected and measured [5].

3. On the absolute nature of rotations

This section is included as a support of the following one. Indeed, both challenge one of the dogmas of contemporary physics: *absolute motion does not exist*. In a very simple way, the following text demonstrates the opposite: practically all cosmic objects are subject to absolute motions, both around internal axes of rotation and around external centers of rotation. [4]:

> In the case of the Earth, the first rotation to be considered is its rotation around an internal axis (the Earth's rotation axis). It is a real rotation because it produces observable and measurable effects: the apparent rotation of the Sun and the rest of the cosmic objects around the Earth. In each rotation of the Earth around its internal axis of rotation, each of its points describes a unique circle, with a unique center of rotation that will be a unique point on the

[1] We have chosen M. Kaku as a substitute for Galileo because he is one of the best known and most valued physicists of our time, as well as because of the Spanish sonority of his name... let's see if that helps someone to read this article.

unique Earth's rotation axis. And since in a single rotation a point cannot rotate at the same time around two different centers of rotation without being in different places at the same time, the motion of rotation of each of the points of the Earth around its corresponding center of rotation is unique and can only be referred to that unique center of rotation, which will therefore be an absolute center of absolute rotation. And this is true for every point of the planet. The rotation of the Earth around its internal axis of rotation is, therefore, a real and absolute rotation. Although, as we shall see, that absolute internal axis of absolute rotation is in turn rotating around other centers of absolute rotation external to the planet.

Instead of considering the points of the Earth, let us now consider the Earth as a whole, the Earth as a planet. The planet Earth, as a whole, now rotates in an elliptical orbit around the Sun (which occupies one of the two foci of the ellipse). That (so-called) translational motion of the Earth around the Sun also produces apparent motions in the rest of the cosmic objects. And although they are apparent, not real, appearances as such appearances are real: they are observable and measurable. And for the same reason as in the case of the points in the rotation of the Earth around its absolute internal axis of absolute rotation, the elliptical orbit of the Earth is also unique (although it is not stable and in time may oscillate with respect to certain equilibrium positions). So, also in this case, the rotation of the Earth around the Sun is a real and unique motion that can only be referred to the absolute geometrical elements of its unique absolute elliptical orbit (its two foci). It is therefore another real and absolute motion.

According to everything we know about the observable universe, the vast majority of its trillions of physical objects are subject to rotational motions (from one revolution every 100 quadrillion years in the case of some galaxies, to one quadrillion revolutions per second in the case of electrons.). And the above argument applies to all of them. Therefore cosmic objects do not rotate WITH RESPECT to the sphere of fixed stars, as advocated by E. Mach. [6, p. 83-84] [7, p. 45], but each of their rotations is a motion AROUND a unique and absolute axis, or center/foci, of rotation. They are, therefore, real absolute rotations, real absolute motions [3]. Thus, the vast majority of motions in the observable universe are absolute, not relative.

4. Preinertia and the nature of motion

As already announced, the first physical consequence of preinertia is the impossibility of detecting absolute motion. To demonstrate this, let us consider the possible detection of the absolute motion of an object A, for example the Earth, by setting in motion from A other physical objects B, C D etc. In doing so, and due to preinertia, they all inherit the motion of A to be detected, therefore they will move during all the time in the same way as A moves with the motion to be detected, so that from A only the relative motion of objects B, C D etc. with respect to A can be detected, exactly the same as if there were no absolute motion to be detected. A more formal version can be seen in [2, p. 421-426]. Thus, preinertia would make it impossible to detect absolute motion if such motion existed. One may wonder how different the history of modern physics would have been if Newton had rediscovered Galileo's preinertia (his *marvelous effect in Nature*).

But the same preinertia that makes impossible for us the detection of absolute motion, serves us to demonstrate, now in formal terms, the absolute nature of the motion of all physical objects in the universe. Indeed, let us consider any one of these objects, for example the object A of the previous paragraph, and suppose that another object B, which is at rest in A, is set in motion, obviously from A (or is created in A just before being set in motion, as could be the case with photons, which are also preinertial [2, p. 385-404]). If all motions are relative, A maintains literally trillions of such relative motions, one for each of the trillions of cosmic objects with respect to which it moves. And if B is to inherit the relative motion of A when it is set in motion (preinertia) which of those trillions of relative motions will it inherit, and why not another? What memory and what mechanism determines that inheritance? From everything we know about the physical world, neither that memory nor that mechanism exists. Therefore, if there is neither memory nor mechanism for that inheritance of relative motion, the only motion that B can inherit from A is the absolute motion of A **THROUGH** (NOT WITH RESPECT TO) the same real physical space, which was also the absolute motion of B when B was part of A, before it was set in motion from A. It must be concluded that preinertia, whose physical reality is unquestionable, demonstrates the absolute nature of motion (more details in [2, 3]).

Experimental tests carried out with a new scientific instrument, the inercioscope, point to the fact that photons do indeed inherit the motion of the reference system of their emitting source, thus pointing to the universal existence of preinertia. We currently have a working prototype

whose registration and patenting process will be the work of one of us, Ana León Mejía (University of Salamanca).

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