New Verification Experiment of an "Ether Vacuum" and Measurement of Absolute Velocity of the Earth

—A New Interpretation of the Michelson–Morley Experiment

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[Abstract] Based on an in-depth analysis of the Michelson–Morley experiment, this study reveals that the moving speed of the Michelson–Morley experimental apparatus cannot be superimposed on the propagation speed of light in "ether vacuum". Furthermore, there are design flaws in the Michelson–Morley experiment. Therefore, the Lorentz's length contraction hypothesis and the Lorentz transformation have no experimental basis. A new experimental apparatus is proposed in this study to verify the existence of an "ether vacuum" and measure the absolute velocity of the Earth. The new experimental apparatus has an asymmetric optical path structure and double-slit interference. A laser source is divided into two laser beams, the first laser beam is always in the glass medium, and the second laser beam is partially in the glass medium and partially passes through an "ether vacuum". With theoretical analysis and calculation, it can be concluded that the number of interference fringes moving is 1.12 before and after the apparatus is stationary and moving at a constant speed of 100 m/s. To measure the absolute velocity of the earth in the "ether vacuum", the experimental apparatus is placed in different positions and directions and slowly rotated 180 degrees to observe the number of interference fringes moving. When the number of interference fringes moving is the maximum, the x-axis of the experimental apparatus is consistent with the direction of the absolute velocity of the earth. The absolute velocity of the Earth relative to the "ether vacuum" can be calculated with the number of interference fringes moving. The "ether vacuum" is an integral and indivisible absolute stationary space. Therefore, the inertial frames involved in the "ether vacuum" are not independent of each other. Neither Newton's classical principle of relativity, nor Einstein's general validity of the principle of relativity is applicable to inertial frames involving the "ether vacuum". The special relativity derived from the principle of invariance of the speed of light and the general validity of the principle of relativity is no longer true.

[Keywords] Michelson–Morley Experiment, "Ether Vacuum", Lorentz transformation, New Verification Experimental Apparatus, Inertial Frame, Principle of Relativity, Special Relativity.

1. Introduction

In the 19th century, it was widely believed that cosmic spaces were filled with a medium called "ether", which was an elastic medium that propagated electromagnetic waves, including light waves. The stationary "ether" was a special inertial frame, which is the absolute stationary space. According to the Galilean transformation, in the stationary "ether" inertial frame, the propagation speed of light waves in all directions is equal to a constant c. In the inertial frame of relative "ether" motion, the propagation speed of light waves along various directions is not equal.

To search for "ether" and measure the speed of the Earth relative to "ether", in 1887, Albert Michelson and Edward Morley conducted a famous physics experiment, the Michelson–Morley experiment [1] [2][3][4]. Below, "ether" and "vacuum" are referred to as "ether vacuum".

In the Michelson–Morley experiment, an apparatus as shown in Figure 1-1 was used. It mainly includes a light source A, a partially silver-plated glass sheet B, and two mirrors C and E. All of these are mounted on a sturdy base. Two mirrors were placed at a distance equal to L from B. The glass sheet B divides the incoming light into two beams, which are directed perpendicular to each other toward two mirrors and reflected to B. After returning to B, the two beams of light are combined as superimposed components D and F. If the time for the light to travel back and forth from B to E is the same as the time for the light to travel back and forth from B to C, then the two beams D and F have the same phase, thus resulting in the strengthening of the two beams. However, if there is a slight difference between the two times, there will be a slight phase difference between the two beams, resulting in an interference phenomenon. If the apparatus is stationary in an "ether vacuum", then the two times should be exactly equal. However if the apparatus moves to the right at speed u, then the two times should be different.

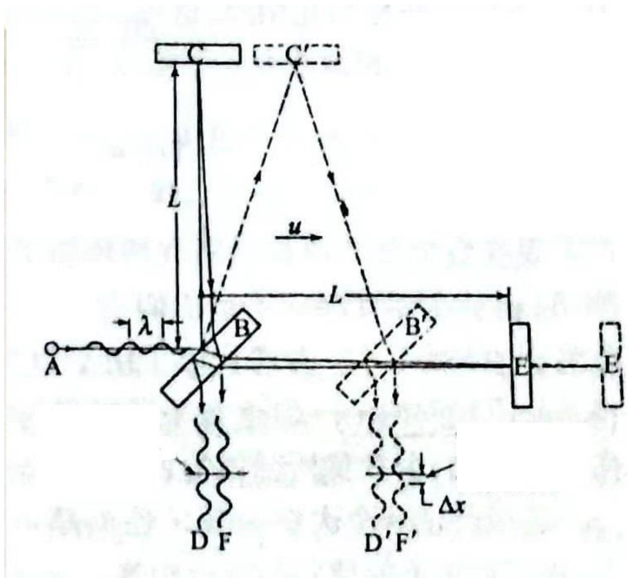

Figure 1.1. Apparatus of the Michelson–Morley Experiment

First, we calculated the time required for the first beam of light to travel from B to E and then back to B. We assumed that the time required for light to travel from B to mirror E is t_1 and the return time is t_2. We can obtain the time required for light to travel from B to E:

$$t_1 = L/(c - u)$$

The time required for light to return from E to B is:

$$t_2 = L/(c + u)$$

Therefore, the total time required for light to travel from B to E and then back to B is:

$$t_1 + t_2 = L/(c-u) + L/(c+u)$$

$$t_1 + t_2 = 2cL/(c^2 - u^2) \qquad (1\text{-}1)$$

For the purpose of comparing the time, we used the following:

$$t_1 + t_2 = (2L/c)/(1 - u^2 / c^2) \qquad (1\text{-}2)$$

The second beam of light travels from B to C and then back to B. We assumed that t_3 is the required time for light to travel from B to mirror C. Within time t_3, mirror C moves to the right ut_3 and reaches position C'. The light moves a distance ct_3 along the hypotenuse of a right triangle, i.e., BC'. For this right triangle, we have:

$$(ct_3)^2 = L^2 + (ut_3)^2$$

Thus, the following can be concluded:

$$t_3 = L/(c^2 - u^2)^{1/2}$$

The distance and time returned from C' are the same as above. Therefore, the total time of travel of the second beam of light is:

$$2t_3 = 2\,L/(c^2 - u^2)^{1/2}$$

$$2t_3 = (2\,L/c)/(1 - u^2/c^2)^{1/2} \qquad (1\text{-}3)$$

According to Equations (1-2) and (1-3), the time difference between the two beams is:

$$\Delta t = (t_1 + t_2) - 2t_3$$

$$= (2\,L/c)/(1 - u^2 / c^2) - (2\,L/c)/(1 - u^2/c^2)^{1/2}$$

$$\Delta t = (2\,L/c)\,(1/(1 - u^2 / c^2) - 1/(1 - u^2/c^2)^{1/2}) \qquad (1\text{-}4)$$

In the above experiment, the time difference and optical path difference between the two beams of light are not zero, and interference fringes appear on the observation screen. If the entire experimental device is slowly rotated 90 degrees, the interference fringes should move. After the experimental device is rotated 90 degrees, the time difference that can be obtained is:

$$\Delta t' = (t_1' + t_2') - 2t_3'$$

$$\Delta t' = (2\,L/c)\,(1/(1 - u^2/c^2)^{1/2} - 1/(1 - u^2 / c^2)\,) \qquad (1\text{-}5)$$

The change in the time difference before and after the experimental device is rotated 90 degrees is:

$\delta t = \Delta t - \Delta t'$

$= (4\ L/c)\ (1/(1 - u^2 / c^2) - 1/(1 - u^2/c^2)^{1/2})$

Since u/c is much less than 1, the approximate formula can be obtained:

$1/(1 - u^2 / c^2) = 1 + u^2 / c^2$

$1/(1 - u^2/c^2)^{1/2} = 1 + (u^2 / c^2)/2$

Then, the following can be obtained:

$\delta t = (2\ L/c)\ (u^2 / c^2)$

The number of interference fringes moving is as follows:

$$\Delta N = c\delta t/\lambda \qquad (1\text{-}6)$$

$$\Delta N = (2\ L/\lambda)\ (u^2 / c^2) \qquad (1\text{-}7)$$

where λ is the wavelength of light in a vacuum.

In the Michelson–Morley experiment, L=11 m, λ=5.9 x 10^{-7} m, and u = 3.0 x 10^{-4} $m \cdot s^{-1}$ (the speed at which the Earth rotates around the sun), calculated by Equation (1-7), and ΔN=0.37 can be obtained. However, the experimental observation results are less than 0.01.

The results of the Michelson–Morley experiment were very confusing. In 1892, Lorentz first proposed the length contraction hypothesis: objects contract when they move, and contraction only occurs in the direction of motion. A strict mathematical formula, which is called the Lorentz transformation, was obtained.

$$x' = \frac{x - ut}{\sqrt{1 - u^2/c^2}}$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t - ux/c^2}{\sqrt{1 - u^2/c^2}}$$

In the above equations, the spatiotemporal coordinates of the inertial frame S are (x, y, z, t), and the spatiotemporal coordinates of the inertial frame S' are (x', y', z', t'). The x'-axis of the inertial frame S' coincides with the x-axis of the inertial frame S, and the inertial system S' moves along the x-axis at a uniform speed u relative to the inertial system S.

Through an in-depth analysis and research of the results of the Michelson–Morley experiment, Lorentz abandoned the Galilean transformation and proposed the hypothesis of length contraction. With mathematical derivation, Lorentz obtained the Lorentz transformation.

2. A New Interpretation of the Michelson–Morley Experiment

In the above analysis of the Michelson–Morley experiment, the second beam of light travelling from B to C and then back to B passes along the hypotenuse of the right triangle BC', which is a misconception of light propagation.

Below, we will conduct an in-depth analysis of this problem based on Newton's classical kinematics. As shown in Figure 2.1, a small car moves at a constant speed u in the x-direction. From Point A at the front end of the car, a solid small ball P_A is emitted at a constant speed u_x relative to the car, and the total speed of the small ball P_A is $u_A = u+u_x$. From Point B on the side of the car, a solid small ball P_B is emitted at a constant speed u_y toward the y direction. The small ball P_B moves along the inclined edge BC at the combined speed of u and u_y. Figure 2.1 shows the inclined edge BC of the solid small ball P_B, which is the path inclined edge BC' of the beam in Figure 1.1.

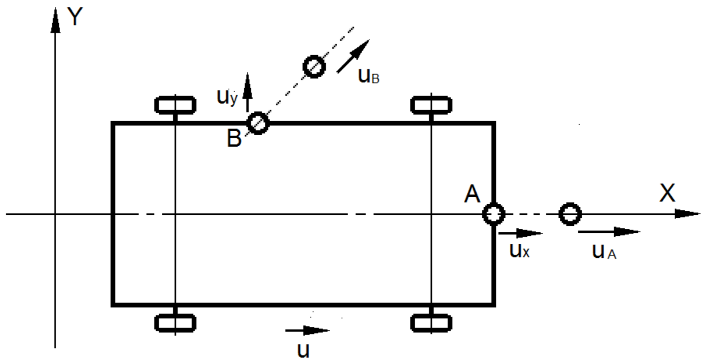

Figure 2.1. The speed of a solid small ball on a moving car

Furthermore, the solid balls at Points A and B in Figure 2.1 are replaced with Sounders S_A and S_B, as shown in Figure 2.2.

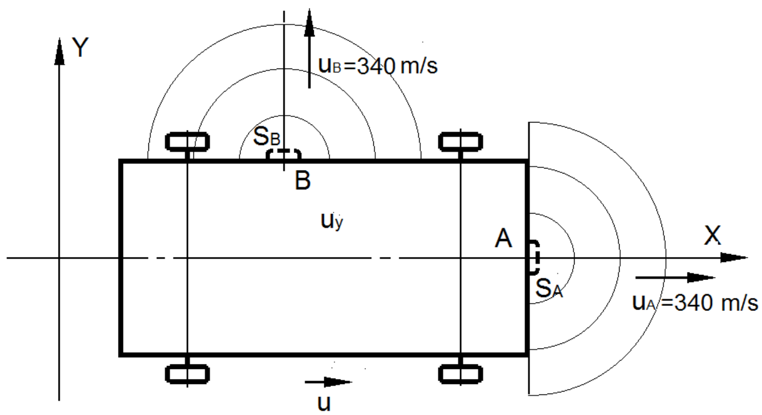

Figure 2.2. The propagation speed of sound waves on a moving car

The sound waves emitted by the sounder are mechanical waves. The moving speed u of the car in the x-direction cannot be superimposed on the gas molecules participating in the propagation of sound waves; that is, the moving speed u of the car cannot affect the propagation speed and direction of sound waves. The sound wave emitted by Sounder S_A has a constant propagation speed u_A of 340 m/s, but based on the Doppler effect, its frequency increases. The sound wave emitted by Sounder S_B has a constant propagation speed u_B, and the propagation direction is parallel to the y-axis, not along the inclined path superimposed on the moving speed u of the car.

From the above analysis, even for Newton classical dynamics, the moving speed u of the car cannot be superimposed on the propagation speed of mechanical sound waves. In the Michelson–Morley experiment, as shown in Figure 1.1, the light beam is a wave of light fields, and the speed u of the experimental device cannot be superimposed on the propagation of the second beam of light from B to C and then back to B. Therefore, the propagation path of the second beam of light is not the inclined edge BC'. and the second beam of light is perpendicular to the direction of motion of the experimental device from Point B to Point C and then returns from the original path of Point C to Point B. Therefore, the total time of the second beam of light is:

$$2t_3 = 2\,L/c \qquad (2\text{-}1)$$

According to Equations (1-2) and (2-1), the time difference between the two beams is:

$$\Delta t = (t_1+t_2) - 2t_3$$

$$\Delta t = (2\,L/c)/(1-u^2/c^2) - 2\,L/c \qquad (2\text{-}2)$$

After the experimental device is rotated 90 degrees, the time difference between two light beams can be obtained:

$$\Delta t' = -((2L/c)/(1-u^2/c^2) - 2L/c) \quad (2\text{-}3)$$

From Equations (2-2) and (2-3), it can be concluded that before and after the experimental device is rotated 90 degrees, although the time difference between the two beams of light has changed, the absolute value of the time difference is equal, and the "-" sign in Equation (2-3) indicates that the positions of two beams of light with different phases are swapped. Since the two beams of light are not double-slit interference, and are only superimposed at the same position, this does not affect the interference fringes of the two beams of light, that is, they do not produce a shift in the interference fringes.

Reconsider Equations (1-4) and (1-5), and rewrite equation (1-5) as:

$$\Delta t' = -(2L/c)\,(1/(1-u^2/c^2) - 1/(1-u^2/c^2)^{1/2}) \quad (2\text{-}4)$$

From Equations (1-4) and (2-4), it can also be concluded that although the time difference between the two beams of light has changed before and after the experimental device is rotated 90 degrees, the absolute value of the time difference is equal, and the "-" sign in Equation (2-4) indicates that the two beams of light with different phases are swapped in position. This does not affect the interference fringes of the two beams of light, that is, they do not produce a shift in the interference fringes. Therefore, there are design flaws in the Michelson–Morley experiment. The new experimental device should use double-slit interference to achieve a shift in the interference fringes.

In summary, in the Michelson–Morley experiment, the second beam of light moves not along inclined edge BC', and there are design flaws in the Michelson–Morley experiment. Therefore, the Lorentz's length contraction hypothesis and Lorentz transformation have no experimental basis.

2. New Verification Experiment of an "Ether Vacuum" and Measurement of Absolute Velocity of the Earth

To verify the existence of an absolutely stationary "ether vacuum" and measure the velocity of the Earth relative to the "ether vacuum", a new verification experiment of an "ether vacuum" is proposed in this study. The experimental apparatus is shown in Figure 3.1.

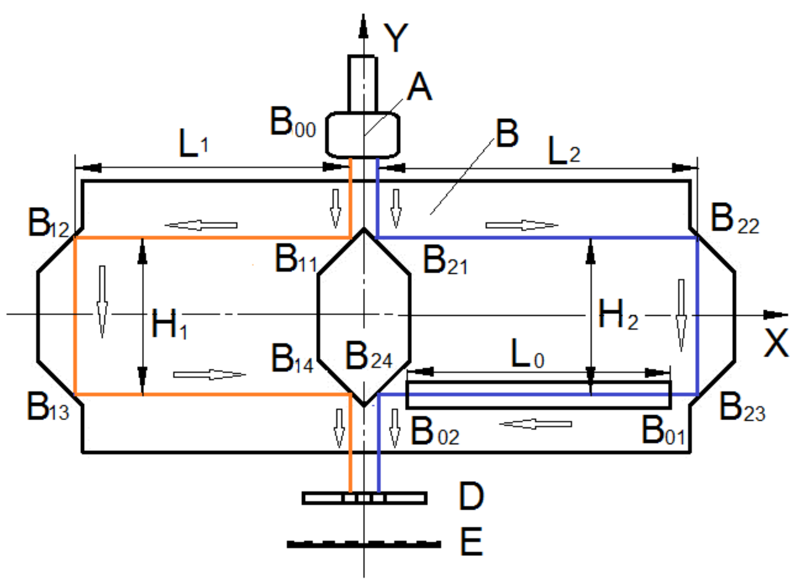

Figure 3.1 Verification experimental apparatus of an "ether vacuum"

The apparatus mainly includes a laser light source A, a glass optical path system B, a double slit plate D, and an interference observation screen E. All these components are installed inside a vacuum container. In the glass optical system B, reflective surfaces are formed by silver plating at B_{11} and B_{21}, B_{12} and B_{22}, B_{13} and B_{23}, and B_{14} and B_{24}. The laser beam generated by Laser Source A is vertically injected into the glass optical path system B from B_{00}. The beam is divided into two beams that transmitted to the left and right directions through the two reflection surfaces B_{11} and B_{21}. The first beam on the left passes through B_{12}, B_{13} and B_{14} and is emitted from the left slit of the double slit plate D to the interference observation screen E. The second laser beam on the right passes through B_{22} and B_{23}, is emitted from the glass at B_{01} into the "ether vacuum", and is then injected into the glass again at B_{01}. The second laser beam is reflected at B_{24} and then emitted from the right slit of the double-slit plate D to the interference observation screen E. In this way, two laser beams generate interference fringes on the observation screen E.

In the apparatus shown in Figure 3.1, the distance from B_{11} to B_{12} on the left side of the optical path is L_1, the distance from B_{12} to B_{13} is H_1, and the distance from B_{13} to B_{14} is L_1. On the right side of the optical path, the distance from B_{21} to B_{22} is L_2, the distance from B_{22} to B_{23} is H_2, $H_2=H_1$, and the "ether vacuum" distance from B_{01} to B_{02} is L_0. The speed of light in glass is set to 0.67c. When the car is stationary, the time of the first laser beam on the left from B_{11} to B_{14} can be calculated as follows:

$$t_1 = (2L_1 + H_1)/(0.67c) \qquad (3\text{-}1)$$

The time of the second laser beam on the right from B_{21} to B_{24} can be calculated as follows:

$$t_2= (2L_2 + H_2 - L_0)/(0.67c) + L_0/c \qquad (3\text{-}2)$$

In the experiment, we set L_0=2 m，L_2=2.1 m， and $H_2 = H_1$ =0.1 m. To make the time difference between the two laser beams equal to 0 when the car is stationary, the following is obtained from Equations (3-1) and (3-2):

$$(2L_1 + H_1)/(0.67c) = (2L_2 + H_2 - L_0)/(0.67c) + L_0 / c$$

Then, L_1=1.77 m is obtained.

In the experimental apparatus with the above structural parameters,the time difference between the two laser beams reaching the observation screen E is equal to 0 when the car is stationary, that is:

$$\Delta t_0=0$$

When the car moves to the right at a constant speed u=100 m/s, the first laser beam on the left is always in the glass, and the speed u of the car does not affect the speed of the light in the glass. Therefore, the time of the first laser beam from B_{11} to B_{14} is the same as when the car is stationary:

$$t_1 = (L_1 +H_1+L_1)/(0.67c)$$
$$= (1.77+0.1+1.77)/(0.67x3x10^8)$$
$$t_1 = 1.81094527x10^{-8}$$

The second laser beam, in the L_0 section of the "ether vacuum" from B_{02} to B_{42}, has a speed c relative to the stationary "ether vacuum". The car and experimental apparatus have a speed u relative to the stationary "ether vacuum". According to the speed addition of classical kinematics, the speed of the second laser beam relative to the experimental apparatus is c + u. The time of the second laser beam on the right from B_{21} to B_{24} is:

$$t_2 = (2L_2 + H_2 - L_0)/(0.67c) + L_0 / (c + u) \qquad (3\text{-}3)$$
$$t_2 = (4.2 + 0.1-2)/(0.67x3x10^8) + 2/(100+3x10^8)$$
$$=1.14427861x10^{-8} +0.66666644x10^{-8}$$
$$t_2 =1.81094505x10^{-8}$$

The time difference between the first and second laser beams reaching the observation screen E is:

$$\Delta t_1 = t_1- t_2 = 1.81094527x10^{-8} - 1.81094505x10^{-8}$$
$$= 0.00000022x10^{-8}$$
$$\Delta t_1= 2.2x10^{-15} \text{ Second}$$

The change in the time difference between moving the car to the right at a constant speed of u=100 m/s and before and after the car is stationary is:

The change in the time difference before and after the car is moving to the right at a constant speed u=100 m/s is:

$$\delta t =\Delta t_1 -\Delta t_0$$
$$\delta t =2.2x\ x10^{-15}$$

The number of interference fringes moving is as follows:

$$\Delta N = c\delta t/\lambda$$
$$= 3x10^8 x\ 2.2x\ 10^{-15}/ (5.9\ x\ 10^{-7})$$
$$\Delta N =1.12$$

Based on the above calculation results, it can be concluded that the number of interference fringes moving is 1.12, and the movement of interference fringes can be clearly observed on the observation screen E. This verification experiment was conducted to confirm the existence of an absolutely stationary "ether vacuum" and whether the space contraction hypothesis of Lorentz and Einstein is correct. These basic problems in modern physics can be concluded through this experiment.

This experimental device can also measure the absolute velocity of the Earth in the "ether vacuum". The absolute speed of the Earth includes its own rotation, its orbit around the sun, the solar system with the Earth rotating around the center of the Milky Way, and the movement of the Milky Way with the Earth.

To measure the absolute velocity of the Earth in the "ether vacuum", if the absolute velocity of the Earth is u_0, the x-axis of the experimental device is consistent with the velocity direction of u_0.

The first laser beam on the left is continuously in the glass. According to Equation (3-1), the time it takes for the first laser beam on the left traveling from B_{11} to B_{14} is:

$$t_1 = (2L_1 + H_1)/(0.67c)$$

According to Equation (3-3), the time it takes for the second laser beam on the right to travel from B_{21} to B_{24} is:

$$t_2 = (2L_2 + H_2 - L_0)/(0.67c) + L_0/(c + u_0)$$

The time difference between the second and first laser beams reaching the observation screen E is:

$$\Delta t = t_2 - t_1$$
$$= (2L_2 + H_2 - L_0)/(0.67c) + L_0 / (c + u_0) - (2L_1 + H_1)/(0.67c)$$
$$\Delta t = (3L_2 - L_0 - 2L_1)/(0.67c) + L_0 / (c + u_0)$$

After rotating the experimental device 180 degrees, the time difference between the second and first laser beams reaching the observation screen E is:

$$\Delta t' = (L_2 - L_0 - 2L_1)/(0.67c) + L_0 / (c - u_0)$$

The change in the time difference before and after the experimental device is rotated 180 degrees is:

$$\delta t = \Delta t' - \Delta t$$
$$\delta t = L_0/(c - u_0) - L_0/(c + u_0)$$

The number of interference fringes moving can be calculated as follows:

$$\Delta N = c\ \delta t/\lambda$$
$$\Delta N = (2c\ u_0 L_0/\lambda)/(c^2 - u_0^2) \qquad (3\text{-}4)$$

In the experiment, the experimental device is placed in different positions and directions and slowly rotated 180 degrees to observe the number of interference fringes moving. When the number of interference fringes moving is the maximum, the x-axis of the experimental device is consistent with the direction of the absolute velocity u_0 of the Earth. By substituting the number of interference fringes into Equation (3-4), the absolute velocity u_0 of the Earth relative to the stationary "ether vacuum" can be calculated.

In the above Michelson–Morley experiment and the new verification experiment of the "ether vacuum" proposed in this study, the stationary "ether vacuum" cannot be sealed in a container like air and move together with the container. The "ether vacuum" is an indivisible and integral absolute stationary space. The "ether vacuum" in any two inertial frames cannot be separated from each other, so the inertial frames involved in the "ether vacuum" are independent of each other. Both the Galilean transformation and the Lorentz transformation are no longer applicable to inertial frames with the participation of an ether vacuum. However, the speed addition of classical kinematics is still valid.

4. Einstein's general validity of the principle of relativity does not apply to the "ether vacuum"

Based on the principle of invariance of the speed of light in the "ether vacuum" and the general validity of the principle of relativity, Einstein established special relativity[5] in 1905. According to the above analysis, the stationary "ether vacuum" cannot be sealed in a container like air and move together with the container. The "ether vacuum" is an indivisible and integral stationary space. The speed of light in one integral

stationary "ether vacuum" must be constant. Therefore, Einstein's principle of invariance of the speed of light in the "ether vacuum" must be true.
However, the "ether vacuum" in any two inertial frames cannot be separated from each other, and the inertial frames involved in the "ether vacuum" are not independent of each other. Newton's classical principle of relativity and Einstein's general validity of the principle of relativity are not applicable to inertial frames involving the "ether vacuum". The special relativity derived from the principle of invariance of the speed of light and the general validity of the principle of relativity are no longer true.

5. Conclusion

Based on an in-depth analysis of the Michelson–Morley experiment, this study reveals that the moving speed of the Michelson–Morley experimental apparatus cannot be superimposed on the propagation speed of light in an "ether vacuum". In the experiment, the propagation path of the second beam of light is not the inclined edge, and the beam is perpendicular to the moving direction of the experimental device from Point B to Point C and then returns from the original path of Point C to Point B. The Lorentz's length contraction hypothesis and Lorentz transformation have no experimental basis. Furthermore, there are design flaws in the Michelson–Morley experiment. Before and after the experimental device is rotated 90 degrees, the time difference between the two beams of light is equal in amount, and only the order of the time difference is reversed. Because the two beams of light are only superimposed at the same position, the interference fringes of the two beams remain unchanged.
In this study, a new experimental apparatus is proposed to verify the existence of an "ether vacuum" and measure the absolute velocity of the Earth. The apparatus adopts an asymmetric optical path structure and double-slit interference. A laser source is divided into two laser beams. The first laser beam is always in the glass medium, while the second laser beam is partially in the glass medium and partially passes through an "ether vacuum". With theoretical analysis and calculation, it can be concluded that the number of interference fringes moving is 1.12 before and after the apparatus is stationary and moving at a constant speed of 100 m/s. To measure the absolute velocity of the Earth in the "ether vacuum", the experimental apparatus is placed in different positions and directions and slowly rotated 180 degrees to observe the number of interference fringes moving. When the number of interference fringes moving is the maximum, the x-axis of the experimental device is consistent with the direction of the absolute velocity of the Earth. The absolute velocity of the Earth relative to the "ether vacuum" can be calculated with the number of interference fringes moving.
The absolute stationary "ether vacuum" cannot be sealed in a container like air and move together with the container. The inertial frames involved in the "ether vacuum" are not independent of each other. Newton's classical principle of relativity and Einstein's general validity of the principle of relativity are not applicable to inertial frames involving the "ether vacuum". The special relativity derived from the principle of invariance of the speed of light and the general validity of the principle of relativity are no longer true.
The velocities of the light field, electric field, and magnetic field relative to the "ether vacuum" are c, which is the maximum absolute velocity. When two beams of light propagate in opposite directions on the same straight line, the relative velocity of the two beams is 2c, which is the maximum relative velocity.

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AUTHOR DECLARATIONS
Conflict of Interest
The author has no conflicts to disclose.

DATA AVAILABILITY
All data generated or analysed during this study are included in this article.

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