

A Little Secret Of Light And The Physical Meaning Of Fresnel's Formula. Why Did This Formula Pass The Water Telescope Test?

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Abstract

It is reported that experimental set-ups have been created and experiments have been conducted by which an "Aether wind" has been discovered. Based on the experimental results obtained, it can be stated with a high degree of certainty that the Special Theory of Relativity is invalid. It is noted that the experiments conducted were successful because the Fresnel formula (Fresnel's drag hypotheses) was used as a basis for sizing the experimental set-ups. The question of the physical meaning of this formula is discussed. Formulas for sizing experimental set-ups by which an Aether wind can be searched for are given.

Keywords: Aether, Aether wind, Fresnel's drag hypotheses, Special Relativity

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I. Introduction

For more than five years, experimental set-ups have been created and experiments have been conducted to detect Aether wind. Based on the experimental results obtained, it can be stated with a high degree of certainty that the Special Theory of Relativity (STR) is invalid [1-4]. The experiments conducted were successful because the Fresnel formula was used as a basis for sizing the experimental set-ups [5]. The question of the physical meaning of this formula is discussed here. Formulas for sizing experimental set-ups to detect Aether wind are given.

II. The Fresnel-Einstein Dilemma

In 1818, when explaining stellar aberration from the perspective of the wave theory of light, Fresnel [5] derived the following formula

$$u = \frac{c}{n} \pm V \left(1 - \frac{1}{n^2} \right) \quad (1)$$

where the expression in parentheses is the so-called Fresnel's drag coefficient, namely

$$\alpha = 1 - \frac{1}{n^2} \quad (2)$$

It is obvious that according to (1), the velocity u of light propagation in a given optical medium, with refractive index n , must depend on the speed V with which the Earth moves in space, i.e. formula (1) predicts that there must be an "Aether wind". Here c is the speed of light in vacuum. In a broader sense, "Aether wind" should be understood as the influence that the Earth's motion has on optical phenomena.

As an alternative to Fresnel's formula (1), at the end of the 19th century the formula appeared

$$u = \frac{c}{n} \pm V \left(1 - \frac{1}{n^2} \right) - \frac{V^2}{cn} \quad (3)$$

which is derived if we start from the Lorentz transformations [6].

As can be seen, formulas (1) and (3) are almost identical. The difference lies in an additional additive, which in some cases can be neglected. But there is a significant difference in their interpretation. For example, on the one hand, Fresnel's formula is derived on the basis of classical concepts: absolute time and absolute space, i.e. there is an absolute reference system and absolute motion of celestial bodies with respect to this reference system. Therefore, there is a real change in the speed of light propagation when a given optical medium moves in space and there must be an Aether wind. On the other hand, Einstein and his followers reject the Aether and claim that there is no absolute reference system, no absolute motion. Therefore, formula (3) has no real physical meaning and there is no Aether wind. Therefore, the question is justified. On which side is the truth? The answer to this question can only be given through experiments. That is why back in 2013, in [7], and later in [8-10], we proposed how to such experiments in order to resolve this age-old dispute. However, our voice was not heard and we had to take up solving this difficult task ourselves.

III. Did Michelson Make A Mistake In Sizing His Interferometer?

What does Fresnel tell us with his formula? The speed of light propagation in optical media is directly related to the refractive index. That is why an Aether wind can be detected only if the experiments are carried out in optical media! Another important condition is that when sizing the experimental set-ups, one must proceed from Fresnel's formula. Such are the reasons why the Aether wind has not been discovered for more than a hundred years. In our opinion, Michelson is most to blame for the emergence of the STR. When sizing his interferometer, he made a catastrophic mistake [11].

As it is established, the speed of propagation of light in a given optical medium depends on the refractive index n . Therefore, when sizing experimental set-ups for searching for Aether wind, it is mandatory to include the refractive index. It is necessary to distinguish between different optical media, i.e. why Aether the light is propagating in air, water or another optical medium. Michelson's error lies in the fact that this coefficient is missing in his formula for sizing an interferometer. Here is Michelson's formula [12]

$$\Delta t^{\bullet} = (l_1 + l_2) \frac{V^2}{c^3} \quad (4)$$

According to our calculations, if we proceed from the Fresnel formula, this difference should be (Appendix A, equation A6)

$$\Delta t^{\bullet} = 2(l_2 - l_1)n^3(2\alpha - \alpha^2) \frac{V^2}{c^3} \quad (5)$$

Let's compare the required optical path calculated using the Michelson formula and Fresnel formula

$$l_1 + l_2 = l_M = \frac{\Delta t^{\bullet} c^3}{V^2} \quad \text{required Michelson optical path}$$

$$l_2 - l_1 = \frac{1}{2n^3(2\alpha - \alpha^2)} \frac{\Delta t^{\bullet} c^3}{V^2} \quad \text{required Fresnel optical path}$$

Now, if under the same initial conditions (optical medium air, with the refractive index $n = 1,000293$, coefficient $\alpha = 0,0005857$, Earth's orbital speed 30 km/sec and the same light source) one calculates how much optical energy should be required according to the above formulas, it will turn out that in order to detect an Aether wind, Michelson's interferometer had to have 426 times longer arms, i.e. the sum had to be 426 times larger. It is obvious that the error is catastrophic. His chance of detecting an Aether wind was zero. The same mistake is repeated by his followers. This is the reason why an Aether wind has not been discovered until now.

Our opinion is that experiments whose formulas for sizing the interferometer lack a refractive index should be considered erroneous, and even meaningless.

IV. Hypothesis: Sources Of Huygens Spherical Waves Are The Repeater Atoms Of The Optical Medium

When Fresnel derived his formula, he could not explain its physical meaning. And although it successfully withstood all experimental tests, for example, the experiments of Fizeau [13], Michelson [14], and also the experiments of Hooke and Ayre with a water telescope [15,16], for two centuries this formula remained misunderstood and neglected. Therefore, the question is reasonable, what is the physical meaning of this formula? We have already discussed this question in [8,9], and also in [10], but here we will dwell on it again.

In our opinion, the question of the physical meaning of Fresnel's formula can be solved. It has a direct connection with Huygens' principle in optics and a little secret about the propagation of light in optical media. As is known, according to Huygens' principle, any point that light reaches becomes a source of a spherical wave. However, a point is not a physical object and cannot emit waves. Therefore, the question is reasonable: what is the physical object that can emit waves in order to be placed in the place of Huygens' points? It is not difficult to answer this question. According to quantum mechanics, the only physical objects that can emit light waves are atoms of chemical elements. So, in our opinion, where Huygens refers to points, atoms that are repeaters of the corresponding optical medium should be placed.

The propagation of light in optical media can be compared to the way radio and television broadcasts are propagated with intermediate repeaters. In the beginning, powerful transmitters were used for long distances. It turned out that it is much more efficient to do this with intermediate repeaters located at shorter distances, i.e. a way to transfer energy with less loss. It is obvious that nature has chosen this more efficient way of propagating light. In our opinion, every atom, respectively molecule of the optical medium can be considered as a potential repeater of light waves. This means that it can be excited and then re-radiate the acquired energy in the form of a spherical wave, as follows according to Huygens' principle. Every light source emits certain spectral lines at a certain frequency, and each such spectral line finds its repeater atoms tuned to the same frequency, so that a large number of spectral lines can be transmitted simultaneously in the optical medium.

V. Black Sky In Space And Light Sky On Earth

As is known, when astronauts look at the Sun or the Moon, they see that the sky around them is black, while people on Earth see that the sky around them is light. That is why the question is reasonable, why in space the Huygens principle does not work and there is no emission of secondary spherical waves? The answer is simple, Huygens points do not exist, because in space, there is no optical medium, respectively, there are no translator atoms.

In our opinion, the dark sky in space categorically confirms our hypothesis that the real physical sources of the spherical Huygens waves are the atoms that relay the chemical elements. People on Earth see a bright sky because all parts of the Earth's atmosphere that are illuminated by the Sun are the sources of light waves that reach the Earth observer, while astronauts only reach the waves that are directly emitted by the Sun.

VI. Kinematic Elongation/Reduction Of The Optical Path Between The Repeater Atoms, When They Move Relative To The Aether

Now we will try to explain what will be the consequences of the hypothesis that emitters of Huygens spherical waves are repeater atoms of the optical medium, if this medium moves relative to the Aether. Above, we noted that we proceed from the classical ideas: the speed of light propagation in the Aether is constant ($c = const$), the Aether is an absolute reference system and that there is an absolute motion of the optical media relative to this reference system.

Let us recall an illusion that occurs when a fast-flying airplane flies across the sky. We look for the airplane in the direction from which the sound comes, but it is no longer there, because by the time the sound reaches the observer, the airplane has moved far ahead. This is an important feature that occurs when vibrations propagate in a continuous medium, air, water, and also in an optical medium that moves in the Aether. In [7] we call these features the term lagging/leading position. Here, however, we will use the term kinematic elongation/shortening of the optical path. The feature is that if waves are emitted from some source of oscillation, and the observer moves, then the optical path that the waves must travel to reach him increases or decreases. This depends on the speed and direction in which the observer moves. In this case, we mean the propagation of light in an optical medium that moves with respect to the stationary Aether.

Let us imagine that the black dots shown in Fig. 1 are repeater atoms of an optical medium that moves relative to the Aether with a velocity V . The speed of light propagation is u , and Δx is the so-called kinematic additive by which the optical path between the repeater atoms increases or decreases.

In (Fig. 1a) is shown the case when the optical medium is stationary ($V=0$). In this case the distance between the repeater atoms x remains constant and does not change over time.

In (Fig. 1b) is shown the case when the direction of propagation of light u coincides with the direction V of movement of the optical medium. In this case the optical path between the repeater atoms increases ($x + \Delta x$).

In (Fig. 1c) shows the case where the direction of propagation on the light u and the direction of movement on the optical medium V are opposite. In this case, the distance between the repeater atoms decreases ($x - \Delta x$).

Here the so-called kinematic increase/decrease of the optical path between the repeater atoms is due to the simple fact that the speed of light propagation u is finite, as a result of which, in the time t that the light needs to travel the distance x from the emitter atom to the receiver atom, it is no longer there because it has moved to a distance $\Delta x = \pm t V$.

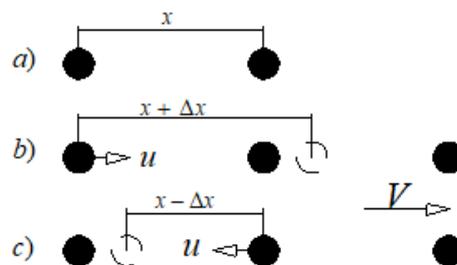


Fig. 1. Motion of an optical medium relative to the Aether.

The physical distance between the repeater atoms is x . When this optical medium moves relative to the Aether, the optical path between them increases ($x + \Delta x$) or decreases ($x - \Delta x$), where Δx is the so-called kinematic additive.

VII. Kinematic Elongation/Reduction Of The Optical Path In A Body Of An Optical Medium, When This Body Moves Relative To The Aether

In (Fig. 2) a body of an optical medium is shown, which moves relative to the Aether, with a speed V . Let this body have a physical length l . It can be a piece of glass, a piece of optical fiber, air enclosed in a vessel with solid walls, etc. The light source is located at point 1, and the observer at point 2 (Fig. 2a). We assume that the speed of propagation of light in an optical medium changes according to Fresnel's formula (1). Here we also consider two cases:

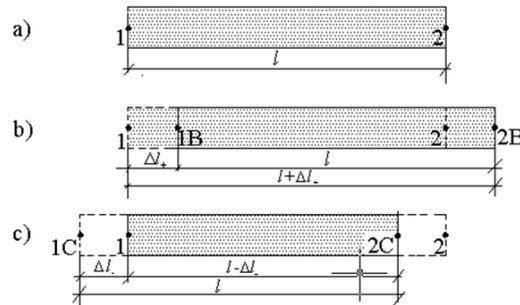


Fig. 2. Motion of a body from an optical medium with respect to the Aether

The physical length of the body from an optical medium is l . When this body moves with respect to the Aether, the optical path between the light source, at point 1, and the observer, at point 2, increases $l_+ = l + \Delta l_+$ or decreases $l_- = l - \Delta l_-$, where Δl_+ and Δl_- are the so-called kinematic supplements

In the first case (Fig. 2b), the direction of propagation of light and the direction of movement of the optical medium are the same. In this case, while the light travels the optical path l , the emitter has moved to point 1B, and the observer has moved to point 2B. The optical path increases $l_+ = l + \Delta l_+$. The speed of light, in this case according to (1) must be,

$$u = u_0 + V\alpha \tag{6}$$

Second case (Fig. 2c), when the direction of propagation of light and the direction of motion of the optical medium are opposite. In this case, while the light travels the optical path l , the observer has moved to point 2C. The optical path is reduced $l_- = l - \Delta l_-$. The speed of light, according to (1), must be,

$$u = u_0 - V\alpha \tag{7}$$

where $u_0 = c/n$, a α is the Fresnel coefficient.

To determine the additions Δl_+ and Δl_- , by which the optical path is increased/decreased, we proceed from the condition that for the time t , while the light beam travels the physical path $l = tu$, the body from the optical medium moves a distance $\Delta l_{\pm} = tV$. Under this condition, the following two equalities will be in force

$$t_+ = \frac{l}{u_0 + V\alpha} = \frac{\Delta l_+}{V} \tag{8}$$

$$t_- = \frac{l}{u_0 - V\alpha} = \frac{\Delta l_-}{V} \tag{9}$$

From equality (8) it follows that the optical path elongation Δl_+ , when the direction of motion of the optical medium coincides with the direction of light propagation, must be,

$$\Delta l_+ = l \frac{V}{u_0 + V\alpha} \tag{10}$$

and from equality (9) it follows that the reduction Δl_- of the optical path when the direction of movement of the optical medium and the direction of light propagation are opposite must be,

$$\Delta l_- = l \frac{V}{u_0 - V\alpha} \tag{11}$$

VIII. On The Question Of The Physical Basis Of Fresnel's Formula

In our opinion, the question of the physical meaning of Fresnel's formula is directly related to the hypothesis that the sources of the secondary spherical Huygens waves are the repeater atoms of the corresponding optical medium and the fact that the speed of light propagation is not infinite, but limited. Therefore, when the optical medium moves with respect to the Aether, for the time t , which is necessary for the light to travel the optical path l , equal to the physical distance between the emitter atoms and the repeater atoms, the distance between them has changed by the so-called kinematic additions (10) and (11), where V is the speed with which the optical medium moves with respect to the Aether.

Therefore, when a given optical medium moves with respect to the Aether, the consequences are; kinematic increase/decrease of the optical path between the relay atoms, kinematic expansion/contraction of the volume of the optical medium, kinematic increase/decrease of the density of the optical medium, respectively kinematic change of the refractive index.

Let us compare Fresnel's theory and the one we propose. In justifying his formula, Fresnel proceeds from the equation (12) (Fresnel's letter to Arago in 1818 [5]).

$$\frac{\Delta' - \Delta}{\Delta} = \left(\frac{d^2 - d'^2}{d'^2} \right) \quad (12)$$

where Δ and Δ' are the densities of the Aether outside and inside the optical medium, and d и d' are wavelengths, respectively.

Also, according to our theory, if the kinematic change of the density of the optical medium is taken into account, the following similar equality can be written

$$\frac{\rho_{\pm} - \rho}{\rho} = \left(\frac{l^2 - l_{\pm}^2}{l_{\pm}^2} \right) \quad (13)$$

where ρ and ρ_{\pm} are the physical and kinematic densities of the optical medium, respectively, and l and l_{\pm} are the physical and kinematic optical paths.

In this case, the fact that the physical number of repeater atoms inside the body of optical medium (Fig. 2. a, b and c) is equal, and the volumes are different, i.e. the densities in the kinematically expanded/reduced volumes b and c must also be different, is taken into account.

Fresnel based his theory on the hypothesis that the density of the Aether outside and inside the optical medium is different. However, this is an absurd hypothesis. According to the classical theory, the Aether is an absolute medium in which the speed of light propagation is an absolute constant. This is the reason why his theory is viewed with distrust.

An advantage of the theory we propose is the fact that it explains the change in the density of the optical medium, respectively the refractive index, without requiring any additional hypotheses, for example, changing the physical properties of the Aether and optical media.

IX. Why Did Fresnel's Formula Stand The Water Telescope Test?

Let us substitute the coefficient α in equation (A10). (Appendix A) its value according to equation (2). Here is this equation

$$\Delta t^{\bullet} = l(1 - \alpha)n^2 \frac{V}{c^2}$$

And here is the new equation we get:

$$t = \frac{lV}{c^2} \quad (14)$$

The result obtained in this way is very interesting. It turns out that the time t for which light travels an optical path l does not depend on the refractive index. And this means that light can pass through different optical media without undergoing refraction. On the one hand, this result explains why Fresnel's theory has withstood the experimental test with a water telescope [15,16]. But on the other hand, the illusion is created that the speed of light propagation in different optical tracks is, as it were, the same. However, this is not the case. In fact, this speed in different optical media is always different:

- When the direction of light propagation and the direction of movement of the optical medium are the same, the kinematic density of the optical medium is reduced, the refractive index is reduced, and the speed of light propagation increases (equation 6), i.e. it depends on the refractive index, but the optical path with the kinematic additive (10) increases proportionally, which is why the time according to (14) does not change.

- And vice versa, when the direction of light propagation and the direction of movement of the optical medium are opposite, the kinematic density of the optical medium increases, the refractive index increases, and the speed of light propagation decreases (7), but the optical path with the kinematic additive (11) is also reduced, so that in this case the time does not change.

X. Appendix A: Sizing Of Experimental Set-Up For Searching For Aether Wind Based On Fresnel's Formula.

Here are two ways to dimension experimental set-ups for searching for Aether wind: Approximate, if only the physical length of the optical path l is taken into account and more accurate, when, in addition to the physical length of the optical path l , the kinematic additions Δl_+ and Δl_- according to (10) and (11), by which it is increased/decreased, are also taken into account.

For example, in order to determine the time for which light travels the optical path l , i.e. the approximate way, in the case of sizing an experimental installation of the second order, one must proceed from the equation,

$$t = \frac{l}{u_0 + V\alpha} + \frac{l}{u_0 - V\alpha} \tag{A1}$$

and when sizing first-order experimental set-ups, the equation should be used

$$t = \frac{l}{u_0 \pm V\alpha} \tag{A2}$$

In our opinion, Michelson knew Fresnel's formula well and if he had used equation (A1), i.e. the rougher and simpler way in sizing his experimental set-up, he would not have made the catastrophic mistake mentioned above.

Here we recommend and give the formulas for sizing experimental set-ups, in a more precise way, taking into account the so-called kinematic additions Δl_+ and Δl_- .

1. Sizing of a second-order experimental set-up

The time interval t for which light travels twice (forward and backward) an optical path of length l , when the interferometer, moves with respect to the Aether, must be calculated according to the following relationship

$$t = \frac{l + \Delta l_+}{u_0 + V\alpha} + \frac{l - \Delta l_-}{u_0 - V\alpha} \tag{A3}$$

where l is the physical length of the optical path in one direction, Δl_+ and Δl_- are the kinetic additives according to (10) and (11), $u_0 + V\alpha$ is the speed of light propagation according to (6), in the case when the direction of motion of the optical medium coincides with the direction of light propagation, $u_0 + V\alpha$ is the speed of light propagation according to (7), in the case when the direction of motion of the optical medium is opposite to the direction of light propagation, a is the Fresnel coefficient according to (2).

After the necessary transformations of equation (A3), the following result is ultimately obtained

$$t \approx \frac{2l}{c} n + \frac{2l}{c} n^3 (2\alpha - \alpha^2) \frac{V^2}{c^2} \tag{A4}$$

And since the first term in equation (A4) is a free constant, it can be ignored and simplified

$$t = 2ln^3 (2\alpha - \alpha^2) \frac{V^2}{c^3} \tag{A5}$$

In order to detect an Aether wind by a second-order interferometer, there must be a difference Δl between the lengths of its two arms. Let us assume that the length of one arm of the interferometer is l_2 , and that of the other is l_1 . In such a case, the difference in time between the two beams must be

$$\Delta t^* = 2(l_2 - l_1)n^3 (2\alpha - \alpha^2) \frac{V^2}{c^3} \tag{A6}$$

Furthermore, we recommend using an interferometer with parallel arms. In our opinion, apart from the error in sizing his interferometer, which was discussed above. Michelson made another mistake, namely that he and his followers used an interferometer with mutually perpendicular arms. Our opinion is that searching for an Aether wind with an interferometer with mutually perpendicular arms, as noted in [11], is mission impossible.

2. Sizing of a first-order experimental set-up

The time interval t for which light travels an optical path of length l , when the interferometer moves with respect to the Aether, must be calculated according to the following relationship

$$t_{\pm} = \frac{l \pm \Delta l_{\pm}}{u_0 \pm V\alpha} \tag{A7}$$

where l is the physical length of the optical path, Δl_{\pm} are the additions according to (10) and (11), $u_0 \pm V\alpha$ is the speed of light propagation according to (6) or (7), with the sign + (plus) valid for the case when the direction of motion of the optical medium coincides with the direction of light propagation, and the sign – (minus) valid for the case when the direction of motion of the optical medium is opposite to the direction of light propagation, α is the Fresnel coefficient according to (2)

After the necessary transformations of equation (16), the following result is ultimately obtained

$$t_{\pm} \approx \frac{ln}{c} \pm \frac{l}{c}(1-\alpha)n^2 \frac{V}{c} \tag{A8}$$

And since the first term in equation (A8) is a free constant, it can be ignored and simplified

$$t_{\pm} = \pm \frac{l}{c}(1-\alpha)n^2 \frac{V}{c} \tag{A9}$$

Let's assume that the length of one arm of the beam is l , and the other arm is l . The difference, over time, between the two beams will be

$$\Delta t^* = l(1-\alpha)n^2 \frac{V}{c^2} \tag{A10}$$

In order to observe a maximum difference in the amplitude of the resultant wave in interference for a first-order interferometer, as well as for a second-order interferometer, the difference in the path of the two beams must be equal to or greater than the wavelength $\lambda/2$, which means that $\Delta t^* \geq T/2$, where T is the oscillation period of the light source.

Equations (A6) and (A9) are our formulas for sizing an interferometer, of second and first order, respectively, to detect Aether wind.

XI. Conclusion

From the experiments conducted so far, it has been established with a high degree of certainty that there is an Aether wind and that the speed of light propagation depends on the movements of the Earth in space, as predicted by Fresnel's formula.

Our experiments are successful because when sizing the experimental set-ups we proceed from Fresnel's formula.

The Aether wind has not been discovered until now because when sizing their experimental set-ups Michelson and his followers made a catastrophic mistake.

Einstein himself stated that if an Aether wind were discovered, it would have to be admitted that the Special Theory of Relativity, as well as the General Theory, would be invalid.

"My opinion about Miller's experiments is the following. ... Should the positive result be confirmed, then the special theory of relativity and with it the general theory of relativity, in its current form, would be invalid. Experimentum summus iudex. Only the equivalence of inertia and gravitation would remain, however; they would have to lead to a significantly different theory."

— Albert Einstein, in a letter to Edwin E. Slosson, 8 July 1925 (from copy in Hebrew University Archive, Jerusalem.) See citations below for Silberstein 1925 and Einstein 1926.

The authors are ready to demonstrate their experiments to a competent committee.

The experimental set-ups are easy to implement and anyone who wishes can do such experiments themselves and discover an Aether wind.

The authors are ready to answer questions and give advice on how to prepare the experimental set-ups, and also to provide a fully completed and ready to use interferometer. It is necessary that the correspondent has a suitable light source and an optical power meter.

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