

Abstract.-In this article, five violations of the Principle of Relativity are presented, all of which are immediately deduced from the Lorentz Transformation. Each of these violations implies that certain physical laws, which should hold in all inertial reference frames, do not hold in all inertial reference frames. The areas involved include hydrostatics, structural crystallography, light reflection, elastic body mechanics, and chemical kinetics.

1 Introduction

Long before special relativity established the Principle of Relativity, 19th-century naturalists had already proposed and assumed something similar: the Principle of Actualism-Uniformitarianism (see for example [2]) which states:

The laws of nature are the same at all times and in all places.

Biology and Geology were founded and developed based on this principle. But, as usual, the sciences ignore each other. In fact, the Principle of Relativity says the same thing, although it refers to (abstract) reference frames instead of time:

The laws of physics are the same in all reference frames.

It is, therefore, a classical and modern conviction that the physical laws, or natural laws, must be the same at all times and in all places. However, this article explains several cases in which the Principle of Relativity is violated in certain reference frames, precisely by referring events to reference frames based on the spacetime continuum (interested readers can find other violations of this principle in [1]). For the rest of the article, I will always consider two inertial reference frames: RF_o , which will be the proper reference frame of the objects and processes discussed, and RF_v , another reference frame that coincides with RF_o at a certain instant and from which RF_o moves with a uniform velocity $v = kc; 0 < k < 1$ parallel to the increasing direction of the X_v axis of RF_v .

2 Violation of Pascal's Law

Let B be a bubble of a certain fluid F_2 in hydrostatic equilibrium within another fluid F_1 at rest inside an undeformable container. In the proper reference frame of the bubble (RF_o), the bubble is spherical due to the fact that the hydrostatic pressure is the same in all directions, which is an immediate consequence of Pascal's Law of hydrostatic pressure. Therefore, any section of the bubble, for example, the one parallel to the X_oY_o plane of RF_o , will be a circle (Figure 1, left).

In the inertial reference frame RF_v , the bubble has an ellipsoidal shape according to the FitzGerald-Lorentz contraction in the direction of the relative motion, and the corresponding section parallel to the X_vY_v plane of RF_v will be an ellipse (Figure 1, right). But that el-

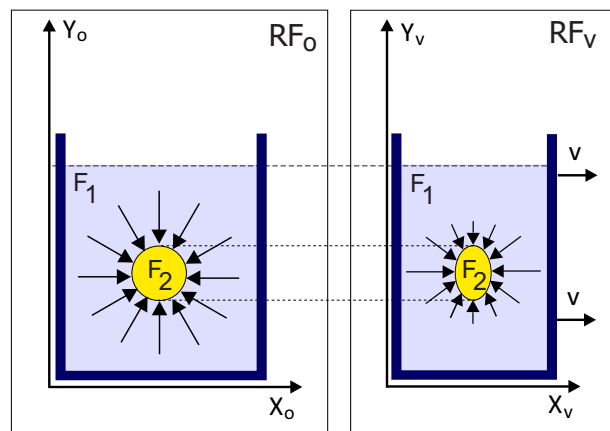


Figure 1 – Bubble of a fluid F_2 in hydrostatic equilibrium within another incompressible fluid F_1 , as seen from its proper reference frame RF_o (left) and from the reference frame RF_v (right).

lapse observed from RF_v is not compatible with Pascal's Law of hydrostatic pressure: in the reference frame RF_v , hydrostatic pressure is not equal in all directions; it is maximum in the direction of v and minimum in the direction perpendicular to v . We then have a simple and clear example of a violation of the Principle of Relativity: a physical law that holds in RF_o but not in RF_v . The alternative to this violation is that the corresponding deformation of space in the direction of relative motion is only apparent, an alternative that has the same consequences for the Principle of Relativity, for the reason that will be given in the last section of this article.

3 Crystallographic Violations

Non-amorphous minerals on Earth exhibit an internal structure based on the periodic distribution of their ionic or molecular constituents, which determines the fundamental laws of crystallography and the external morphology of crystals, a morphology that can vary within certain limits depending on the conditions of nucleation and crystal growth. As is well known, there are 7 major groups of crystal structures with their corresponding internal and external symmetries (crystallographic symmetry classes and subclasses).

One of the fundamental laws of crystallography is the Law of the Constancy of Dihedral

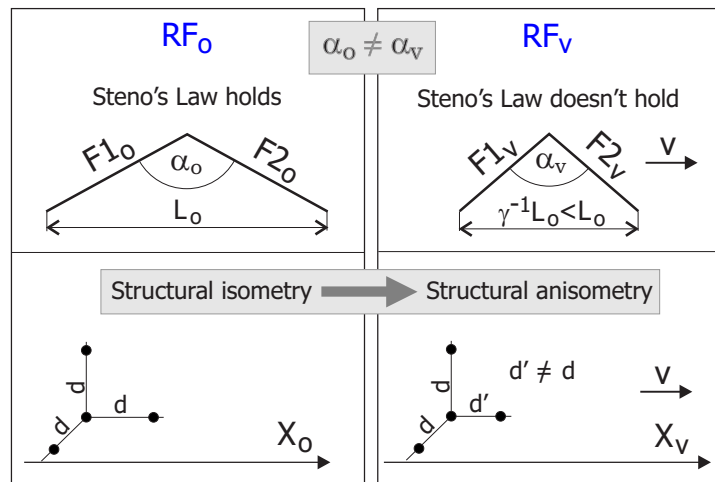


Figure 2 – Top, left and right: Steno's Law only holds in the proper reference frames (RF_o) of the crystals. $F1_o$ and $F2_o$ are faces of a crystal in RF_o , and α_o is their dihedral angle. $F1_v$ and $F2_v$ are the same faces on the left but seen from RF_v , and α_v is their dihedral angle. Bottom, left and right: Isometric crystals are only isometric in their proper reference frames (RF_o).

Angles, or Steno's Law, which states that any pair of crystal faces always forms the same dihedral angle as the equivalent faces of any other crystal of the same mineral species, an angle characteristic of that pair of faces and the mineral species to which the different crystals belong. But this law only holds in the reference frame RF_o proper to the corresponding crystals, because in any other inertial reference frame, like RF_v , a shortening of distances in the direction of the relative velocity v with which the crystals are observed will be observed, a shortening that will have inevitable consequences on the dihedral angles of some pairs of faces of each of the crystals. These relative dihedral angles will always be smaller than the corresponding proper dihedral angles, and consequently, different dihedral angles from what they should be, which are those characteristic of each mineral species (Figure 2, top).

But the violation of Steno's Law is not the only relativistic violation of the laws of crystallography. As is known, the system with the highest crystallographic symmetry is the cubic system (also called isometric). For the same reason as in the case of Steno's Law (the FitzGerald-Lorentz contraction in the direction of relative motion), crystals of the cubic system, as isometric crystals, can only be observed in their corresponding proper reference frames; in any other inertial reference frame, there will always be a shortening in the direction of the relative motion with respect to the crystals, a shortening that makes isometry impossible, and therefore the observation of isometric crystals. In other words: minerals of the cubic or isometric system are only isometric in their respective proper reference

frames. Isometric Bravais lattices are only possible in the proper reference frames of the corresponding crystals.

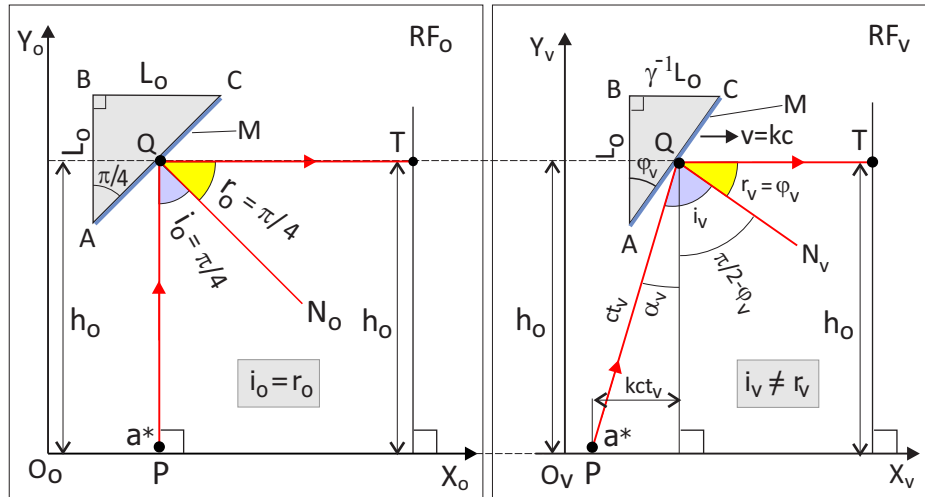


Figure 3 – Left: Reflection of the photon a^* by the mirror M as seen in the proper frame RF_o of the mirror M . Right: The same reflection as seen in RF_v .

4 Violation of the Law of Reflection of Light

Figure 3 (left) represents the reflection of a photon a^* by a mirror at 45° relative to the vertical trajectory PQ of that photon. The Second Law of Light Reflection establishes the equality of the angles of incidence i_o and reflection r_o . The right part of that figure represents the same reflection of a^* from the point of view of RF_v , according to which:

- The side BC of the mirror structure is contracted by a factor $\gamma^{-1} = \sqrt{1 - k^2}$. Therefore, the mirror is tilted relative to the vertical by an angle $\phi_v = \arctan \sqrt{1 - k^2}$.
- The photon a^* takes a time t_v to go from the point P at which it is emitted to the point Q where it is reflected, and during that time the mirror will have moved a distance $vt_v = kct_v$, so the incident trajectory of a^* will form an angle α_v with the vertical that satisfies:

$$\alpha_v = \arcsin \left(\frac{kct_v}{ct_v} \right) = \arcsin k \quad (1)$$

- Points Q and T are at the same vertical height h_o from the X_v axis, so the reflected trajectory will also be horizontal in RF_v .

Therefore, the angle of incidence i_v will be:

$$i_v = \alpha_v + \frac{\pi}{2} - \phi_v = \frac{\pi}{2} + \arcsin k - \arctan \sqrt{1 - k^2} \quad (2)$$

And the angle of reflection r_v :

$$r_v = \arctan \sqrt{1 - k^2} \quad (3)$$

And the difference $D_{vir} = i_v - r_v$ between the two depends on the relative velocity $v = kc$:

$$D_{vir} = i_v - r_v = \frac{\pi}{2} + \arcsin k - 2 \arctan \sqrt{1 - k^2} \quad (4)$$

As illustrated in Figure 4, this difference increases with the relative velocity. Therefore, the Second Law of Light Reflection is not verified in RF_v , regardless of the relative velocity $v = kc$.

5 Violation of the Mechanical Laws of Elastic Bodies

The case of the elastic band examined in the first article of this series showed how an elastic band, free of external forces, can appear with some parts more stretched than others when

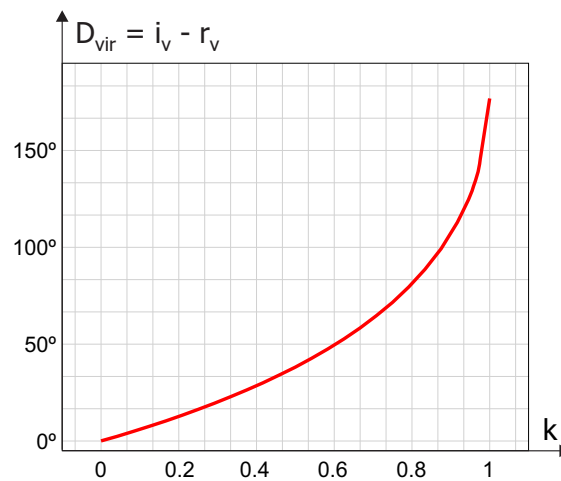


Figure 4 – In RF_v , the difference $i_v - r_v$ between the angle of incidence and the angle of reflection increases as k increases within the interval $(0, 1)$.

observed from inertial reference frames different from the proper inertial reference frame of the elastic band. The mechanical laws that explain the behavior of elastic bodies are not, therefore, satisfied in all inertial reference frames. Either the deformations responsible for these violations of mechanical laws are only apparent, not real. And being apparent, they cannot be used to establish physical laws, as will be seen at the end of the article.

6 Violation of Chemical Kinetics

This section uses the simplest possible chemical reaction: a single-step, first-order reaction for its only reactant R and its only product P . It will be sufficient to demonstrate the relativistic violation of the laws governing chemical kinetics. Indeed, consider the proper reference frame RF_o of the chemical reaction:



whose rate constant, for given conditions, is k_o . In the proper inertial reference frame in which the reaction occurs, and according to the laws of chemical kinetics, the following holds:

$$k_o = \frac{1}{dt} \frac{-d[R]}{[R]} \quad (6)$$

In any other inertial reference frame RF_v from which the proper reference frame RF_o of the previous reaction moves with uniform velocity v , a dilated time will be observed by the relativistic factor γ , and consequently, the rate constant of that reaction will be different from k_o under the same chemical conditions. Therefore, only in the proper reference frame of a chemical reaction is the rate constant what is deduced from the laws of chemical kinetics.

7 Consequences

The alternative to the relativistic violations of the laws of physics discussed in the preceding sections is to admit that the inertial spacetime deformations responsible for these violations are not real, but only apparent. But if they are only apparent, then they cannot be used to establish the corresponding physical laws; only measurements made in the proper systems of the objects involved can be used to establish those laws. Therefore, the Principle of Relativity is not verified: certain laws can only be established in certain systems and not in others.

Bibliographical References

- [1] A. León. *Apparent relativity*. Amazon's Kindle Direct Publishing, 2022. [Free pdf](#).
- [2] Charles Lyell. *Principles of Geology*. Penguin Books, 1997.