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# Mistakes in Michelson and Morley's Experimental Calculations and Disproof of Special Theory of Relativity

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**Abstract:** ***In Michelson and Morley experiment the classical mechanics was used in wrong way. In this paper, I have used it in proper way so it is proved that there is no difference in between experimental results obtained in Michelson and Morley's experiment and results of mathematical calculations by using classical mechanics. In this paper it is proved that the speed of light is not constant. It varies with speed of source. The special theory of relativity is based on the wrong results came from Michelson and Morley's experiment. As speed of light is not constant, all results of special theory of relativity becomes false.***

**Keywords:** classical mechanics, interferometer; speed of light; relativistic time; relativistic mass, energy mass relation; relativistic movemenum; Lorentz's contraction; special theory of relativity

## 1. Introduction

The special theory of relativity is based on two postulates-

1) The laws of Physics will be the same whether you are testing them in a frame at rest or a frame moving with a constant velocity relative to the rest frame.
2) The speed of light in vacuum is measured to be the same for all of their hours in inertial frames.

In these postulates, second postulate is based on the results came from Michelson and Morley experiment. The aim of this experiment was to find the hypothetical medium ether. Michelson and Morley were expecting that the light should move through the ether at different speeds, depending upon relative movement of earth through space. If earth is supposed to be propagating through the stationary ether with a uniform velocity and if a beam of light is sent from source to observer towards the direction of the motion of the earth, then it should take more time if sent through the opposite direction. If this time difference can be measured then velocity of earth with respect to ether can be measured. But in actual practice, the speed of light in different direction is observed same. Hence the second postulate were created. But the time equations they were obtained were much different from experimental observations. That was happened because the mechanics they used was not in proper way.

In this paper, with proper mechanics, the equations of time, required to travel light beams in two different direction, obtained are same for same distance. Hence the conclusions made in Michelson and Morley experiments becomes wrong. And the Einstein's special theory of relativity which was based on the results of Michelson and Morley experiment is also disproved.

### a) Applied Mechanics usefull for Michelson & Morley Experiment

To understand the mistakes in calculations in Michelson and Morley experiment, first of all we have to study the Applied Mechanics. This applied mechanics is often used for engineering calculations and is universally accepted. There are two major concepts in classical/applied mechanics that we must understood before doing calculations in Michelson and Morley experiments. These concepts are

a) Resultant Velocity
b) Relative Velocity

As velocity is a vector quantity, it has directional characteristics. If there are more than one velocity components acting on a single object, there is only one velocity with which that object can move, that particular velocity vector is called resultant velocity. The magnitude of resultant velocity is depended on the magnitude and direction of its velocity components.

Relative velocity is the velocity that depends on the position and velocity of observer. Relative velocity may be different for different observers. We are going to study applied mechanics which is useful to understand Michelson and Morley's experimental calculations and their mistakes with the help of simple examples. Let us consider a plane. If the plane is traveling at a velocity of 150 km/hr with respect to the air, and if the wind velocity is 50 km/hr, then what is the velocity of the plane relative to an observer on the ground below? The resultant velocity of the plane (that is, the result of the wind velocity contributing to the velocity due to the plane's motor) is the vector sum of the velocity of the plane and the velocity of the wind. This resultant velocity is quite easily determined if the wind approaches the plane directly from behind. As shown in the Figure.1 below, the plane travels with a resulting velocity of 200 km/hr relative to the ground.

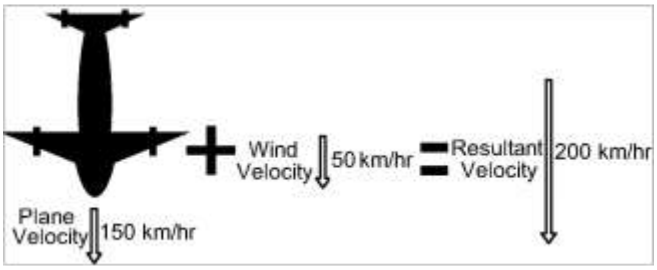


**Figure 1**

If the plane encounters a headwind, the resulting velocity will be less than 150 km/hr. Since a headwind is a wind that approaches the plane from the front, such a wind would decrease the plane's resulting velocity. Suppose a plane traveling with a velocity of 150 km/hr with respect to the air meets a headwind with a velocity of 50 km/hr. In this case, the resultant velocity would be 100 km/hr; this is the velocity of the plane relative to an observer on the ground. This is depicted in the diagram below.

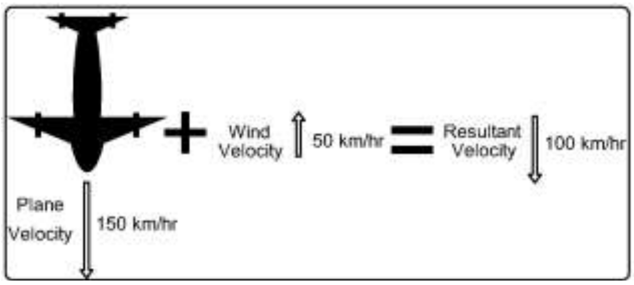


**Figure 2**

Let us consider a plane traveling with a velocity of 150 km/hr, South that encounters a side wind of 50 km/hr, West. Now what would the resulting velocity of the plane be? The resulting velocity of the plane is the vector sum of the two individual velocities. To determine the resultant velocity, the plane velocity (relative to the air) must be added to the wind velocity.

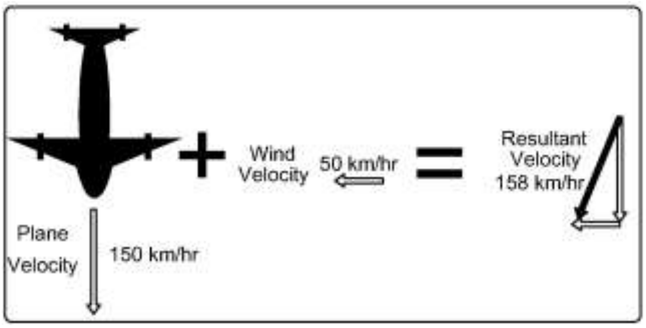


**Figure 3**

For this we have to use Parallelogram Law of Vector addition. This law states that, "*if two vectors of the same type starting from the same point, are represented in magnitude and direction by two adjacent sides of parallelogram, then their resultant vector is given by in magnitude and direction by the diagonal of the parallelogram starting from same point.*"

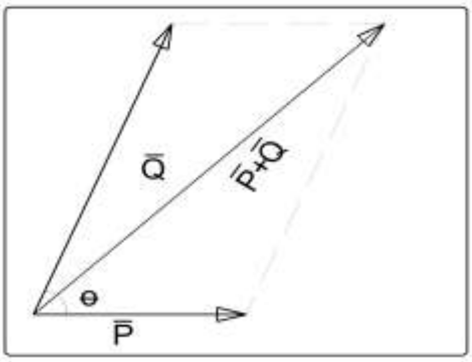


**Figure 4**

The magnitude of resultant vector is given by,

$$R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$$

Where,

$P, Q$ - magnitude of nonlinear vectors $\vec{P} \& \vec{Q}$

$R$- magnitude of resultant vector

ϴ- angle between vectors $\vec{P} \& \vec{Q}$

In this case, as the plane traveling with a velocity of 150 km/hr, South that encounters a side wind of 50 km/hr, West, the angle between velocity vectors is 90 degree.

i.e.

$\theta = 90$

$\cos 90 = 0$

Hence the magnitude of resultant velocity is given by,

$$R = \sqrt{150^2 + 50^2}$$
$$R = 158.1\ km/hr$$

Thus the plane will move along the direction of diagonal with this resultant velocity.

Let us consider another example, there is a bus in which there are two persons, person A and person B. Person A have a ball shooter gun. He shoots a ball with velocity $u$ on person B. If bus is standing on a bus stop then that ball will hit person B with velocity $u$. In this event person A and person B both observe the moving ball moves with velocity $u$ only.

If there is another person C, who is outside the bus, will observe the same velocity that is $u$ .

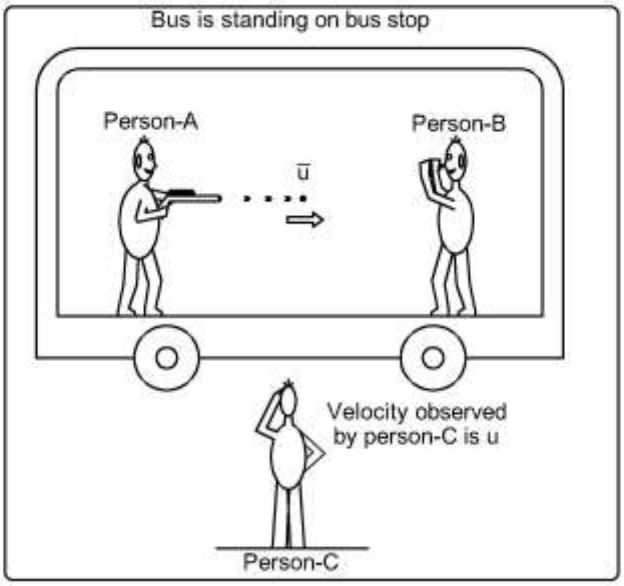


**Figure 5**

Now bus is started and it is moving with uniform velocity $v$ towards right as shown in figure-2.

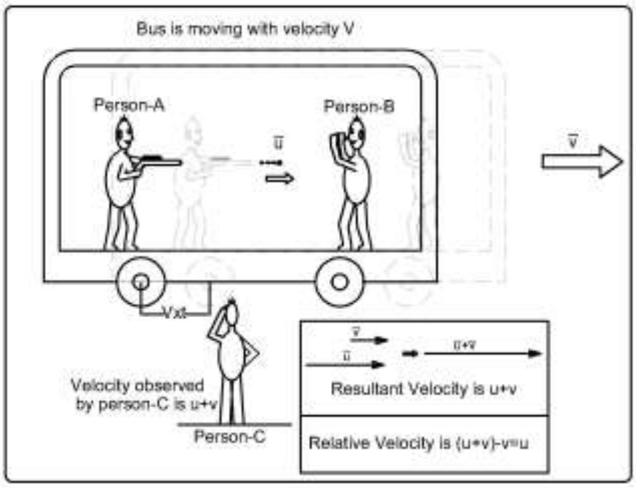


**Figure 6**

If person A shoot a ball again on person B with velocity $u$, for the person C will observe the resultant velocity of ball which is vector sum of both velocities,

$$\vec{V_R} = \vec{u} + \vec{v} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

We can use parallelogram law of vector addition stated above to find magnitude of resultant velocity,

$$V_R = \sqrt{u^2 + v^2 + 2uv\cos\theta} \ldots\ldots \quad \ldots\ldots (2)$$

Where,

$u$ – *Velocity of ball*
$v$ – *Velocity of gun (or bus)*
$V_R$ – *Resultant velocity of ball*
$\theta$ – *Angle between velocity vector* $\vec{u}$ *and* $\vec{v}$

In this case both ball and gun are moving in same direction, hence angle between $\vec{u}$ and $\vec{v}$ is zero.

i.e.

$\theta = 0$

$\cos 0 = 1$

Therefore, equation (2) becomes,

$V_R = \sqrt{u^2 + v^2 + 2uv}$

$V_R = \sqrt{(u+v)^2}$

$$\boxed{V_R = u + v} \ldots\ldots\ldots\ldots \quad \ldots\ldots\ldots (3)$$

This is the resultant velocity of ball which is moving along the direction of velocity of bus.

Person A and B both observe the speed of ball is $u$ which is relative velocity between velocity of bus (or person A or B) and resultant velocity of ball. As bus and ball, in this case, are moving in same direction, the relative velocity is given by subtracting the velocity of bus $v$ from resultant velocity of ball $(u + v)$.

$$Relative\ Velocity = (u+v) - v = u \ \ldots\ldots\ldots\ldots (4)$$

If person C who is outside the bus will observe that ball is moving with velocity $(u + v)$ towards B. This is because before shooting, ball is inside the shooter gun, already moving with velocity of bus that is v and when it is shot, it moves with velocity $(u + v)$.

Now a person B shoots a ball on person A with same velocity $u$ then the velocity observed by person C will be given by doing vector summation of velocity vector as given in equation (1) and magnitude of resultant velocity is given by equation (2).

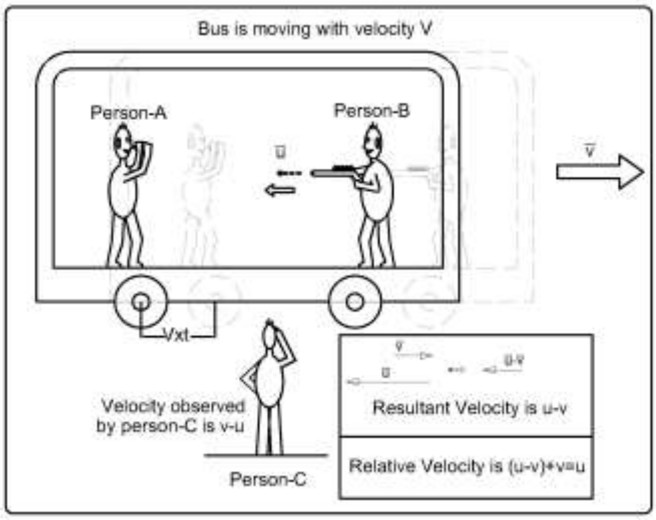


**Figure 7**

In this case gun and ball are moving in opposite direction hence angle between $\vec{u}$ and $\vec{v}$ is 180 degree.

i.e.

$\theta = 180$

$\cos 180 = -1$

Therefore, equation (1) becomes,

$V_R = \sqrt{u^2 + v^2 - 2uv}$

$V_R = \sqrt{(u-v)^2}$

$V_R = u - v$

$$\boxed{V_R = u - v}$$

This is the resultant velocity of ball which is moving along the direction of velocity of bus.

Person A and B both observe the speed of ball is $u$ which is relative velocity between velocity of bus (or person A or B) and resultant velocity of ball. As bus and ball, in this case, are moving in opposite direction, the relative velocity is given by adding the velocity of bus $v$ and resultant velocity of ball $(u - v)$.

$$Relative\ Velocity = (u-v) + v = u \ \ldots\ldots\ldots\ldots (5)$$

From equation (4) and (5) it is clear that in this both events the relative velocity of ball is same.

Now let us consider one more event. There is a bus standing on bus stop. There is person A inside the bus. He has a ball in his hand. He throws it towards the floor of bus in perpendicular direction with velocity $u$. He observe, he get the ball in his hand after bouncing. If there is another person C observing this event from outside the bus. According to his observations also ball gets reflected with same speed $u$ in perpendicular direction.

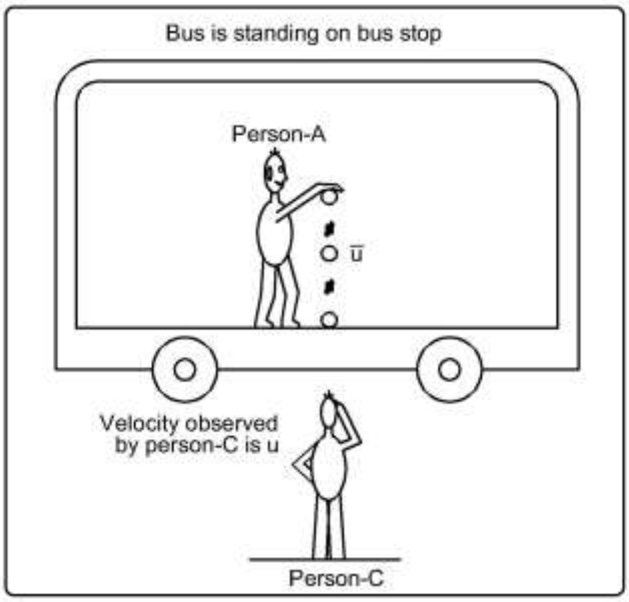


**Figure 8**

Now bus is started and it is moving with uniform velocity $v$ towards right as shown in figure-5. As bus is moving in forward direction the person C will observe the ball is moving along the path as shown in Fig. 5.

But though bus is moving, for person A velocity of ball is u only and for him the path of ball is same as bus is on bus stop.

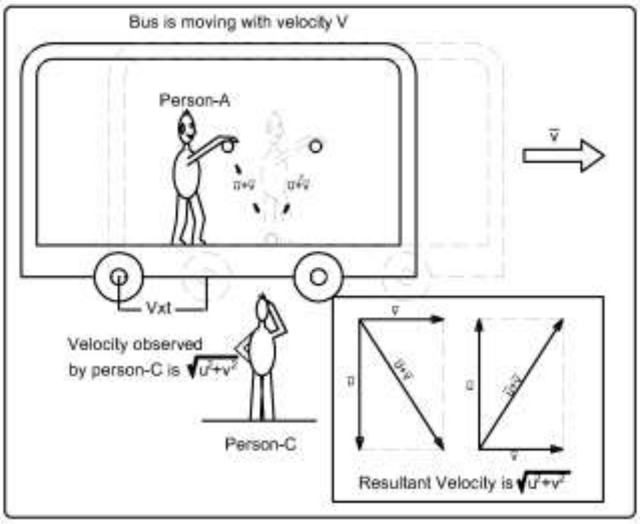


**Figure 9**

Now the velocity of the ball while moving along this path is vector sum of velocity of bus that is $v$ and velocity of ball $u$ as shown in equation (1) and the magnitude of resultant velocity of ball is given by equation (2). In this case gun is moving in forward direction and ball is moving in downward direction hence angle between $\vec{u}$ *and* $\vec{v}$ is 90 degree.

i.e.

$\theta = 90$

$\cos 90 = 0$

Therefore equation (1) becomes,

$$V_R = \sqrt{u^2 + v^2} \qquad \text{.............. (6)}$$

This is the magnitude of resultant velocity.

Now let us see the Michelson Morley experiment and calculation on the basis of applied mechanics used in above examples.

**Correction of Micholson and Morley Experimental calculations**

The apparatus of the experiment are: Monochromatic source S of light, telescope T, one semi-silvered glass plate G and two mirrors, M1, M 2 (see figure).

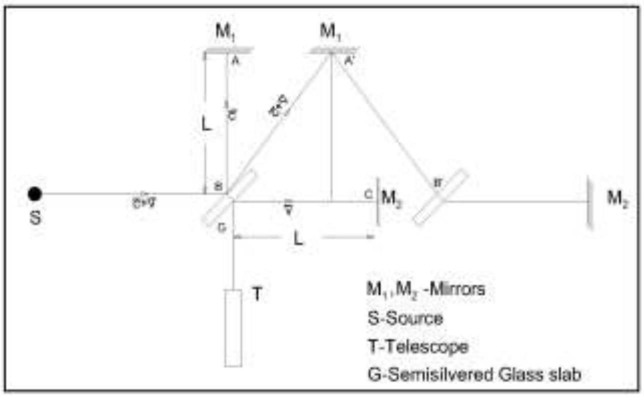


**Figure 10:** Michelson and Morley Interferometer.

The light from a source at S falls on a semi-silvered plate B inclined at 45◦ to the direction of propagation. The plate B, due to semi-silvered face, it divides the beam of light into two parts namely reflected and transmitted beams. The two beams, after reflecting at mirrors M1 and M2 are brought together at A, where light rays interfere, there will be fringe shift and fringes formed are observed in the telescope (T) if there is small difference between the path lengths of two beams.

If whole apparatus is stationary, reflected ray follow path BAB and transmitted ray follow path BCB with velocity c.

Let us assume that earth (carrying the apparatus) is moving with velocity v. As source is moving with velocity v and we are taking measurements from a stationary position in space, the speed of the light coming from that source must move with the resultant velocity which is vector sum of velocity of light and velocity of source i.e. ($\bar{c}+\bar{v}$). *In Michelson and Morley experiment, they were taken this velocity only c.* When light ray is incident on semi silver plate B, the part of light is reflected and part of light is transmitted through the plate B. As earth is in motion with velocity v, both transmitted ray and reflected ray also travel with those resultant velocities which are vector sum of both velocity of light and velocity of earth.

As mentioned before the magnitude of resultant velocity is also given by,

$$V_R = \sqrt{v^2 + c^2 + 2vc\cos\theta} \qquad \text{.................... (7)}$$

Where, $\theta$ = angle between velocity vector $\bar{c}$ and $\bar{v}$.

When light ray is incident on semi silver plate B, the part of light is reflected towards mirror M1 with velocity c.

But as whole apparatus is moving with velocity v with earth, the light will moves path B M1B' as shown in figure-1 with velocity of magnitude $V_{R1}$ given by,

$$V_{R1} = \sqrt{v^2 + c^2 + 2vc\cos 90}$$

(In this case $\bar{c}$ and $\bar{v}$ are perpendicular with each other hence ϴ =90 degree)

Since, cos90=0,

$$V_{R1} = \sqrt{v^2 + c^2} \quad \text{......... (2)}$$

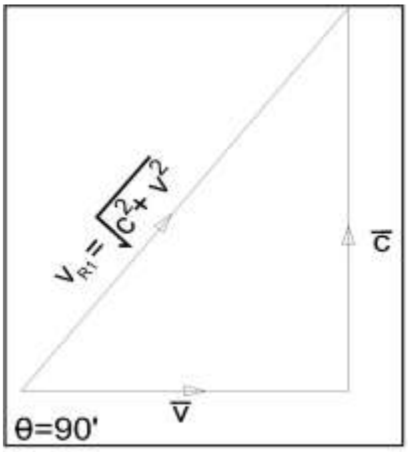


**Figure 9:** Velocity vectors in perpendicular directions

This is the velocity of light along BA'. *But in Michelson and Morley experiment the mistake was the velocity of light along BA' is taken as c instead of* $\sqrt{v^2 + c^2}$.

Let T be the time required to travel the ray from point B to A'. Thus, distance BA' is given by,

BA'= $V_{R1} \times T$

BA'=$\sqrt{v^2 + c^2} \times T$

In the same time the earth will move with velocity v through distance = *(v ×T)*

Now according to Pythagoras theorem,

$$(BA')^2 = (BA)^2 + (AA')^2$$

$$\left[\left(\sqrt{v^2 + c^2}\right) \text{x T}\right]^2 = L^2 + (vT)^2$$

$$v^2T^2 + c^2T^2 = L^2 + v^2T^2$$

$$c^2T^2 = L^2$$

$$cT = L$$

$$\boxed{T = \frac{L}{c}} \quad \text{......... (3)}$$

Let $T_1$ be the time required to light to travel path BA'B' which will be twice of *T*.

$$T_1 = 2T$$

$$\boxed{T_1 = \frac{2L}{c}} \quad \text{......... (4)}$$

Now let us calculate velocity of light along path BM2.

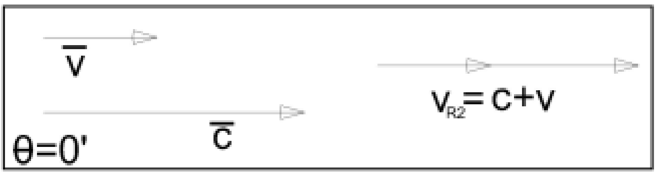


**Figure 10:** Velocity vectors in same directions.

The magnitude of velocity is given by,

$$V_R = \sqrt{v^2 + c^2 + 2vc\cos\theta}$$

In this case velocity vector $\bar{c}$ and $\bar{v}$ are collinear, therefore ϴ = 0 degree.

$$V_{R2} = \sqrt{v^2 + c^2 + 2vc\cos 0}$$

$$V_{R2} = \sqrt{v^2 + c^2 + 2vc}$$

$$V_{R2} = \sqrt{(v + c)^2}$$

$$V_{R2} = c + v$$

As the ray of light and mirror M2 are moving in same direction, their relative velocity in between light beam traveling towards mirror M2 is given by the difference in their velocities,

$$Relative\ velocity = c + v - v = c$$

*In Michelson and Morley experiment the mistake was the velocity of light along BM1 is taken as c instead of c+v and relative velocity was taken as c-v instead of c.* Thus the time required to reach that light ray from slab B to mirror M2 is given by,

$$\boxed{t_2 = \frac{L}{c}} \quad \text{.. (5)}$$

Now let us calculate velocity of light along path M2B.

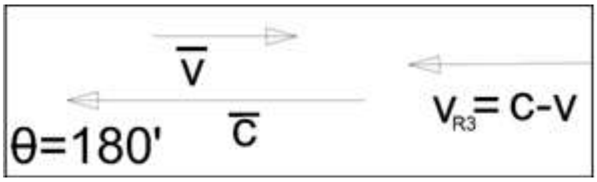


**Figure 11:** Velocity vectors in opposite directions.

In this case velocity vector $\bar{c}$ and $\bar{v}$ are directed in opposite direction therefore ϴ =180 degree.

$$V_{R3} = \sqrt{v^2 + c^2 + 2vc\cos 180}$$

$$V_{R3} = \sqrt{v^2 + c^2 - 2vc}$$

$$V_{R3} = \sqrt{(c - v)^2}$$

$$V_{R3} = c - v$$

As the ray of beam and mirror M2 are moving in opposite direction, the relative velocity between them is given by the adding their velocities.

$$Relative\ velocity = c - v + v = c$$

*In Michelson and Morley experiment the mistake was the velocity of light along BM1 is taken as c instead of c-v and relative velocity is taken as (c+v) instead of c.*

Thus the time required to reach that beam from mirror M2 to semi silvered plate is given by,

$$\boxed{t_3 = \frac{L}{c}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Thus total time required to the transmitted ray to travel from point B to mirror M2 and again from mirror M2 to point B is given by,

$$T_2 = t_2 + t_3$$

$$T_2 = \frac{L}{c} + \frac{L}{c}$$

$$\boxed{T_2 = \frac{2L}{c}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ldots \quad (7)$$

From equation (4) and (7), we can give,

$$\boxed{T_1 = T_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ldots \quad (8)$$

This shows that the transmitted beam and reflected beam arrive at a point B at same instant. And from experimental evidence, we get the same result. There is no any time difference between two rays traveling along two perpendicular directions. If the apparatus is rotated and experiment is repeated, there will not any difference in this calculation.

## 2. Disproof of Special Theory of Relativity

The special theory of relativity is based on two postulates-

1) The laws of Physics will be the same whether you are testing them in a frame at rest or a frame moving with a constant velocity relative to the rest frame.
2) The speed of light in vacuum is measured to be the same for all of their hours in inertial frames.

But in actual practice, the speed of light is not constant for all inertial frames. It varies if source is moving. We have to take vector sum of velocity of source and velocity of light to get resultant velocity of light. If we do that then we get all results of Michelson and Morley Experimental calculations correctly.

This means the postulates on the basis of which the special theory of relativity is based were completely wrong. This indicates that time is absolute, it is not relative. It is impossible to travel time even if we could travel with velocity comparable to that of light. It is wrong to say nothing is faster than light. The light is the only thing that can travel faster than itself. If source of light is moving, the velocity that light gain is the vector sum of velocity of source and velocity of light. The concepts of Lorentz transformation, relativistic mass, energy-mass relation, relativistic momentum and relativistic time are based on the wrong results of Michelson and Morley experiment hence all are wrong concepts.

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