Michelson-Morley Experiment is the Experimental Proof Against the Constancy of the Speed of Light and Einstein's Theory of Relativity

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The statements about the "failure of the classical mechanics" to explain the null results of the Michelson-Morley experiment can be found in practically every physics textbook dealing with this subject and in every manual on relativity. While the diagrams of the MM experiment according to the ether theory is readily shown, no physics textbook or manual on relativity has presented a diagram of the motion of the light beams in the MM experiment from Newton's classical mechanics point of view and explain exactly where, how and why Newton's classical mechanics failed to explain its null results.

Einstein also believed that Newton's classical mechanics failed to explain the results of the MM experiment, and that his theory of relativity, along with the theory of contractions, would provide an answer.

This paper will show that Newton's mechanics, where light behaves like any particle of matter and that the ether does not exist, is in perfect agreement with the null results of the MM experiment and the principle of relativity. It will also present new drawings of this experiment according to Einstein's mechanics that are in contradiction with the same principle, with the concept of the constancy of the speed of light and with the theory of relativity.

Introduction

The principle of relativity is often expressed in physics with sentences such us: *"The laws of physics are the same in all inertial frames of reference."* Although this explanation is correct, it does not give us a clear picture of why these laws remain the same.

Would it be possible to express the principle of relativity with an algebraic equation or relationship? Or could this principle be expressed in a geometric form so we can easily see and understand why the laws of physics that affect an object at rest are the same as those when the object is in the state of uniform motion?

The following two theorems lead to the algebraic and geometric expressions of the principle of relativity.

Theorem #1. The times in the parallelogram of speeds and distances

When two forces act on an object simultaneously, they form a parallelogram of forces and speeds where the resulting force is directed along the diagonal of this parallelogram. The object will travel along the diagonal that bisects the parallelogram into two identical triangles, the sides of which are the initial two speeds v and u *(Fig. 1)*.

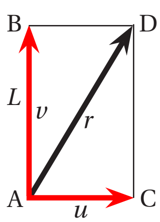

Figure 1

The time for the object at A to travel along the diagonal of a parallelogram (or the hypotenuse of the two right triangles) at the resulting speed r will be the same as the time for the body to travel along the side AC at speed u and the time to travel along AB at speed v, if the forces acted separately along these distances. That is,

$$t_{AD} = t_{AC} = t_{AD}$$

or

$$AD / r = AC / u = L/v$$

In other words, in a parallelogram of speeds in this example, the ratio of distances to speeds along these distances would be the same.

Theorem #2. Constancy of time in a parallelogram of speeds and distances

Suppose we reduce the force along AC in *Figure 1* so that the resulting speed along AD_1 is also reduced to r_1, shown in *Figure 2*. However, the time to reach D_1 at the reduced speed would remain the same, L/v.

If we increase the force along AC so that the speed u is also increased to u_2, the resulting speed would increase to r_2. However, the time to reach D_2 would remain the same, L/v.

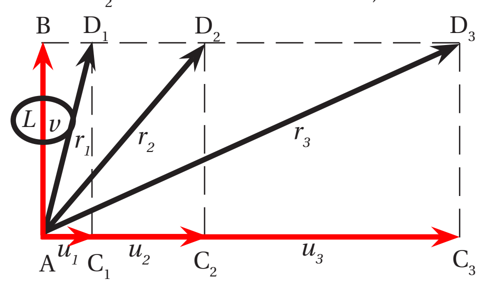

Figure 2

If we increase the speed along AC even further, or if we change the direction of travel, so that the resulting speed r_3 increases, the time to travel along AD_3 would remain unchanged, L/v.

In other words, we can vary the magnitude and the direction of the force acting along AC, but the time along AD_1, AD_2 or AD_3 and AC_1, AC_2, or AC_3, will remain the same, L/v. That is:

$$\frac{L}{v} = \frac{AC_1}{u_1} = \frac{AC_2}{u_2} = \frac{AC_3}{u_3} = \frac{AD_1}{r_1} = \frac{AD_2}{r_2} = \frac{AD_3}{r_3}$$

If only one force changes its magnitude in the above example so that the speed due to this new force also changes, no change in times would occur—it would occur only if the magnitude of both forces should change.

These two theorems can be applied to the MM experiment where the speed of the earth and the speed of the light beams form a parallelogram of speeds and where the times of travel always remains the same regardless of how the setup is rotated.

The speed of the earth around the sun varies depending on the position of the earth in its elliptical orbit. Thus, the earth also travels at a varying speed. However, the initial speed of the light beams and the lengths of the arms of the apparatus are constant.

Therefore, according to Newton's classical mechanics and the two theorems, the actual time for the light beams to travel their optical paths to the mirrors and back to the beamsplitter will always be the same, regardless of the changes in the speed of the earth or the apparatus' orientation relative to the earth's motion.

These relationships were first outlined by Newton in his *Principia*. In *Corollary I*, following the three famous laws of motion [1], and in the very first drawing of his book, Newton defined the essence of the above relationship:

> *"A body, acted on by two forces simultaneously, will describe the diagonal of a parallelogram in the same time as it would describe the sides by those forces separately."*

> *"If a body in a given time, by the force M impressed apart in the place A, should with an uniform motion be carried from A to B, and by the force N impressed apart in the same place, should be carried from A to C, let the parallelogram ABCD be completed, and, by both forces acting together, it will in the same time be carried in the diagonal from A to D."* [1]

Newton demonstrated this relationship with the following drawing:

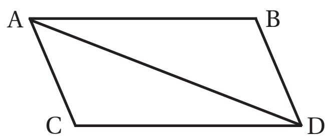

Figure 3

Geometric and algebraic expression of the principle of relativity

Let us consider the motion of the perpendicular light beam in the MM experiment from the classical mechanics point of view. The motion of this light beam will be affected only by the motion of the earth, as the ether has no effect on the motion of the light beams in Newton's mechanics.

When the apparatus is at rest, the light beam will travel along the vertical arm from the beamsplitter at A to a mirror at B and back; that is, twice the distance *L*, in time *2L/c*, as shown in *Fig. 4*.

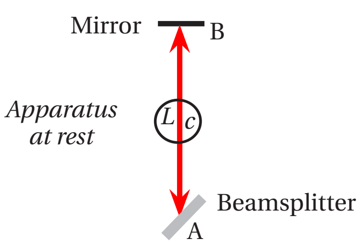

Figure 4

When the apparatus is in uniform motion, as shown in *Figure 5*, the moment the beam begins its journey, the mirror at B and the beamsplitter at A will start moving to the right, carried by the motion of the earth.

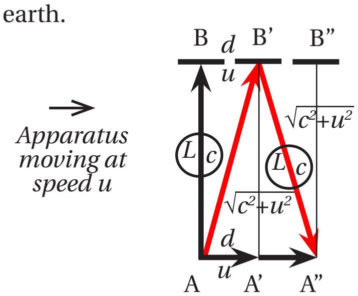

Figure 5

Because the earth's motion affects the light beam and the mirror proportionally, the beam will reach the center of the mirror at B'. The initial speed of the light beam and the motion of the earth form a parallelogram of speeds ABB'A'. The light beam will travel along the diagonal AB' of this parallelogram. According to *Theorem 1*, the time to travel along the diagonal must be the same as the time for the light beam to travel the distance AB at its initial speed *c*; that is, *L/c*.

On its return, the light beam will travel along the diagonal B'A" of another yet equal parallelogram, A'B'B"A". The travel time along the diagonal of the second parallelogram must also be *L/c*.

Let us rotate the apparatus 45^0, as shown in the next figure. The length *L* and the initial speed *c* remain the same. The light beams will now travel different distances at different speeds along the diagonals of the two slanted parallelograms, which share the common side $A'B'_1$ of length *L* and the time along it *L/c*. The square roots represent different speeds of the light beam.

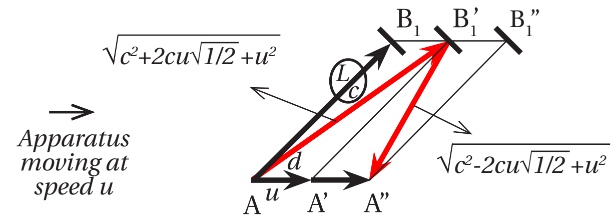

Figure 6

The travel time along the diagonals will be the same, *L/c*.

Let us rotate the arm of the apparatus another 45^0 so that the motion of the light beam is parallel to the motion of the earth, as shown in *Fig. 7*. This new figure shows the parallelograms from *Fig. 5* and *6,* which have *collapsed* along the length AC".

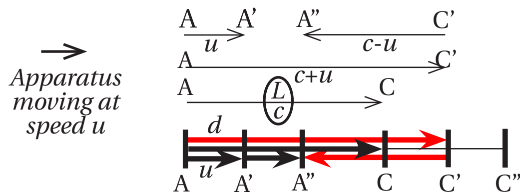

Figure 7

All relationships remain the same as established in the previous figures. The time for the light beam moving at speed *c+u* to reach the mirror C receding at speed *u* must be the same as the time to travel distance *L* at speed *c*. Upon the reflection at C', the light beam will travel at speed *c-u* in the direction of the advancing beamsplitter. The time to reach the beamsplitter at A" must also be *L/c*.

In the last three figures, the light beams travel different distances at different speeds, yet they reunite at A" and the travel time remains the same. By combining the four diagrams into one, we get the diagram of the motions of the light beams in the MM experiment as the apparatus is rotated relative to the motion of the earth *(Fig. 8)*.

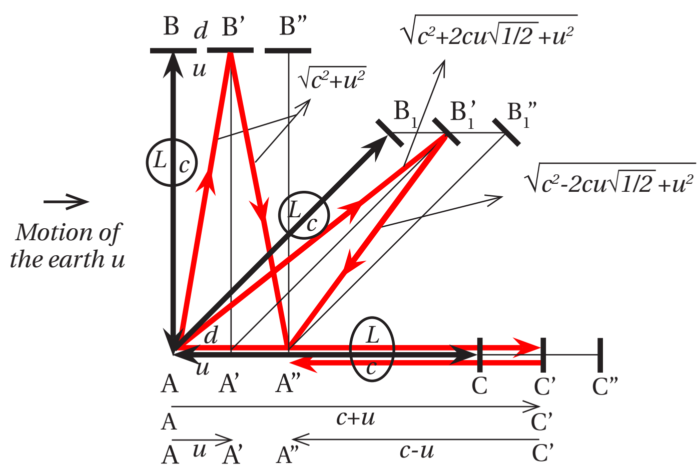

Figure 8

The time relationships among the speeds of the light beams in all orientations and the distances traveled by these beams, as presented in *Fig. 8*, can be expressed as:

$$\frac{L}{c}=\frac{d}{u}=\underbrace{\frac{AB'}{\sqrt{c^2+u^2}}=\frac{B'A''}{\sqrt{c^2+u^2}}}_{90^0}=\underbrace{\frac{AB'_1}{\sqrt{c^2+2cu\sqrt{1/2}+u^2}}=\frac{B'_1A''}{\sqrt{c^2-2cu\sqrt{1/2}+u^2}}}_{45^0}=\underbrace{\frac{AC'}{c+u}=\frac{C'A''}{c-u}}_{0^0}$$

Orientation to earth's motion

These relationships and the last diagram represent the algebraic and geometric expression of the classical principle of relativity from the particle point of view of the nature of light. They show that the ***ratio*** of distances traveled by the light beams to their speeds—that is, the ***time***—is constant, regardless of how the apparatus of the experiment is oriented relative to the motion of the earth so that the light beams always arrive back at the beamsplitter at A" at the same time and in phase.

It is because of the constancy of this *ratio*, and the geometry presented in the last figure, that the light beams in the MM experiment travel their corresponding distances in equal times, regardless of how the apparatus is oriented relative to the earth's motion, and regardless of the earth's orbital speed.

Such is the power of the principle of relativity.

Newton's and Galileo's principle of relativity and the changes in the distances traveled by the light waves

The formation of fringes in the MM experiment is also determined by the manner in which the waves of the light beams interfere with one another.

Because the speed of light can vary in classical mechanics, the distances traveled by a wave will have to vary proportionally depending on the speed of the light beams. To demonstrate this interdependence, let us begin with the diagram of the MM apparatus at rest, as shown below.

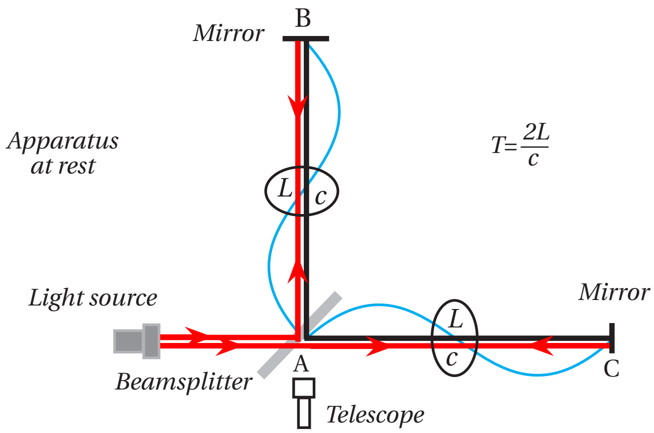

Figure 9

Suppose a light beam (or a radio wave) that is split into two waves at A has the wavelength *L*, which is the length of the arms of the apparatus *(Fig. 9)*. When the apparatus is at rest, the two beams will cover their distances to the mirrors (AB and AC) with one wavelength, reflect from them and reunite again at A in phase; that is, in the same way as when they left point A.

The above system is now put into motion so arm AB is perpendicular and arm AC parallel to that motion, as shown in *Figure 10*. According to classical mechanics, the motion of the apparatus will affect the speeds of the light beams so that the component *u* (the speed of the earth) will be added to the speeds of the light beams.

The perpendicular beam, which covered the length AB with one wavelength when the apparatus was at rest, will travel along the diagonal AB' at a faster speed and cover a longer distance. The wave will expand proportionally so this longer distance is covered with one wave. The same thing happens after the beam is reflected from the mirror at B'. The beam will arrive at A" in the same phase as when it left point A.

The parallel beam will travel in the direction of the receding mirror at speed *c+u* and cover a much longer distance, AC'. However, the wave of the light beam will expand proportionally and cover the distance with one complete wave. When the light wave arrives at C', the source will move to A' and begin the emission of the next wave.

Therefore, *the beam's wavelength will remain unchanged* λ=L=A'B'=A'C'. On its return, the light beam will travel in the direction of the approaching beamsplitter. The light beam will now cover a shorter distance (C'A"), but it will travel at a slower speed *(c-u)*. The light beam will contract proportionally to the decreased speed and cover this shorter distance. However, the wavelength, that is, the distance between the beginnings of each wave remains the same.

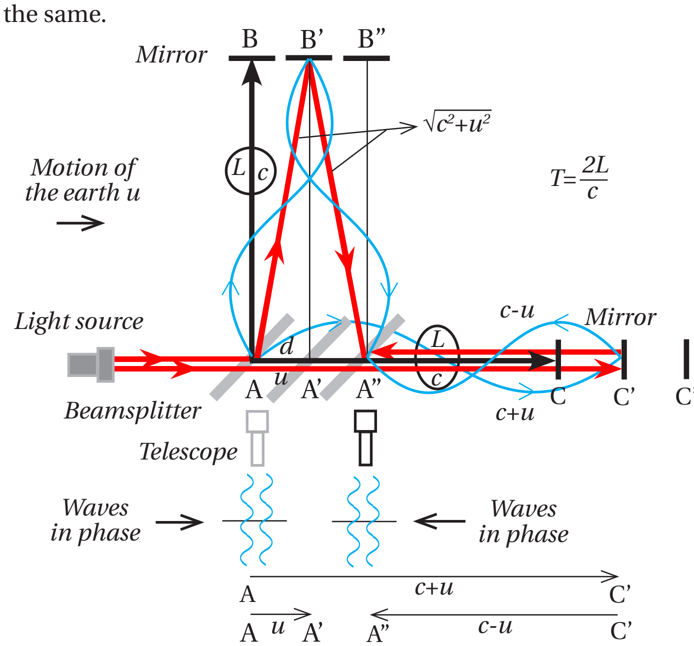

Figure 10

This proportionality guarantee that the parallel and the vertical light waves will arrive at the beamsplitter and the viewing telescope at the same time, same phase and at the same place on the beamsplitter as when they departed it.

The essence of classical mechanics interpretation of the behavior of light waves when a source is in motion:

The essence can be summarized in two points:

a. The distance traveled by each wave is proportional to the speed of light.

b. The wavelength of the light beams remains constant.

Both of these points are extremely important, as they fully explain why the light waves arrive in phase at the mirrors and at the beamsplitter in the MM experiment. The two points also explain why this interpretation is in full agreement with the principle of relativity.

The essence of the Newton's classical mechanics interpretation of the principle of relativity is that the motion of the earth, the laboratory and the interferometer in the MM experiment proportionally affect every component of the experimental setting, including the speed of light.

When we combine the drawings in *Figs. 8* and *10*, we get the following drawing, which represents *the geometric expression of the principle of relativity from the particle and wave nature of light*.

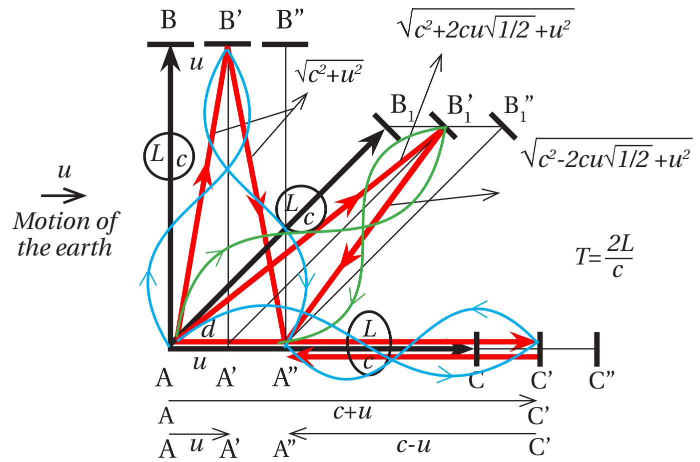

Figure 11

According to classical mechanics of Newton and Galileo, when the two light beams reunite at point A" in the above figure, they will always reunite at the same place on the beamsplitter and in phase regardless of how the apparatus of the experiment is oriented relative to its direction of motion through space. The travel times of the beams remains the same, *2L/c*, along all optical paths.

Einstein's interpretation of the null results of the MM experiment contradicts the principle of relativity

According to Einstein's mechanics, when the MM apparatus is at rest, the light waves travel in the same manner as in classical mechanics, as shown in *Fig. 9*. The two light waves travel at speed *c* to the mirrors and back to the beamsplitter at the same time and in the same phase as when they left point A.

The next diagram in *Figure 12* shows the same apparatus moving to the right at a uniform speed *u*, the speed of the earth around the sun. According to relativistic interpretation of the null results of the MM experiment, the waves must travel at the constant speed *c* along all optical paths.

Due to this constancy, the total travel times of the vertical and the parallel beams are different.

$$T_{vertical} = \frac{2L}{c\sqrt{1-u^2/c^2}} \qquad T_{parallel} = \frac{2L}{c(1-u^2/c^2)}$$

The different times of travel would cause the fringe shift in the experiment when the apparatus is rotated, which did not occur in the actual experiment.

The theory of contraction along the parallel length was conceived for the sole purpose of making the above two times equal and explain the absence of fringe shift in the actual experiment.

When the *L* in the above equation for the parallel time is changed to $L\sqrt{1-u^2/c^2}$, and the term $(1-u^2/c^2)$ is expended, the parallel time changes to

$$T_{parallel} = \frac{2L\sqrt{1-u^2/c^2}}{c\sqrt{1-u^2/c^2}\,\sqrt{1-u^2/c^2}}$$

Thus, the parallel and vertical times would become equal:

$$T_{vertical} = T_{parallel} = \frac{2L}{c\sqrt{1-u^2/c^2}}$$

Based on these relativistic times, the following diagram of the motions of the light *waves* along the optical paths in the MM experiment is constructed.

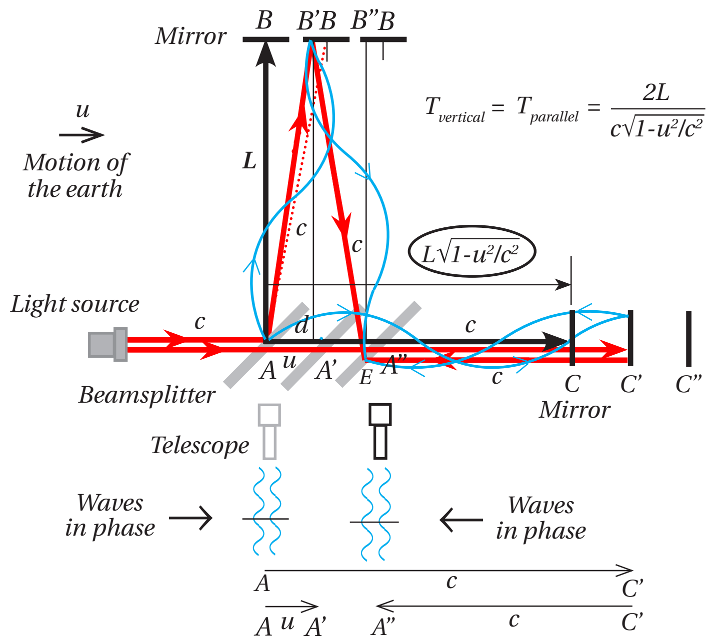

Figure 12

Because the optical path of the parallel light beam AC' is longer than the wavelength (λ=L), the beam must travel more than a wavelength to reach the mirror. By the time the parallel wave covers the distance *L* and arrives at C, the source will advance to the right, to A', ready to emit a new wave. The wavelength of the wave is now shorter than the initial wavelength *L* when the apparatus was at rest. The same would happen to the vertical wave.

Therefore, in the relativistic interpretation of the speed of light, the distance traveled by each wave is always the same regardless of the speed of the source, while the distance between the beginnings of the two adjacent waves (the wavelength) will change depending on the speed of the source. The essence of the relativistic interpretation of the behavior of the light waves when the source is in motion is expressed by the following two points:

a. The distance traveled by each wave remains constant.
b. The wavelength changes depending on the speed of the source.

These two points, along with the calculated relativistic travel times of the light beams in the MM experiment, are responsible for the asymmetry in the last figure, which does not exist in the diagram according to Newton's mechanics *(Fig. 11)*. By observing this asymmetry, it is easy to see that the waves do not arrive at the mirrors or at the beamsplitter in the same manner as when the apparatus is at rest. The asymmetry in this diagram indicates major conflicts with the principle of relativity.

MM experiment is an experimental proof against Einstein's theory of relativity and the constancy of the speed of light

Einstein's model of the MM experiment without the concept of contraction is identical to Michelson's model. In both models the light beams travel at constant speed so that the travel times of the vertical and parallel beams are different. Hence, both models predict the fringe shift as the result of the experiment.

Michelson and Morley wrote: "If now the whole apparatus is turned through the 90^0, the difference will be in the opposite direction" [2]

The same thing will happen in Einstein's model in *Fig. 12*.

By applying the theory of contractions along the parallel path, rendering the parallel and vertical times equal, Einstein and Lorentz, who invented the theory of contractions, thought that this would be sufficient to explain the absence of the fringe shift in the experiment.

However, equally important in the experiment is where the two beams reunite. *If not always at the same place on the beamsplitter when the apparatus is rotated, the fringe shift would occur*.

However, when the contractions are applied, and the parallel length L becomes $L\sqrt{1-u^2/c^2}$, the times of travel of the two beams become the same, yet still different than when the apparatus is at rest, so that the reunion point of the two beams, E, is a distance away from the center of the beamsplitter at A", as shown in *Fig. 12*.

In other words, the contraction along the parallel path does nothing to the vertical beam, which arrives at the beamsplitter at E and out of phase, which will result in the fringe shift when the apparatus is rotated, as seen in *Fig. 13b*.

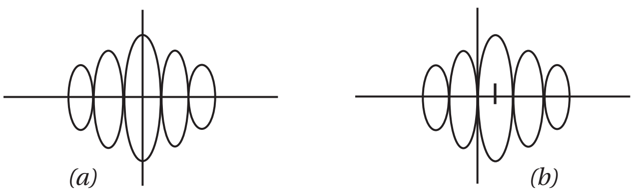

Figure 13

Only when the MM experiment is explained using light waves, as was done in *Figs. 11* and *12*, that can be noticed that in Einstein's interpretation of this experiment the light waves do not reunite at the beamsplitter in the same place and in the same phase as when they left the beamsplitter even though their travel times are the same. *The beams may arrive at the beamsplitter at the same time but at different places on the beamsplitter.* This will cause the fringe shift when the apparatus is rotated.

What are the causes for this outcome?

In Einstein's mechanics, the light beams travel along all optical paths at the same speed unaffected by the motion of the apparatus.

Inequalities caused by the constancy of the speed of light, where the motion of the earth affect every aspect of the MM experiment except the speed of light, are directly responsible for the fringe shift according to Einstein's mechanics when the apparatus is rotated.

Constancy of the speed of light carries many liabilities. It was thought that the contraction of the parallel length would mitigate these liabilities in the MM experiment. They only did partially.

The fringe shift and the different times of travel in Einstein's model are caused by the violation of the principle of relativity where the changes in the lengths of the optical paths in the MM experiment are not proportionally compensated by the changes in the speed of the light beams, as this speed is always the same, *c*.

The constancy of the speed of light prevents this proportional compensation, which ultimately leads to inequalities in travel times and fringe shift. In other words, Lorentz-Einstein contraction factor $\sqrt{1-u^2/c^2}$, invented for the sole purpose of having equal times and avoid the fringe shift, does not prevent the occurrence of the fringe shift in the MM experiment, as believed by Lorentz, Feynman, Einstein, physics textbooks and manuals of the theory of relativity.

On the contrary, Einstein's mechanics predicts the fringe shift that did not occur in the actual experiment.

Thus, the MM experiment becomes the most important and the most convincing experimental proof against Einstein's theory of the constancy of the speed of light for all observers, against his theory of contractions and against his theory of relativity.

Reality v. theory of the MM experiment

In their paper of 1887, Michelson and Morley started their theoretical interpretation of their experiment by presenting two diagrams: The first diagram shows the apparatus at rest. A beam from a source is split by a beamsplitter into two beams perpendicular to each other, and sent to two mirrors located at an equal distance. The two beams reflect from the mirrors and reunite back at the beamsplitter in phase, forming visible fringes.

The second diagram shows the same interferometer put into uniform motion with one arm parallel and the other vertical to the motion of the earth and the interferometer through the ether.

However, in the *actual* experiment, the apparatus is never at rest. The apparatus, along with the earth and the lab, is always in motion. In the starting stage of the actual MM experiment, the length of the parallel beam and the side-to-side and up-and-down position of the beams on the screen were manually adjusted so that the beams were superposed in order to produce a fringe pattern.

Therefore, in the first stage of the real experiment, the two beams leave the beamsplitter in phase and reunite back at the beansplitter in phase, forming a fringe pattern.

In the second stage of the actual experiment, the apparatus is rotated 90^0 in order to see if the fringe shift would or would not occur..

The experiment itself does not tell us how the beams travelled after being split by the beamsplitter in order to form the fringe pattern, and how the pattern is maintained after the rotation. We have to deduce from the theoretical interpretations of the at-rest and in-motion diagrams as to how the beams *would* interact to produce the absence of the fringe shift.

It was shown in this paper that Einstein's mechanics predicts the fringe shift in the MM experiment contrary to the actual results of the experiment.

Proof

Parameters that define the principle of relativity

Because the principle of relativity is intimately connected to the two states of existence, rest and uniform motion, the manner in which the two beams travel in the MM experiment when the apparatus is at rest *(Fig. 9)* and when in motion *(Figs. 11* and *12)* allow us to define the parameters with which to express the principle of relativity and to see whether Newton's or Einstein's mechanics agree or disagree with these parameters.

1. Times of travel of the two beams.

Classical mechanics: When the apparatus is at rest, the total time for either beam to travel from the beamsplitter to the corresponding mirror and back is the same, *2L/c*. According to Newton's classical mechanics, when the apparatus is in motion, these times remain the same. Because it is the total time that determines the nature of the fringe pattern, Newton's mechanics and Galileo's equations, which permit the light to have speeds other than *c*, are in agreement with the null results of the experiment and in agreement with the principle of relativity.

Einstein's mechanics: When the apparatus is at rest, the total time for either beam to travel to their corresponding mirrors and back is the same, $2L/c$. When the apparatus is in motion, this total time according to Einstein's mechanics changes to $2L/c\sqrt{1-u^2/c^2}$, allowing us to distinguish the states of rest and motion.

2. Ratio of distances traveled to speeds.

Classical mechanics: When the apparatus is in motion, the motion of the earth will add its component to the speed of light. The parallel beam will first travel at a faster speed but cover a proportionally longer distance to reach the mirror at C' *(Fig. 8)*. On the way back, the beam will travel at a slower speed, but cover a proportionally shorter distance. The vertical beam will also travel at a faster speed when the apparatus is motion but will also cover proportionally a longer distance, AB'. This proportionality guarantees that the ratio of distances to the speeds of each *leg* of the journey of either beam will remain constant, L/c, whether the apparatus is at rest, moving or rotated.

Einstein's mechanics: The lengths of all optical paths of the two beams are different when the apparatus is in motion from when the apparatus is at rest. Because the speed of the light beams remains the same when the apparatus is in motion, the ratios of distances covered by each light beam in each leg of the journey to the same constant speed c are different from those when the apparatus is at rest and impermissible by the principles of relativity.

3. Phase of the light beams at the mirrors.

Classical mechanics: When the motion of a light beam is presented by a single wave equal to the length of the arms of the apparatus, the waves will travel a longer or a shorter distance proportional to the speed of the light beams. Thus, the vertical wave will reach the mirror in the same phase the parallel wave reaches its mirror. In other words, the phase at which the light waves arrive at the mirrors when the apparatus is at rest is the same as when the apparatus is in uniform motion or when they leave the beamsplitter. The state of rest is once again indistinguishable from the state of uniform motion.

Einstein's mechanics: The time to reach the parallel mirror is $L\sqrt{1-u^2/c^2}/c-u$. This time takes into consideration the contractions of length along the parallel arm. The time for the other beam to reach the vertical mirror is $L/c\sqrt{1-u^2/c^2}$. Hence the two waves will arrive at the corresponding mirrors in a different phase relative to each other, in a different phase relative to the one at the departure and also in a different phase relative to the phase of the arrival at the mirrors when the apparatus is at rest.

4. Phase when leaving and arriving at the beamsplitter.

Classical mechanics: The two waves leave the mirrors at the same time and in the same phase. The parallel wave will now travel at a slower speed but will cover a proportionally shorter distance so that it will reach the beamsplitter at the same time and in the same phase as the vertical wave. Thus, the two waves will arrive at the beamsplitter in the same phase relative to each other and to the phase when the apparatus is at rest. Furthermore, the waves will arrive at the beamsplitter in the same phase in which they leave the beamsplitter. Hence, the state of rest is indistinguishable from the state of uniform motion, according to classical mechanics.

Einstein's mechanics: The two beams reunite at the beamsplitter at the same time and the same phase relative to each other, which is in agreement with the principle of relativity. However, because it would take more than two full wavelengths for the light beams in *Figure 11* to reach the mirrors and return to the beamsplitter, the beams will arrive at different places on the beamsplitter than the place when they left it at A, and in a different phase when the apparatus is at rest, which contradicts the principle of relativity. The two beams would not reunite at A".

5. Constancy and the changes in the wavelength.

Classical mechanics: In *Figure 10*, the source moves to the right at speed *u*, but all the emitted waves are also displaced at the same ratio so that the distance between any two adjacent wave crests remains the same. The wavelength remains the same relative to the source, as is the case when the source is at rest, in full agreement with the principle of relativity.

Einstein's mechanics: It was shown earlier that in Einstein's mechanics the wavelength of a light beam changes depending on the speed of the source. Therefore, the wavelength of the light beams when the MM experiment is in motion will be different than when at rest, which contradicts the principle of relativity.

6. Number of waves between the beamsplitter and mirrors.

Classical mechanics: The direct consequence of the constancy of the wavelength in classical mechanics is that the number of waves between the beamsplitter and the mirrors in the MM experiment remains the same regardless of whether the apparatus is at rest or moving, and regardless of its orientation relative to the motion. This constancy guarantees that there will be neither temporal nor spacial shifts in the fringe pattern when the MM interferometer is put into motion from the state of rest or rotated while in motion.

Einstein's mechanics: In Einstein's mechanics the wavelength of a light beam changes depending on the speed of the source, Therefore, number of waves between the beamsplitter and the mirrors in the MM experiment would also change when the apparatus is put into motion from rest. Furthermore, the number of waves in the individual optical paths will continually change when the apparatus is rotated while in motion.

7. Changes in the lengths of the arms due to motion.

Classical mechanics: When the MM interferometer is put into motion from rest or rotated relative to the motion, the lengths of the two arms remain unchanged, confirming that the laws of physics are the same at rest as in the state of uniform motion.

Einstein mechanics: According to Einstein, when the MM apparatus is put in motion from rest, the arm parallel to the motion will contract by a factor, while the vertical arm will remain unchanged. Also, when the apparatus is rotated while in motion, one arm will expand its length while the other contracts. Hence, in Einstein's mechanics, different laws of physics exist in the state of uniform motion than at rest, which violates the principle of relativity.

Only on one single point in Parameter 4 do the motion of the light waves and the concept of the constancy of the speed of light, along with Einstein's theory of contractions, agree with the principle of relativity: The light waves indeed reunite at the beamsplitter at the same time and in the same phase relative to each other. However, even this detail, the only one that makes the constancy of the speed of light in agreement with the principle of relativity, is greatly discredited by the fact that the same two beams arrive at the beamsplitter in a different phase than when they left it and in a different phase than when the apparatus is at rest.

Stanford Linear Accelerator could be used to measure Einstein's predication of contraction of a body in motion. The vacuum tube that is about 3,200 m long should contract about 2 mm when the orientation of the earth and the tube is changed from vertical to parallel relative to the motion of earth in the direction of the Constellation Leo and prove or disprove the theory of contractions.

Complete or partial cancellation of inequalities and the principle of relativity

In all seven parameters, the classical mechanics of Newton and Galileo is in perfect agreement with the principle of relativity, as the motion of the earth proportionally affects every aspect of the MM experiment including the speed of light.

Yet, from the point of view of rest and motion, there are some inequalities in the classical interpretation of the MM experiment. For example, the vertical light beam covers a longer distance when the interferometer is in motion than when at rest. However, this inequality is compensated by another *complimentary* and *proportional* inequality. The light beam travels at a proportionally faster speed when the apparatus is in motion $(\sqrt{c^2+u^2})$ than when at rest (c), so that the total time (which is the function of the distance and speed), and the times along every leg of the journeys of both beams, are the same whether the apparatus is at rest or in motion.

This is not the case with the relativistic interpretation of the MM experiment. All the inequalities in the above seven parameters are not compensated by any other inequality, except in one case in parameter 4 where there is only a partial compensation.

A new definition of the principle of relativity

The principle of relativity states that being in the state of uniform motion is indistinguishable from being in the state of rest because uniform motion equally or proportionally affects every aspect of an experimental setting, including the speed of light; and if there are some inequalities, they will be completely compensated for by other proportional and complimentary inequalities so that the state of uniform motion cannot be distinguished from the state of rest.

The above definition assumes that the laws of physics and Maxwell equations would be the same in both uniform motion and rest, because being in either state is indistinguishable.

If it becomes possible to detect and measure different speeds or different distances traveled by the light beams in the MM experiment, then the principle of relativity would need to be amended.

More than a century-old injustice must be corrected—Contrary to Einstein, Newton's mechanics is in perfect agreement with the null results of the MM experiment

The belief that Newton's mechanics failed to explain the null result of the MM experiment, and the absence of the fringe shift, that was maintained among physicists to the present time, came from the fact that the Galilean equations were used to calculate the travel times of the light beams in this experiment, when the ether wind was present. These equations permit the speed of light to be faster or slower than the speed c. Because the use of these equations resulted in disagreement with the result of the MM experiment, physicists blamed Galilean equations and Newton's mechanics for this failure.

However, it is the theory of existence of the ether and its supposed effect on the speed of the light beams to be blamed. Newton's mechanics and Galilean equations have nothing to do with this failure. In Newton's mechanics, the ether does not exist and, therefore, has no effect on the speed of the light beams.

Contrary to Einstein's and other relativists' claim that Newton's mechanics failed to explain the null results of the MM experiment, claim that was maintained for over a century, Newton's mechanics is not only in perfect agreement with the null results of the MM experiment, but that the principle of relativity, universally accepted as one of the most important principles of physics, can be expressed by Newton's classical mechanics interpretation of this experiment.

From the classical mechanics point of view, there is neither a theoretical nor a practical possibility of distinguishing the state of rest from the state of uniform motion from within a moving body. This also implies that it is impossible to detect the earth's motion by an optical experiment performed on earth.

According to all physical parameters examined in this paper and according to the diagram drawn following Einstein's mechanics in *Fig. 12*, his interpretation of the mechanics of the MM experiment is in disagreement with the principle of relativity and in disagreement with the results of the experiment.

References

[1] Isaac Newton, *Principia,* University of California Press, Berkeley, CA, p. 14, 1962.

[2] Albert Michelson & Edward Morley, *On the Relative Motion of the Earth and Luminiferous Ether*, Amer. J. of Sci. Vol. XXXIV, pp. 335.