The Fizeau Experiment – the Experiment that Led Physics the Wrong Path for One Century

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Abstract

Although Fresnel's ether drag coefficient was ad hoc, its curious confirmation by the Fizeau experiment forced physicists to accept and adopt it as the main guide in the development of theories of the speed of light. Lorentz's 'local-time' , which evolved into the Lorentz transformations, was developed to explain the Fizeau experiment and stellar aberration. Given the logical, theoretical and experimental counter-evidences against the theory of relativity today, it turns out that the Fresnel's drag coefficient may not exist at all. The Fizeau experiment and the phenomenon of stellar aberration have no common physical basis. The result of the Fizeau experiment can be explained in a simple, classical way. It is as if nature conspired to lead physicists astray for more than one century. Alternative theories and interpretations for the ether drift experiments and invariance of Maxwell's equations will be proposed. Physicists rightly assumed the invariance of Maxwell's equations, but their deeply flawed conception of light as ordinary local phenomenon led them unnecessarily to seek an 'explanation' for this invariance, which was the Lorentz transformation. Einstein went down the wrong path when he sought an 'explanation' for the light postulate, when none was needed. The invariance of Maxwell's equations *for light* is a direct consequence of non-existence of the ether and there is no explanation for it for the same reason that there is no explanation for light being a wave when there is no medium for its propagation. Constancy of phase velocity of light and rotation of the wave fronts for a moving observer, which are direct consequences of non-existence of light carrying medium, can explain the phenomenon of stellar aberration . The group velocity of light behaves in a conventional way: independent of source absolute velocity, but varying with observer absolute velocity. Light is a dual phenomenon: local and non-local. Light is a dual and quantum mechanical phenomenon. The paradoxes in classical electromagnetism, such as the moving magnet and conductor problem, arose due to incompleteness of classical electromagnetism and its wrong interpretation. The solutions to these paradoxes lay in unconventional and subtle, yet logical and natural, fundamental nature of light and electromagnetism.

Introduction

There were two rival theories of light in 19th century: the corpuscular theory and the wave theory. In 1810, Francois Argo carried out an experiment to test the corpuscular theory of light that predicted variation in the refractive index of optical media. Argo observed light from different stars through a telescope with a glass prism in front. Contrary to his expectation, light from all stars was refracted by the same angle, showing that the speed of light is independent of the motion of the stars. This disproved the corpuscular theory. Argo repeated the experiment by observing light from the same star at different times of the year. Since the speed of light varies

with motion of the observer according to ether theory, Argo expected variation in the refraction index. However, no variation in the index of refraction was observed, and all Argo observed was the familiar stellar aberration. This was perhaps the first revelation of the paradoxical nature of the speed of light, which would baffle and mislead physicists for the coming one hundred years and more. In 1871, Airy repeated the experiment by observing the stars through water filled telescope. He did not detect any deviation from the familiar Bradley aberration angle that would be expected given the lower velocity of light in water.

In 1818, Augustin-Jean Fresnel proposed the Fresnel partial ether drag theory and the Fresnel ether drag coefficient to account for the null result of the Argo star light refraction experiment. In 1851, the Fresnel ether drag coefficient was curiously confirmed by the Fizeau experiment. Although Fresnel's theory was ad hoc, the apparent confirmation of the drag coefficient by the Fizeau experiment was indeed troublesome. Physicists did not accept the Fresnel's ether drag theory behind it because it was ad hoc and because it predicted different relative velocities of ether and matter for lights of different colours. Yet they were forced to accept and adopt the drag coefficient ever since. In fact, the Fresnel drag coefficient became so important and unavoidable [1] that it became the basis for theories of the speed of light to be developed. Lorentz's 'local time', which later evolved into the Lorentz transformations we know today, was invented to explain stellar aberration and the Fizeau experiment. Einstein's relativity theory was also based on these experiments, as reported by Einstein himself.

This also sheds some light on the long standing debate on whether Einstein was aware of the Michelson-Morley experiment and its importance in the development of the theory of special relativity. Despite Einstein's insistence that " stellar aberration and the Fizeau experiment were enough", historians continued to debate over this. In light of the argument presented in this paper, for Einstein, the Michelson-Morley experiment was no extraordinary evidence for his extraordinary claim of special relativity because: 1. Emission theory could explain it 2. It gave a null result.

It is unlikely for a wrong theory to correctly predict a *non-null* result of an experiment, but it turns out that Lorentz's and Einstein's theories curiously agreed with the Fizeau experiment. It may be argued that these theories were created to explain the Fizeau experiment in the first place, but it is hard to explain that multiple theories (Fresenel's theory, Lorentz's 'local-time' and special relativity) can explain two phenomenon: stellar aberration and the Fizeau experiment.

The argument in this paper is based on presenting alternative explanations for the ether drift experiments and a new interpretations of the invariance of Maxwell's equations, thereby showing that Lorentz's and Einstein's theories are wrong.

The Michelson-Morley experiment

The Michelson-Morley experiment was conceived and designed to detect the ether and it failed to detect the ether. The non-existence of the ether was tacitly understood as non-existence of absolute motion. In fact, no one ever considered the possibility of distinction between the two. I have already shown that the ether doesn't exist, but absolute motion does exist, by providing an alternative explanation (Apparent Source Theory)[2] for the Michelson-Morley experiment.

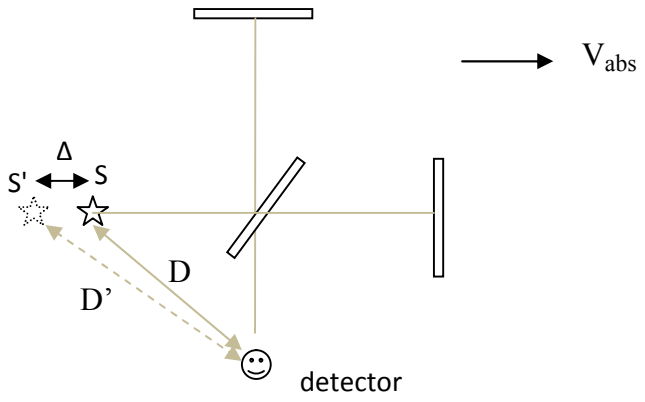
Apparent Source Theory (AST)

I have already proposed Apparent Source Theory[2] (AST) to explain the Michelson-Morley experiment, the Sagnac effect, moving source experiments and many other experiments within a single theoretical framework. AST turns out to be a fusion of ether theory and emission theory in a novel way. In this paper, we give a brief introduction to it.

We will present a new interpretation of absolute motion as follows.

The effect of absolute motion for co-moving light source and observer is to create an <u>apparent</u> change in the position(distance and direction) of the light source relative to the observer.

With this interpretation, the Michelson- Morley and the Kennedy-Thorndike experiments can be readily explained.



From the above diagram of the Michelson-Morley experiment, we see that the effect of absolute velocity is just to create an *apparent* change of the position of the light source *as seen by the detector*. The apparent change in position is determined by the direct source-detector distance D , the orientation of the source-detector line with respect to the absolute velocity and the magnitude of the absolute velocity[2].

The procedure of analyzing the Michelson-Morley experiment is:

1. Replace the real source S by an apparent source S' , to account for the absolute velocity
2. Analyze the experiment by assuming that the (*group*) velocity of light is constant *c relative to the apparent source S'*.

The best way to understand the effect of this apparent change of source position is to ask:
what is the effect of actually, physically shifting the source from position S to position S' ?
Obviously there will be no (significant) fringe shift in this case because, intuitively, both the longitudinal and lateral beams will be affected identically. It is possible to prove this experimentally in optics.
Therefore, in the present case, the apparent shift of the source is common both to the forward and lateral/transverse light beams and doesn't change the relative path lengths of the two beams and hence no (significant)fringe shift will occur.

A comprehensive description of Apparent Source Theory can be found in papers [2][5][6][7][8][9][10][11][12][13].

Implications of non-existence of the ether on the fundamental nature of light

The Argo experiment disproved not only the corpuscular or emission theory but also the wave or ether theory. Ether theory was conclusively ruled out by the Michelson-Morley experiment.

Light has always been conceived as an ordinary local phenomenon, despite the fact that the ether was disproved by multiple experiments. Although special relativity theory is based on the non-existence of ether, it treats light as ordinary local phenomenon. It turns out that any theory that considers light as an ordinary local phenomenon is destined for failure like the ether theory. This view of light as ordinary local phenomenon has led physicists to eternal confusions where such fantasies as " length-contraction, time-dilation, twin-paradox, Trouton-Noble paradox, dark matter, dark energy, black holes " have become mainstream science for more than a century.

According to Apparent Source Theory [2], light is a ***dual phenomenon: local and non-local***. This theory is a direct consequence of AST, a theory that successfully explains the Michelson-Morley experiment. Light is a dual and quantum mechanical phenomenon.

Constant phase velocity and variable group velocity of light

A consequence of the non-existence of the ether is the constancy of the *phase* velocity of light. The constant *c* in Maxwell's equations is the phase velocity of light and hence invariance of Maxwell's equations *for light* requires constancy of *phase* velocity. The *group* velocity is not relevant in this case. The phase velocity of light in vacuum is always constant *c* irrespective of

motion of the source and motion of the observer, for uniform motion or accelerated motion. However, the group velocity of light behaves in a conventional way: it is independent of source velocity but depends on group velocity. I adopted the theory of constancy of phase velocity from Einstein's thought experiment: 'chasing a beam of light'. However, Einstein never made distinction between *phase* velocity and *group* velocity. It is revealed in this paper that the phase velocity and group velocity of light in vacuum are completely independent of each other.

Imagine a light source and an observer moving relative to the source. Suppose that the observer is moving directly away from the source at or near the speed of light. The new finding being proposed here and in previous papers [2] is that the *group* will be 'frozen' where as the *phases* will still move past the observer at the speed *c* of light.

The *phase* velocity of light in vacuum is always constant *c* irrespective of source or observer motion. If an observer at rest relative to a light source measures the phase velocity to be *c* , another observer moving directly towards or away from the source will also measure *c*. The wavelengths and frequencies measured by the two observers will be related as:

$$f\,.\lambda \;=\; f'.\lambda' = c$$

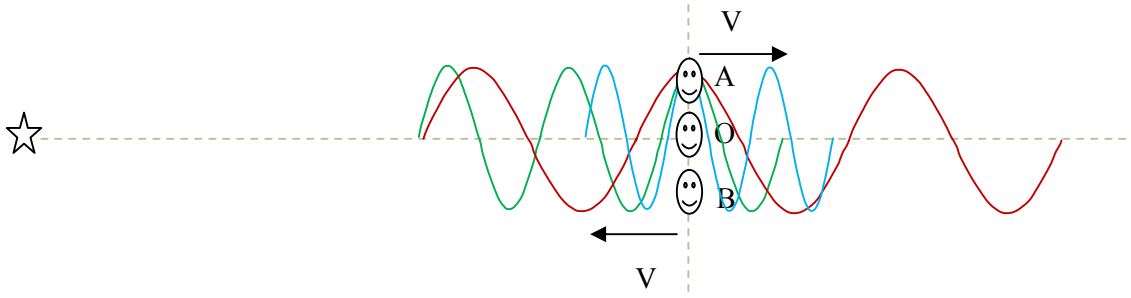
Invariance of Maxwell's equations *for light and electromagnetic waves*

Physicists rightly assumed invariance of Maxwell's equations *for light* for observers moving relative to each other, and this can be inferred directly from non-existence of the ether. However, their conception of light as ordinary local phenomenon was deeply flawed. Since they assumed light as an ordinary local phenomenon, they were led astray when, naturally, they sought an 'explanation' for this invariance of Maxwell's equations. This 'explanation' was the Lorentz transformations, in which they paid too much price by giving up all logic.

I propose that Maxwell's equations for light have the same form for all observers moving relative to each other, *without any further explanation* because no explanation exists for it. The invariance of Maxwell's equations is a direct consequence of the non-existence of a medium for light, which has no explanation either. Lorentz transformation is a result of a mixture of correct, unconventional thinking and wrong, conventional thinking. The assumption of invariance of Maxwell's equations was unconventional but correct, but the treatment of light as ordinary local phenomenon is a conventional but wrong thinking.

The new theory proposed in this and previous papers [2] is that light is not only a local phenomenon, but also a non-local phenomenon. Light is a dual phenomenon: local and non-local. Light is a dual and quantum mechanical phenomenon.

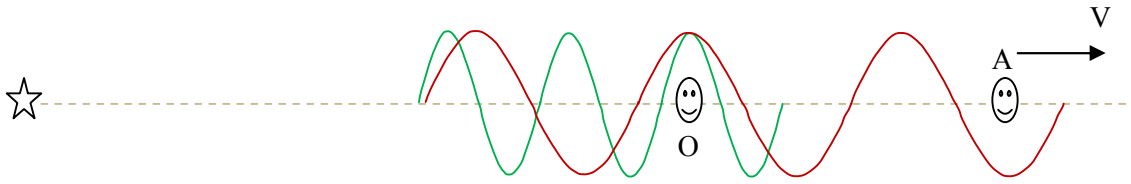
Consider a light source S and three observers O, A and B. Observer O is at rest relative to the source. Observer A is moving directly away from the source with velocity V. Observer B is moving directly towards the source with velocity V.



Imagine that all observers are at the same point relative to the source at a certain instant of time. The stationary observer O will see the green wave, moving observer A sees the red wave and moving observer sees the blue wave, due to Doppler effect.

For classical waves, for example for sound and the hypothetical ether, Doppler effect is a change of frequency only; the wave length will not change. For light, unconventionally, Doppler effect is due to a change of both frequency and wavelength. The phase velocity is always constant *c* irrespective of source or observer velocity. Therefore, Maxwell's equations will have the same for all observers. All observers (O, A and B) will see 'their own' wave. This is unconventional. The wave seen by each observer is inaccessible to any other observer, even if two observers are at the same point in space and at rest relative to each other.

For further illustration, consider another case in which there is a light source S and two observers O and A at different locations. Observer O is at rest relative to the source, and observer A is moving away with velocity V away from the source. Suppose that the source is emitting light of green wavelength.



Since observer A is moving away from the source, he will see the red shifted light (the red wave). Stationary observer O will see the green wave. Unconventionally, although observer O is on the path of the red light going from the source to observer A, observer O cannot intercept and has

no access to the red light wave of observer A ! Each observer sees their own light (rather ' their own photon ')!

In the case of classical waves, such as water waves, two observers at the same point in space at a an instant of time, in relative motion, will definitely see the same value of the wave (e.g. the peak) at that instant of time. This is because the wave has an objective existence. There is a common medium for the wave. This is not the case for light waves. Scientists were led astray when they correctly assumed invariance of Maxwell's equations, but wrongly treated light as classical waves, leading to Lorentz transformation.

Non invariance of Maxwell's equations for electric and magnetic fields

I have shown in a previous paper [14] that electric and magnetic fields are not invariant. Einstein's argument in his 1905 paper regarding the moving magnet conductor problem is misleading and wrong because he considered only two special cases: the magnet is at (absolute) rest and the conductor is in (absolute) motion OR the conductor is at (absolute) rest and the magnet is in (absolute) motion. His argument holds only for these special cases and fails for the general case in which both the magnet and the conductor can be in absolute motion, with different absolute velocities. The general case is one in which both are in absolute motion and also are in relative motion.

Imagine a magnet and conductor both on a common platform, say on a space craft, that is moving with absolute velocity $V_{abs} = 0.1\ c$. Consider two cases: the magnet at rest relative to the space craft and the conductor moving relative to the magnet AND the conductor at rest relative to the space craft and the magnet moving relative to the conductor. I have shown in [14] that the two cases will not give the same result. Einstein's argument holds only if the space craft is at rest, which means if one of them (either the magnet or the conductor) is at absolute rest. Even in this case, Einstein's argument will be fully correct only if he makes an extraordinary assumption: relativity of simultaneity [15]. Therefore, Einstein's fallacious consideration of only a special case of magnet and conductor moving relative to each other misled him to the general conclusion that Maxwell's equations must be invariant, which required the relativity of simultaneity [15]. The very fact that one has to resort to such extraordinary, unnatural, illogical solutions such as time dilation and length contraction to make Maxwell's equation invariant is a proof that Maxwell's equations are not invariant in the way this is currently thought. This means that Lorentz transformation is incorrect at best.

The paradoxes in classical electromagnetism, such as the moving magnet and conductor problem, arose due to incompleteness of classical electromagnetism and its wrong interpretation. Maxwell's equations should be modified and interpreted according to Apparent Source Theory. For example, classical electromagnetism has no answer or gives the wrong answer for the electric force between absolutely co-moving charges. The constant c in Maxwell's equations should be interpreted as constancy of phase velocity, not group velocity.

Doppler effect

The new theory of light should explain Doppler effect and experiments apparently supporting relativistic Doppler effect (i.e. transverse Doppler effect). These are the Ives-Stilwell experiments. In my previous paper[2], I have proposed a simple law of Doppler effect of light, Exponential Doppler Effect (EDE), that can explain the Ives-Stilwell experiments. The law of Doppler effect is given by:

$$f' = f\, e^{\frac{V}{c}} \qquad \lambda' = \lambda\, e^{\frac{-V}{c}}$$

where V is the source observer relative velocity and is positive for approaching source and observer, and *e* is Euler's constant.

Einstein's thought experiment (' chasing a beam of light ') was extremely compelling. The constancy of the velocity of light is an immediate consequence of non-existence of the ether. However, Einstein was puzzled by his own thought experiment. This led him to resort to illogical solutions. The simplest logical explanation of constancy of phase velocity would be to make distinction between phase velocity and group velocity and then accept that not only the frequency but also the wavelength changes for a moving observer so that:

$$f\,.\lambda = f'.\lambda' = c$$

Einstein failed to make the distinction between phase velocity and group velocity of light.

The question follows : then what law governs the Doppler effect ? The Exponential Doppler Effect (EDE) of Light is a very compelling theory that can explain both the Ives-Stilwell experiment and its modern version: the fast ion beam experiment[2].

The argument for EDE is summarized as follows. *Constancy of phase velocity of light is self evident*. But there is no other *logical* way of describing it except by accepting that both the frequency and wavelength change, so that their product always equals *c*. EDE is perhaps the simplest law not only satisfying this requirement, but also in agreement with Ives-Stilwell experiments. This implies that Einstein's relativistic formula of Doppler effect is wrong, invalidating also the whole Lorentz transformation on which it is based.

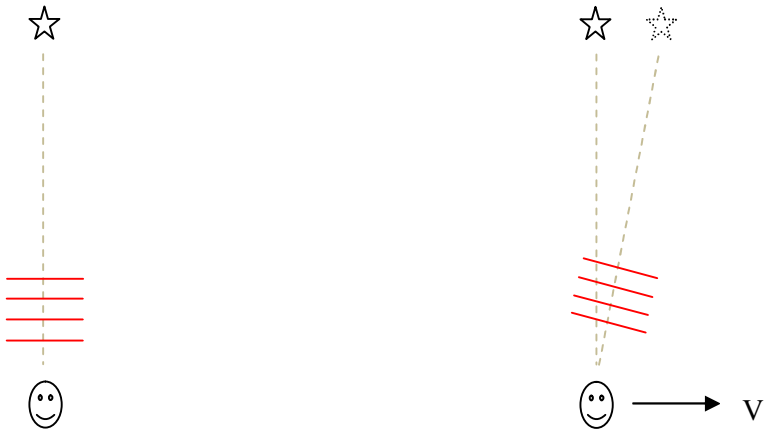
Experimental evidences for variable group velocity of light

A direct experimental refutation of the assumption of the constancy of the group velocity of light assumed by special relativity (special relativity makes no distinction between phase velocity and group velocity of light in vacuum) has been performed by using lunar laser ranging experiment [3]. It was confirmed that the group velocity of light varies with observer velocity.

Rotation of wave-fronts

We have seen that the constancy of the phase velocity of light in vacuum is a direct consequence of the non-existence of ether. The same argument explains the phenomenon of stellar aberration. The Lorentz transformation was developed to 'explain' this rotation when no explanation existed or was needed. The rotation of the wave fronts of star light for a moving observer is a direct consequence of non-existence of the ether. It is something that is to be accepted without any 'explanation'.

Consider two cases below in which the observer is also at absolute rest (left figure) and the observer is moving transversely relative to the star to the right (right figure). The star is at absolute rest in both cases.



For the observer moving relative to the star (right figure), the wave fronts are rotated. This again is a consequence of non-existence of ether theory and there is no explanation for it because there is no explanation for light being 'a wave without medium'. Lorentz transformation was created to 'explain' this, when no explanation actually exists or is needed. Whereas I adopted Einstein's thought experiment to arrive at the theory of constancy of phase velocity, I independently proposed the theory of rotation of the wave front.

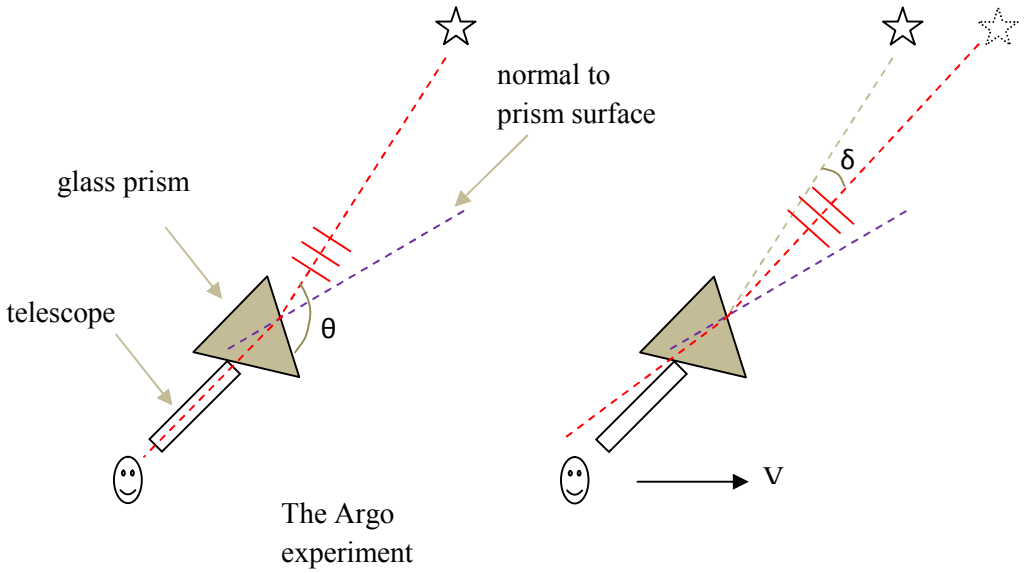
The Argo and the Airy star light refraction and aberration experiments

With the above theories, the Argo and Airy star light refraction and aberration experiments can easily be understood. The first experiment of Argo involved observing the lights from different stars through a telescope with a glass prism at the entrance. According to the corpuscular theory, there would be a range of different velocities of lights from different stars and hence variation in refractive index of the glass. Since no variation in the angle of refraction was observed, emission

or corpuscular theory was disproved, showing that the speed of light is independent of the velocity of the source.

The second experiment of Argo was similar to the first one except that this time, instead of observing lights from different stars at nearly the same time, light from the same star was observed at different times of the year. Since, according to the ether theory, the speed of light varies with observer velocity, Argo expected variation in the angle of refraction. However, no such variation was observed other than the familiar Bradley aberration. This was baffling because, logically, if corpuscular theory was proved wrong then wave (ether) theory, the only alternative, should have been confirmed. It appeared that the speed of light is independent of motion of the observer either. The explanation will be proposed below.

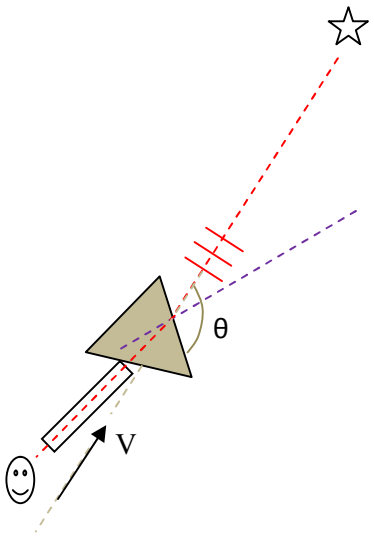
The following figure shows the principle of the Argo experiment. The left figure shows the case when both the star and the observer are at absolute rest, hence at rest relative to each other. As can be seen, the telescope is aligned with the refracted light from the star and the observer can see the star. Let the angle between the light ray and the prism surface be θ for the light ray to be aligned with the axis of the telescope. Assume that the telescope and prism are rigidly fixed to a common platform and hence always move together. When the observer is in motion relative to the star (the star at absolute rest), there will be aberration of the star light by angle δ as seen from the point where the light strikes the prism (right figure). Since the direction of the light ray has tilted forward by angle δ, therefore, the whole apparatus (the telescope and the prism) should be tilted forward by the same angle δ so that the angle between the light ray and the prism remains θ, in order to see the star. Therefore, the apparatus (telescope and prism) needs to be tilted by the angle of aberration only. Therefore, Argo's star light refraction experiment can be explained by the theory of rotation of the wave front.



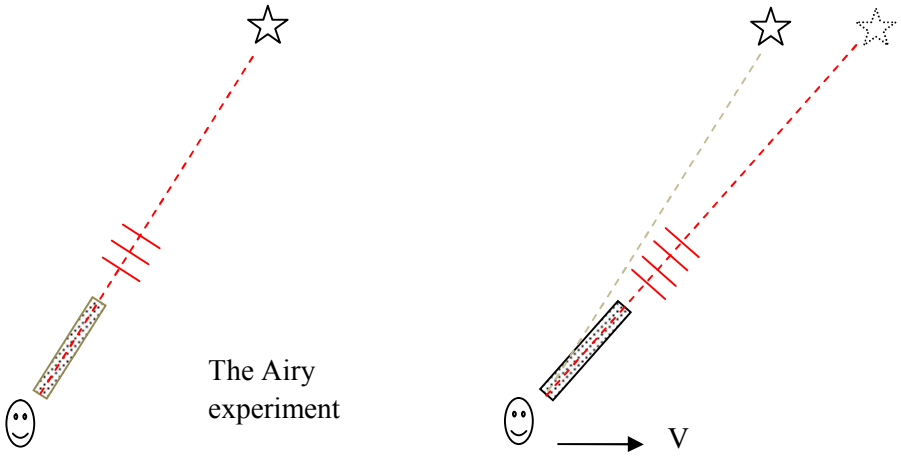
The Argo
experiment

Imagine now that the apparatus (telescope and prism) is moving directly towards the star. Obviously, there will be no aberration and hence no rotation of the wave fronts. But, ether theory somehow predicts that there will be a change in refraction angle because the phase velocity of light will increase due to observer motion. Since no such effect has been detected, therefore, the Argo and the Airy experiments can be explained by:

1. Theory of rotation of the wave fronts AND
2. Theory of constancy of the phase velocity of light, independently of source or observer motion.



The Airy experiment is shown below, in which the star is observed through a telescope filled with water.



The Airy experiment

In the above figures, the star is assumed to be at absolute rest in both cases. The observer is at absolute rest (left figure) and the observer is in absolute motion (hence in motion relative to the star) (right figure). When the observer is at rest (left) figure, the axis of the telescope is parallel and aligned with the light from the star. When the observer is in motion relative to the star, the telescope should be tilted forward by the amount of angle of aberration. This angle will be the same whether the telescope is filled with air or with water. The telescope needs only tilting by the angle of aberration, i.e. by the same amount of rotation of the wave fronts.

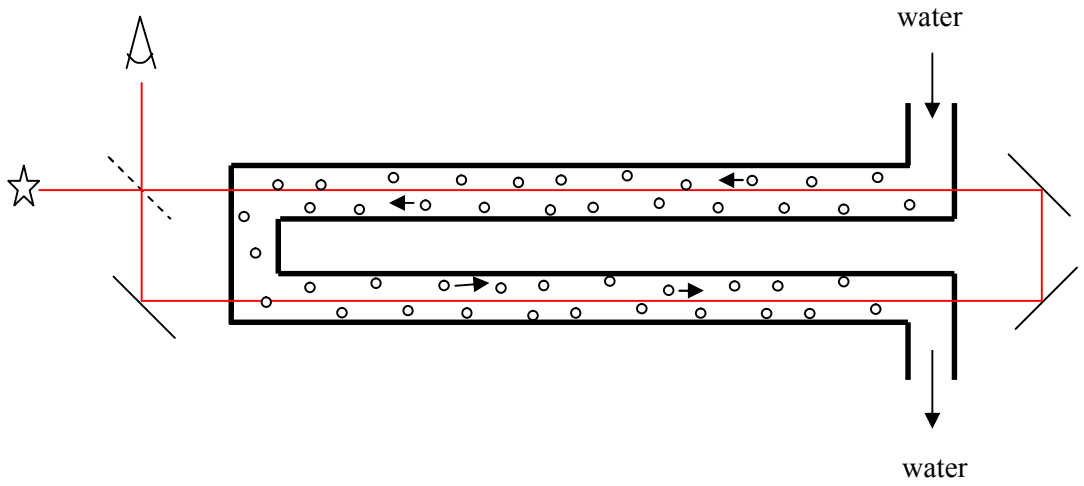
The Fizeau experiment

With the theoretical frame work above, we have been able to explain first order and second order ether drift experiments. Apparent Source Theory (AST) easily explains the Michelson-Morley experiment, where as the theory of constancy of phase velocity and rotation of wave fronts for an observer moving relative to the star explains the Argo and the Airy experiments. With this theoretical framework, I was also able to explain other experiments of the speed of light including the Sagnac effect, the Silvertooth experiment, the Marinov experiment, the Roland De Witte experiment, the Venus planet radar ranging experiment anomaly (as reported by Bryan G Wallace) and the Ives -Stilwell experiments.

Of all the experiments, the Fizeau experiment resisted explanation within the theoretical framework above. The fact that the Fresnel's drag coefficient was apparently confirmed by the Fizeau experiment was problematic for me. It was at this point that, considering all the circumstances, I decided that it was only a curious coincidence that Fresnel's drag coefficient was confirmed by the Fizeau experiment. To support this assertion, I came across a paper [4] that explains the Fizeau experiment based on a simple classical way.

Moreover, what makes me doubt the perceived connection between the stellar aberration experiments and the Fizeau experiment is that the Fresnel drag coefficient cannot be derived from the Fizeau experiment. I asked : if the Argo and Airy experiments were never performed, would it be possible to derive the Fresnel's coefficient from the Fizeau experiment at all ?

The classical explanation of the Fizeau experiment is base on the theory of absorption and remission of light by the molecules of water. In the case of light moving in the same direction as the motion of water molecules, the light will encounter less number of molecules compared to light moving opposite to the direction of water flow. The more the number of molecules light encounters, the more the number of absorptions and re-emissions and hence the less the speed of light. The less the number of molecules light encounters, the less the number of absorptions and re-emissions and hence the more the speed of light will be. Therefore, light moving in the same direction as the water flow will be speeded up, while light moving in the opposite direction of the water flow will be slowed down.



Conclusion

Logical, experimental and observational evidences against the theory of relativity (special and general) are continuing to accumulate. Despite all the counter-evidences, the theory of relativity still persists partly because of lack of an alternative explanation. The argument goes like: ' if there is no alternative explanation then relativity must be correct '. The theories I have already proposed (Apparent Source Theory, Exponential Doppler Effect) may bring an end to the last argument. It is hard to justify how the scientific community lives with the paradoxes of relativity: twin paradox, Trouton-Noble paradox. The group velocity of light has been shown experimentally to vary with observer velocity. The speed of electrostatic fields has been shown to be infinite experimentally, disproving the assertion of special relativity that no information can travel faster than light. Tom Van Flandern also argued that the speed of gravity must be at least billions times the speed of light for stability of planetary systems. Absolute translational motion of the earth has been detected by multiple experiments. Dark matter and dark energy are not solutions, but failures of general relativity. In general, relativity theory has no logical, observational and experimental foundations. All this makes one curious about the origins and foundations of the theory. In this paper, it has been stressed that the Fizeau experiment played the key role in the evolution of Lorentz transformation, which gave birth to the special relativity theory. The apparent (and curious) confirmation of the Fresnel drag coefficient by the Fizeau experiment is perhaps the single most important factor that has led physics down the wrong path for more than a century. If it was not for the Fizeau experiment, perhaps the history of physics

would have been different. There is no common physical basis for the ether drift experiments and the Fizeau experiment. In this paper it has been argued that the invariance of Maxwell's equations does not also require Lorentz transformation. It is a direct consequence of unconventional, counterintuitive nature of light: non-existence of the ether, dual (local and non-local) and quantum mechanical nature of light.

Glory be to Almighty God and to His Mother, Our Lady Saint Virgin Mary

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