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The Study of Absoluteness Overlooked by Special Relativity

Hyoungseok Koh

Paradigm Research Center, 5 Gwangnaru-ro 16-gil, Gwangjin-gu, Seoul 05008, Republic of Korea

***Corresponding Author**
Hyoungseok Koh, Paradigm Research Center, 5 Gwangnaru-ro 16-gil, Gwangjin-gu, Seoul 05008, Republic of Korea

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Abstract

This study has reinterpreted the relativity of the laws of physics, an axiom of the special theory of relativity. Einstein interpreted that the relativity of the laws of physics is established due to the relativity of the inertial system. However, he did not consider that relativity was established despite the absoluteness of the inertial system being established. In this paper, we have assumed that relativity holds despite the absoluteness of the inertial system. This perspective is called observer relativity and is used distinguish it from the relativity of the inertial system. Relativity between the observers is expressed using the Lorentz and inverse transform since lights are used by the observers in both cases. To prove the absoluteness of the inertial system, a rigid ruler and light are used. If the observers measure the length with a rigid ruler and light, the reference system is consistent but the system of motion is different. This is defined as the absoluteness of the inertial system. To prove this absoluteness, several experiments were conducted to measure the electrostatic force between two electric charges fixed at the same distance. If the isotropy of space is satisfied, a stationary system can be defined. Conversely, it is defined as a constant velocity system. In the inertial system, the relativity between observers and absoluteness of the inertial system coexist.

Keywords: Special Relativity, Relativity between Observers, Inertial System, Absoluteness, Lorentz Transformation, Electrostatic Force

Introduction

The inertial system is governed by the law of inertia specified in "Mathematical Principles of Natural Philosophy," published by Newton in 1687 [1]. The law of inertia states that an object at rest remains at rest and an object in motion continues to move in the same direction unless external forces act on it. In the same book, Newton divided time–space into absolute and relative. He argued that only relative time–space can be measured and absolute time–space cannot [1]. However, the concept of absolute time and space is based on the Galilean transformation and its inverse transformation accepted in classical mechanics, wherein observers generally use a clock. An inertial system with a fixed clock becomes a resting system, and an inertial system without a clock becomes a constant velocity system.

The concept of absolute time and space was challenged with the development of electromagnetism. According to classical mechanics, light interference experiments were conducted to discover the stationary ether in absolute space. In 1886, Michelson–Morley's experiment was conducted to discover the ether known to be at rest. However, no interferences expected from classical mechanics could be found [2]. Accordingly, in 1899, Lorentz thought that different time scales should be used for every inertial system to express the electromagnetic law in the same form in each of them [3]. He proposed the Lorentz transformation equation, which is invariant to the speed of light even when transforming Maxwell's equations [3].

Meanwhile, in 1905, Einstein published the principle of special relativity, which adopted the principle of the constancy of light velocity and relativity of the physical laws [4]. He derived the Lorentz transformation and its inverse transformation again based on the two axioms [4]. The reference system and motion system observers use light and an atomic clock together; the principle of the constancy of light velocity is applied, and the Lorentz transformation and its inverse transformation are established between the two observers. Therefore, the reference observer considers itself stationary with the motion observer moving, whereas the motion observer considers itself stationary with the reference observer moving in the opposite direction. This is called relativity between observers. Here, it is crucial to distinguish the relativity between observers and that of the inertial system, primarily because the criteria for determining the relativity between observers and that of the inertial system are different. The relativity between observers indicates that the coordinates of two observers are relative except for the sign of the relative speed, such that the coordinates can be exchanged. The relativity of the inertial system indicates that the reference system and the motion system can be exchanged because both the observers are using the same clock and ruler.

However, Einstein did not distinguish between the relativity between observers and that of the inertial system. In addition, he interpreted the relativity of the laws of physics as being caused by the relativity of the inertial system, although he did not use the term relativity of the inertial system. He stated that it was physically impossible to distinguish between a resting system and a constant velocity system. An example is the electromotive force generated in a conductor moving relative to a magnet [5]. Einstein misunderstood the relativity between observers as the relativity of the inertial system. The absoluteness of the inertial system is established and not the relativity of the inertial system. Moreover, if the ruler and clock used by the reference system and motion system observers are examined, the resting system and constant velocity system can be distinguished. Distances measured by both are different in the motion system but are the same in the reference system.

This study reveals that the absoluteness of the inertial system is established in two stages. First, the theory describes that a reference system observer directly measures coordinates using a rigid ruler, light ruler, and an atomic clock. The law of invariance of the rigid ruler and the principle of the constancy of light velocity in the reference system apply here. Second, the motion system observer uses the light ruler and atomic clock to match the coordinates with the reference system observer. The principle of the constancy of light velocity in the inertial system applies here. Finally, it is found that when the reference system observer uses a rigid ruler and a light ruler, the length is the same, but when a motion system observer uses the aforementioned rulers, the length is different. In the experiment and discussion, theoretical experiments are presented to distinguish between the reference and motion systems using a rigid and light ruler together. An experiment was conducted to measure the electrostatic force acting between two electric charges located at the same distance using a rigid ruler in the reference inertial system and the motion inertial system. It was shown that the electrostatic force is isotropic in the reference system and not isotropic in the motion system. It is also proved that the resting system and the constant velocity system can be distinguished through electrostatic force experiments.

Theory

As matter and energy are distributed irregularly throughout the universe, establishing a universal inertial system is impossible. However, it is possible to construct an inertial system in a localized domain by defining the reference system as a local vacuum where the force exerted by the outside is zero, and an inertial system with a relative velocity v is the motion system. The transformation and its inverse transformation hold between an observer in the reference system and the observer in the motion system who meet simultaneously in the neighborhood.

Reference System Used By the Rigid Ruler, Light Ruler, and Clock

The rigid ruler is used to measure the space coordinates of a stationary point P. The material of the rigid ruler used in the reference system should be resistant to shrinkage and expansion. A rigid ruler does not change in length regardless of its location in the inertial system and which inertial system it is located in. This is called the principle of the constancy of the rigid ruler. When a mutual distinction is physically impossible, i.e., when the point and the graduation coincide mathematically, the graduation and the point are assumed to be in the neighborhood. Therefore, measuring the length using the rigid ruler means that two graduations on the ruler need to be in the neighborhood of the two points to be measured. However, Einstein did not define the concept of neighborhood.

The concept of the neighborhood should also be expressed to define the simultaneity of the reference system and motion system observers. The Lorentz transformation and its inverse transformation indicate that the reference system and the motion system observer have different times, but they meet at the same time in the vicinity. This is because in the Lorentz transformation and its inverse transformation, the simultaneous meeting between the reference system and motion system observers means being in the neighborhood.

To measure time in the reference system, an atomic clock with a constant period is fixed in the neighborhood of the stationary points in the reference system. The stationary point observer is equipped with the atomic clock, a light source, light receiving device, and reflecting mirror. To calculate the speed of light, the atomic clock measures the time in which the light travels to and from the rigid ruler. The speed of light is constant regardless of the location or direction of the rigid ruler. This is called the principle of the constancy of light velocity in the reference system. After measuring the speed of light, the times of the mutually separate atomic clocks are made to coincide. If the light is emitted when the clock O shows $t = t_1$ and it reaches the clock A at a distance of l, it is synchronized to

$$t_2 = t_1 + l/c, \tag{1}$$

Then, the clock A is assumed to have been synchronized with the clock O. All the clocks in the reference system are made to coincide in this manner; this is called the synchronization of atomic clocks [6]. When the rigid scale is used, the coordinates of the orthogonal coordinate axes x, y, z may be set with origin O at the center. This point is referred to as a stationary point P in Euclidian space. Furthermore, the time coordinate t of the point P may be obtained by the synchronization of the atomic clocks. Here, the stationary point of the reference system may be denoted in Cartesian coordinates $P(x,y,z,t)$. Thus, if the clocks of the reference system are synchronized, the distance between two points may be measured using light. For instance, when light from the clock P_1 at $t = t_1$ reaches the clock P_2 at $t = t_2$, the distance between the two points is determined as

$$l = c\,(t_2 - t_1). \tag{2}$$

This is referred to as the light ruler. Hence, the light ruler is composed of an atomic clock, light source, synchronous light, and light-receiving device.

There are two methods for measuring distance in the reference system, which is, using the rigid ruler and using the light ruler. However, Einstein did not distinguish between the rigid and light ruler when defining the reference system. In Equation (2), the distance measured by the light ruler is $c(t_2-t_1)$. Here, the distance measured by the rigid ruler from the clock P to clock Q is r, in which case the expression

$$r = c\,(t_2 - t_1). \tag{3}$$

Should hold. This is referred to as the coincidence between the rigid ruler and the light ruler in the reference system. Unlike the stationary point P, the coordinates of the moving point P'cannot be measured directly using the ruler and clock. Thus, the coordinates of P in the neighborhood are used instead. When moving, point P' passes the reference system observer at $P(x,y,z,t)$, the corresponding coordinates areP' (x,y,z,t), and these become P' $(x+\Delta x,y+\Delta y,z+\Delta z,t+\Delta t)$ when point P' passes the reference system observer

$$P_1\ (x+\Delta x,y+\Delta y,z+\Delta z,t+\Delta t) \tag{4}$$

Thus, as the coordinates of the stationary point and the moving point are defined, the velocity and acceleration of the moving point in the reference system can be obtained. In the reference system, the coordinates of the moving point are replaced by those of the stationary point passing by the neighborhood. In such a case, a question may arise as to whether the moving observer may be substituted with the reference system observer in the neighborhood. The moving observer cannot substitute the reference system observer. As the moving observer P' is fixed on the motion system, the moving observer P' is called the motion observerP'.

Relativity between Observers Revealed Using Light and Atomic Clocks Together

P' Passes the reference system observer P, meaning that P' is in the neighborhood of P. From Equation (4), it has been affirmed that a different light and clock must be used for the motion system observer moving at a relative velocity v with respect to the reference system observer $P(x,y,z,t)$. The reference system observer can directly measure the coordinates of time and space because they have a rigid ruler, light ruler, and clock, whereas some motion system observers prepare their atomic clocks and light rulers. As the motion system and reference system observers use the light ruler and the atomic clock together, two observers can derive the Lorentz transformation equation and its inverse transformation by applying the principle of the constancy of light velocity and the relativity of the laws of physics.

When the motion system observer P' $(\xi,\eta,\varsigma,\tau)$ passes by the neighborhood of the reference system observer $P(x,y,z,t)$, $\xi = k(x-vt)$, $\eta = y$, $\varsigma = z$, and $\tau = k\ (t-vx/c^2)$ $(k=1/\sqrt{(1-(v/c)^2})$. This is called the Lorentz transformation. When the point of the motion system P' $(\xi,\eta,\varsigma,\tau)$ is considered as the reference, the coordinates of the reference system $P(x,y,z,t)$ are $x = k(\xi+v\tau)$, $y = \eta$, $z = \varsigma$, and

$$t = k\ (\tau+v\xi/c^2\ ); \tag{5}$$

This is called the Lorentz inverse transformation.

Comparing the Lorentz transformation and its inverse transformation, all coordinates of the reference system and the motion system observers are relative except for the sign of the relative velocity. By analyzing the Lorentz transformation and its inverse transformation, it is impossible to distinguish between a stationary observer and a constant velocity observer. This suggests that the relativity of the physical laws is because of the relativity between observers. The relativity between observers is established because the reference system and motion system observers use the light ruler and atomic clock together. In the Lorentz transformation and its inverse transformation, times and the axes parallel to the direction of motion are relative. However, Einstein argued that the theory of relativity in the laws of physics was because of the relativity of inertial systems. To establish the relativity of the inertial system, the motion system observer must use a rigid ruler similar to the reference system observer. However, the motion system observer does not use a rigid ruler because it is not needed to derive the Lorentz transformation and its inverse transformation. The question then arises as to what happens when the motion system observer uses a rigid body as well as a light ruler and an atomic clock. In the next section, the length measured by the motion system observer with a rigid and a light ruler will be explained.

Absoluteness of the Inertial System Proved Using a Light Ruler and Rigid Ruler Together

From Equation (3), it can be observed that when a reference system observer measures the length using both the rigid ruler and light ruler, the length is the same. However, it is important to determine whether the length measured by a motion system observer using a rigid ruler and light ruler will be the same. Herein, a motion system using a light ruler and a mechanical motion system using a rigid ruler are described separately. The principle of the constancy of light velocity is applied to the light ruler, whereas the law of invariance of the rigid ruler is applied to the rigid ruler. The ξ-axis of the motion system is set to coincide with the x'-axis of the mechanical motion system. The η and y' axes are parallel, and the ς-axis and the z'-axis are parallel. Einstein did not distinguish between the motion system that commonly uses the light ruler and the mechanical motion system that commonly uses the rigid ruler.

The mechanical motion system observer P'' (x',y',z',t') passing by the neighborhood of the reference system observer $P(x,y,z,t)$ satisfies the following equations.

The reference system observer $P(x,y,z,t)$ is considered as the reference and the following Galilean transformation holds: $x' = x - vt$, $y'=y$, $z'=z$, and $t'=t$. When the mechanical motion system observer P'' (x',y',z',t') is considered as the reference, the following Galilean inverse transformation holds:

$$x = x' + vt,\ y = y',\ \text{and}\ z = z' \tag{6}$$

Where t indicates the time in the reference system.

The Lorentz transformation and inverse transformation, both of which generally use light, indicate relative time and space, whereas the Galilean transformation and its inverse transformation, which commonly use a rigid body, use absolute space and time.

Fig. 1 indicates the origin O and observer P of the reference system, the origin O' and observer P' of the motion system, and the origin O'' and observer P'' of the mechanical motion system. Observer P'' of the mechanical motion system and observer P' of the motion system simultaneously pass the reference system observer P at a velocity v in the positive axis direction. Three observers locate the relative simultaneous line perpendicular to the motion axis. The distance measured by the motion system observer with a light ruler is called the electromagnetic length, whereas that measured with a rigid ruler is called the mechanical length. The electromagnetic length from the origin of the motion system O' to the observer P' is given by $L=\sqrt{[k(x-vt)]^2+y^2+z^2}$ (or by $L=\sqrt{\xi^2+\eta^2+\varsigma^2}$). Thus, the mechanical distance from the origin of the mechanical motion system O'' to the observer P'' is given by $R=\sqrt{(x-vt)^2+\eta^2+\varsigma^2}$ (or by $R=\sqrt{(\xi/k)^2+\eta^2+\varsigma^2}$). It can be seen that $L\neq R$, indicating non-coincidence.

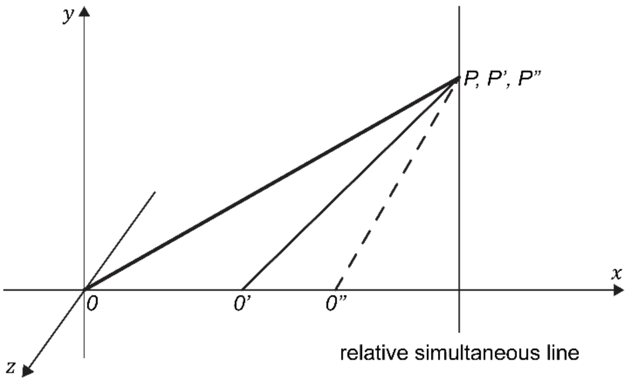

Figure 1: Observer P'' of the mechanical motion system and observer P' of the motion system simultaneously meet the neighborhood of the reference system observer P at a velocity v in the positive axis direction. Three observers locate the relative simultaneous line perpendicular to the motion axis

The distances measured by an observer P' of the motion system and an observer P'' of the mechanical motion system are not the same.

Since the special relativity presupposed the relativity of the inertial system, Einstein misunderstood that the motion system uses both light and a rigid ruler to measure the length in the same way as the reference system. He did not know that the lengths measured with light and rigid ruler differed in motion. He thought that when a motion system observer P' $(\xi,\eta,\varsigma,\tau)$ uses a light ruler and a rigid ruler to measure coordinates parallel to the motion axis, they are given by $\xi=k(x-vt)$. Einstein argued that the length of a rigid ruler placed in a motion system was reduced [7]. In reality, the length of the rigid ruler remains constant, but the length of the rigid ruler measured with light only increases by k times. He failed to recognize that when a mechanical motion system observer P'' (x',y',z',t') uses a rigid ruler, the coordinates of the axis parallel to the motion axis are given as $x'=x-vt$. When the inertial system observers measure the distance between two stationary points using both the rigid ruler and light ruler, it can be assumed as the resting system in the case of coincidence; otherwise, it is identified as the constant velocity system. This is referred to as the absoluteness of the inertial system.

Results and Discussion

In the previous section, the reference system observer directly measures coordinates with a rigid ruler, light, and an atomic clock, whereas the motion system observer matches the reference system observer with light and an atomic clock. The relativity between observers is established because the reference system and motion system observers use light and the atomic clock together, and the absoluteness of the inertial system is established because only the reference system observer uses a rigid ruler. To prove that the relativity between observers and the absoluteness of the inertial system coexist, a thought experiment measuring the electrostatic force is conducted separately in the reference and motion systems.

Electrostatic Experiments Distinguishing the Reference System from the Motion System

As mentioned above, one can distinguish between the resting system and constant velocity system if the inertial system observer uses both the rigid ruler and light ruler together. However, it is difficult for the inertial system observer to measure the length using both the rulers together.

Fig. 2 shows two experiments performed in the reference system and the exercise system together. Two experiments are conducted when $t=0$, based on the clock of the reference system. The origin O' of the motion system and the motion system observer P^' simultaneously move the origin O of the reference system and the reference system observer P at a velocity v in the positive x-axis direction. To conduct an experiment distinguishing the resting system from the constant velocity system, it is necessary to use the property that the quantity of electric charge does not change in the reference and motion systems. To provide identical experimental conditions, the electric charges Q_1 and Q_2 (quantity of electric charge q_1 and q_2, respectively) are set as constants. The distance r measured between the electric charges Q_1 and Q_2 using a rigid ruler is also set as constant. Thus, measuring the electromagnetic forces exerted between the electric charges determines whether it is the resting system or the constant velocity system. After the experiments, the electrostatic forces measured in the reference system and motion system are compared.

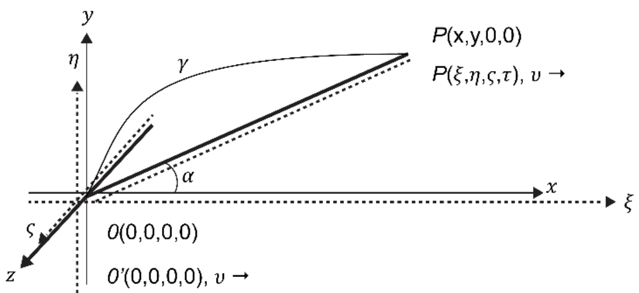

Figure 2: As the reference system and the motion system are installed in a local region, two experiments are conducted when $t=0$, based on the clock of the reference system. The origin O' of the motion system and the motion system observer P' simultaneously move the origin O of the reference system and the reference system observer P at a velocity v in the positive x-axis direction.

Electrostatic Force Exerted Between Two Electric Charges of the Reference System

Fig. 3 is an experiment to measure the electrostatic force acting between two electric charges fixed to the reference system. As the electric charge Q_1 is at the origin $O(0,0,0,0)$ of the reference system, and the electric charge Q_2 is fixed at the reference system observer $P(x,y,0,0)$, Coulomb's law is applied. The force mutually acting between the two electric charges is given by

$$F_1 = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}\left(r = \sqrt{x^2+y^2}\right). \qquad (7)$$

The electrostatic forces are the same irrespective of the directions of the two electric charges.

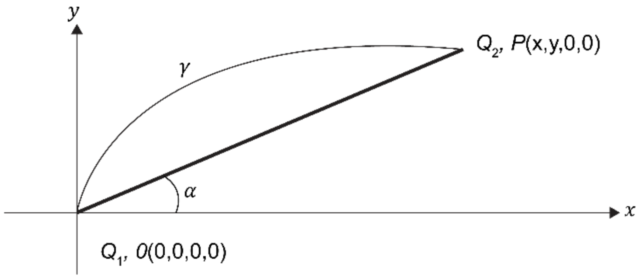

Figure 3: Measurement of electrostatic forces exerted by the electric charge of the reference system Q_1 on the electric charge of the reference system Q_2

Electrostatic Force Exerted Between Two Electric Charges of the Motion System

Fig. 4 is an experiment to measure the electromagnetic force acting between two electric charges fixed in a motion system. Electric charge Q_1 is at the motion system origin*O*' (0,0,0,0), whereas electric charge Q_2 is fixed at the motion system observer P^' (ξ,η,ς,τ). Thus, Q_1 passes by the neighborhood of the reference system originO(0,0,0,0), whereas Q_2 passes by the neighborhood of the reference system observer *P*(*x,y,0,0*). *P*' Measures the electrical force vector *E*(*X*',*Y*',*Z*') produced by Q_1 as follows: ξ = *R cos α*' ,*η* = *R sin α*' ,ς=0,R=√($\xi^2+\eta^2$). The distance R and the direction cosine of wave tangentcosα,cos(*π/2-α*), 0 were measured with a light ruler.

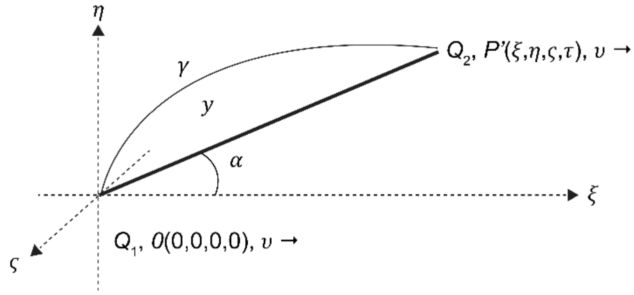

Figure 4: Measurement of electrostatic forces exerted by the electric charge of motion system Q_1 on the electric charge of the motion system Q_2

$$X' = \frac{q_1}{4\pi\varepsilon_0}\frac{\cos\alpha'}{R^2},\ Y' = \frac{q_1}{4\pi\varepsilon_0}\frac{\sin\alpha'}{R^2},$$

$$\therefore X' = \frac{q_1}{4\pi\varepsilon_0}\frac{\xi}{(\xi^2+\eta^2)^{\frac{3}{2}}},\ Y' = \frac{q_1}{4\pi\varepsilon_0}\frac{\eta}{(\xi^2+\eta^2)^{\frac{3}{2}}}, Z' = L' = M' = N' = 0.$$

Meanwhile, *P*' perceives that P moves at velocity -v along the x-axis.

As mentioned previously, the Lorentz transformation and its inverse transformation can be applied to two observers moving relatively. Therefore, it is possible to derive the transformations between observers in electromagnetic fields by applying the Lorentz transformation and its inverse transformation to the Maxwell–Hertz equation that consists of differential equations. Einstein derived the transformation on the electromagnetic field by applying the Lorentz transformation and its inverse transformation to Maxwell's equation.

The motion system observer *P*' (*ξ,η,ς,τ*) moving at velocity v with respect to the reference system observer *P*(*x,y,z,t*) in the positive x-axis direction is assumed to satisfy the Lorentz transformation. If the electric force vector of P is given as *E*(*X,Y,Z*) and the magnetic force vector is *A*(*L,M,N*), whereas the electric force vector of the motion system observer is given as E^' (*X*',*Y*',*Z*') and the magnetic force vector is *A*' (*L*',*M*',*N*'), then the following transformation holds [8]:

$$\begin{aligned} &X' = X, \qquad L' = L, \\ &Y' = k\left(Y - \frac{v}{c}N\right), M' = k\left(M + \frac{v}{c}Z\right) \\ &Z' = k\left(Z + \frac{v}{c}M\right),\ N' = k\left(N - \frac{v}{c}Y\right) \end{aligned} \qquad (8)$$

When the Lorentz transformation holds, the inverse transformation on the electromagnetic field will hold, as follows:

$$\begin{aligned} &X = X', \qquad L = L' \\ &Y' = k\left(Y' + \frac{v}{c}N'\right),\ M = k\left(M' - \frac{v}{c}Z'\right) \\ &Z = k\left(Z' - \frac{v}{c}M'\right),\ N' = k\left(N' + \frac{v}{c}Y'\right) \end{aligned} \qquad (9)$$

In Equations (8) and (9), the transformation and inverse transformation on the electromagnetic field are mutually relative, which is similar to the case of the Lorentz transformation and its inverse transformation. The transformation and inverse transformation of the electromagnetic field are products of the relativity between observers and not the relativity of the inertial system.

The electromagnetic force vector m"asur'd by P may be calculated by applying the electromagnetic field vector of *P*' to the electromagnetic field transformation using Equation (9).

$$X = X' = \frac{q_1}{4\pi\varepsilon_0}\frac{\xi}{(\xi^2+\eta^2)^{\frac{3}{2}}},$$

$$Y = kY' = k\frac{q_1}{4\pi\varepsilon_0}\frac{\eta}{(\xi^2+\eta^2)^{\frac{3}{2}}} \tag{10}$$

$$N = k\frac{v}{c}Y' = k\frac{q_1}{4\pi\varepsilon_0}\frac{v}{c}\frac{\eta}{(\xi^2+\eta^2)^{\frac{3}{2}}}, Z = L = M = 0.$$

Meanwhile, $\xi=kx,\eta=y,\varsigma=0,\tau=-vkx/c^2$ are obtained from the Lorentz transformation using Equation (5) when t = 0. Substituting Equation (5) in Equation (10), the electromagnetic force vector measured by P can be obtained.

$$\begin{aligned} X &= X' = \frac{q_1}{4\pi\varepsilon_0}\frac{x}{((kx)^2+y^2)^{\frac{3}{2}}}, \\ Y &= kY' = k\frac{q_1}{4\pi\varepsilon_0}\frac{ky}{((kx)^2+y^2)^{\frac{3}{2}}}, \\ N &= k\frac{v}{c}Y' = k\frac{q_1}{4\pi\varepsilon_0}\frac{v}{c}\frac{ky}{((kx)^2+y^2)^{\frac{3}{2}}}, \\ Z &= L = M = 0. \end{aligned} \tag{11}$$

It shows the electromagnetic force vector instantaneously applied from the charge Q_1 of the motion system origin *O*' to the charge fixed to the reference system observer P. This shows the electromagnetic force vector instantaneously exerted by the electric charge Q_1 of the motion system origin *O*' on *P*.

When *P*' observes the previous experiment, it appears as if the observer is stationary while *P* is passing by the neighborhood at velocity -v on the ξ-axis. Hence, the electric charge Q_2 of *P*' senses the occurrence of the Biot–Savart force owing to the electromagnetic force vector measured by P in Equation (11). The electromagnetic force sensed by Q_2 of *P*' is given by $F'=q_2[E+1/c(-v)\times A]$ with respect to the electrical force vector E and the magnetic force vector A of P. The force exerted by Q_1 of the motion system origin *O*' on Q_2 of *P*' is given as follows:

$$F'_x = q_2 X = \frac{1}{k^2}\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}\frac{\cos\alpha}{\left[1-\left(\frac{v}{c}\sin\alpha\right)^2\right]^{\frac{3}{2}}}$$

$$F'_y = q_2\left[Y-\frac{v}{c}N\right] = \frac{1}{k^4}\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}\frac{\sin\alpha}{\left[1-\left(\frac{v}{c}\sin\alpha\right)^2\right]^{\frac{3}{2}}},$$

$$F'_z = 0,$$

Therefore,

$$F'_4 = \frac{1}{k^2}\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}\frac{\sqrt{1-2\left(\frac{v\sin\alpha}{c}\right)^2+\left(\frac{v^2\sin\alpha}{c^2}\right)^2}}{\left[1-\left(\frac{v}{c}\sin\alpha\right)^2\right]^{\frac{3}{2}}} \tag{12}$$

$$\alpha = 0, F'_4 = \frac{1}{k^2}\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}, \tag{13}$$

Corresponding to the minimum. When

$$\alpha = \frac{\pi}{2}, F_4'' = \frac{1}{k}\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}, \quad (14)$$

When viewed from the reference system, the force exerted by Q_1 on Q_2 can be observed to vary depending on the velocity v of the motion system and angleα.

Distinction between the Resting System and Constant Velocity System Using Electrostatic Forces

In the first experiment, the forces exerted between Q_1 and Q_2 are identical, regardless of the direction, according to Equation (7). The electrostatic force acting mutually between the two electric charges in the reference system is the same, regardless of the directions of the two electric charges. In the second experiment, the force between Q_1 and Q_2 varies depending on the relative velocity v of the motion system and angle α, according to Equation (12). The electrostatic forces between the two electric charges in the motion system differ each time the direction is changed. Thus, the system can be defined as a resting system if the isotropy of the space is satisfied upon examination of the electrostatic forces between the two electric charges, and as a constant velocity system otherwise.

Conclusion

The reference system observer directly measures coordinates with a rigid ruler, light, and an atomic clock, whereas the motion system observer matches the reference system observer with light and an atomic clock. When an experiment is conducted in the inertial system using lights and atomic clocks, the Lorentz transform and its inverse transform are established. The reference system and motion system observers are relative to each other except for their relative velocities. This is called relativity between observers. However, if the experiments are conducted in inertial systems where both the light ruler and rigid ruler are used together, one can distinguish between the reference and motion systems. The Lorentz transformation is satisfied for a motion system observer using a light ruler, whereas the Galilean transformation is satisfied for a mechanical motion system observer using a rigid ruler. Therefore, if the lengths measured by the light ruler and rigid ruler are the same, the system is a resting one; otherwise, it is a system with constant velocity. This is called the absoluteness of the inertial system. In the inertial system, the relativity between observers and the absoluteness of the inertial system coexist. Meanwhile, in electromagnetic experiments, the relativity between observers and the absoluteness of the inertial system coexist. For example, the relativity of the observer was shown in the transformation of the electromagnetic field and its inverse transformation, whereas the absoluteness of the inertial system was shown in the electrostatic force experiments. Consequently, it should be noted that the relativity of the laws of physics is due to the relativity between observers and not the relativity of the inertial system. In this study, it was theoretically and experimentally proved that the constant velocity system differs in length measured with a rigid ruler and a light ruler, unlike a resting system. This means that electromagnetics as well as special relativity described on the premise of relativity of the inertial system must be corrected.

Statements and Declarations

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Conflicts of Interest

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Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

References

1. Newton, I. (1999). The Principia mathematical principles of natural philosophy. Univ of California Press.
2. Michelson, A.A., Morley, E.W. (1887). On the relative motion of the Earth and the luminiferous ether. Am. J. Sci. 34, 333–345.
3. Lorentz, H.A. (1904). Electromagnetic phenomena in a system moving with any velocity smaller than that of light. Proc. R. Netherlands Acad. Arts Sci. 6, 809–831.
4. Einstein, A. (1981). On the Electro mechanics of Moving Bodies. In: Miller A.I. (eds.) Albert Einstein's Special Theory of Relativity, p. 395. Addison-Wesley Publishing Company, Inc., MA.
5. Einstein, A. (1981). On the Electromechanics of Moving Bodies. In: Miller A.I. (eds.) Albert Einstein's Special Theory of Relativity, p. 392. Addison-Wesley Publishing Company, Inc., MA.
6. Einstein, A. (1981). On the Electromechanics of Moving Bodies. In: Miller A.I. (eds.) Albert Einstein's Special Theory of Relativity, pp. 393-394. Addison-Wesley Publishing Company, Inc., MA.
7. Einstein, A. (1931). Relativity, the Special and General Theory p. 47-48. Crown Publishing Group Publishers, New York.
8. Einstein, A. (1981). On the Electro mechanics of Moving Bodies. In: Miller A.I. (eds.) Albert Einstein's Special Theory of Relativity, p. 406. Addison-Wesley Publishing Company, Inc., MA.