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New Interpretation of the Michelson-Morley Experiment

by
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This new interpretation, which requires some mathematical complication but easy to follow, eliminates much of the physical concepts that have misdirected physics for over a century.

This Article is based on the Book "A New Physics for a New Millennium". It consists of a 286-page book that describes the reasoned steps that have allowed establishing the essential elements that govern the material world. This Work has a Certificate of Registration issued under the Seal of the United States Copyright Office – The Library of Congress in accordance with title 17, United States Code. The contents of the Article belongs to Part Two "Light and Relativity" of said Book.

In 1887 Albert Abraham Michelson, U.S. physicist, born in Germany, and E. W. Morley performed an optical experiment, in which an interferometer was used to attempt to detect a difference in the velocities of light in directions parallel and perpendicular to the Earth's motion. The aim of the experiment, which was repeated in improved forms several times later by various experimenters, was to measure the absolute motion of the Earth.

The negative result of the experiment was a great surprise and it led to a dilemma. Physics had to choose between two options:
1 - The Earth was the one body in the Universe which is permanently at rest.
2 - The principle of the addition of speeds, as in Classical Physics, was not valid.

The first option is hardly tenable and cannot be considered. Physics had only one path, which implied that the mechanical model of Classical Physics was in the end found to be definitely in contradiction with the result of this experiment.

In 1905, 18 years later, Albert Einstein presented his solution in the Special Theory of Relativity. Einstein drew a series of conclusions which have completely changed the meaning of Physics, forasmuch as it requires a contraction of time and space, introducing new ideas such as the contraction of a moving rod and the slowing down of a moving clock.

The principle of Relativity may be stated thus: There is no meaning in absolute motion. There is no standard at rest fixed by Nature. You may adopt any standard you wish. In other words, no one of any number of bodies moving with uniform relative velocities can be chosen more properly than other as a standard of rest. That makes the length of a body indefinite and that means that all other physical measurements that are definitely related to length must share that indefiniteness.

According to Einstein's Special Theory of Relativity, the velocity of light in empty space, determined by Maxwell's theory, is the same whatever the relative speed of the source and the receiver, regardless of the speed of either of these with respect to the Universe as a whole. In space, light moves at a speed of approximately 300.000 km/sec (299.794 km/sec). This speed is not dependent on the movement of the source of emission. On the other hand, the speed of light reaching an observer is not dependent on his movement. For a system in movement like the Earth, which moves at a speed v, c being the speed of light in space, the relative speed is not composed, as one might deduce from Classical Physics. On the contrary, the speed of light in respect of the

Earth is constant, even if the luminous ray goes in the same direction as the Earth or the opposite or in any other direction.

Inasmuch as the Earth turns around the sun in one year as an ellipse, one of the focus of which is the Sun, every six months the Earth moves in opposite directions. Since the approximate speed of the Earth around the Sun is 30 km/sec, the speed of light as seen from the Earth would, according to Classical Physics, be 299.970 km/sec at a certain moment and six months later, 300.030 km/sec. For the time being, we are going to dispense with the movement of the Solar System. Einstein's theory states that the speed of light observed from the Earth is always the same, at any time of the year and whatever the direction of the luminous ray. The result of the experiment performed by Michelson and Morley is entirely consistent with a null result at all epochs during a year.

The Special Theory of Relativity showed that it was no longer admissible to consider space-time properties always as attributes of individual objects. The question "What is the length of this rod?" has a unique answer only if it is specified with respect to what system of reference one determines the length. The same is true for the duration of physical processes and the simultaneity of distant events. It is not possible to give an absolute meaning to the notion of simultaneity of distant events. The concepts of space, time and even cause and effect were totally different from the traditional ideas in Classical Physics.

All these conclusions formed a true scientific revolution when Einstein made them known. The Special Theory of Relativity affects the very foundations, the primary definitions and concepts on which the whole science is built.

Relativity is essentially a physical theory in itself no more and no less philosophical than any other such theory. Nevertheless, it is probably of more importance to philosophers than any other department of physics. The philosophical importance of Relativity arises from the light which it sheds on the character of physical thought.

The question is this: Is the Special Theory of Relativity generally accepted? There has been great controversy and many physicists are or have been against it. This is what Herbert Dingle from University College, London, has said: "Reasons have appeared, which to me are conclusive, for believing that the Special Theory of Relativity is no longer tenable. Though this is not yet generally accepted, it has not been questioned that, so far as experimental evidence goes, an alternative theory is equally possible". And he continues: "It seems to me that the Special Theory of Relativity cannot be true, and the probability is very great that the velocity of light with respect to its source, but not with respect to any body moving with respect to that source, is always c. The Special Theory of Relativity, so far as mechanics is concerned, therefore seems to me to have become of historical interest only."

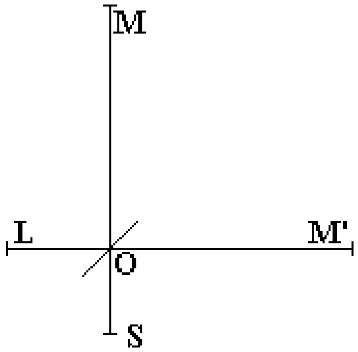
Nevertheless, no one of those who disagree with Relativity has been able to present a satisfactory alternative. It is easy to disagree with the solution of a problem, but it is not so easy to come up with a consistent answer to the problem. One thing is to be against the idea that the velocity of light with respect to any body moving with respect with the source is always c, and another thing is to solve the above dilemma. The problem is there: the experiment of Michelson and Morley, repeated many times, leads to accept the fact that either the Earth is at rest in the Universe or the velocity of light is always c, regardless of the speed of the source and the receiver with respect to the Universe as a whole.

The solution of this dilemma is the subject of this Article.

The Michelson-Morley Experiment

Let us analyse the experiment, the objective of which was to manifest the Earth's movement as for an absolute reference system.

A light ray proceeding from a point S reaches the mirror O inclined 45º to the direction SO of the ray. Part of the light continues to point M of a mirror shown as horizontal in the figure below and part is reflected on O and meets a vertical mirror M', following the direction OM', perpendicular to OM.



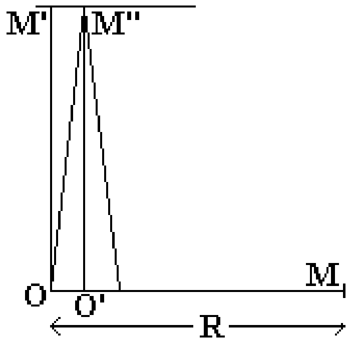
Both rays reflect on O and from there meet on the observation glass L. The two light beams have traversed the routes SOMOL and SOM'OL. The distances OM and OM' can be regulated by sliding the mirrors M and M' along each of the arms which hold them. The beams mix at the point of the observation glass, where an interference fringe can be observed. The apparatus can be adjusted so that the routes OMO and OM'O can be made simultaneously, simply by making the central interference fringe coincide with the crossing point of the hair lines of the observation glass.

Assuming an absolute speed of light and bearing in mind the movement of the Earth, the speed of light in the directions OM and OM' should be different and consequently the arms OM and OM' of different lengths. In the experiment, after making this first adjustment, the apparatus was turned 90º on its axis, thus changing direction OM'. In other words, M' now coincides with M. Logically the system will now be disarranged, because the arms are of different lengths. This disarrangement would be noticed in the displacement of the interference fringes, so that the central fringe would no longer coincide with the crossing points of the hairlines in the observation glass. By measuring this displacement, one could calculate the speed of the Earth.

The result is that no displacement is observed in the fringes of the observation glass. In other words, it is as if the Earth does not move, or as if the speed of light compared to the Earth is independent of the Earth's movement. Many scientists refused to believe such an unexpected result of this experiment, but the same experiment has been carried out many times on high quality apparatus, with the greatest care. The experiment has been performed pointing in all directions of space, at different times of the year, in January and July for example, to show the Earth's positions in its movement around the Sun, in different directions. The results obtained are always the same: as if the Earth were immobile. There was no possible explanation for such a strange phenomenon, which Science had to admit, until Einstein gave an explanation through his Special Theory of Relativity, introducing the concept of time and space contracting.

The mathematical interpretation of this phenomenon is as follows: Let us imagine that the Earth moves in the direction OM with speed v and that the length of arm OM is R as shown in the next figure..

According to Classical Physics, from O to M the speed would be c-v during the time $\frac{R}{c - v}$ and from M to O the speed would be c + v during the time $\frac{R}{c + v}$.



The return time would therefore be $T = \frac{R}{c - v} + \frac{R}{c + v} = \frac{2Rc}{c^2 - v^2}$.

If R' is the length of arm OM' and t' the time it takes the light ray to cover the distance OM'', where M'' is the position of mirror M' after time t', which has changed with the Earth's movement, we get: M'M'' = OO' = vt'. Moreover, we have: OM'' = ct', thus

$c^2 t'^2 = v^2 t'^2 + R'^2$ and $t'^2 = \frac{R'^2}{c^2 - v^2}$; $t' = \frac{R'}{\sqrt{c^2 - v^2}}$. And the total return time would

be $T' = \frac{2R'}{\sqrt{c^2 - v^2}}$. If we compare T and T' we can see they are different.

If we equal the times: $\frac{2Rc}{c^2 - v^2} = \frac{2R'}{\sqrt{c^2 - v^2}}$. Where $R = R'\sqrt{1 - \frac{v^2}{c^2}}$ which forms Lorentz's transformation and gives the contraction of space in the direction of movement.

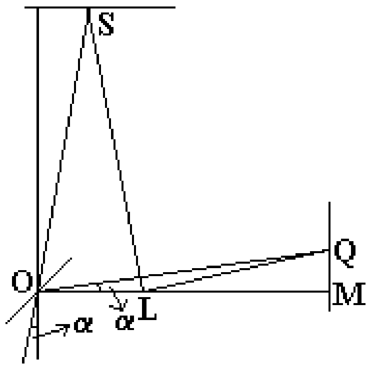
Since the results of such a precise experiment could not be denied, nor upset the laws of propagation of light, identical to those of electromagnetism, it was necessary to establish that the principle of the addition of speeds, as in Classical Physics, was not valid.

It would be convenient to analyse the route of light in the experiment. When I was a student and met for the first time the above demonstration, which leads to Lorentz's transformations, I was not quite satisfied. I considered that the path of light might be justified in the vertical ray but not in the horizontal ray.

From the figure on the next page, we can see in fact the vertical ray which moves in an outgoing direction OS and its return route SL. The route of the ray OSL responds perfectly to the laws of reflection.

In the above demonstration, the horizontal ray is supposed to follow a horizontal line, even when the point at which the ray meets the mirror is not exactly point M, but slightly displaced, as a result of the vertical mirror's displacement in its movement with the Earth. For simplification, we have taken the route to be OML in our study.

We are going to analyse the course of the horizontal ray in further detail. To reach Lorentz's contractions we have found the route considered to be OML. But this is not acceptable, because if the vertical ray in its outgoing route has a direction OS, forming a specific angle α with the vertical and assuming that the inclined mirror forms 45º with the vertical and consequently 45º with the horizontal, the ray called horizontal should form an angle α with the horizontal, according to line OQ, as shown in the figure. The fact that there is interference makes it evident that the light of the two rays meets at point L. The return route of the so called horizontal ray would therefore be according to line QL and the complete route would thus be OQL, which in no way fulfils the laws of optical reflection.



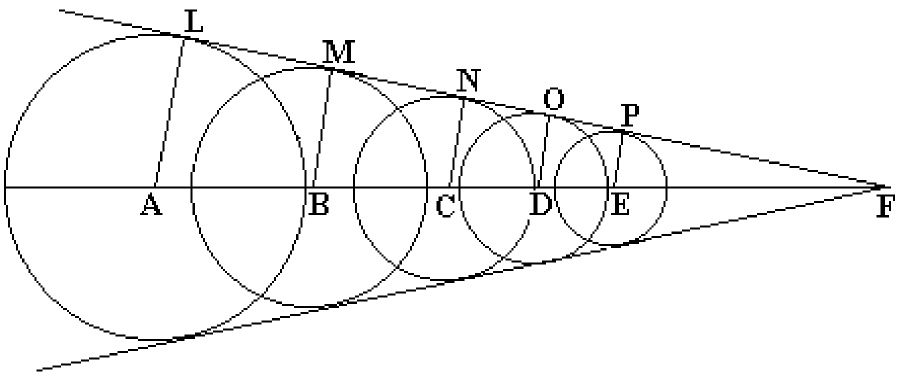
If we therefore accept route OSL for the vertical ray, we must accept either route OML or OQL for the horizontal one. The laws of reflection in the inclined mirror fail in the first case and, in the second, the laws of reflection in the vertical mirror fail. Whatever hypothesis is admitted, the laws of reflection are not respected by light.

The experiment of Cerenkov

Backed by the experiment carried out in 1934 by the Russian physicist Cerenkov, we are going to demonstrate that light and all undulatory electromagnetic process is unchanged by the movement of the emitting source. This hypothesis is in agreement with Einstein's Special Theory of Relativity.

The experiment consists in moving a particle in a medium at a speed greater than that of light in this medium. During its displacement, the particle emits light behind itself at an angle which depends on the speed of the particle.

The reason for this is that the spherical electromagnetic waves, as shown in the next figure, whose central positions are points A, B, C, D, E, etc, occupied by the particle previously, form a conical wave front, whose vertex is position F, occupied by the particle in the instant considered. When the particle arrives at F, the wave emitted at A reaches L and all the other points of a sphere with radius AL. The wave emitted at B reaches M and so on. The cone which has formed moves away with the particle in the same direction, the angle of the cone depending on the speed of the particle. To produce this effect, the speed of the particle must be greater than the speed of the waves. In other words, the particle must precede the electromagnetic effect which it produces.



The aim of this experiment was certainly not to demonstrate that the propagation of electromagnetic waves is independent of the movement of the emitting source, but it does demonstrate it without trace of doubt. If the waves were affected by the speed of the particle, it could never precede the waves, as in fact happens.

The idea that the velocity of light depended on the velocity of the material source of light cannot be maintained. On the one hand Cerenkov's experiment shows that light is unchanged by the movement of the emitting source. In other words, light does not take part in the inertia of the source. On the other hand, the above dependence would require a spurious eccentricity to appear in the orbits of double stars which is not consistent with observation.

The Phenomenon of Interference

Interference is a phenomenon which is manifested when two disturbances of an undulatory type and of the same physical nature are superimposed in space, whether they are of mechanical or electromagnetic origin, as in the case of light. Interference causes a strengthening of the disturbance in certain zones and attenuation of same in others. Two light waves can interfere, causing dark zones, alternating with zones of intense luminosity.

We should remember that to produce the phenomenon of interference with light, firstly the light must be coherent and secondly the difference between the distances covered by the two wavetrains must have an order of magnitude similar to that of the wavelength in question. On the other hand, the interference is greater the smaller the difference in the distances covered. Stating that the light must be coherent implies that the light waves must proceed simultaneously from the same source.

An ideal source should emit radiation of a single frequency from a single point. This is closely achieved by lasers. Provided that a parallel monochromatic beam is split and combined after travelling along two different optical paths, we expect to observe interference fringes as long as the path difference is shorter than the wavetrains. We call this maximum path difference the coherence length.

I would like to remark here that the interference phenomenon is always related to undulatory processes.

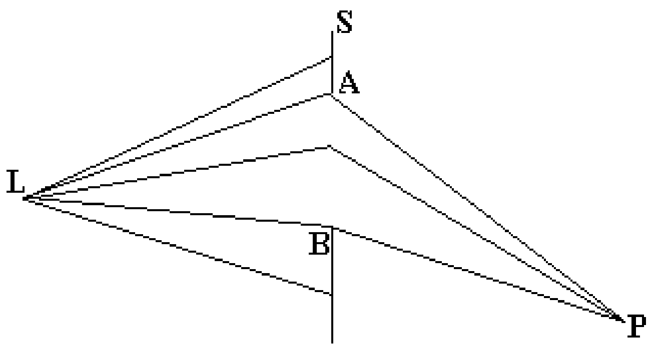
We can also recall the principle of Huygens, applicable to any undulatory process, specially that of light, which shows that any point of space reached by a wave, in our case light, can be considered as a starting point for light radiation, which is propagated in all directions of space. If light is propagated without meeting any material body, or if, on their way, the rays only meet orifices whose dimensions are large in comparison with the light wavelength, the light is rectilinearly propagated and the light which starts from a point in space in all directions is neutralized by interference with light coming from other points, and only the light propagating rectilinearly subsists.

Also in accordance with the principle of Huygens, if the rectilinear route of light meets with a material body or an orifice with a diameter comparable to the wavelength of the light, the point of incidence in the material body and the orifice act as new sources, emitting light in all directions of space, like spherical waves.

There are two cases therefore in which light creates new sources of light, which act in the same way as the original source. Firstly, the light incidence in a material body and, secondly, the passage of light through a narrow hole, originating the phenomenon of diffraction. In the first case the material body can be a mirror. But we must bear in mind that there are no perfect mirrors as complete reflection never occurs. Even in the best mirrors part of the luminous energy is absorbed. This is why the number of images obtained through multiple reflection in parallel mirrors is not infinite. On the other hand, reflection can be regular or diffuse. This second type of reflection means that light is dispersed in all directions. In this respect there are no perfect mirrors either. **Part of the light is always dispersed in the best mirrors**. In the next chapter we shall see a simple experiment which proves this point.

Let us now see the diffraction phenomenon of Fresnel, with the production of light interference at a point P, to which the rectilinear rays from a source of light L do not have direct acces.

Let us suppose, as shown in the next figure, that the light source L is at a certain distance from screen S, on which there is a narrow diaphragm AB, whose diametre is small compared to the light wavelength coming from L. According to the principle of Huygens, the orifice becomes a source emitting coherent light in all directions. Let us consider any point P behind the orifice. At this point, rays coming from all points of the orifice are cut; these rays have covered paths of different length to go from L to P.



The luminous effect at P depends on whether the rays which meet at this point intensify or are weakened and this effect varies when the position P changes. If we move P in a certain direction in the space behind the orifice, for example on a plane parallel to screen S, we can observe periodic variations in the quantity of light.

This phenomenon was also noted by Young, through two orifices, always observing interference between the light beams coming from the same source.

From these experiments we can conclude that the interference phenomena are governed by undulatory laws, any point of space being susceptible to interference, which two coherent waves have access to, namely coming from the same light source, such that their wavelength is the same and the difference of phase is constant with time. In other words, the wave trains are originated by the same elemental radiation act. Under these conditions, interference lines are produced.

If, for any reason, the different distances covered by light are modified, the interference lines will change their position. If, on the contrary, the paths covered by light are changed, either by modification of their respective directions or lengths, **without the difference in these lengths covered being changed**, the interference lines would remain in the same position. This is what happens in the Michelson experiment, no matter the direction of light in space, as we shall see later on.

Interpretation of the route of light in Michelson's Experiment

The situation we are facing is this: the mathematical demonstration based on the supposed path taken by light in the experiment leads to a unique explanation, first suggested by Fitzgerald, and independently by Lorentz, that a material body moving in space is automatically contracted. Acceptance of this fact has changed completely our concept of the Universe. It has affected notions such as simultaneity of distant events and cause and effect. These concepts are fundamental to our view on the world around us. But **the whole reasoning is based on something which presents a serious anomaly: the supposed path taken by light does not fulfil the laws of optical reflection.**

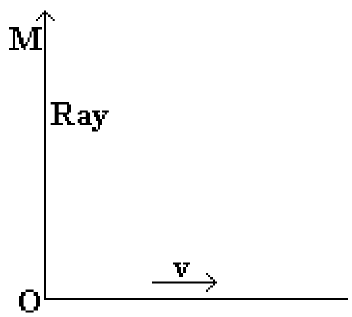
If an anomalous path taken by light in the experiment has led us to such a dramatic change of our view on the Universe, couldn't it be possible the existence of a more logical path of light inside Michelson's apparatus capable of avoiding any concept of contraction? In this case the sacred principle of cause and effect would not be affected.

Let us see that there is a more logical path taken by light in the experiment which prevents us from accepting the idea of time and space contraction . The mathematical demonstration is quite amazing and will be shown later on.

As we have seen before, light does not take part in the inertia of the source. If a luminous point emits a vertical ray, this ray will follow a vertical route independent of the speed and direction of the point and if a horizontal ray is emitted, the ray will carry on being horizontal, no matter the speed and direction of the point.

That is to say, the direction of the light ray OM is never affected by the movement of the luminious source O, as shown in the next figure.

We have seen, on the other hand, that the interference phenomenon has a purely undulatory nature and that the route followed by light therefore need not necessarily be adjusted to the optical laws. Interference is produced in point P in Fresnel's experiment, even though the straight line between this point and the luminous source is intercepted by the screen S.

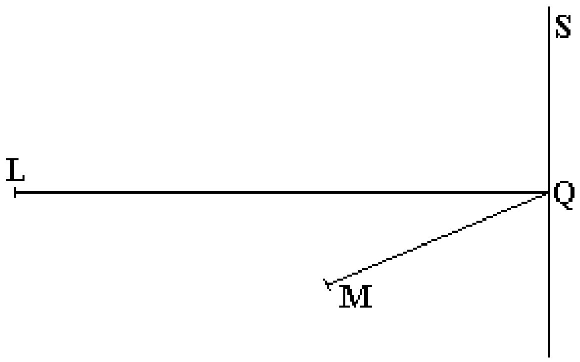


In the Fresnel diffraction-interference experiment, we have seen that orifice AB can be considered a light propagation source in all directions, so that light can cause interference at any point P.

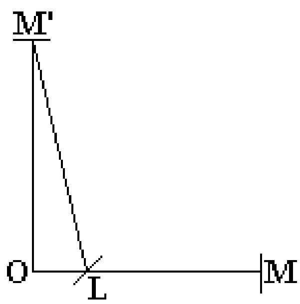
Let us now consider the case of the screen S without the orifice AB, as shown in the figure below. We have seen that point Q becomes a starting point for light radiation, reflected on the screen in a diffuse way. If the screen is a mirror, there will be a reflected ray QL, but part of the light will be dispersed in all directions as we have discussed in the previous chapter. Let us remember that **part of the light is always dispersed in the best mirrors**.

For the same reason that interference was produced at point P in Fresnel's experiment, provided that the two waves with the aforementioned conditions reached point P, interference can also be produced at any point M, provided that two coherent waves reach this point.

If the differences in the routes covered by light from the same source to point M do not change, we can be sure that the interference lines will remain immobile.



Observing the next figure, we can therefore affirm that the vertical and horizontal rays hit the mirrors at M' and M respectively. If the two rays produce interference, they must necessarily be re-united at point L, centre of the inclined mirror when the two rays have completed their journeys. Light has evidently returned on routes M'L and ML. The fact that the return route M'L does not follow the laws of **regular reflection**, does not make this reasoning invalid. The decisive factor is that light from the point of incidence M' reaches L, light which is transmitted according to its own propagation laws, in a straight line from M' to L as a **diffuse** reflected ray. The fact that this is what happens can be demonstrated in a very simple way.

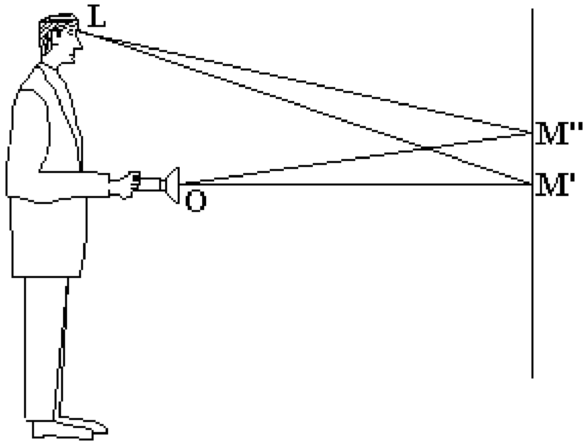


Let us now imagine a simple experiment which consists in standing in front of a mirror with a parabolic torch, such that light is concentrated more or less according to a beam of rays OM', perpendicular to the mirror, as shown in the figure on the next page.

The torch lies 40 cm below the observer's sight. He sees the light reflected at M'' according to the laws of regular reflection, but he also sees a luminous spot from zone M', where the light falls dirctly on the mirror. It is therefore shown that part of the light follows route OM'L. By lifting the torch slightly, we find that the luminous spot at M' increases in intensity on nearing M". Obviously M'L is not a regular reflected ray. It is a dispersed ray originated through diffuse reflection, produced by the fact that the mirror cannot be perfect.

In Michelson's experiment, M' and M" practically coincide, since the distance M'M" corresponding to the distance covered by the mirror is negligible in respect of OM'.

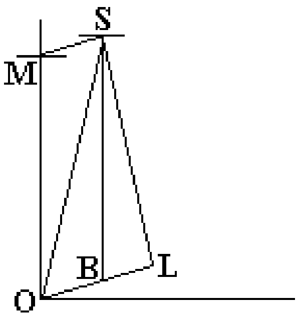
If we consider the case when the direction of the Earth coincides with the direction M'M" and we suppose distance OM' to be for instance one metre, it is easy to see that distance M'M" will be equal to 0,1 mm. We are assuming here that the sole movement of the Earth is the one corresponding to the orbit around the sun at 30 km/sec. As the above direction of the Earth corresponds to the maximum value of distance M'M", it is evident that it will take on values between 0 and 0,1 mm for a distance OM' equal to 1 m. I recall that the luminous spot at M' increases in intensity on nearing M".



The problem is now to check the amount of light the observer perceives from point M' when distance M'M" is in the range of 0,1 mm. But no doubt this amount of light is enough to produce an interference phenomenon when mixing with a similar light beam. Another thing to be considered is the physical dimensions of the light beams.

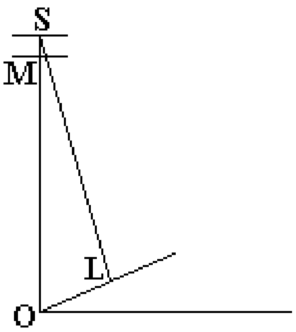
We have before seen the interpretation of the route of light in Michelson's experiment, since it took place in 1887, following the route OSL, as shown in the next figure, where O is the centre of the inclined mirror, S the point of incidence in the horizontal mirror and L the point where the inclined mirror is found when it is reached by the luminous ray on its return route. In this figure the Earth's direction does not coincide with the horizontal ray.

The new interpretation of the route of light proposed in this Work is based firstly on the observation of Cerenkov's experiment and secondly on the experiment of Fresnel and Young, the former being relative to the independence of light with respect to the movement of the light source and the latter two on the behaviour of the interference phenomenon, of a purely undulatory character and completely apart from the laws of optical reflection and the rectilinear propagation of light, since, as we have seen, interference is produced in point P in Fresnel's experiment, even though the straight line between this point and the luminous source is intercepted by the screen S.



Accordingly, observing the next figure, the new interpretation of the route of light in Michelson's experiment is following the path OSL, using the same letters as in the earlier case, for simplification.

The luminous source throws a ray OS perpendicular to the horizontal mirror, meeting it at point S. A ray SL, forming part of the diffuse reflection, departs from this point S, capable of interfering with any other luminous radiation, as long as they both have the conditions we have already explained, so the interference phenomenon can come about. The ray of light OS is naturally reflected in the mirror according to ray SO. Therefore it is not the ray directly reflected in the mirror which reaches point L, but light from point S, which is propagated according to the laws of diffuse reflection.



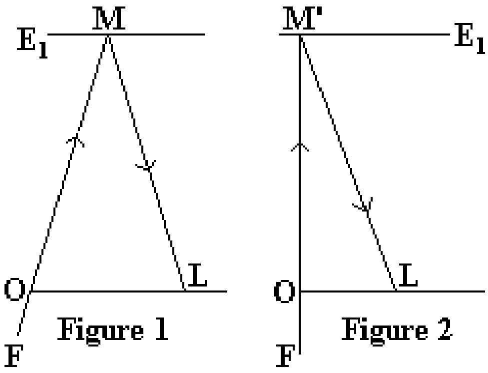
Now, the two proposed routes of light will be discussed.

The two proposed routes of light

The key point in the discussion is merely the pace of light inside the Michelson apparatus. According to orthodoxy the pace of light is as shown in figure 1 and according to this Work, the pace of light is as shown in figure 2.

To make things easier, we have considered in the figures and consequently in this reasoning, the particular case of the horizontal ray coinciding with the Earth's direction.

If the pace of light according to figure 1 is admitted, the contraction of time and space and Lorentz's transformations must be followed, rejecting the speed addition principle for light. The consequence is a Universe with very specific characteristics. **The sacred principle of cause and effect must also be rejected**.



If we accept the pace of light in accordance with figure 2, we find ourselves within the field of Classical Physics, as it will be demonstrated in the next chapter. Light moves following the same laws as those of anything mobile in space. Its speed must be composed with the speed of the observer receiving the light, according to the speed addition principle of Classical Physics. There is an absolute time and space. There is no contraction phenomenon.

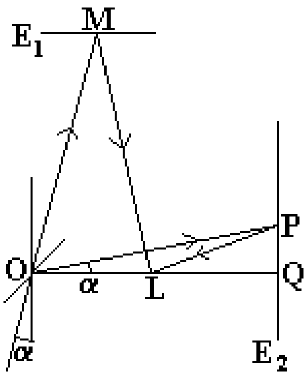
Although we have already sufficiently discussed the pace of light in the Michelson apparatus, according to the two possibilities, we are going to go back to this point as I feel it is the decisive point to determine the correct theory. We have seen how, if a light ray departs from a light source F, perpendicular to a mirror E_1 , which we shall take as horizontal, independent of the speed and direction of the source, this light ray will remain vertical, as it does not participate in the inertia of the source. Therefore the pace of the outward ray will be that corresponding to figure 2, OM'. It can never be OM as indicated in figure 1, bearing in mind that **the apparatus has been designed to produce a light beam OM' perpendicular to mirror E and at an angle of 45º to the inclined mirror.**

I would like to point out here that, when the light ray departs from source F, the ray does not know either the speed or the direction of the Earth, so that angle α which it should take in respect of the axis of the vertical arm of the apparatus cannot be determined. It is therefore deduced that the choice of the ray's direction according to FOM is fanciful.

As there is interference, the two rays must necessarily be re-united at point L. Consequently light from M' evidently reaches this point L. We are therefore faced with the problem that light does not follow the laws of regular reflection. There is a consideration which seems to me to be decisive: **Whatever possibility we admit, it is physically impossible for light interferring inside the Michelson's apparatus to follow the laws of optical regular reflection.**

If the route we accept for the light is that of figure 1 FOML, the so called horizontal ray, on being reflected in the mirror inclined at 45º, will follow route OP, as shown in the following figure, with an angle α deviated on the horizontal and since light returns to L, the return path should be PL. The laws of optical regular reflection therefore fail in the vertical mirror E_2 .

If we take the horizontal ray to remain horizontal, following route OQ-QL, the laws of regular reflection fail in the inclined mirror.



Referring now to the route of light proposed in this Work, route OM'L, no matter what way we focus the problem, we reach the conclusion that the laws of regular reflection cannot be fulfilled for the return ray. This clearly shows that light's return journey to the inclined mirror does not coincide with the regular reflected ray, which indefectibly does fulfil the laws of regular reflection. The explanation for this is that the light returns from the point of incidence M' on the mirror according to the light propagation laws as a diffuse reflected ray.

On the other hand, as I have mentioned before, we must consider the own dimensions of the light ray in comparison with distance OL travelled by the inclined mirror. Bearing in mind the speed of light equal to 3 x 10^{10} cm/sec, the speed of the Earth around the Sun equal to 3 x 10^6 cm/sec and considering 1 m = 10^2 cm as the length of the apparatus arm, we reach the conclusion that the maximum value of distance OL is 0,2 mm. The light ray can cover distance OM' going perpendicular to the mirror E_1 and come back as a diffuse reflected ray to meet the inclined mirror at L so that point L is still inside the initial outward ray. But the two distances covered by light are different. The distance travelled by the outward ray is OM', and that covered by the return ray is M'L, both depending on the apparatus inclination and on the absolute speed of the Earth. The great paradox, as we shall see in the next chapter, is that the total distance covered by light OM' + M'L **is independent of the apparatus inclination and of the absolute direction of the Earth at the moment the experiment is carried out. This distance OM' + M'L, no matter which of the two arms of the apparatus we consider, will always be the same. It is a trick of nature which has misled Physics for more than a century.**

There are two options concerning the path of light in the Michelson's experiment. None of them fulfil the laws of regular reflection.

The option put forward in this Work presents no contradiction, bearing in mind the undeniable existence of diffuse reflection in mirrors and its capability of interfering with other light rays under suitable circumstances.

The orthodox option should explain why the initial ray takes a deviated path before knowing the speed and direction of the Earth, and why this deviation occurs if the apparatus have been well designed to produce a light beam perpendicular to the horizontal mirror and at an angle of 45º to the inclined mirror. In any case, if the orthodox option is supposed to be the right one, its defenders should also explain why the so called horizontal beam fails to fulfil the laws of regular reflection.

We have to decide on which side the balance of evidence lies.

By admitting the pace of light according to figure 2, Michelson's experiment can be explained according to Classical Physics, thus restoring the principle of speed addition for light. And we shall see how, by applying this principle, the aberration phenomenon of the fixed stars and the Mossbauer effect observed by Pound and

Rebka can be explained in a surprisingly simple way. The laws governing the Dopler effect can also be easily deduced by applying the speed addition principle.

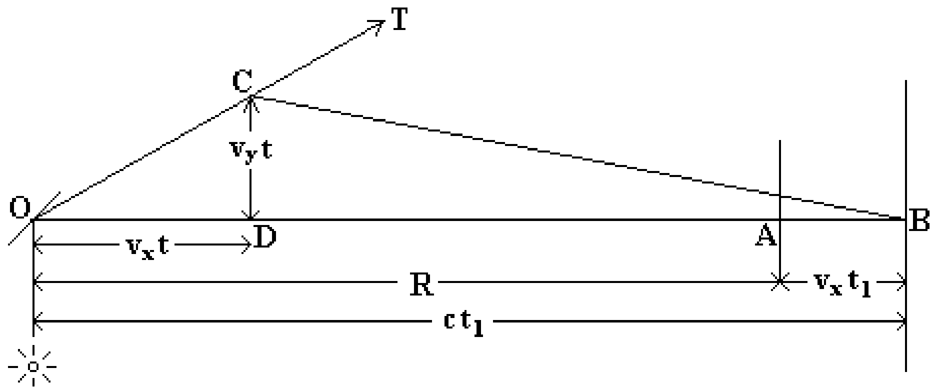
The conclusion that the speed addition principle for light is correct therefore seems justified, bearing in mind that the great objection against admitting this principle has merely been the result of the Michelson experiment, made in 1887. This Work presents a more logical interpretation of this experiment.

If we admit this new interpretation, we can draw the conclusion that relativity is merely a deformation in respect of reality, produced as a consequence of the observer's own limitation. There are two well defined fields: the real and the fictitious or relative field. The latter depends on the observer's conditions. On the contrary, reality is one and unchanging and comprises all that exists. The physical world and the Universe belong to the real field and are governed by their own laws which are unchangeable.

The demonstration

In the next figure, O is the point of incidence of light in the inclined mirror of Michelson's experiment. The ray we call horizontal is reflected in a direction OAB and the Earth has any direction OT. The initial position of the vertical mirror is A, so that OA = R is the length of the arm in Michelson's apparatus. When the light reaches the vertical mirror, it is no longer in position A, but in another position B, so that AB is the horizontal component of the Earth's movement, corresponding to the outgoing time of the horizontal ray, which we shall call t_1 . Therefore, AB = $v_x t_1$ where v_x is the horizontal component of the absolute speed v of the Earth in space.

Let C be the place occupied by point O in the inclined mirror, when the radiation from point B reaches this point. On receiving the horizontal ray, point B becomes a new source of diffuse reflected light rays. OC is therefore the absolute displacement of the Earth in the total time t, sum of the outgoing time t_1 of the outgoing ray and the return time t_2 . We therefore find that OD is the horizontal component of the Earth's displacement in time t, so that OD = $v_x t$; CD is the vertical component, therefore CD = $v_y t$.



The length covered by the light on its return route is BC = $c\, t_2$.

We can now write: BD = OA + AB - OD and substituting their values: BD = $R + v_x t_1 - v_x t = R + v_x t_1 - v_x (t_1 + t_2) = R – v_x t_2$

We also have OB = OA + AB, expressed as $ct_1 = R + v_x t_1$, where $t_1 = \dfrac{R}{c - v_x}$.

For simplification, we shall call $h = c - v_x$ so that $t_1 = \frac{R}{h}$.

We get the value of t_2 as follows:

$t_2 = t - t_1 = t - \frac{R}{h}$; So we have: $t_1 = \frac{R}{h}$; $t_2 = \frac{th - R}{h}$

In the right angled triangle CDB we have $BC^2 = CD^2 + BD^2$ and substituting their values:
$c^2 t_2^2 = v_y^2 t^2 + (R - v_x t_2)^2$.

Putting the value we have found for t_2 in this expression, we get:
$\frac{c^2 (th - R)^2}{h^2} = v_y^2 t^2 + \left[R - v_x \frac{(th - R)}{h} \right]^2$. Thus we have:
$c^2 t^2 h^2 + c^2 R^2 - 2 R t h c^2 = v_y^2 t^2 h^2 + (Rh - v_x t h + R v_x)^2$.

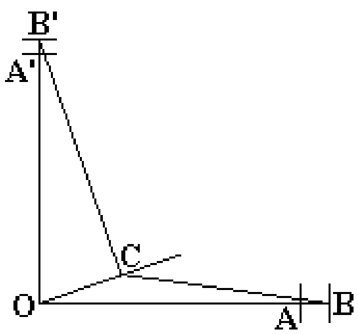
Bearing in mind that $h = c - v_x$; the final parenthesis is:
$\left[R(c - v_x) - v_x t h + R v_x \right]^2 = (Rc - v_x t h)^2$

Adding this value to the above equation:
$c^2 t h - 2 R c^2 = v_y^2 t h + v_x^2 t h - 2 R c v_x$.

Since $v^2 = v_x^2 + v_y^2$, we have $c^2 t h - 2 R c^2 = v^2 t h - 2 R c v_x$. Clearing the value of t, we are left with
$t = \frac{2 R c (c - v_x)}{h (c^2 - v^2)}$. Since $h = c - v_x$, we have $t = \frac{2 R c}{c^2 - v^2}$

This expression shows that the time taken by light in covering the route OBC at a fixed speed c is independent of the Earth's direction, since in this expression, the value of t is independent of v_x and v_y . This demonstration is rather complex. Who could have thought, when going through these difficult calculations, that the time taken by light in the whole journey would be independent of the Earth's direction? I can assure you that the calculations are very complicated unless one resorts to the stratagem $h = c - v_x$.

Let us now suppose, as in the Michelson's experiment, two perpendicular rays leaving from point O, one horizontal OA and the other vertical OA' and, according to the diffuse reflection laws, they are reflected in points B and B' of the vertical and horizontal mirrors, as shown in the figure.



These light rays reach point C in a time given by
$t = \frac{2 R c}{(c^2 - v^2)}$

whatever the direction of OC may be. As the times are equal, and as the speed c of the light is fixed, the route covered will therefore be:

$$c\ t = \frac{2\ R\ c^2}{c^2 - v^2} = \frac{2\ R}{1 - \frac{v^2}{c^2}}$$ for the horizontal and the vertical ray.

And since the route covered have the same length for each pair of routes of the light OBC and OB'C, there will be no modification in the interference lines observed, in any direction of the Earth OC. When making the experiment, the Earth has a speed v and a certain direction and by turning the apparatus in different directions, directions OB and OB' vary. The result is the same when considering a fixed direction of the rays and a varied direction of the Earth in space, in the instant considered.

If we thus accept the route of light as proposed in this Work, the fact that there is no displacement of the interference lines is thus explained, since the two routes covered by the light always have the same length.

This demonstration has been deduced considering that the Earth moves within the plane formed by the two arms of Michelson's apparatus. The reason to do that is the fact that, by using two dimensions, it is easier to compare the resultant figure with that presented by the treatises on the Special Theory of Relativity.

The demonstration is exactly the same when the Earth moves in any direction. Then the absolute displacement of the Earth OC has three components instead of two: v_x , v_y and v_z . Having in mind that now $v^2 = v_x^2 + v_y^2 + v_z^2$, we get the same value of t , the time taken by light in covering the complete route OBC at speed c. This time is again independent of the Earth's direction, as its value is independent of v_x , v_y and v_z .

I hope this interpretation of the famous Michelson-Morley Experiment is sufficiently satisfactory to abandon some pernicious ideas that have prevailed for more than a century and this new wind serve to finish cleaning up the Physics, along with the abandonment of absurd and virtual ideas related to the microcosm of the material particles that inhabit the atom and atomic nucleus.

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