A New Explanation for the Result of Michelson-Morley Experiment

Abolfazl Soltani *

Department of Physics, University of Birjand, Birjand, Iran

E-mail: soltani.a.physics@gmail.com

Abstract

Various theories were presented to explain the result of Michelson-Morley observations, namely the non-displacement of interference fringes after 90 degrees rotation of the interferometer. Like the theory of length contraction of FitzGerald, Einstein's theory (namely the theory of independence of light velocity from observer velocity and source velocity without the necessity of the presence of Luminiferous Aether), the theories of Aether drag, and Emission theories. However, it seems that, apart from these theories, there is another way to explain Michelson-Morley null observations. In this article, we propose the theory of "Aether Attached to Earth" or abbreviated AATE. In this theory, Luminiferous Aether is a fact and is a transparent continuous medium that has filled the entire universe and is attached and is locked to the center of Earth and the whole of it, just like an integrated rigid object, is moved along with Earth in Space. It's clear, in AATE theory, the velocity of Earth relative to Aether is zero; Therefore, the null displacement of the fringes can be explained. In addition to explaining the Michelson-Morley experiment, this theory can explain six other important phenomena and experiments. Here you will see that the AATE theory does not experience the failures of previous Aether theories.

Keywords: Michelson-Morley experiment, Luminiferous Aether, Stellar aberration, Sagnac experiment, Michelson-Gale experiment, Trouton-Noble experiment, Tomaschek experiment

1. Introduction

In this article, we take a closer look at the experiments of 1881 and 1887 by Michelson and Morley. The theories of the 19th century scientists about Aether faced problems. For example, Fresnel's stationary Aether theory could not explain the Michelson-Morley experiment (MME) [1]. And Stokes's theory could not explain stellar aberration [1] and Sagnac observations [2][3]. In this article, we present a new theory about the Aether, which in addition to describing the three mentioned phenomena, explains four other phenomena. This theory does not experience the failures of previous Aether theories. In this article, first, we analyze the method of Michelson experiment and then we show that, apart from Einstein's theory and some other theories, there is another way for the explanation of Michelson's observations. In the following, based on the AATE theory, we explain stellar aberration [4], Trouton-Noble experiment [5], Sagnac experiment [3], Michelson-Gale Experiment [6] and De Sitter Observations from Binary Stars [7].

In the AATE theory, Luminiferous Aether is a fact and is a transparent continuous medium that has filled the entire universe and is attached and is locked to center of Earth and whole of it, just like an integrated rigid object, is moved along with Earth in Space. It is clear, that the theory of AATE considers a special property for Earth compared to the other objects of the universe (Of course, this does not mean that the location of Earth is special in the universe).

2. Analysis of Michelson-Morley Experiment Method

At least in none of the books and articles that I have read to write this article; I have not found a complete and comprehensive explanation about the method of Michelson-Morley experiment. *The theory behind of MME has been discussed in detail in many books and articles* (e.g., [1],[8])*; But about the method of this experiment, I did not find a comprehensive explanation in any of the sources I read* (e.g., [1, 8, 10-14]). Therefore, I felt that in this article it is useful and necessary to present a complete explanation about the method of MME. Fig. 1 is very helpful for understanding the method of MME. Fig. 1 shows the Michelson interferometer, namely the interferometer of Fig. 2, on Earth. Michelson used the interferometer of Fig. 2 in 1881 [13], and his calculations [13][1][8] are based on this interferometer. In 1887 Michelson along with Morley used the interferometer of Fig. 3 [14]. All of Michelson experiments were performed in US cities [1] such as Cleveland and Potsdam, which their latitudes are above the equator, but to simplify Fig. 1, we assume that these experiments were performed on the equator. This assumption does not affect the discussion. In addition, to simplify the shape, we ignore the skew of Earth's axis and assume that Earth's axis is perpendicular to the plane of orbit. If we consider the skew, the result of discussion will not be different. Earth orbits counterclockwise around the sun at an almost constant velocity $V = 30\,\frac{km}{s}$, and its spin is counterclockwise too. In Fig. 1, the interferometer is in position 1. Twelve hours later, due to the spinning motion of Earth, the device goes to point 2, on the other side of Earth. And 3 months later, due to the Earth's orbital motion, the device is moved to point 3, and 6 months later it goes to the other side of the sun, point 4. At point 1 and in 1881, Michelson turned screws of behind the mirrors M_1 and M_2 of Fig. 2 until the interference fringes were created in the telescope. Then, he rotated the interferometer gently 90 degrees around the mirror M (clockwise or counter-clockwise does not matter) without change the adjustment of the mirrors, and then he recorded the amount of displacement of the fringes relative to the telescope's center line (Michelson expected the displacement of interference bands relative to the vertical center line of telescope, after 90° rotation [13],[1]). Once again, after 12 hours, he formed the fringes at point 2 and then turned the device 90 degrees and recorded the observations. He did the same in points 3 and 4. The observations showed almost zero displacement [13], namely displacements less than the result of Michelson calculations [13] (Michelson in 1881 expected a displacement of 0.08 of a fringe, but the observed displacements were at most equal to 0.02 of a fringe [13]). This method was repeated in 1887 by the interferometer of Fig. 3 [14], and the observations showed almost zero displacement of the fringes relative to the center line of the telescope (Michelson and Morley in 1887 expected a displacement of 0.4 of a fringe, but the observed displacements were at most equal to 0.01 of a fringe [14][1]).

Question: Why did Michelson and Morley repeat the experiment at different times of the year (namely points 1 to 4 in Fig. 1)? Answer: The null result was unexpected for Michelson and Morley, so they repeated the experiment at different points in the Fig. 1 (equivalent to different seasons of the year) to find a significant displacement for the fringes, after 90 degrees rotation [1]. But no displacement was observed. And secondly, they wanted to consider the effect of motion of solar system in space [14] and reduce the number of possible errors of experiment [14].

Question: Michelson and Morley observed maximum displacements 0.02 and 0.01 fringe in their experiments [1]. What is the reason of these displacements? In their experiments, Michelson and Morley used ordinary light sources (like sodium flame [13],[14]) that were not fully single-frequency and coherent like a Laser. In addition, the light of sodium flame has vibrations. And in addition to these, although their stone table was floating on mercury pool and did not transmit vibrations, it was still slightly affected by movements like turning 90 degrees [14]. In addition to these reasons, both interferometers in Fig. 2 and Fig. 3 were very sensitive to temperature changes during the experiment [13][14]. Although Michelson and Morley covered the interferometer of Fig. 3 with a wooden box in 1887, still the effects of temperature changes were observable [14]. Therefore, the reason for the observation of displacements 0.02 and 0.01 fringe, as Michelson himself has pointed out [13], is experiment's errors. In the following years, these errors decreased.

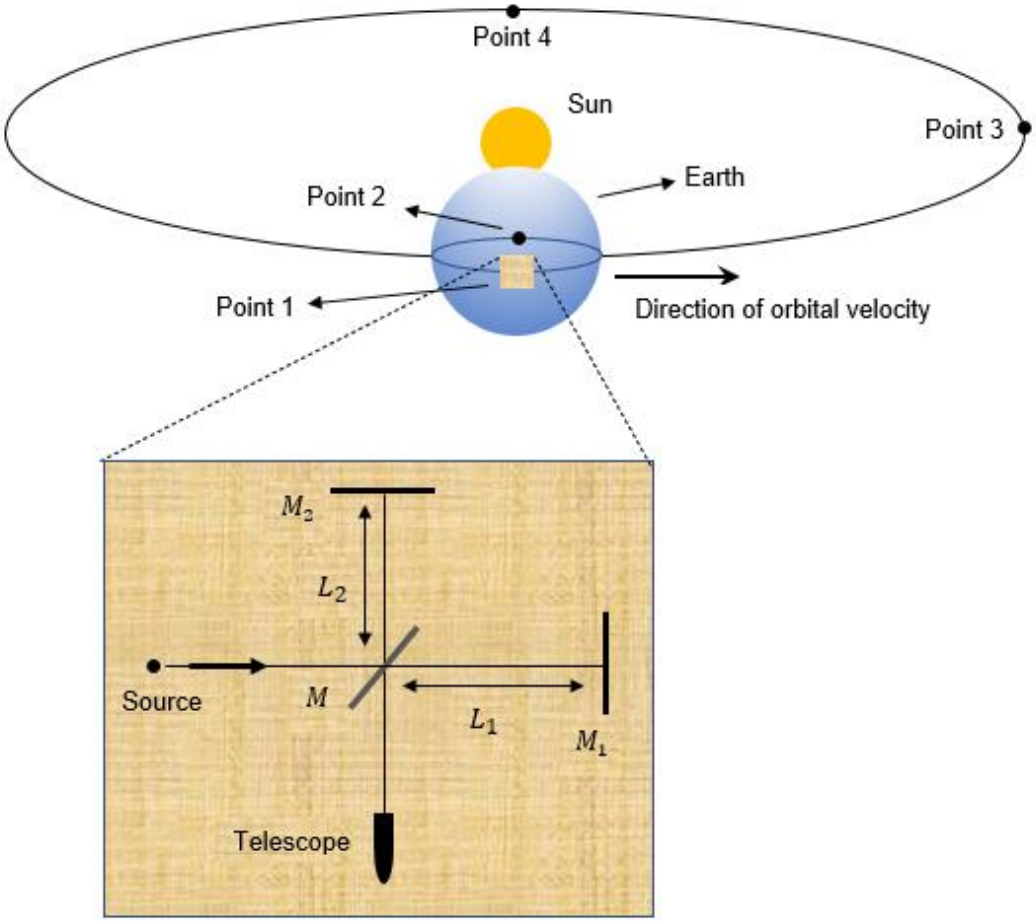

Fig. 1. In this figure Michelson interferometer is on the equator line. The direction of spinning motion of Earth in this figure is counterclockwise. In this figure, the apparatus is at point 1. Twelve hours later, due to spinning motion of Earth, the device goes to point 2, on the other side of Earth. And 6 months later, due to the orbital motion of Earth, the interferometer goes behind Sun, namely point 4.

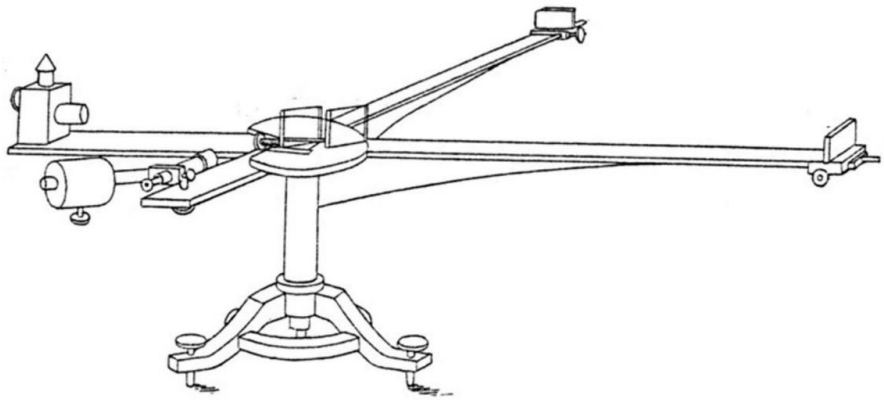

Fig. 2. Michelson Interferometer in 1881 (reproduced from his paper of 1881)

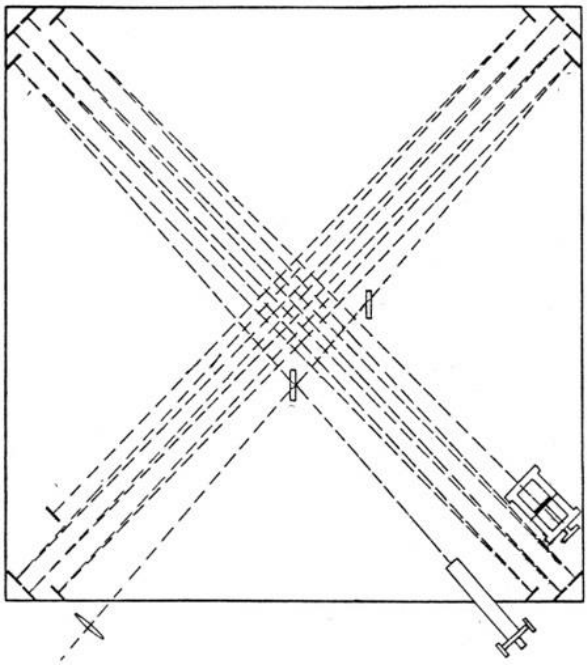

Fig. 3. Michelson-Morley interferometer with sixteen mirrors on a stone table floating in a mercury pool in 1887 (reproduced from their paper of 1887). The mercury pool is not shown in this figure.

Now the question that arises is whether, apart from Einstein's theory and some other theories, can another theory explain the reason for Michelson-Morley's zero observations? The answer is yes. Michelson-Morley's zero observations will be agreed with Michelson calculations if we assume Luminiferous Aether is a fact and is attached and is locked to the center of Earth (Fig. 4). Michelson's observations led me to think that the velocity of Earth relative to Aether is probably much lower than 30 km/s. Because this is one way to make agreement between observations and calculations of Michelson. If we consider the velocity of Earth relative to Aether equal to zero, based on Michelson's equation namely $\Delta N = \frac{L_1+L_2}{\lambda}\frac{v^2}{c^2}$ [1], we will have $\Delta N = 0$ (that means zero displacement of interference fringes). Zero velocity of Earth relative to Aether is possible only if we assume that Aether is attached to Earth. That's how I came up with theory of Aether attached to Earth. In this theory, Aether is a transparent continuous medium that has filled the entire universe and *whole of it*, just like an integrated

rigid object, is moved along with Earth in Space. Earth is moving around the sun and the sun is moving around the center of Milky Way galaxy. And Milky Way is moving in the local group, and so on. The Aether attached to Earth experiences all these movements along with Earth. *In AATE theory, Aether is not affected by the spinning motion of Earth and only has translational motion along with Earth in space* (In the next section, you will see that the non-rotation of Aether along with Earth is a result that Michelson and Gale had arrived at.).

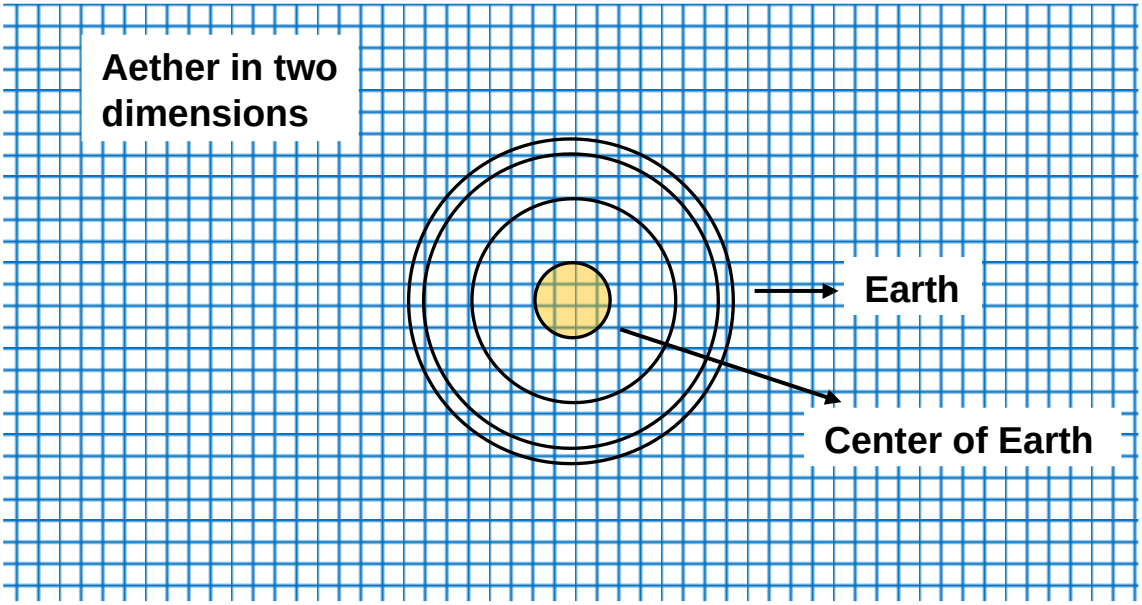

Fig. 4. Luminiferous Aether which is attached and is locked to the center of Earth. In our theory Luminiferous Aether is a rigid medium that has filled the entire universe and whole of it, just like a rigid object, is moved along with Earth in Space. In this figure, four main layers of Earth have been shown. As we have shown in the figure, Earth is a transparent object for Aether. Aether is completely continuous in small scale; and here we have shown it in reticular form only for visualization.

As you observed, by considering a stationary Aether relative to Earth, we were able to explain the null result of Michelson-Morley experiment. But, in AATE theory, only the transitional velocity of Earth relative to Aether is zero and Earth has spinning motion relative to Aether. Because as we said, in AATE theory, Aether is not affected by the spinning motion of Earth. It means that Earth rotates around its axis with an angular velocity of one rotation per 24 hours with respect to Aether. The effect of the spinning motion of Earth relative to Aether can be calculated by the method of Michelson: The linear velocity of a point at the equator line due to Earth's spinning motion is almost $0.5\ km/s = \frac{1}{60} 30\ km/s$. This means that in Michaelson's formula ($\Delta N = \frac{L_1+L_2}{\lambda}\frac{v^2}{c^2}$), we should put $\frac{1}{60} 30\ km/s$ instead of $30\ km/s$ (Because in our theory, the net motion of Earth relative to Aether is only the spinning motion of Earth, not its orbital motion). Substituting, the result is equal to $\Delta N = \frac{1}{3600}(0.4)$ fringe. This value is much less than what we can measure by the Michelson-Morley interferometer (The accuracy of the Michelson-Morley interferometer is about $\frac{1}{100}$ fringe [1]). Therefore, the Michelson-Morley interferometer is not able to prove the existence of spinning motion of Earth relative to Aether; But, as you will see in the next section, the Michelson-Gale experiment has proven the existence of this motion.

3. Sagnac and Michelson-Gale Experiments

In his experiment on a rotating table (Fig. 5), Georges Sagnac observed the displacement of the interference fringes, compared to the state of the stationary table [2],[3]. In the Sagnac experiment, like the MME experiment, we first need to create the fringes in the detector (or telescope) and then rotate the table. This experiment violated the Stokes's theory about Aether. Because Stokes's theory had predicted that Aether should be dragged along with the rotating table [1]. Therefore, based on Stokes's theory, there is not any difference between the stationary and moving state of table, and in the rotating state the displacement of the fringes should not be observed in the detector. The AATE theory can explain the Sagnac experiment. If we assume that the Aether is attached to Earth, in such a case, the rotating table of Sagnac experiment has spinning motion relative to Aether and we have *Aether wind* along the sides of the square; and as you know, Aether wind causes the change of the velocity of light on square sides and therefore, we expect the displacement of the interference fringes in the rotating state of the table, which Sagnac observed this displacement.

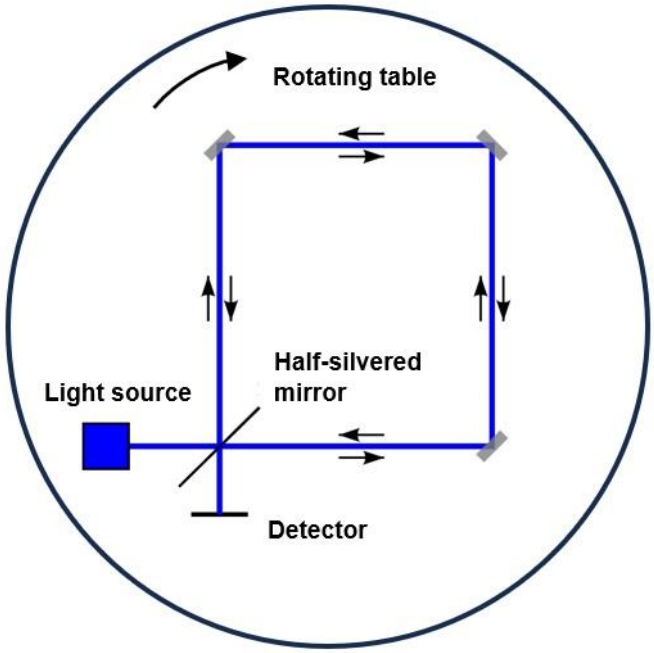

Fig. 5. Sagnac interferometer mounted on a turntable. Sagnac experiment showed that the fringes, formed in the detector before the table rotation, are moved because of the table rotation. As we said, this displacement of the fringes can be explained in AATE theory.

Moreover, the displacement of interference fringes in Michelson-Gale Experiment [15] is explainable based on AATE theory. In the Michelson-Gale Experiment (which is a kind of Sagnac experiment) they wanted to see *the effect of rotation of Earth around its axis* on the displacement of interference fringes. The experiment was designed to test whether the velocity of light is influenced by the Earth's rotation. Their observations showed a displacement for the fringes [15]. That is the velocity of light is under the effect of rotation of Earth around its axis. It is clear this experiment is not justifiable with Stokes's theory about Aether. Because Stokes's theory had predicted that the Aether should be dragged at the vicinity of surface of rotating Earth, and therefore we should not observe the displacement of the fringes. Fresnel's stationary Aether theory can explain Michelson-Gale Experiment, but

we know that Fresnel's theory fails to justify MME. In AATE theory, we assumed that Aether does not rotate with Earth. Therefore, in such a case the rotation of Earth is a motion relative to Aether and we have Aether wind and thus the displacement of the fringes in the Michelson-Gale Experiment can be expected. They concluded from their experiment that if Aether is existed, it should rotate relative to Earth with an angular velocity of one revolution per day [16]. Which means non-rotation of Aether along with Earth. In fact, the Michelson-Morley experiment showed that Earth has no translational motion relative to Aether, and the Michelson-Gale experiment showed that Earth has rotational motion relative to Aether.

4. AATE Theory and Stellar Aberration

The reason for observation of stellar aberration can be explained by AATE theory. Any theory about the Aether should be able to explain this phenomenon. Suppose we want to observe a star like Gamma Draconis which Bradley observed in London in 1727 [4]. Bradley and his colleague (Molyneux) studied the apparent motion of Gamma Draconis and several other stars for several months [4]. They understood that for the observation of these stars, they had to tilt the telescope slightly in the direction of the Earth's orbital motion. This is how *stellar aberration* was discovered [4].

Consider Fig. 6. In this figure we have an Inkjet and the sheet of paper $ABCD$. When the paper is stationary along the y axis, because of moving the inkjet downward and parallel to the x axis, a straight line parallel to the x axis is drawn on the paper (red vertical line in Fig. 6). But when the paper is moved to the left with a constant velocity, the inkjet will draw a diagonal line while it is moving downward, the slope of which depends on the amount of paper velocity.

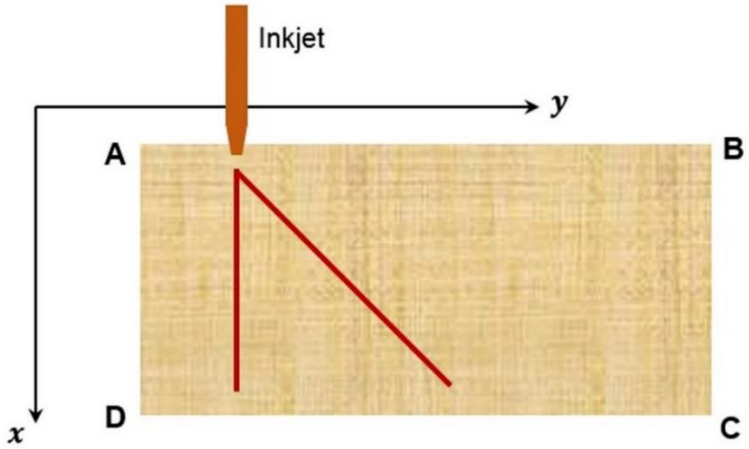

Fig. 6. When the sheet of paper $ABCD$ is stationary along the y axis, because of moving the inkjet downward and parallel to the x axis, a straight line parallel to the x axis is drawn on the paper. When the paper is moved to the left with a constant velocity, the inkjet will draw a diagonal line while it is moving downward, the slope of which depends on the amount of paper velocity.

In a similar way, in AATE theory, the propagation of light in Aether attached to Earth is like the propagation of ink inside a moving Sponge or like the drawing a diagonal line on the moving sheet of paper of Fig. 6. As you observed in Fig.6, the direction of propagation of ink (namely red diagonal line) is opposite to the direction of the moving sheet of paper. For example, in March in Fig. 7, because of orbital motion of Earth and subsequently Aether

attached to Earth toward the left, the starlight takes a diagonal path toward the right within Aether attached to Earth (because the direction of propagation of light is opposite to the direction of motion of Aether. Propagation of starlight in Aether attached to Earth is exactly like the propagation of ink in a moving Sponge.). Therefore, we should tilt the telescope to the direction of the Earth's orbital motion (left) to receive the light. In Fig. 7 blue diagonal dotted lines in March and September show the direction of the telescope or the direction of the starlight entering the telescope. The five vertical dashed lines show the direction of the starlight when we assume that the Aether is stationary relative to the star.

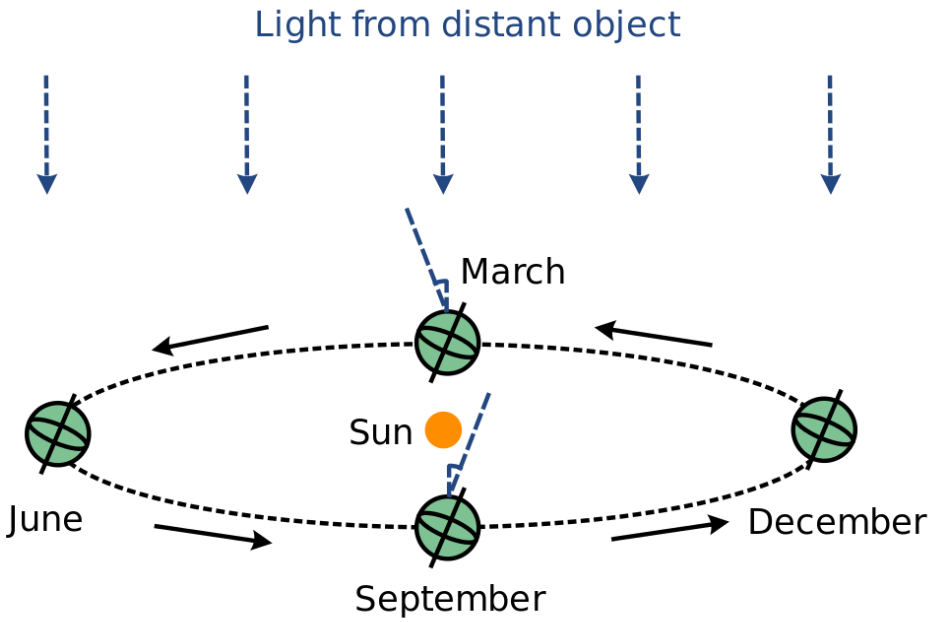

Fig. 7. Stellar Aberration. In Stellar Aberration, the direction of deviation of telescope from vertical line (namely blue dotted diagonal lines in March and September) is always in the direction of Earth's orbital motion. The five vertical dashed lines show the direction of the starlight when we assume that the Aether is stationary relative to the star.

Fig. 8 shows the situation of the telescope from a close-up view in March of Fig. 7. The angle of tilt α can be obtained in the following way. During the time that the light travels the length of the telescope (L) in Fig. 8 (namely from the objective lens to the eyepiece lens), the telescope goes to the left with the amount of $V\Delta t$. Where V is the orbital velocity of Earth. we have:

$$\sin\alpha = \frac{Opposite}{Hypotenuse} = \frac{V\Delta t}{L} = \frac{V\Delta t}{c\Delta t} = \frac{V}{c} = \frac{29.78}{299792} = 0.00009933$$

$$\Rightarrow \alpha = \arcsin(0.00009933) = 20.49 \ \ sec\, of\ arc \qquad (1)$$

This value has a very good agreement with the observed value namely $20.47\ sec\ of\ arc$ [4],[17].

Note: The motion of the Earth at a constant orbital velocity does not cause the drag in Aether. However, if the Earth is moving at an accelerated motion, due to the mass of the Aether (the inertia of the Aether), a drag is created in the Aether, which increases as we move further away from the center of Earth (In section 8 we will prove Aether has mass). Based on these

explanations, the telescope in Fig. 8 can see Gamma Draconis because the Earth does not accelerate along its orbit and its orbital velocity is constant. Therefore, there is no drag in the Aether in the orbital direction, and so the observer can see the starlight according to the mechanism we explained in Fig. 6. However, if the Earth's orbital velocity were not constant (For example, incremental), then, under any circumstances, Bradley could not see Gamma Draconis. Because the drag of Aether would prevent the starlight from entering the observer's eye. If the Earth, for example, had a positive orbital acceleration in March, then the path of the light in the Aether in Fig. 7 would be a curved line instead of a straight diagonal line (the blue diagonal dashed line in March). So, if light enters the telescope, it will not reach the eyepiece from the objective lens.

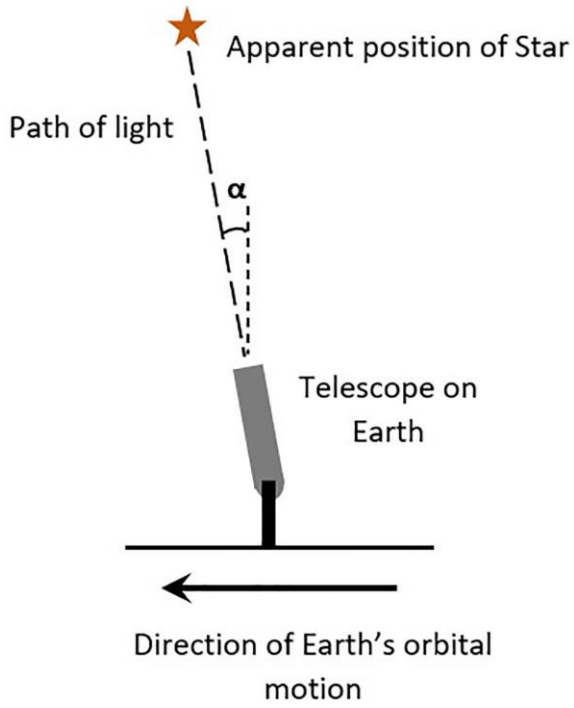

Fig. 8. Direction of stellar aberration in March. Because of motion of Aether along with Earth toward the left, the path of star's light in Luminiferous aether is diagonal. And we should tilt the telescope to the left.

5. AATE Theory and Trouton-Noble Experiment

Although, according to some physicists, the theory behind the Trouton-Noble experiment is not reliable enough to be able to comment on the existence or nonexistence of Aether [18]; However, based on AATE theory the reason for the null result of Trouton-Noble experiment can be explained. Trouton and Noble believed that if there was a stationary Aether in which Earth moves with a velocity of 30 $\frac{km}{s}$ relative to it, in such a case the plates of a capacitor, so that it could rotate freely, would always be perpendicular to the direction of Earth's motion in Aether [5]. But in their experiment, they did not observe this rotation of the capacitor. It is clear that such a rotation cannot be expected based on the theory of AATE. Because the net velocity of Earth relative to Aether in AATE theory is zero. So here the prediction of AATE theory is consistent with the observation.

6. De Sitter Observations from Binary Stars

The movement of source or observer relative to the air causes a change in the frequency of the sound received by the observer but has no effect on the velocity of sound in the air. If the received frequency is decreased due to the movement of source or observer relative to the air, then the wavelength is increased and vice versa. So that the velocity of sound in the air is always constant ($v\lambda = constant$). The velocity of sound only depends on the physical properties of the air such as density and temperature, not on the velocity of source or observer relative to air. The same is true of Aether attached to Earth. Because of motion of Aether along with Earth, all stars are in the motion relative to Aether. Just like the discussion about sound, because of the motion of stars relative to Aether, the frequencies of the light which we receive from the stars change. But this change in the frequency causes the received wavelength to change so that always we have: $v\lambda = c$. Therefore, the observations of de Sitter from binary stars, which is demonstrator of independence of velocity of light from velocity of source [1],[7], can be explained based on AATE theory.

7. The Michelson-Morley Experiment Using an Extraterrestrial Source

The Michelson-Morley experiment using an extraterrestrial source has been performed by R. Tomaschek, who used starlight, and D. C. Miller, who used sunlight [19][20][1]. That is, in Figure 1, instead of the light source on the table, we must use external sources. If the source velocity affects the velocity of light, after 90-degrees rotation of interferometer, we should observe a different fringe displacement compared to when the source was on the table. But no such different was observed in either of the experiments. This is because, as explained in Section 6, the velocity of the source does not affect the velocity of light propagation in the Aether attached to the Earth. Therefore, there is no difference between the results of the experiment with the source on the table and the experiment with an external source.

8. Luminiferous Aether and its Properties

From mechanics, we know that a wave cannot be transmitted along a string except when the string is under tension [9] and, based on the $v = \sqrt{T/\mu}$ formula, the speed of wave propagation along any ideal stretched string depends only on the string's linear density μ (string mass per unit length) and the tension T [9]. Accordingly, the Luminiferous Aether that transmits light should be a set of stretched strings with linear density μ, in which light propagates at a speed c and according to the relation $c = \sqrt{T_{Aether}/\mu_{Aether}}$. Since the value of c is not infinite, we can conclude that the linear density of Aether, that is the Mass per unit length of each of the strings of Aether and consequently the mass of the total Aether, is not zero. Because if it was zero, then c would be infinite according to the $c = \sqrt{T_A/\mu_A}$. And since c is not zero, we can conclude that Tension of the each of Aether's strings are not zero, because if T was zero, then c would also be zero according to the $c = \sqrt{T_A/\mu_A}$.

The phenomenon of light polarization showed that light is a transverse wave [21] and we know that a transverse wave propagates only in elastic rigid objects. Therefore nineteenth-century scientists believed that light transmission medium (namely Luminiferous Aether) is a *rigid medium* like solids. Since no measurable resistance or effect from the Aether on the motion of objects, such as the motion of planets in their orbits, has been observed; It can be concluded that the mass of the Aether and, consequently, its density is remarkably small

(much, much smaller than the density of air). Therefore, the Aether is a very, very light rigid object. And based on the $T_A = c^2\mu_A$, it can be concluded that the T of the Aether strings is also very, very small[1]. A light rigid object made of very thin threads with very little force T. Based on Green's theory [21], we can consider that Aether's strings are made of very small particles that are connected to each other by a short-range force (Fig. 9). The force between the constituent particles of Aether is a special force that acts only on themselves [21].

Fig. 9. The particles that make up Aether are arranged in a cubic lattice. They are very small. Probably Much, much smaller than the diameter of an electron, and each one is like a billiard ball with a little elasticity. They are held together by a short-range force.

Based on all of these explanations and based on the observations of Michelson-Morley experiment, it seems that *Luminiferous Aether is a rigid medium that is attached to Earth and is moved in Space along with Earth. A medium with very, very little mass that is perfectly continuous in small scale*.

Note: At the end of this section, it is necessary to explain the mechanism of creating drag in the Aether, which we mentioned at the end of section 4. If the Earth experiences accelerated motion, due to this accelerated motion, a slight shear stress is applied to the layers of the Aether in the opposite direction of the Earth's acceleration. This stress causes shear strain in the Aether and moving its layers on top of each other (Just like a piece of metal like Lead where applying shear stress causes its molecules and molecular layers to move on top of each other). This shifting of layers is the cause of what we know as Aether drag. The amount of the stress increases as we get further away from the Earth. Since the mass of the Aether is very, very small, the amount of this stress becomes significant only at very far distances from the Earth. In the stellar aberration in the Section 4, the effect of this stress and drag is not observed in the telescope. Because we are observing the star in the direction of the Earth's orbital motion, which is a motion without tangential acceleration. We said that if the Earth's motion on its orbit were accelerated, the effects of stress and drag in the Aether would affect our observations of the star.

[1] We can choose the linear density of the Aether so small that even multiplying it by the c^2 does not give a comparable and large value for T, compared to, for example, the T of the metals and even the weakest cotton threads. It is this small value of T and the linear density of the Aether that causes us not to feel our motion within the Aether.

9. An Experiment

So far, we have been able to explain seven important phenomena by AATE theory. As we said, some of these seven phenomena could not be explained by previous theories about Aether. This shows that our theory is the most complete theory of the Aether ever proposed. In this section, based on the AATE theory, I suggest performing an experiment. If we put the Michelson interferometer in a spacecraft, which is moving away from Earth with a constant velocity; In such a case and based on the theory of AATE, after 90 degrees rotation of interferometer around its center mirror, we should be able to observe the shift of the fringes. Because based on the theory of AATE, the velocity of spacecraft relative to Earth is the net velocity of spacecraft relative to Aether. Therefore, according to Michelson equation ($\Delta N = \frac{L_1+L_2}{\lambda}\frac{v^2}{c^2}$), we should be able to observe the displacement of the fringes after 90 degrees rotation. The maximum displacement of the fringes will be observed when the direction of the velocity of spacecraft is opposite to the direction of the Earth's orbital motion.

Suppose we use a 450 nm laser in Michelson Interferometer and the total length of the two arms is $L_1 + L_2$ =3 meters. In this status, if the spacecraft moves with velocity 100 $\frac{km}{s}$ relative to Earth (spacecrafts reach this velocity easily today) and in the opposite direction of Earth's orbital motion, based on Michelson equation, we should be able to observe a displacement equal to 0.7 of one fringe after 90 degrees rotation.

$$\Delta N = \frac{L_1 + L_2}{\lambda}\frac{v^2}{c^2} = \frac{3}{450 \times 10^{-9}} \times \frac{10^{10}}{9 \times 10^{16}} = 0.7 \qquad (2)$$

It is clear, via increasing the length of $L_1 + L_2$, it is possible to reach to the significant displacements (for example 0.5 or 0.7 one fringe) at lower velocity from 100 $\frac{km}{s}$. All steps of the experiment can be performed without the need for human presence in the spacecraft.

The theory of Stokes is about drag of Aether along with moving objects. Therefore, based on Stokes's theory, in the spacecraft experiment, just like the experiment on Earth, we should not observe the displacement of the fringes after 90 degrees rotation. Because according to Stokes's theory, Aether is dragged along with the interferometer in the spacecraft. Moreover, according to Einstein's theory of relativity, there is no difference between performing the MME in spacecraft or on Earth. Therefore, theory of relativity predicts the non-displacement of the fringes for the experiment of spacecraft. So, if in the experiment of spacecraft, we observe displacement of fringes it is only the evidence for existence of Aether attached to Earth.

Conclusion

I was initially trying to find a problem in the theory, calculations and the method of Michelson-Morley experiment. But everything seems to be correct in this experiment. So, I thought of explaining the result of this experiment. In February 2022, an exciting thought came to my mind: maybe Luminiferous Aether is attached to Earth. This thought gave me such confidence that I thought I had found the final explanation. Michelson's observations led me to think that the velocity of Earth relative to Aether is probably much lower than 30 km/s. If we take the velocity of Earth relative to Aether to be zero, the zero displacement of interference fringes in the MME can be explained. The zero velocity of Earth relative to

Aether is only possible if we assume that Aether is attached to Earth. We called this theory AATE. In addition to justification of Michelson-Morley experiment based on AATE theory, the cause of observe of stellar aberration and the reason for the null result of the Trouton-Noble experiment are justifiable. The AATE theory also explains de Sitter observations from binary stars and the observations of Sagnac, Michelson-Gale, Tomaschek and Miller.

As we said, in the AATE theory, Aether does not rotate along with Earth. The non-rotation of Aether along with Earth was a conclusion reached by Michelson and Gale too. They concluded from their experiment that if Aether is existed, it should rotate relative to Earth with an angular velocity of one revolution per day [16]. Which means no rotation of the Aether along with Earth. In fact, the Michelson-Morley experiment showed that Earth has no translational motion relative to Aether, and the Michelson-Gale experiment showed that Earth has rotational motion relative to Aether.

In this article, we analyzed the properties of Aether and showed that there is no out of logic property for Aether. The important point is that AATE theory does not experience the failures of previous Aether theories to describe phenomena. For example, Fresnel's stationary Aether theory fails to explain MME [1]. Or Stokes's Aether theory fails to explain stellar aberration [1] and Sagnac experiment [3], but AATE theory explains all these phenomena. After three years, I think this theory is complete.

Data Availability Statement: No datasets were generated or analyzed during the current study.

Declarations:

Funding: The authors did not receive support from any organization for the submitted work.
Financial interests: The authors declare they have no financial interests.
Conflicts of interest/Competing interests: There is no Conflicts of interest

References:

[1]. Resnick, R. *Introduction to Special Relativity*, (John Wiley and Sons, Inc, 1968), Chapter 1
[2]. Sagnac G. L'éther lumineux démontré par l'effet du vent relatif d'éther dans un interféromètre en rotation uniforme. *CR Acad. Sci*.. 1913;157:708-10
[3]. Pascoli G. The Sagnac effect and its interpretation by Paul Langevin. *Comptes Rendus Physique*. 2017 Nov 1;18(9-10):563-9.
[4]. Stewart, A. "The discovery of stellar aberration." *Scientific American 210, no. 3* (1964): 100-109.
[5]. Trouton, F & Noble, H. "The mechanical forces acting on a charged electric condenser moving through space," *Phil. Trans. Royal Soc. A* **202**, 165–181 (1903).
[6]. Michelson, A & Gale, G. The Effect of the Earth's Rotation on the Velocity of Light, II. *The Astrophysical Journal. 1925* Apr; 61:140.
[7]. De Sitter, W. "Ein astronomischer Beweis für die Konstanz der Lichgeshwindigkeit." *Physikalische Zeitschrift* 14 (1913): 429-429.
[8]. Weidner, R. Sells, R. *Elementary Modern Physics* (Allyn and Bacon, ed. 2, 1973)
[9]. Walker, J., & Halliday, D. *Fundamentals of Physics*, (2007) pp 449-564
[10]. Ohanian, H. *Modern Physics.* (Prentice-Hall, Inc, 1987)
[11]. Eisberg, R. *Fundamentals of Modern Physics.* (John Wiley & Sons Inc, ed. 4, 1964)
[12]. Krane, K. *Modern Physics* (Wiley, ed. 4, 2019)
[13]. Michelson, A. the relative motion of the earth and the luminiferous aether. *American Journal of Science. **22** (128),* 1881*: 120–129.*

[14]. Michelson, A & Morley, E. (1887) LVIII. On the relative motion of the earth and the luminiferous aether, *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 24:151, 449-463
[15]. Michelson, A & Gale, H. The Effect of the Earth's Rotation on the Velocity of Light, II. *Astrophysical Journal*, vol. 61, p. 140. 1925
[16]. Bowden, M. 2017, Michelson-Gale Experiment explained. URL: http://www.youtube.com/@MalcolmBowden
[17]. Spence, J. *Lightspeed: the ghostly aether and the race to measure the speed of light*. (Oxford University Press, 2019), Page 56
[18]. Hayden H. High sensitivity Trouton–Noble experiment. Review of scientific instruments. 1994 Apr 1;65(4):788-92.
[19]. Tomaschek R. Über das verhalten des lichtes außerirdischer lichtquellen. Annalen der Physik. 1924;378(1-2):105-26.
[20]. Miller DC. Ether-drift experiments at Mount Wilson. Proceedings of the National Academy of Sciences. 1925 Jun;11(6):306-14.
[21]. Schaffner, K. *Nineteenth-Century Aether Theories* (Pergamon Press Ltd, 1972), pp 14-67