

The Context of Lorentz Transformation

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Abstract

The hypothesis that the universe is filled with a “drifting aether” was initially explained by Maxwell’s discovery that the speed of light in a vacuum is a constant, independent of the implicated velocity in the reference frame. The Michelson-Morley experiment was designed to look for “drifting aether”. Instead, the experiment turned out to be zero. Disappointed, Lorentz came up with the Lorentz contraction factor, which perfectly explained the zero results of the Michelson-Morley experiment. Then, the famous Lorentz transformation was proposed. But the “local time” is just a hypothesis, a virtual number, with no physical or mathematical meaning. Finally, Einstein put forward the space-time view of special relativity, which gave the physical significance of “Lorentz transformation” and “local time”. At the same time, we put forward the design principle of Michelson-Morley experiment, the derivation principle of Lorentz transformation formula, the definition principle of Einstein’s simultaneity, and the existing problems, and put forward our own questions, looking forward to teachers’ criticism and correction.

Keywords

Michelson-Morley experiment, Lorentz contraction, Lorentz transformation, Definition of simultaneity, Relativity of simultaneity

1. Introduction

In the 17th century, Descartes rejected Newtonian mechanics of action at great distances, arguing that the interaction between objects, namely gravity, was transmitted through a uniformly distributed, absolutely static medium in the universe, known as the Ether. The celestial bodies in the universe, in which, according to certain laws, free shuttle.

In 1861, Maxwell showed that the speed of light in a vacuum

$$V = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

It’s a constant.

In fact, measuring instruments on Earth are always within the earth’s atmospheric medium. If the static aether is true, since the earth is orbiting the sun at 30 kilometers per second, the aether creates an “aether wind” relative to the earth’s surface.

The speed of light in this particular inertial frame is equal to V only in the ether, which is at absolute rest in a vacuum, by means of the light waves propagating in the ether. Suppose the earth rotates at a speed of V , and if the absolutely static aether really exists, the speed at which light waves travel in the atmosphere at the surface of the Earth is v plus or minus V . To prove this fact, a series of optical and electrical experiments were conducted, known as “etheric drift” experiments. The most famous of these, in July 1887, Michelson conducted the Michelson-Morley experiment in Cleveland with the

famous chemistry professor Morley. However, the final result was “zero results”.

The negative result of the search for etheric indicates that the etheric flow being detected does not exist. In 1889 and 1892, respectively, Fitzgerald and Lorentz, who protected the aether, proposed their own so-called “contraction hypothesis” in order to conform to the zero result of the Michelson-Morley experiment. The negative result, they argued, was because the experimental tube was shortened in the direction of motion.

In 1895, Lorentz published “Theoretical Study on Electromagnetic and Optical Phenomena in Moving Objects”, and formally proposed the transformation formula between static reference variables x, y, z, t and reference variables x', y', z' and local time t' moving with v , which is known as Lorentz transformation. However, the local time t' is merely an auxiliary variable introduced for mathematical convenience. It is a hypothetical number with no real physical or mathematical significance.

In his paper “On the Electrodynamics of Moving Bodies” published in The German Journal of Physics in September 1905, Einstein proposed the space-time view of the special theory of relativity, and formally gave a new physical meaning to the Lorentz coordinate transformation formula of static and dynamic systems, comprehensively opening a new situation of the revolution of physics.

Einstein proved Lorentz transformation in two ways, a simple method and a coordinate method. Here are some of the problems we found, for discussion with interested readers [1-5].

2. The Michelson-Morley Experiment

Relativity was born out of the Lorentz transformation, Lorentz transformation from Michelson Morley experiment. Michelson Morley experiment was designed by Michelson and Morley in 1887 to prove that the Earth was drifting at the speed of revolution v in the absolutely static “ether” that filled the universe.

The idea is that parallel and vertical beams of light passing through a spectroscope are refracted back through an equidistant mirror, and the two beams are combined as superimposed components. If the last time the light traveled back and forth from the parallel arm is the same as the last time the light traveled back and forth from the vertical arm, the two resulting rays are in the same phase and thus reinforce each other. But if the two times are slightly different, there will be a slight phase difference between the two rays, resulting in interference. If the device is “stationary” in the ether, then the two times should be exactly equal, but if it is moving to the right with velocity v , then the two times should be different. The instrument was sensitive enough to see the effect, but no time difference was detected—the earth’s speed through the ether could not be detected. The results of the experiment showed no such effect.

$$t_{\parallel} = \frac{L}{V-v} + \frac{L}{V+v} = \frac{2LV}{V^2 - v^2} = \frac{2L/V}{1 - v^2/V^2}$$

$$t_{\perp} = \frac{2L}{\sqrt{V^2 - v^2}} = \frac{2L/V}{\sqrt{1 - v^2/V^2}}$$

$$t_{\parallel} \neq t_{\perp}$$

$$t_{\parallel} < t_{\perp}$$

PROBLEM (1) The light on the vertical axis does not have inertia superposition with the velocity v of the ether relative to the earth’s surface, but moves at an equal distance L up and down, perpendicular to the horizontal direction

$$t_{\perp} = \frac{2L}{V} \neq \frac{2L}{\sqrt{V^2 - v^2}}$$

PROBLEM (2) The relative velocity of the light on the vertical axis with the spectroscope is

$$\sqrt{V^2 + v^2}$$

The path is a zigzag diagonal line with symmetry up and down opposite to the direction of the spectroscope.

PROBLEM (3) the distance between the light on the vertical axis and the spectroscope when it returns to the parallel plane of the starting point

$$\because \frac{2L}{V} < \frac{2L/V}{\sqrt{1 - v^2/V^2}}$$

$$\therefore \text{Deviating from the distance} = 2 \cdot \frac{2L}{V} \cdot v = 4L \cdot \frac{v}{V}$$

In other words, when the light on the vertical axis returns, it has already deviated from the position of the spectroscope, that is, the starting point. In any case, it will not meet the light returning from the parallel arm. Of course, the interference phenomenon will not be observed, which is a “zero result”.

PROBLEM (4) the time of the light “going” on the parallel arm

$$t_1 = \frac{L}{V-v}$$

The time of the light “back” on the parallel arm

$$t_2 = \frac{L}{V+v}$$

The travel of the light “going” on the parallel arm

$$L_1 = t_1 V = L + t_1 v = L + \frac{Lv}{V-v}$$

The travel of the light “back” on the parallel arm

$$L_2 = t_2 V = L - t_2 v = L - \frac{Lv}{V+v}$$

The travel of the light “back and forth” on the parallel arm

$$L_1 + L_2 = 2L + 2L \cdot \frac{v/V}{1 - v^2/V^2} > 2L$$

In other words, the distance of light going back and forth on the parallel arm is not equal to the distance of light going back and forth on the vertical axis. The design of the Michelson-Morley experiment was mathematically wrong and physically meaningless.

3. Lorentz Transformation

In fact, the Michelson-Morley experiment, in the atmosphere of the Earth’s surface, has the following conditions:

(1) There is no aether in the universe and on the surface of the Earth, and the atmosphere is relatively stationary with the ground. Light travels to and from the parallel and vertical arms in the same way

$$t_{\parallel} = t_{\perp} = \frac{2L}{V}$$

The experiment yielded zero results.

(2) The idea that medium completely drags the ether. Stokes proposed in 1845 that at the surface of the Earth, the aether had the same speed as the Earth, that is, the earth completely dragged the aether. The atmospheric and etheric media are relatively stationary with the ground, and the travel of light to and from the parallel and vertical arms is the same.

$$t_{\parallel} = t_{\perp} = \frac{2L}{V}$$

The experiment yielded zero results.

(3) The idea that the medium does not drag the ether at all. Fresnel argued in 1818 that the earth was made of extremely porous material through which the aether moved with little hindrance. The aether on the earth’s surface can be regarded as stationary because the air on the earth’s surface, with an index of refraction close to 1, cannot or can only be extremely weakly dragged. This is what the Michelson-Morley experiment looked at earlier, namely that the Earth was designed to drift at the speed of revolution v in the absolutely static “ether” that fills the universe. However, we have shown that:

1) The aether is equivalent to the earth's surface moving at the speed of revolution v , and the travel of the light in the parallel arm and the travel of the light in the vertical arm are actually different.

2) The interpretation of the light on the vertical axis is wrong, as is the resulting speed of light and the time taken for the round trip.

3) The light returned from the vertical axis has deviated from the light emitted by the spectroscope, and the experiment is of course zero.

Because, with or without an ether, and whether the ether is stationary or moving, all experiments have zero results. That is, there is no way to determine whether there is an aether in the universe or not; If there is an aether, is it static or moving?

In addition, the principle on which the experiment is based is wrong, and the calculation formula is wrong, so it is meaningless in mathematical principle, and meaningless in physical principle.

However, the Michelson-Morley experiment, the meaningless experiment, the wrong conclusions, the wrong formulas, led to a series of epochal events in physics, the most important of which was the Lorentz contraction theory that revolutionized physics.

In order to explain the zero result of the Michelson-Morley experiment, Lorentz assumed that in the absolutely static aether, the moving body would have Lorentz contraction in the direction of motion due to the physical changes taking place inside. Let the rest length of the object in the ether be L_0 , then the length after contraction due to motion is L

$$L = L_0 \sqrt{1 - \frac{v^2}{V^2}}$$

$$L_0 = \frac{L}{\sqrt{1 - \frac{v^2}{V^2}}}$$

So the length of the vertical arm should be the rest length L_0 , and the length of the parallel arm should be the motion length L

$$t_{\perp} = \frac{2L_0}{V} \cdot \frac{1}{\sqrt{1 - \frac{v^2}{V^2}}} = \frac{2LV}{V^2 - v^2} = t_{\parallel}$$

In this way, the round-trip time of the light ray on the vertical arm is equal to the round-trip time of the light ray on the parallel arm, which corresponds to the zero result of the experiment, and then comes up with the famous Lorentz transformation.

If there are electromagnetic states represented by x, y, z and t as variables in the stationary reference frame, then there must also be electromagnetic states represented by the same functions represented by relative coordinates x', y', z' and local time t' as independent variables in the reference frame with the same physical structure and with v moving.

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{V^2}}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - \frac{v}{V^2}x}{\sqrt{1 - \frac{v^2}{V^2}}}$$

It's important to note that the original Lorentz transformation, and the Lorentz transformation of special relativity, are formally the same, but in fact represent completely different meanings.

The condition for formula transformation here is that there is an absolute static aether in the universe, and the earth rotates around the sun in the aether at the speed of revolution v . $x-vt$ refers to the length measured parallel to the ground in the reference frame relative to the earth at rest, which is actually the contraction length corresponding to the length in the

ether at absolute rest. x' is the corresponding uncontracted length in the ether, which is absolutely stationary and moving relative to the earth's surface. The relationship between the two is

$$x - vt = x' \sqrt{1 - \frac{v^2}{V^2}}$$

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{V^2}}}$$

y and z refer to the measured lengths perpendicular to the ground in the reference frame with respect to the earth at rest, which in fact correspond to the lengths in the ether at absolute rest without contraction. y' and z' are the corresponding uncontracted lengths in the absolutely stationary aether moving relative to the earth's surface. Because there's no contraction, the vertical length is always the same.

$$y' = y$$

$$z' = z$$

As for the local time t' , it is just an auxiliary variable introduced for mathematical convenience. It is a hypothetical number with no real physical or mathematical significance, so it is called the so-called "local time". The t in the relation is the "real time"—the observed time in the etheric reference frame, which has practical physical significance.

The hypothetical time, the hypothetical relationship, they come out like this

$$x' = Vt', x = Vt, t = \frac{x}{V}$$

$$Vt' = \frac{Vt - v \frac{x}{V}}{\sqrt{1 - \frac{v^2}{V^2}}} \Rightarrow t' = \frac{t - \frac{v}{V^2} x}{\sqrt{1 - \frac{v^2}{V^2}}}$$

In 1905, Einstein established the special theory of relativity, which formally gave a new physical meaning to the Lorentz coordinate transformation formula of static and dynamic systems, opening a new situation of the revolution of physics.

4. Special Relativity

The introduction of special relativity was an epoch-making event in physics. The opening work of special relativity, *On the Electrodynamics of Moving Bodies*, introduces two axioms, the principle of special relativity and the principle of invariance of light speed, as well as the definition of simultaneity, thus deduces the relativity of length and time and its transformation formula, namely Lorentz transformation.

5. The Principal of Narrow Relativity

The principle of relativity in a narrow sense means that all inertial systems are equal and all physical laws have the same representation.

In particular, Einstein said, the effect of shrinking feet and slowing clocks in dynamical systems with respect to static systems; if the original dynamic system is regarded as static system, the original static system becomes dynamic system, and the same effect of shrinking feet and slowing clock is observed.

Let a rigid measuring rod L_0 be placed in the static system, and its length L in the dynamic system

$$L = \frac{L_0}{\sqrt{1 - \frac{v^2}{V^2}}}$$

According to the principle of relativity, the original dynamic system is regarded as static system, and the original static system is regarded as dynamic system. Relative to the length L of the static system, the length L_0 in the dynamic system also has the same scaling effect.

$$L_0 = \frac{L}{\sqrt{1 - \frac{v^2}{V^2}}}$$

$$L = \frac{L_0}{\sqrt{1 - \frac{v^2}{V^2}}}, L_0 = \frac{L}{\sqrt{1 - \frac{v^2}{V^2}}} \Rightarrow L = \frac{L}{1 - \frac{v^2}{V^2}} \Rightarrow v = 0$$

If and only if, the implicated velocity $v=0$, it can be seen that motion does not change the space interval, and the principle of relativity is not valid.

Let's place a clock with time t at the stationary origin and a clock synchronized with the stationary origin at the moving origin. Because of the clock slow effect, time becomes τ

$$\tau = \sqrt{1 - \frac{v^2}{V^2}} \cdot t$$

According to the principle of relativity, the original moving system is regarded as static system, and the original static system is regarded as dynamic system. The clock time t of the moving origin has the same clock slow effect relative to the clock time τ of the stationary origin.

$$t = \sqrt{1 - \frac{v^2}{V^2}} \cdot \tau$$

$$\tau = \sqrt{1 - \frac{v^2}{V^2}} \cdot t, t = \sqrt{1 - \frac{v^2}{V^2}} \cdot \tau \Rightarrow \tau = \tau \left(1 - \frac{v^2}{V^2}\right) \Rightarrow v = 0$$

If and only if, the implicated velocity $v=0$, it can be seen that motion does not change the time interval, and the relativity principle is not valid.

6. Principle of Invariance of Light Speed

The principle of the invariable speed of light refers to that the speed of light in a vacuum is independent of the motion state of the light source and the viewer. The speed measured in any inertial system is the same and is a constant.

In fact, this is not only a phenomenon of light, the speed of sound has the same phenomenon. And it's easy to explain. The fact that light and sound can travel through solid glass and steel, as well as liquid water, suggests at least the following:

- (1) Their propagation velocity does not occur inertial superposition of the velocity of the reference frame;
- (2) They are transmitted not by macroscopic particles, but by microscopic particles;
- (3) The velocities of light and sound measured in any reference frame are instantaneous, not average, and are the velocities of microscopic particles traveling through the medium; And the reference system in which the macroscopic object is located, neither superposition velocity, nor relative velocity, but relative to the ground velocity, therefore has no relation with the reference speed, is always a constant value;
- (4) Their velocities are only relative to the reference frame;
- (5) Galilean velocity superposition occurs only when there is inertial involvement between the object and the reference frame; it's something that happens between macroscopic and rigid objects. Light and sound, however, are not macroscopic rigid objects, but waves of microscopic particles traveling through a medium, and do not superimpose inertia with the speed of the reference frame, and do not follow galilean velocity transformations. There is no contradiction between the two, and there is nothing incomprehensible. The so-called contradiction, the so-called unintelligibility, is caused by the conflation of phenomena which are fundamentally different in nature, and of two physical events which are microscopic and macroscopic respectively.

QUESTION (5) The speed of light in all the formulas of special relativity can be replaced by the speed of sound, so if we say that the maximum speed in the universe is the speed of sound, and that time and space are linked by the speed of sound, we can see how absurd the theory of relativity is.

QUESTION (6) Let's look at the expression of the principle of invariance of the speed of light in the motion system

expressed in special relativity

$$\xi = V\tau$$

Doesn't make any sense.

We know that a physical event has a fixed beginning and end. We also know that the application of reference system and transformation, is for mathematical calculation, to simplify, convenient and practical and adopted. However, it does not change the nature of physical events, let alone the beginning and end of physical events. However, $\xi = V\tau$, if it is a physical event, its starting point is always the origin of the moving coordinate system, and it changes continuously. The starting point of this physical event is the origin of the static coordinate system, which is fixed. Therefore $\xi = V\tau$ has no physical significance.

We also notice that the origin of the moving frame is always the same as the end of the event. A beam of light, simultaneously driven from the origin of the coordinate system, travels to the end of the event. Such a physical event does not exist at all. $\xi = V\tau$ has no physical significance.

7. Absolute Time and Relative Time

Newton defined time in the following way: "Absolute, real and mathematical time is determined by its properties and passes itself uniformly, independent of all external things. Relative, superficial, and ordinary time is perceived and external, a measure of the continuity of movement, and is often used instead of real time, such as an hour, a day, a month, a year".

We think the time is used to represent the motion state and properties of the universe, such as the concrete and the abstract, the material of the concrete and the abstract material performance changes, such as reform and opening up, the environmental pollution, metabolism, and a physical change and chemical change, and so on. Their time interval has nothing to do with space interval.

Time is a concept, there is no absolute time and specific time. Newton's absolute, real and mathematical time, which is determined by its characteristics, actually refers to what the concept of time is, that is, the definition of time.

Time, perceivable, external, the measure of the continuance of motion, relative, superficial, and ordinary, is the measure of time, the instrument of measure of time, and the unit of measure of time.

Newton said that time flows freely through history and has nothing to do with anything external; that is, every point in space is at the same time.

These are the most basic natural knowledge and the most basic axioms. If it is distorted and tampered with in any form, it is bound to bring science into the absurd metaphysical abyss and bring devastating disaster to mankind.

The clock is just one of the many ways people have represented time through the ages, and it is now largely obsolete. No method of telling time is infallible, and no timekeeping device is infallible. Naturally, no representation can take the place of standard time, nor can any timekeeping device. A clock is only a slightly better timekeeper than an hourglass. Clocks cannot represent either standard time or time at a point in space. Because time at a certain point in space is physically, strictly speaking, meaningless, and all points in space are simultaneously, otherwise the world and science would be thrown into chaos; it doesn't make sense mathematically because cosmic time is calculated, not read with a timekeeping tool.

That is to say, with the change of any object's position in space, with the change of any object's performance state, can be used to represent the local time, also can represent the historical time and the time of the universe. However, for the convenience of daily life, cultural exchanges, scientific research, economic development and information communication of people around the world, since ancient times, people have used the well-known, eternal and regular movement cycle of celestial bodies as the standard for calculating time. Usually, the earth orbits the sun once a year as a standard, with the birth of Jesus Christ as the first year of the Year, to calculate time.

8. Einstein's Definition of Simultaneity

A clock at point A can define the time of an event at A (t_A), and a clock at point B can define the time of an event at B (t_B). When an optical signal travels from position A to position B and immediately returns to A, we can say that the two points are at the same time if we have the time relation $t_B - t_A = t'_A - t_B$, that is, if the light takes the same amount of time to go back and forth between the two points.

$$t_B = \frac{1}{2}(t_A + t'_A)$$

The experimental condition is static reference frame, namely ground reference frame. We know that there is no such

thing as a stationary reference frame in the universe, and the ground reference frame is not a stationary reference frame. The earth is going around the sun at 30 kilometers per second, so this experimental method, it doesn't make any physical sense.

We have said many times that calling time at a point is short for "time in space at a point", and if it is not a definite physical event, time refers to time in space, not time at a point in space, where all points are simultaneously. So Einstein's definition of the simultaneity of two points is a false statement, that is, it makes no sense in physics.

9. Relativity of Simultaneity

Einstein said that when a static system is a simultaneous event, in motion its simultaneity breaks down and it can no longer be simultaneous. This is the sole basis and reason of special relativity. When moving, the time at a certain point in the static system will change in the dynamic system, and then it can be deduced that the space position will also change. Finally, the transformation formula of space-time coordinates, namely lorentz transformation, is derived.

The most typical example is "lightning strikes the locomotive and caboose". Observing the locomotive and caboose on the stationary ground corresponds to two points on the track at the same time, but observing the locomotive and caboose on the moving train is different

$$t_{AB} = \frac{L}{V-v}$$

$$t_{BA} = \frac{L}{V+v}$$

$$t_{AB} \neq t_{BA}$$

$$t_B - t_A \neq t'_A - t_B$$

$$t_B \neq \frac{1}{2}(t'_A + t_A)$$

In fact, we assume that the simultaneous definition is correct, and this conclusion is also wrong. Because, in motion, the travel of the light from the back of the car to the front of the car, and the travel of the light from the front of the car to the back of the car, is not the distance L of the car. One is a little bit longer than L, one is a little bit shorter than L. Now, using the definition of simultaneity, if the light rays take the same amount of time to go back and forth between two points at equal distances, then we can say that these two points are at the same time, and it doesn't make any sense to determine the simultaneity of these two points.

The time of light "going" from the rear to the front

$$t_1 = \frac{L}{V-v}$$

The time of light "returning" from the front to the rear

$$t_2 = \frac{L}{V+v}$$

The journey of light from the rear to the front

$$L_1 = t_1V = L + t_1v = L + \frac{Lv}{V-v}$$

The journey of light from the front to the rear

$$L_2 = t_2V = L - t_2v = L - \frac{Lv}{V+v}$$

The "back and forth" of the light travel

$$L_1 + L_2 = 2L + 2L \cdot \frac{v/V}{1 - v^2/V^2} > 2L$$

That is to say, the round-trip distance of the tail-light is not equal to the round-trip distance of the tail-light at rest. Einstein's principle of experimental design, in which relativity is simultaneously destroyed in motion, is mathematically wrong and physically meaningless.

There is no doubt that the lorentz transformation of special relativity derived from these erroneous conclusions must also be wrong.

10. Conclusion

Across the bridge of Newton's classical space-time to Einstein's special theory of relativity time space view, lorentz transformation, is certainly a big and heavy and complicated project, in order to let the reader to see as much as possible, the cause and effect of lorentz transformation, we all know the classic of the original theory, always with the least amount of words, sketching out in non-professional not rigorous style. For our analysis, but also strive to be concise, clear at a glance, multi-use formula, less text method, so that readers can easily understand our meaning. However, due to the lack of our knowledge, the level of restrictions, mistakes are unavoidable, hope teachers can criticize and correct, not stingy give advice for hope.

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